

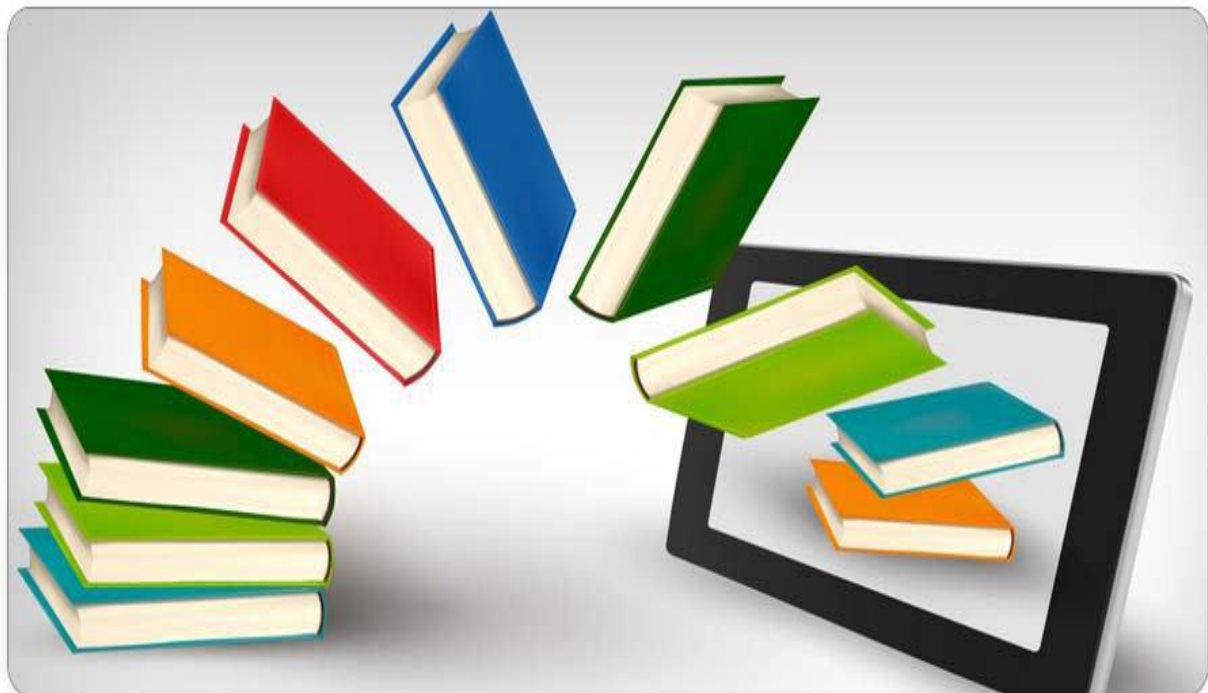
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Force and Deformation Response of U-Shaped Multi-storeyed Reinforced Concrete Buildings

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Abstract— Recently it has become mandatory to design all the civil engineering structures including building frames for the earthquake effects in addition to dead load, live load and wind load effects. The present work deals with the determination of storey drifts and force response of 20-storeyed reinforced concrete U-shaped buildings located in different seismic zones using ETABS 2013 Ultimate 13.2.2. The effects of plan dimensions, severity of seismic zone, infill walls on the storey drifts and force response of U-shaped reinforced concrete buildings have been evaluated. It is observed that the absolute maximum storey drift occurs in Zone V and that the effect of presence of infill walls in the analysis is to reduce the storey drifts. Both the design ultimate positive and negative moments in transfer girders and main beams decrease in magnitude when the effect of infill wall is considered in the analysis. The response spectrum method predicts lower maximum storey drift in x- and y-directions compared to the equivalent static lateral force method in all the cases.

Keywords—reinforced concrete buildings; storey drift; force response; infill wall; seismic zone

1. INTRODUCTION

Building Codes specify that the effects due to earthquake load be considered in addition to

those due to dead, live load and wind loads. A vast literature on dynamic analysis exists and a few of them are briefly mentioned here. Wakchaure M R and Ped S P [1] studied the effects of infill in high rise buildings. The infill walls were modeled as equivalent single strut by using the FEMA-356 approach. Mohammed Yousuf and P M Shimpale [2] carried out dynamic analysis for G+5 storied buildings located in seismic zone IV. They considered a rectangular symmetrical, C-shape, L-shape and irregular L unsymmetrical buildings for the analysis. The analysis was carried out by using the ETABS 9.5 software. Amin Alavi and P Srinivasa Rao [3] studied the behavior of the 5-storied buildings located in seismic zone V. The buildings consisted of eight different configurations with re-entrant corners. Himanshu Gaur et al. [4] analyzed the horizontally irregular buildings for their stability using STAAD.Pro software. They considered the 20-storeyed buildings of different shapes like L, U and H-shape for the analysis, each shape having different lateral length ratios. M G Shaikh and Hashmi S Shakeeb [5] investigated the seismic performance of L-shaped building with varying bay length and storey height. The buildings were modeled using STAAD.Pro V8i software. The results obtained for infill and without infill building models were compared. Ravikumar C M et al. [6] studied the seismic performance of the buildings which are having irregularities in plan with geometric and diaphragm continuity, re-entrant corners, vertical irregularity with setback and also

buildings resting on sloping ground. S Mahesh and Dr P B Panduranga Rao [7] studied the behavior of the G+11 storied building of regular and irregular configurations subjected to earthquake and wind load using ETABS and STAAD.Pro V8i software. B Srikanth and V Ramesh [8] studied the earthquake response of a 20-storeyed building by seismic coefficient and Response spectrum methods. Pravin Ashok Shirule and Bharti V Mahajan [9] conducted the parametric studies on G+13 storeyed RC frame building with asymmetric column distribution with and without shear wall by using response spectrum method of analysis. A E Hassaballa et al. [10] carried out the seismic analysis of a multi-storied RC frame building situated in Khartoum city using STAAD.Pro software. Critical damping of 5% was considered in response spectrum method of analysis. Ramesh Konakalla et al. [11] studied the response of the 20-storeyed building by linear static analysis using STAAD.Pro software. One regular symmetric model and three vertical irregular models were considered in the analysis. S.S. Patil et al. [12] carried out the response spectrum analysis for G+14 storeyed building situated in the seismic zone IV using STAAD.Pro software. The buildings were modeled as RC bare frame, bare frame with bracing and bare frame with shear wall in the analysis. Bracing and shear walls were located at different locations and directions in the building. Haroon Rasheed Tamboli and Umesh.N.karadi [13] performed the seismic analysis on ten storey buildings considering three cases i) bare frame ii) infill frame iii) infill with ground soft storey and using ETABS software. Seismic zone III and 5% damping was considered in the analysis. Infill was modeled as an equivalent diagonal strut in the analysis. Mohit Sharma and Savitha Maru [14] carried out static and dynamic analyses on G+30 storeyed regular building using STAAD.Pro software. Seismic zones II and III and medium soil type were considered in the analysis. P.B Prajapathi and Prof.Mayur G. Vanza [15] analysed 10 storeyed RCC residential buildings with different plan configurations and studied the influence of plan irregularity on the building. Static and dynamic analyses were carried out using SAP software. For dynamic analysis, response spectrum method and time history methods were used. Md Irfanullah and

Vishwanath. B. Patil [16] studied the behavior of the building when subjected to seismic loading with various arrangements of infill. The building was having five bays in both X and Y directions and situated in seismic zone IV. Models considered for the analysis were i) Bare frame ii) full infill frame iii) infill in all floor except below plinth iv) infill with first floor as soft storey v) Infill with soft storey at first floor and basement vi) Infill with soft storey at first and basement and infill provided in swastika pattern in ground floor. Equivalent static analysis was carried out by using ETABS 9.6 software.

2. PRESENT WORK

2.1 Details of Buildings, Loads and Load Combinations Considered

U-shaped Reinforced Concrete Buildings of 20 storeys having soft storey, floating columns and transfer girders with and without infill are analyzed for all loading combinations specified by IS Codes using ETABS software. The effects of the following parameters: 1) L_1/L_2 ratio (L_1 and L_2 are defined later), 2) Location of building and the corresponding seismic zone, 3) Infill walls or No infill walls on (a) storey drifts and (b) maximum ultimate forces and moments in the main beams and transfer girders are evaluated by performing the stiffness analysis using ETABS Version 2013 Ultimate 13.2.2 software. In the present work, U-shaped reinforced concrete buildings having a foundation depth of 2.0 m below existing ground level, plinth height = 0.5 m and 20 storeys each of 3 m height located in seismic zones II, III, IV and V (Infill and No infill) are considered. In all the cases the first storey (ground floor) is a soft storey. The floating columns start from the top of the 15th floor and extend up to the roof. These are marked as FC in Fig. 1. The other columns shown in Fig. 1 extend up to the roof starting from footing top (regular columns). The floating columns are supported by transfer girders (marked as TB1 and TB2) spanning between regular columns. The dimensions L_1 and L_2 are as defined in Fig. 1. The sizes of the beams and columns are given in Table 1. All the slabs including the roof are of 150 mm thickness. M50 grade concrete is used for all slabs, beams and columns.

Table 1: Sizes of beams and columns in U-shaped buildings

Member	Size
Regular Columns	a) footing top to first floor slab 1200 x 1200 mm b) first floor slab to 15 th floor slab 1100 x 1100 mm c) 15 th floor slab to roof slab 350 x 750 mm
Floating Columns	300 x 750 mm
Stub Columns up to plinth level	300 x 300 mm
Plinth Beams connecting stub and other columns	300 x 450 mm
Main Beam (a) 12 m span (up to 15 th floor) (b) 4 m span (16 th floor to roof)	450 x 1200 mm 300 x 450 mm
Secondary Beam (a) 12 m span (b) 4 m span	300 x 750 mm 300 x 450 mm
Transfer Girder TB1 TB2	1000 x 1000 mm 1100 x 1100 mm

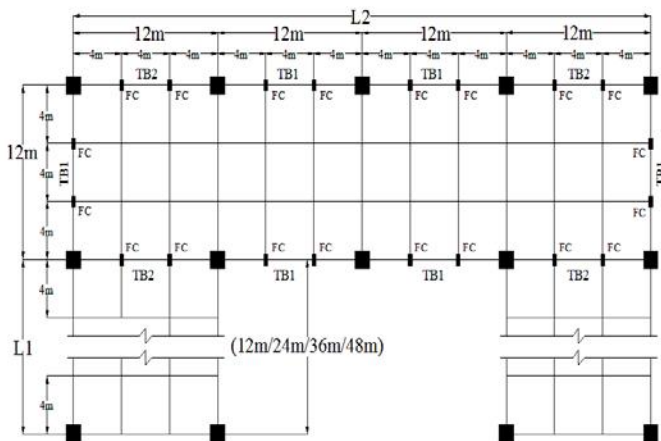


Fig.1: Plan of U-shaped building at 15th floor level

The live loads considered are 3.5 kN/m² for floors and 1.5 kN/m² for roof. The floor finish is assumed as 1.0 kN/m². The roof finish is taken as 2.0kN/m². 300 mm thick masonry walls are provided on the beams at all floor levels along the periphery of the building. 150 mm thick parapet walls are provided along the periphery of the building at the roof level. In addition to the dead and live loads, wind and seismic loads corresponding to the chosen four locations Vishakhapatnam, Vijayawada, Delhi and Darbhanga are considered. Load combinations are made in accordance with IS: 456, IS: 875 and IS: 1893. Stiffness analysis of frames is performed using ETABS Version 2013 Ultimate 13.2.2. The load combinations used for the limit state of collapse are shown in Table 2.

Table 2: Load combinations for the limit state of collapse

Sl. No	Load combination	Sl. No	Load combination
1	1.5 (DL + LL)	20	1.5 (DL + WL _Y)
2	1.2 (DL + LL + EQ _X)	21	1.5 (DL - WL _Y)
3	1.2 (DL + LL - EQ _X)	22	0.9 DL + 1.5 WL _X
4	1.2 (DL + LL + EQ _Y)	23	0.9 DL - 1.5 WL _X
5	1.2 (DL + LL - EQ _Y)	24	0.9 DL + 1.5 WL _Y
6	1.5 (DL + EQ _X)	25	0.9 DL - 1.5 WL _Y
7	1.5 (DL - EQ _X)	26	1.2 (DL + LL + SPEC _X)
8	1.5 (DL + EQ _Y)	27	1.2 (DL + LL - SPEC _X)
9	1.5 (DL - EQ _Y)	28	1.2 (DL + LL + SPEC _Y)
10	0.9 DL + 1.5 EQ _X	29	1.2 (DL + LL - SPEC _Y)
11	0.9 DL - 1.5 EQ _X	30	1.5 (DL + SPEC _X)
12	0.9 DL + 1.5 EQ _Y	31	1.5 (DL - SPEC _X)
13	0.9 DL - 1.5 EQ _Y	32	1.5 (DL + SPEC _Y)
14	1.2 (DL + LL + WL _X)	33	1.5 (DL - SPEC _Y)
15	1.2 (DL + LL -	34	0.9 DL + 1.5

	WL_X		$SPEC_X$
16	$1.2 (DL + LL + WL_Y)$	35	$0.9 DL - 1.5 SPEC_X$
17	$1.2 (DL + LL - WL_Y)$	36	$0.9 DL + 1.5 SPEC_Y$
18	$1.5 (DL + WL_X)$	37	$0.9 DL - 1.5 SPEC_Y$
19	$1.5 (DL - WL_X)$		

10	$DL + WL_X$	23	$DL + 0.8 LL - 0.8 SPEC_X$
11	$DL - WL_X$	24	$DL + 0.8 LL + 0.8 SPEC_Y$
12	$DL + WL_Y$	25	$DL + 0.8 LL - 0.8 SPEC_Y$
13	$DL - WL_Y$		

The load combinations used for the serviceability limit state are shown in Table 3.

Table 3: Load combinations for the limit state of serviceability

Sl.No.	Load combination	Sl.No.	Load combination
1	$DL + LL$	14	$DL + 0.8 LL + 0.8 WL_X$
2	$DL + EQ_X$	15	$DL + 0.8 LL - 0.8 WL_X$
3	$DL - EQ_X$	16	$DL + 0.8 LL + 0.8 WL_Y$
4	$DL + EQ_Y$	17	$DL + 0.8 LL - 0.8 WL_Y$
5	$DL - EQ_Y$	18	$DL + SPEC_X$
6	$DL + 0.8 LL + 0.8 EQ_X$	19	$DL - SPEC_X$
7	$DL + 0.8 LL - 0.8 EQ_X$	20	$DL + SPEC_Y$
8	$DL + 0.8 LL + 0.8 EQ_Y$	21	$DL - SPEC_Y$
9	$DL + 0.8 LL - 0.8 EQ_Y$	22	$DL + 0.8 LL + 0.8 SPEC_X$

The effect due to seismic loading is evaluated using (i) Equivalent Static Lateral Force Method and (ii) Response Spectrum Method separately. The more critical value obtained from these two methods is considered in the design. The effect of the infill wall is accounted in the analysis by treating it as a diagonal strut in accordance with the recommendations of FEMA 356.

2.2 Storey Drifts

(a) Design Storey Drifts in X-Direction (No Infill)

The design storey drifts in x-direction for U-shaped buildings with no infill are given in Table 4 for various values of L_1/L_2 ratio and zones II and III and in Table 5 for various values of L_1/L_2 ratio and zones IV and V. Each storey drift entry in the table represents the maximum value obtained by considering all load combinations specified by the relevant IS Codes (called design storey drift).

Table 4: Values of design storey drift in m

STOREY NO.	WL/EL in X-direction; No Infill							
	ZONE II				ZONE III			
	L_1/L_2 Ratio				L_1/L_2 Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
20	0.00017	0.00018	0.00019	0.00019	0.00027	0.00029	0.00030	0.00030
19	0.00031	0.00033	0.00035	0.00036	0.00050	0.00053	0.00056	0.00058
18	0.00046	0.00049	0.00051	0.00053	0.00073	0.00078	0.00081	0.00084
17	0.00057	0.00061	0.00063	0.00066	0.00091	0.00097	0.00101	0.00105
16	0.00048	0.00052	0.00054	0.00056	0.00077	0.00069	0.00087	0.00089
15	0.00013	0.00014	0.00014	0.00014	0.00021	0.00022	0.00022	0.00023

14	0.00017	0.00017	0.00018	0.00019	0.00027	0.00028	0.00029	0.00032
13	0.00019	0.0002	0.00021	0.00021	0.00030	0.00032	0.00033	0.00034
12	0.00021	0.00022	0.00023	0.00025	0.00033	0.00035	0.00037	0.00038
11	0.00022	0.00025	0.00027	0.00029	0.00036	0.00038	0.0004	0.00041
10	0.00024	0.00028	0.00031	0.00034	0.00037	0.0004	0.00042	0.00043
9	0.00026	0.00031	0.00035	0.00038	0.00039	0.00042	0.00044	0.00045
8	0.00028	0.00034	0.00038	0.00041	0.0004	0.00043	0.00045	0.00047
7	0.00030	0.00037	0.00042	0.00045	0.00041	0.00044	0.00046	0.00048
6	0.00033	0.00039	0.00045	0.00049	0.00041	0.00045	0.00047	0.00049
5	0.00034	0.00042	0.00047	0.00051	0.00042	0.00045	0.00047	0.00051
4	0.00036	0.00044	0.00049	0.00054	0.00042	0.00045	0.00049	0.00054
3	0.00037	0.00044	0.00050	0.00054	0.00041	0.00044	0.0005	0.00054
2	0.00036	0.00043	0.00048	0.00052	0.00039	0.00043	0.00048	0.00052
1	0.00032	0.00037	0.00041	0.00044	0.00034	0.00037	0.00041	0.00044
PLINTH	0.00017	0.00019	0.0002	0.00021	0.00017	0.00019	0.00020	0.00021
BASE	0	0	0	0	0	0	0	0

The following observations are made from Table 4 for U-Shaped Buildings in Zone II (No Infill):

- For all the L_1/L_2 ratios, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift increases. When L_1/L_2 ratio =1.0, the value is 0.66m.

The following observations are made from Table 4 for U-Shaped Buildings in Zone III (No Infill):

- For all the L_1/L_2 ratios, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift increases. When L_1/L_2 ratio =1.0, the value is 1.05 mm.

Table 5: Values of design storey drift in m

STOREY NO.	WL/EL in X-direction; No infill							
	ZONE IV				ZONE V			
	L_1/L_2 Ratio				L_1/L_2 Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
20	0.00041	0.00043	0.00045	0.00046	0.00061	0.00065	0.00067	0.00068
19	0.00075	0.0008	0.00084	0.00086	0.00113	0.0012	0.00125	0.0013
18	0.00109	0.00117	0.00122	0.00126	0.00164	0.00175	0.00183	0.00189
17	0.00136	0.00145	0.00152	0.00157	0.00204	0.00218	0.00228	0.00236
16	0.00116	0.00124	0.0013	0.00134	0.00174	0.00186	0.00195	0.00201
15	0.00031	0.00032	0.00034	0.00034	0.00046	0.00048	0.0005	0.00052

14	0.0004	0.00042	0.00043	0.00044	0.0006	0.00062	0.00065	0.00067
13	0.00046	0.00048	0.0005	0.00051	0.00068	0.00072	0.00075	0.00077
12	0.0005	0.00053	0.00055	0.00057	0.00075	0.00079	0.00083	0.00085
11	0.00053	0.00057	0.00059	0.00061	0.0008	0.00085	0.00089	0.00092
10	0.00056	0.0006	0.00063	0.00065	0.00084	0.0009	0.00094	0.00098
9	0.00058	0.00063	0.00066	0.00068	0.00088	0.00094	0.00098	0.00102
8	0.0006	0.00064	0.00068	0.00070	0.0009	0.00097	0.00102	0.00105
7	0.00061	0.00066	0.00069	0.00072	0.00092	0.00099	0.00104	0.00108
6	0.00062	0.00067	0.0007	0.00073	0.00093	0.0010	0.00106	0.00110
5	0.00063	0.00067	0.00071	0.00074	0.00094	0.00101	0.00106	0.00110
4	0.00062	0.00067	0.00071	0.00073	0.00094	0.00101	0.00106	0.00110
3	0.00061	0.00066	0.00069	0.00072	0.00092	0.00099	0.00104	0.00108
2	0.00058	0.00062	0.00065	0.00068	0.00087	0.00093	0.00098	0.00101
1	0.00051	0.00054	0.00056	0.00058	0.00075	0.00080	0.00084	0.00087
PLINTH	0.00025	0.00026	0.00027	0.00028	0.00036	0.00038	0.0004	0.00041
BASE	0	0	0	0	0	0	0	0

The following observations are made from Table 5 for U-Shaped Buildings in Zone IV (No Infill):

- For all the L_1/L_2 ratios, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift increases. When L_1/L_2 ratio =1.0, the value is 1.57 mm.

The following observations are made from Table 5 for U-Shaped Buildings in Zone V (No Infill):

- For all the L_1/L_2 ratios, maximum design storey drift occurs at floor no.18.

- As L_1/L_2 ratio increases the maximum design storey drift increases. When L_1/L_2 ratio =1.0, the value is 2.36 mm.

(b) Design Storey Drifts in Y-Direction (No Infill)

The design storey drifts in y-direction for U-shaped buildings with no infill are given in Table 6 for various values of L_1/L_2 ratio and zones II and III and in Table 7 for various values of L_1/L_2 ratio and zones IV and V. Each storey drift entry in the table represents the maximum value obtained by considering all load combinations specified by the relevant IS Codes.

Table 6: Values of design storey drift in m

STOREY NO.	WL/EL in Y-direction; No infill							
	ZONE II				ZONE III			
	L_1/L_2 Ratio				L_1/L_2 Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
20	0.00046	0.00046	0.00046	0.00046	0.00046	0.00046	0.00046	0.00046
19	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062

18	0.00079	0.00079	0.00078	0.00078	0.00079	0.00079	0.00078	0.00078
17	0.00089	0.00087	0.00086	0.00085	0.00089	0.00087	0.00086	0.00085
16	0.00076	0.00069	0.00066	0.00065	0.00076	0.00083	0.00066	0.00065
15	0.00078	0.00049	0.00035	0.00028	0.00078	0.00049	0.00035	0.00028
14	0.00087	0.00054	0.00039	0.00030	0.00087	0.00054	0.00039	0.0003
13	0.00094	0.00058	0.00041	0.00032	0.00094	0.00058	0.00041	0.00036
12	0.001	0.00062	0.00044	0.00034	0.001	0.00062	0.00044	0.00039
11	0.00106	0.00065	0.00047	0.00036	0.00106	0.00065	0.00047	0.00041
10	0.00111	0.00068	0.00049	0.00038	0.00111	0.00068	0.00049	0.00043
9	0.00116	0.00071	0.00051	0.00040	0.00116	0.00071	0.00051	0.00045
8	0.0012	0.00074	0.00054	0.00042	0.0012	0.00074	0.00054	0.00046
7	0.00124	0.00077	0.00056	0.00044	0.00124	0.00077	0.00056	0.00047
6	0.00127	0.00079	0.00057	0.00045	0.00127	0.00079	0.00057	0.00047
5	0.00129	0.00081	0.00059	0.00046	0.00129	0.00081	0.00059	0.00047
4	0.00129	0.00082	0.00060	0.00047	0.00129	0.00082	0.00060	0.00047
3	0.00126	0.00081	0.0006	0.00047	0.00126	0.00081	0.00060	0.00047
2	0.00115	0.00076	0.00057	0.00045	0.00115	0.00076	0.00057	0.00045
1	0.00092	0.00063	0.00049	0.00040	0.00092	0.00063	0.00049	0.0004
PLINTH	0.00041	0.00029	0.00023	0.00019	0.00041	0.00029	0.00023	0.00019
BASE	0	0	0	0	0	0	0	0

The following observations are made from Table 6 for U-Shaped Buildings in Zone II (No Infill):

- For L_1/L_2 ratio = 0.25, maximum design storey drift occurs at floor no.5 and 6.
- For other values of L_1/L_2 ratio, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift decreases. When L_1/L_2 ratio = 0.25, the value is 1.29 mm.

The following observations are made from Table 6 for U-Shaped Buildings in Zone III (No Infill):

- For L_1/L_2 ratio = 0.25, maximum design storey drift occurs at floor no.5 and 6.
- For other values of L_1/L_2 ratio, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift decreases. When L_1/L_2 ratio = 0.25, the value is 1.29 mm.

Table 7: Values of design storey drift in m

STOREY NO.	WL/EL in Y-direction; No infill							
	ZONE IV				ZONE V			
	L_1/L_2 Ratio				L_1/L_2 Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
20	0.00043	0.00050	0.00054	0.00057	0.00059	0.00068	0.00073	0.00078
19	0.00057	0.00067	0.00073	0.00078	0.0008	0.00093	0.00102	0.00109
18	0.00071	0.00083	0.00091	0.00097	0.00099	0.00117	0.00129	0.00139
17	0.00079	0.00090	0.00099	0.00106	0.0011	0.00129	0.00143	0.00153
16	0.00067	0.00071	0.00077	0.00081	0.00094	0.00104	0.00113	0.00119
15	0.00071	0.00052	0.00044	0.00038	0.00093	0.00072	0.0006	0.00053
14	0.0008	0.00059	0.00049	0.00044	0.00104	0.00081	0.00069	0.00061
13	0.00086	0.00064	0.00055	0.00049	0.00112	0.00089	0.00077	0.00069
12	0.00091	0.00068	0.00059	0.00054	0.00118	0.00095	0.00084	0.00077
11	0.00096	0.00072	0.00063	0.00058	0.00124	0.00101	0.0009	0.00083
10	0.001	0.00075	0.00066	0.00061	0.0013	0.00105	0.00095	0.00088
9	0.00104	0.00076	0.00069	0.00064	0.00136	0.00109	0.00099	0.00093
8	0.00108	0.00078	0.0007	0.00066	0.00142	0.00111	0.00101	0.00096

7	0.00111	0.00078	0.00071	0.00067	0.00147	0.00112	0.00103	0.00098
6	0.00114	0.00078	0.00072	0.00068	0.00151	0.00113	0.00104	0.00099
5	0.00115	0.00077	0.00071	0.00068	0.00154	0.00112	0.00104	0.00100
4	0.00115	0.00075	0.0007	0.00067	0.00155	0.0011	0.00103	0.00099
3	0.00112	0.00072	0.00068	0.00066	0.00151	0.00106	0.00100	0.00097
2	0.00102	0.00067	0.00063	0.00061	0.00138	0.00096	0.00093	0.00091
1	0.00081	0.00056	0.00053	0.00052	0.0011	0.00079	0.00078	0.00078
PLINTH	0.00037	0.00026	0.00024	0.00024	0.0005	0.00036	0.00036	0.00036
BASE	0	0	0	0	0	0	0	0

The following observations are made from Table 7 for U-Shaped Buildings in Zone IV (No Infill):

- For L_1/L_2 ratio = 0.25, maximum design storey drift occurs at floor no.5 and 6.
- For other values of L_1/L_2 ratio, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases, the maximum design storey drift decreases from a maximum at L_1/L_2 ratio = 0.25 to a minimum at L_1/L_2 ratio = 0.50 and later increases. When L_1/L_2 ratio =0.25, the storey drift is 1.15 mm.

The following observations are made from Table 7 for U-Shaped Buildings in Zone V (No Infill):

- For L_1/L_2 ratio = 0.25, maximum design storey drift occurs at floor no.5.
- For other values of L_1/L_2 ratio, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases, the maximum design storey drift decreases from a maximum at L_1/L_2 ratio = 0.25 to a minimum at L_1/L_2 ratio = 0.50 and later increases. When L_1/L_2 ratio =0.25, the storey drift is 1.55 mm.

Table 8: Values of maximum design storey drift in m (No infill)

Zone No.	EL / WL in X- Direction				EL / WL in Y- Direction			
	L_1/L_2 Ratio				L_1/L_2 Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
II	0.00057	0.00061	0.00063	0.00066	0.00129	0.00087	0.00086	0.00085
III	0.00091	0.00097	0.00101	0.00105	0.00129	0.00087	0.00086	0.00085
IV	0.00136	0.00145	0.00152	0.00157	0.00115	0.00090	0.00099	0.00106
V	0.00204	0.00218	0.00228	0.00236	0.00155	0.00129	0.00143	0.00153

From Table 8, it can be observed that:

- The maximum design storey drift in x-direction, for any given zone, increases with L_1/L_2 ratio.
- The maximum design storey drift in y-direction, for zones II and III, decreases with L_1/L_2 ratio. For the other zones, the maximum design storey drift decreases from a maximum value at L_1/L_2 ratio =0.25 to a minimum value at L_1/L_2 ratio=0.5 and later increases.
- The absolute maximum design storey drift in x- or y-direction occurs in zone V.

- The maximum design storey drift in y-direction is greater than that in x-direction for zone II. The maximum design storey drift in y-direction is smaller than that in x-direction for zones IV and V. The variation in zone III is as defined in Table 8.

(c) Design Storey Drifts in X-Direction (Infill)

The design storey drifts in x-direction for U-shaped buildings with infill are given in Table 9 for various values of L_1/L_2 ratio and zones II and III and in Table 10 for various values of L_1/L_2 ratio and zones IV and V. Each storey drift entry in the table

represents the maximum value obtained by relevant IS Codes.
 considering all load combinations specified by the

Table 9: Values of design storey drift in m

WL/EL in X-direction; Infill								
STOREY NO.	ZONE II				ZONE III			
	L ₁ /L ₂ Ratio				L ₁ /L ₂ Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
20	0.00012	0.00012	0.00013	0.00013	0.00018	0.00019	0.00019	0.0002
19	0.00020	0.00022	0.00022	0.00023	0.00032	0.00033	0.00033	0.00035
18	0.00029	0.00030	0.00031	0.00031	0.00044	0.00046	0.00046	0.00049
17	0.00036	0.00038	0.00039	0.00040	0.00056	0.00058	0.00058	0.00061
16	0.00034	0.00036	0.00037	0.00038	0.00053	0.00055	0.00056	0.00058
15	0.00012	0.00013	0.00013	0.00013	0.00019	0.0002	0.00021	0.00021
14	0.00016	0.00017	0.00017	0.00017	0.00025	0.00026	0.00027	0.00028
13	0.00019	0.00019	0.00020	0.00021	0.0003	0.00031	0.00032	0.00033
12	0.00021	0.00022	0.00023	0.00024	0.00033	0.00034	0.00035	0.00037
11	0.00022	0.00024	0.00026	0.00029	0.00035	0.00037	0.00038	0.0004
10	0.00023	0.00027	0.00030	0.00033	0.00037	0.00039	0.00041	0.00042
9	0.00025	0.0003	0.00033	0.00036	0.00039	0.00041	0.00043	0.00044
8	0.00027	0.00032	0.00037	0.0004	0.00040	0.00043	0.00044	0.00046
7	0.00029	0.00035	0.0004	0.00044	0.00041	0.00044	0.00045	0.00047
6	0.00031	0.00038	0.00043	0.00047	0.00042	0.00044	0.00046	0.00048
5	0.00033	0.0004	0.00046	0.00050	0.00042	0.00045	0.00046	0.00050
4	0.00034	0.00042	0.00048	0.00052	0.00042	0.00045	0.00046	0.00052
3	0.00035	0.00043	0.00049	0.00053	0.00042	0.00044	0.00047	0.00053
2	0.00035	0.00042	0.00047	0.00051	0.00040	0.00042	0.00046	0.00051
1	0.00032	0.00037	0.0004	0.00043	0.00036	0.00038	0.0004	0.00043
PLINTH	0.00017	0.00019	0.0002	0.00021	0.00018	0.00019	0.0002	0.00021
BASE	0	0	0	0	0	0	0	0

The following observations are made from Table 9 for U-Shaped Buildings in Zone II (Infill):

- For L₁/L₂ ratio = 0.25, maximum design storey drift occurs at floor no.18.
- For other values of L₁/L₂ ratio, maximum design storey drift occurs at floor no.4.

- As L₁/L₂ ratio increases the maximum design storey drift increases. When L₁/L₂ ratio =1.0, the value is 0.53 mm.

The following observations are made from Table 9 for U-Shaped Buildings in Zone III (Infill):

- For all the L_1/L_2 ratios, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift increases. When L_1/L_2 ratio =1.0, the value is 0.61 mm.

Table 10: Values of design storey drift in m

WL/EL in X-direction; Infill								
STOREY NO.	ZONE IV				ZONE V			
	L_1/L_2 Ratio				L_1/L_2 Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
20	0.00027	0.00028	0.00028	0.00029	0.00039	0.00041	0.00043	0.00044
19	0.00046	0.00049	0.00049	0.00052	0.00069	0.00072	0.00075	0.00077
18	0.00065	0.00068	0.00068	0.00072	0.00096	0.00100	0.00104	0.00106
17	0.00081	0.00085	0.00085	0.00090	0.00120	0.00126	0.00130	0.00133
16	0.00078	0.00081	0.00082	0.00086	0.00115	0.0012	0.00124	0.00127
15	0.00029	0.0003	0.00031	0.00032	0.00043	0.00045	0.00046	0.00048
14	0.00038	0.00039	0.0004	0.00042	0.00057	0.00059	0.00061	0.00062
13	0.00044	0.00046	0.00047	0.00049	0.00066	0.00069	0.00071	0.00073
12	0.00049	0.00051	0.00053	0.00055	0.00073	0.00077	0.0008	0.00082
11	0.00052	0.00055	0.00057	0.00059	0.00078	0.00083	0.00086	0.00089
10	0.00055	0.00059	0.00061	0.00063	0.00083	0.00088	0.00092	0.00095
9	0.00058	0.00062	0.00064	0.00066	0.00086	0.00092	0.00096	0.00099
8	0.0006	0.00064	0.00066	0.00069	0.00089	0.00095	0.00100	0.00103
7	0.00061	0.00065	0.00068	0.00071	0.00091	0.00098	0.00102	0.00106
6	0.00062	0.00066	0.00069	0.00072	0.00093	0.00099	0.00104	0.00107
5	0.00063	0.00067	0.00069	0.00072	0.00093	0.00100	0.00105	0.00108
4	0.00063	0.00067	0.00069	0.00072	0.00094	0.00100	0.00105	0.00108
3	0.00062	0.00066	0.00068	0.00071	0.00093	0.00099	0.00103	0.00107
2	0.0006	0.00063	0.00065	0.00068	0.00089	0.00094	0.00099	0.00102
1	0.00053	0.00056	0.00058	0.00059	0.00079	0.00083	0.00086	0.00088
PLINTH	0.00026	0.00027	0.00028	0.00029	0.00038	0.0004	0.00041	0.00042
BASE	0	0	0	0	0	0	0	0

The following observations are made from Table 10 for U-Shaped Buildings in Zone IV (Infill):

- For all the L_1/L_2 ratios, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift increases. When L_1/L_2 ratio =1.0, the value is 0.90 mm.

The following observations are made from Table 10 for U-Shaped Buildings in Zone V (Infill):

- For all the L_1/L_2 ratios, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift increases. When L_1/L_2 ratio =1.0, the value is 1.33 mm.

The design storey drifts in y-direction for U-shaped buildings with infill are given in Table 11 for various values of L_1/L_2 ratio and zones II and III and in Table 12 for various values of L_1/L_2 ratio and zones IV and V. Each storey drift entry in the table represents the maximum value obtained by considering all load combinations specified by the relevant IS Codes.

(d) Design Storey Drifts in Y-Direction (Infill)

Table 11: Values of design storey drift in m

WL/EL in Y-direction; Infill								
STOREY NO.	ZONE II				ZONE III			
	L_1/L_2 Ratio				L_1/L_2 Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
20	0.00044	0.00044	0.00045	0.00044	0.00044	0.00044	0.00045	0.00044
19	0.00059	0.00059	0.00059	0.00058	0.00059	0.00059	0.00059	0.00058
18	0.00074	0.00074	0.00074	0.00073	0.00074	0.00074	0.00074	0.00073
17	0.00083	0.00082	0.00082	0.00081	0.00083	0.00082	0.00082	0.00080
16	0.00071	0.00066	0.00065	0.00063	0.00071	0.00066	0.00065	0.00062
15	0.00072	0.00045	0.0003	0.00033	0.00072	0.00045	0.0003	0.00026
14	0.0008	0.00049	0.00033	0.00035	0.0008	0.00049	0.00033	0.0003
13	0.00087	0.00053	0.00036	0.00038	0.00087	0.00053	0.00036	0.00033
12	0.00092	0.00056	0.00038	0.0004	0.00092	0.00056	0.00039	0.00036
11	0.00097	0.00059	0.0004	0.00042	0.00097	0.00059	0.00041	0.00039
10	0.00102	0.00062	0.00042	0.00044	0.00102	0.00062	0.00043	0.00041
9	0.00106	0.00065	0.00044	0.00047	0.00106	0.00065	0.00044	0.00042
8	0.0011	0.00068	0.00046	0.00048	0.0011	0.00068	0.00046	0.00043
7	0.00114	0.0007	0.00048	0.0005	0.00114	0.0007	0.00048	0.00044
6	0.00117	0.00072	0.00049	0.00052	0.00117	0.00072	0.00049	0.00044
5	0.00119	0.00074	0.0005	0.00053	0.00119	0.00074	0.0005	0.00044
4	0.00119	0.00075	0.00051	0.00054	0.00119	0.00075	0.00051	0.00044
3	0.00117	0.00074	0.00052	0.00054	0.00117	0.00074	0.00052	0.00043
2	0.00108	0.0007	0.0005	0.00052	0.00108	0.0007	0.0005	0.00041
1	0.00088	0.00061	0.00046	0.00046	0.00088	0.00061	0.00046	0.00038
PLINTH	0.0004	0.00028	0.00022	0.00022	0.0004	0.00028	0.00022	0.00018
BASE	0	0	0	0	0	0	0	0

The following observations are made from Table 11 for U-Shaped Buildings in Zone II (Infill):

- For L_1/L_2 ratio = 0.25, maximum drift occurs at floor no.5 and 6.

- For other values of L_1/L_2 ratio, maximum drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift decreases upto L_1/L_2 ratio

=0.50 and remains almost constant thereafter. The maximum value of drift is 1.19 mm.

- For other values of L_1/L_2 ratio, maximum design storey drift occurs at floor no.18.
- As L_1/L_2 ratio increases the maximum design storey drift decreases upto L_1/L_2 ratio =0.50 and remains almost constant thereafter. The maximum value of drift is 1.19 mm.

The following observations are made from Table 11 for U-Shaped Buildings in Zone III (Infill):

- For L_1/L_2 ratio = 0.25, maximum design storey drift occurs at floor no.5 and 6.

Table 12: Values of design storey drift in m

STOREY NO.	WL/EL in Y-direction; Infill							
	ZONE IV				ZONE V			
	L_1/L_2 Ratio				L_1/L_2 Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
20	0.00042	0.00049	0.00054	0.00054	0.00056	0.00065	0.0007	0.00074
19	0.00054	0.00063	0.0007	0.00072	0.00075	0.00087	0.00094	0.001
18	0.00067	0.00076	0.00086	0.00088	0.00092	0.00107	0.00117	0.00125
17	0.00075	0.00083	0.00093	0.00095	0.00101	0.00118	0.00129	0.00137
16	0.00063	0.00066	0.00073	0.00074	0.00086	0.00096	0.00102	0.00107
15	0.00066	0.00049	0.00038	0.00035	0.00086	0.00066	0.00056	0.00049
14	0.00073	0.00055	0.00044	0.0004	0.00097	0.00075	0.00064	0.00057
13	0.00079	0.0006	0.00049	0.00046	0.00105	0.00083	0.00072	0.00065
12	0.00084	0.00064	0.00054	0.00051	0.00112	0.0009	0.00079	0.00072
11	0.00088	0.00068	0.00058	0.00055	0.00117	0.00096	0.00085	0.00079
10	0.00092	0.00071	0.00061	0.00058	0.00121	0.00100	0.0009	0.00084
9	0.00096	0.00073	0.00063	0.00061	0.00125	0.00104	0.00094	0.00088
8	0.00099	0.00074	0.00065	0.00063	0.0013	0.00106	0.00097	0.00092
7	0.00102	0.00075	0.00066	0.00064	0.00135	0.00108	0.00099	0.00094
6	0.00104	0.00075	0.00066	0.00065	0.00139	0.00108	0.001	0.00095
5	0.00106	0.00074	0.00066	0.00065	0.00142	0.00108	0.001	0.00096
4	0.00106	0.00072	0.00065	0.00065	0.00143	0.00106	0.001	0.00096
3	0.00104	0.0007	0.00064	0.00063	0.0014	0.00103	0.00097	0.00094
2	0.00095	0.00064	0.0006	0.0006	0.00129	0.00095	0.00091	0.00089
1	0.00078	0.00054	0.00054	0.00053	0.00106	0.0008	0.00079	0.00079
PLINTH	0.00036	0.00025	0.00025	0.00025	0.00048	0.00037	0.00037	0.00038
BASE	0	0	0	0	0	0	0	0

The following observations are made from Table 12 for U-Shaped Buildings in Zone IV (Infill)

- For L_1/L_2 ratio = 0.25, maximum design storey drift occurs at floor no.5 and 6.
- For other values of L_1/L_2 ratio, maximum design storey drift occurs at floor no.18.
- The maximum design storey drift occurs when L_1/L_2 ratio = 0.25 and the value is 1.06 mm.

The following observations are made from Table 12 for U-Shaped Buildings in Zone V (Infill):

- For L_1/L_2 ratio = 0.25, maximum design storey drift occurs at floor no.5.
- For other values of L_1/L_2 ratio, maximum design storey drift occurs at floor no.18.
- The maximum design storey drift occurs when L_1/L_2 ratio = 0.25 and the value is 1.43 mm.

Table 13: Values of maximum design storey drift in m (Infill)

Zone	EL / WL in X- Direction				EL / WL in Y- Direction			
	L ₁ /L ₂ Ratio				L ₁ /L ₂ Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
II	0.00035	0.00043	0.00049	0.00053	0.00119	0.00082	0.00082	0.00081
III	0.00056	0.00058	0.00058	0.00061	0.00119	0.00082	0.00082	0.00080
IV	0.00081	0.00085	0.00085	0.00090	0.00106	0.00083	0.00093	0.00095
V	0.00120	0.00126	0.00130	0.00133	0.00143	0.00118	0.00129	0.00137

From Table 13, it can be observed that:

- The maximum design storey drift in x-direction, for any given zone, increases with L₁/L₂ ratio.
- The maximum design storey drift in y-direction, for zones II and III, decreases with L₁/L₂ ratio.
- The maximum design storey drift in y-direction decreases from a maximum value

to a minimum value at L₁/L₂ ratio = 0.5 and later increases in the cases of zones IV and V.

- The absolute maximum design storey drift in x- or y-direction occurs in zone V.
- The maximum design storey drift in y-direction is greater than that in x-direction for zones II and III.

2.3 Variation of Design Ultimate Positive Moment and Design Ultimate Negative Moment in Transfer Girders TB1 and TB2

The design ultimate positive and negative moments in transfer girders are given in Tables 14 and 15.

Table 14: Maximum moments in Transfer Girders of U-Shaped Buildings (No Infill)

Transfer Girder	Design Ultimate Positive Moment				Design Ultimate Negative Moment			
	L ₁ /L ₂ Ratio				L ₁ /L ₂ Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
TB1	3315.92	3211.171	3321.2045	3320.9262	5554.4633	5580.9987	5577.271	5574.2551
TB2	4380.75	4384.891	4386.7992	4387.8982	5584.2446	5595.5987	5604.195	5609.2516

Table 15: Maximum moments in Transfer Girders of U-Shaped Buildings (Infill)

Transfer Girder	Design Ultimate Positive Moment				Design Ultimate Negative Moment			
	L ₁ /L ₂ Ratio				L ₁ /L ₂ Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
TB1	2807.66	2812.661	2674.1934	2812.473	4722.1114	4750.9302	4529.304	4744.4007
TB2	3671.86	3675.299	3407.8623	3677.9247	4632.0536	4643.5267	4227.163	4657.4696

From the results obtained, the following are observed in regard to transfer girders:

- The variation of design moments with L₁/L₂ ratio is insignificant.
- The variation of design moments with zone is also insignificant.

- The influence of infill wall on the moments is not insignificant. Both the design ultimate positive and negative moments decrease in magnitude when the effect of infill wall is considered in the analysis as indicated by Tables 14 and 15.

2.4 Variation of Design Ultimate Positive Moment and Design Ultimate Negative Moment in Main Beams

The design ultimate positive and negative moments in main beams are given in Tables 16 and 17.

Table 16: Maximum moments in Main Beams of U-Shaped Buildings (No Infill)

Zone	Design Ultimate Positive Moment				Design Ultimate Negative Moment			
	L ₁ /L ₂ Ratio				L ₁ /L ₂ Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
II	664.833	694.5527	717.0256	733.5771	1235.474	1315.253	1375.827	1420.44
III	664.833	694.5527	717.0256	733.5771	1235.474	1315.253	1375.827	1420.44
IV	739.9536	732.4219	736.0961	742.7527	1438.023	1415.628	1425.542	1443.512
V	861.8816	850.6869	856.3136	866.2555	1766.763	1734.945	1750.129	1776.969

Table 17: Maximum moments in Main Beams of U-Shaped Buildings (Infill)

Zone	Design Ultimate Positive Moment				Design Ultimate Negative Moment			
	L ₁ /L ₂ Ratio				L ₁ /L ₂ Ratio			
	0.25	0.5	0.75	1.0	0.25	0.5	0.75	1.0
II	590.2441	621.8906	644.24	660.8244	1091.547	1176.738	1236.98	1281.682
III	599.3059	621.8906	547.1529	660.8244	1114.3	1176.738	1039.81	1281.682
IV	684.6294	685.8186	612.9714	693.7782	1344.62	1347.779	1227.424	13692686
V	812.5846	814.1504	819.7764	826.6564	1690.018	1694.273	1709.463	1728.039

From the results obtained, the following are observed in regard to main beams:

- The variation of design moments with L₁/L₂ ratio is not significant.
- The variation of design moments with zone is also not significant.
- The influence of infill wall on the design moments is not insignificant. Both the design ultimate positive and negative moments decrease in magnitude when the effect of infill wall is considered in the analysis as indicated by Tables 16 and 17.

2.5 Comparative Study of Equivalent Static Lateral Force Method and Response Spectrum Method

2.5.1 Loading Combinations Considered

For the purpose of comparing the two methods, the load combinations shown in Table 18 are considered.

Table 18: Load combinations for the limit state of serviceability

Load combination

Sl.N o.	Equivalent Static Lateral Force Method	Sl.N o.	Response Spectrum Method
1	DL + EQ _X	1	DL + SPEC _X
2	DL - EQ _X	2	DL - SPEC _X
3	DL + EQ _Y	3	DL + SPEC _Y
4	DL - EQ _Y	4	DL - SPEC _Y
5	DL + 0.8 LL + 0.8 EQ _X	5	DL + 0.8 LL + 0.8 SPEC _X
6	DL + 0.8 LL - 0.8 EQ _X	6	DL + 0.8 LL - 0.8 SPEC _X
7	DL + 0.8 LL + 0.8 EQ _Y	7	DL + 0.8 LL + 0.8 SPEC _Y
8	DL + 0.8 LL - 0.8 EQ _Y	8	DL + 0.8 LL - 0.8 SPEC _Y

2.5.2 Maximum Storey Drifts in X-Direction

The maximum values of storey drift in x-direction for various values of L₁/L₂ ratio and seismic zone are given in Tables 19 through 22 for both infill and no infill.

Table 19: Maximum values of storey drift in x-direction for Zone II

L ₁ / L ₂ RA TIO	ZONE II, X -DIRECTION			
	NO INFILL		INFILL	
	ESLFM	RSM	ESLFM	RSM
0.25	0.000567	0.000504	0.000360	0.000331
0.5	0.000606	0.000534	0.000376	0.000351
0.75	0.000634	0.000551	0.000387	0.000364
1.0	0.000655	0.000563	0.000395	0.000371

Table 20: Maximum values of storey drift in x-direction for Zone III

L ₁ / L ₂ RA TIO	ZONE III, X -DIRECTION			
	NO INFILL		INFILL	
	ESLFM	RSM	ESLFM	RSM
0.25	0.000907	0.000807	0.000555	0.000508
0.5	0.000969	0.000854	0.000580	0.000540
0.75	0.001014	0.000882	0.000577	0.000543
1.0	0.001049	0.000901	0.000611	0.000572

Table 21: Maximum values of storey drift in x-direction for Zone IV

L ₁ / L ₂ RA TIO	ZONE IV, X -DIRECTION			
	NO INFILL		INFILL	
	ESLFM	RSM	ESLFM	RSM
0.25	0.001361	0.001210	0.000814	0.000745
0.5	0.001454	0.001281	0.000852	0.000792
0.75	0.001521	0.001323	0.000848	0.000798
1.0	0.001573	0.001352	0.000898	0.000841

Table 22: Maximum values of storey drift in x-direction for Zone V

L ₁ / L ₂ RA TIO	ZONE V, X -DIRECTION			
	NO INFILL		INFILL	
	ESLFM	RSM	ESLFM	RSM
0.25	0.002041	0.001815	0.001204	0.001099
0.5	0.002180	0.001921	0.001260	0.001170
0.75	0.002282	0.001984	0.001300	0.001217
1.0	0.002359	0.002028	0.001329	0.001243

From Tables 19 through 22, the following observations are made:

- The maximum storey drift in x-direction increases monotonically with the severity of the zone.
- Absolute maximum value of storey drift in x-direction occurs when L₁/L₂ ratio is unity for all zones and both cases of infill and no fill according to ESLFM and RSM.
- The maximum storey drift in x-direction in any case is smaller when infill is considered in the analysis.
- The response spectrum method predicts lower maximum storey drift in x-direction compared to the equivalent static lateral force method in all the cases.

2.5.3 Maximum Storey Drifts in Y-Direction

The maximum values of storey drift in y-direction for various values of L₁/L₂ ratio and seismic zone are given in Tables 23 through 26 for both infill and no infill.

Table 23: Maximum values of storey drift in y-direction for Zone II

L ₁ / L ₂ RA TIO	ZONE II, Y -DIRECTION			
	NO INFILL		INFILL	
	ESLFM	RSM	ESLFM	RSM
0.25	0.000500	0.000456	0.000466	0.000423
0.5	0.000440	0.000415	0.000416	0.000396
0.75	0.000482	0.000445	0.000450	0.000422
1.0	0.000512	0.000466	0.000474	0.000440

Table 24: Maximum values of storey drift in y-direction for Zone III

L ₁ / L ₂ RA TIO	ZONE III, Y -DIRECTION			
	NO INFILL		INFILL	
	ESLFM	RSM	ESLFM	RSM
0.25	0.000676	0.000586	0.000639	0.000553
0.5	0.000637	0.000593	0.000591	0.000557
0.75	0.000699	0.000641	0.000668	0.000619
1.0	0.000745	0.000673	0.000680	0.000625

Table 25: Maximum values of storey drift in y-direction for Zone IV

L ₁ / L ₂ RA TIO	ZONE IV, Y -DIRECTION			
	NO INFILL		INFILL	
	ESLFM	RSM	ESLFM	RSM
0.25	0.000926	0.000802	0.000884	0.000768
0.5	0.000899	0.000834	0.000825	0.000775
0.75	0.000989	0.000902	0.000928	0.000855
1.0	0.001057	0.000948	0.000954	0.000873

Table 26: Maximum values of storey drift in y-direction for Zone V

L ₁ / L ₂ RA TIO	ZONE V, Y -DIRECTION			
	NO INFILL		INFILL	
	ESLFM	RSM	ESLFM	RSM
0.25	0.001308	0.001142	0.001259	0.001104
0.5	0.001292	0.001194	0.001175	0.001101
0.75	0.001425	0.001294	0.001285	0.001187
1.0	0.001525	0.001361	0.001365	0.001244

From Tables 23 through 26, the following observations are made:

- The maximum storey drift in y-direction increases monotonically with the severity of the zone for all the cases.
- Absolute maximum value of storey drift in y-direction occurs when L₁/L₂ ratio is 1.0 for all zones and both cases of infill and no fill according to ESLFM and RSM.
- The maximum storey drift in y-direction in any case is smaller when infill is considered in the analysis.
- The response spectrum method predicts lower maximum storey drift in y-direction compared to the equivalent static lateral force method in all cases.

3. CONCLUSIONS

3.1 Design Storey Drifts

- The absolute maximum design storey drift in x- or y-direction occurs in Zone V.

- The maximum design storey drift in x- or y-direction for any zone and any value of L₁/L₂ ratio is smaller when infill wall is considered in the analysis. Thus the effect of infill walls is to reduce the storey drifts.

(i) No Infill

- As L₁/L₂ ratio increases the maximum design storey drift in x-direction also increases in all zones. The maximum design storey drift in x-direction increases monotonically with the seismic severity of the zone.
- For all the L₁/L₂ ratios and zones, maximum design storey drift in x-direction occurs at floor no.18.
- The maximum design storey drift in y-direction occurs either at floor no.5 or 6 or 18.
- As seismic severity of the zone increases, the maximum design storey drift in y-direction varies and is maximum for zone V.
- The maximum design storey drift in x-direction, for any given zone, increases with L₁/L₂ ratio.
- The maximum design storey drift in y-direction, for zones II and III, decreases with L₁/L₂ ratio. For the other zones, the maximum design storey drift decreases from a maximum value at L₁/L₂ ratio =0.25 to a minimum value at L₁/L₂ ratio=0.5 and later increases.
- The absolute maximum design storey drift in x- or y-direction occurs in zone V.
- The maximum design storey drift in y-direction is greater than that in x-direction for zone II. The maximum design storey drift in y-direction is smaller than that in x-direction for zones IV and V. The variation in zone III is as defined in relevant Table.

(ii) With Infill

- As L₁/L₂ ratio increases the maximum design storey drift in x-direction also increases in all zones. The maximum design storey drift in x-direction increases monotonically with the seismic severity of the zone.

- In zone II, maximum design storey drift in x-direction occurs at either floor no.18 or 4. In the other zones it occurs at floor no.18.
- As seismic severity of the zone increases, the maximum design storey drift in y-direction varies and is maximum for zone V.
- In all the zones, the maximum design storey drift in y-direction occurs either at floor no.5 or 6 or 18.
- The maximum design storey drift in x-direction, for any given zone, increases with L_1/L_2 ratio.
- The maximum design storey drift in y-direction, for zones II and III, decreases with L_1/L_2 ratio.
- The maximum design storey drift in y-direction decreases from a maximum value to a minimum value at L_1/L_2 ratio = 0.5 and later increases in the cases of zones IV and V.
- The absolute maximum design storey drift in x- or y-direction occurs in zone V.
- The maximum design storey drift in y-direction is greater than that in x-direction for zones II and III.

3.2 Design Ultimate Moments in Transfer Girders and Main Beams

- The variation with L_1/L_2 ratio and severity of seismic zone is not significant.
- The influence of infill wall on the design moments is not insignificant. Both the design ultimate positive and negative moments decrease in magnitude when the effect of infill wall is considered in the analysis.

3.3 Equivalent Static Lateral Force Method Versus Response Spectrum Method

- The maximum storey drift in x- and y-directions increases monotonically with the severity of the zone.
- Absolute maximum value of storey drift in x- and y-directions occurs when L_1/L_2 ratio is unity for all zones and both cases

of infill and no fill according to ESLFM and RSM.

- The maximum storey drift in x- and y-directions in any case is smaller when infill is considered in the analysis.
- The response spectrum method predicts lower maximum storey drift in x- and y-directions compared to the equivalent static lateral force method in all the cases.

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New Pulsewidth Modulation Strategy of Z-Source Inverter for Minimum Inductor Current Ripple

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Abstract

The SVPWM strategy based on single phase shoot through in Z-source inverter has many advantages, such as higher equivalent operating frequency, smaller ripple of Z-source inductor current and smaller volume and weight of Z-source network. The optimal design of the inductor in Z-source inverter based on this modulation strategy is carried out in this paper. Firstly, the SVPWM strategy of Z-source inverter is achieved by modifying the traditional SVPWM strategy of Voltage-source inverter. Then the waveform and ripple expression of Z-source inductor current can be got quantitatively. The Z-source inductor is designed. At last, by experiments, it is verified that the ripple of the designed inductor current satisfies all the constraints.

Keywords: Z-source Inverter, SVPWM, ripple of inductor Current

1. Introduction

Due to environmental concerns, more effort is now being put into clean distributed power like geothermal, wind power, fuel cells and photovoltaic that directly uses the energy from the nature to generate electricity. As the distributed power generation is free, the major cost of generation is their installation cost. Their generation system mainly consist of inverters. The main function of inverter circuit is to convert DC input sources to AC output waveforms. Traditionally there are two types of inverters which are voltage source inverters and current source inverters. Both of these types of inverters are differentiated by their type of DC input sources. Voltage source inverters use DC voltage sources as inputs while current source inverters use DC current sources. The traditional inverters have a major setback. The major setback or problem is that the AC output can only be equal or less than the DC input values. This problem has limited the flexibility of the inverters. This means that if one wants to design a circuit that produces AC output larger than

the DC input, one must design a two stage converter which consists of boost converter and inverter. This directly affects the overall efficiency and cost of the circuit. Thus, Z-source inverters were introduced to overcome this barrier and improve the applications of inverters in electronic and electrical power fields. The main challenge faced by the Z-source inverter is system weight and volume. The capacitor value and size can be decreased by introducing new improved topologies of Z-source inverter. But this topologies cannot reduce the size of inductor. In this paper in order to reduce the inductor size a new pulse width modulation strategy is implemented. This is done by reducing the inductor current ripple.

The major advantages Of Z-Source Inverter Over traditional inverters:

- (1) It can used for any type of power conversion.
- (2) Can be used as both V-source as well as I-source inverters.
- (3) Higher efficiency & more reliability
- (4) It can Buck-boost the voltage.
- (5) Self boost phenomenon can be controlled using a battery in the system.

2. Z-Source Inverter

The Z source network employs a unique impedance circuit to couple the converter main circuit to that of the power source in order to obtain the unique features that cannot be achieved using conventional VSI or CSI. The Z-source inverter (ZSI) has been reported suitable for residential PV system because of the capability of voltage boost and inversion in a single stage. The Z-source inverter has overcome the problem associated with the conventional voltage source inverter for implementing DC-AC, AC-DC, AC-AC and DC-DC power conversion. The Z-source inverter reduces harmonics, electromagnetic interference noise and low common mode noise. The Z-source inverter can be used to feed the adjustable

induction motor drive system and it has better performance and results as compared to the conventional VSI. This new approach has been implemented. The Z-source inverter is also implementable to grid connected PV system, which is transformer less and has low cost.

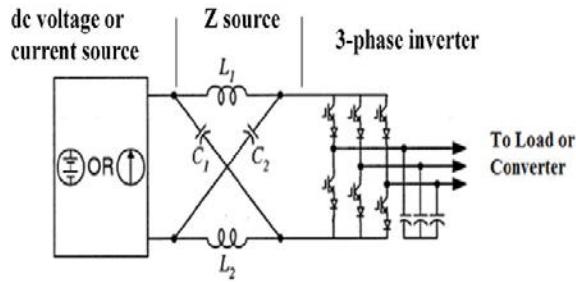


Fig. 2.1 Z-source inverter

2.1 Modes of Operation

ZSI has three modes of operation which includes;

- Mode I- the six active vectors when the dc voltage is connected across the load.
- Mode II- Two zero vectors when the load terminals are shorted through either the upper or lower three devices, respectively.
- Mode III- One more zero state (or vector) when the load terminals are shorted through both the upper and lower devices of any one of the phase leg (i.e., both devices are gated on), any two phase legs, or all three phase legs.

In mode I, the inverter bridge is operating in one of the six traditional active vectors, the equivalent circuit is as shown in figure 2.2. The inverter bridge acts as a current source viewed from the DC link. The diodes conduct and carry currents. Both the inductors have an identical current value because of the circuit symmetry. This unique feature widens the harmonic current.

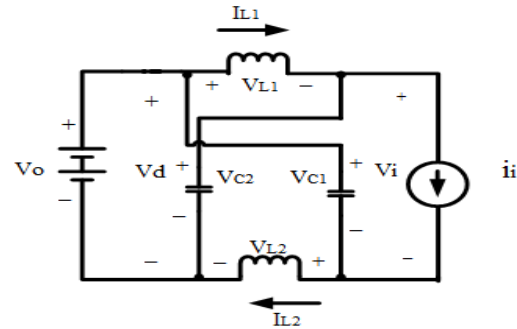


Fig. 2.2 Equivalent Circuit of the ZSI in one of the Six Active States

The equivalent circuit of the bridge in mode II is as shown in the fig 2.6. The inverter bridge is operating in one of the two traditional zero vectors and shorting through either the upper or lower three device, thus acting as an open circuit viewed from the Z-source circuit. Again, under this mode, the inductor carry current, which contributes to the line current's harmonic reduction.

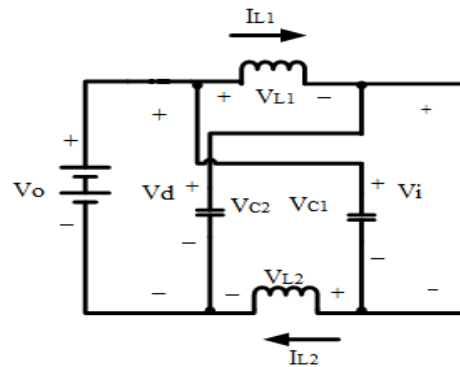


Fig. 2.3 Equivalent Circuit of the ZSI in one of the two traditional zero states.

The inverter bridge is operating in one of the seven shoot-through states. The equivalent circuit of the inverter bridge in this mode is as shown in the below figure 2.4. In this mode, separating the dc link from the ac line. This shoot-through mode to be used in every switching cycle during the traditional zero vector period generated by the PWM control. Depending on how much a voltage boost is needed, the shoot-through interval (T_0) or its duty cycle (T_0/T) is determined. It can be seen that the shoot-

through interval is only a fraction of the switching cycle.

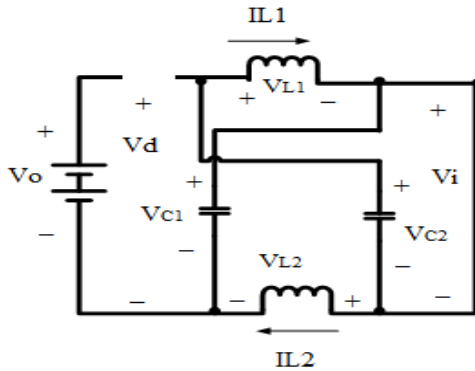


Fig.2.4 Equivalent circuit of the ZSI in the shoot-through state.

2.2 Analysis and Design of Impedance network

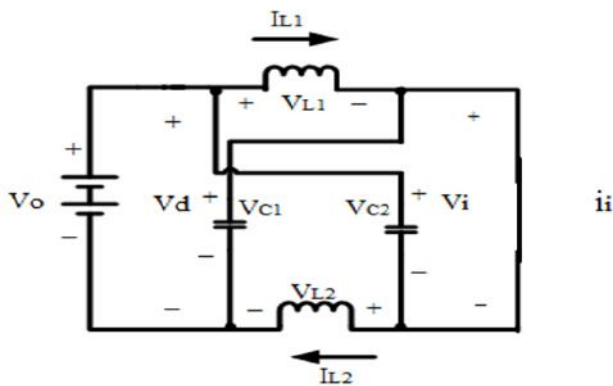


Fig 2.5 Equivalent circuit of ZSI

Assume the inductors (L1&L2) and capacitors (C1 &C2) have the same inductance and capacitance values respectively. From the above equivalent circuit:

$$V_{C1} = V_{C2} = V_C$$

$$V_{L1} = V_{L2} = V_L$$

$$V_L = V_C$$

$$V_d = 2V_C$$

$$V_i = 0$$

During the switching cycle T:

$$V_L = V_o - V_C$$

$$V_d = V_o$$

$$V_i = V_C - V_L = V_C - (V_o - V_C)$$

$$V_i = 2V_C - V_o$$

where, V_o is the dc source voltage and $T = T_o + T_1$

The average voltage of the inductors over one switching period (T) should be zero in steady state:

$$V_L = V_L = T_o \cdot V_C + T_1(V_o - V_C)/T = 0$$

$$V_L = (T_o \cdot V_C + V_o \cdot T_1 - V_C \cdot T_1)/T = 0$$

$$V_L = (T_o - T_c)V_C/T + (T_1 \cdot V_o)/T$$

$$V_C/V_o = T_1/T_1 - T_o \quad (2.1)$$

Similarly the average dc link voltage across the inverter bridge can be found as follows.

From equation (2.1):

$$V_i = V_i = (T_o \cdot 0 + T_1 \cdot (2V_C - V_o))/T$$

$$V_i = (2V_C \cdot T_1/T) - (T_1 V_o/T)$$

$$2V_C = V_o \quad (2.2)$$

From equation (2.2):

$$T_1 \cdot V_o / (T_1 - T_o) = 2V_C \cdot T_1 / (T_1 - T_o)$$

$$V_C = V_o \cdot T_1 / (T_1 - T_o)$$

The peak dc-link voltage across the inverter bridge is:

$$V_i = V_C - V_L = 2V_C - V_o$$

$$= T / (T_1 - T_o) \cdot V_o = B \cdot V_o$$

where, $B = T / (T_1 - T_o)$

B is the boost factor

The output peak phase voltage from the inverter:

$$V_{ac} = M \cdot v_i / 2 \quad (9)$$

where, M is the modulation index:

$$\text{In this source } V_{ac} = M \cdot B \cdot V_o / 2$$

In the traditional sources:

$$V_{ac} = M \cdot V_o / 2$$

For Z-Source

$$V_{ac} = M \cdot B \cdot V_o / 2$$

The output voltage can be stepped up and down by choosing an appropriate buck-boost factor BB:

$$BB = B \cdot M \quad (\text{it varies from 0 to } \alpha)$$

The capacitor voltage can be expressed as:

$$V_{C1} = V_{C2} = V_C = (1 - T_o/T) \cdot V_o / (1 - 2T_o/T)$$

3.Existing SVPWM Strategy

The SVPWM strategy of VSI can also be applied to ZSI through some appropriate modifications. In the traditional SVPWM, there are eight vectors, V1-V6 are effective vectors, V0 and V7 are zero vectors.

If the reference vector Vr is located at Sector I, according to the SVPWM of traditional VSI, Vr can be synthesized with the boundary vectors V1, V2 and zero vectors, the three working times of them are

displayed with T_s (switching period), θ (phase angle of V_r), V_i (the peak DC link voltage).

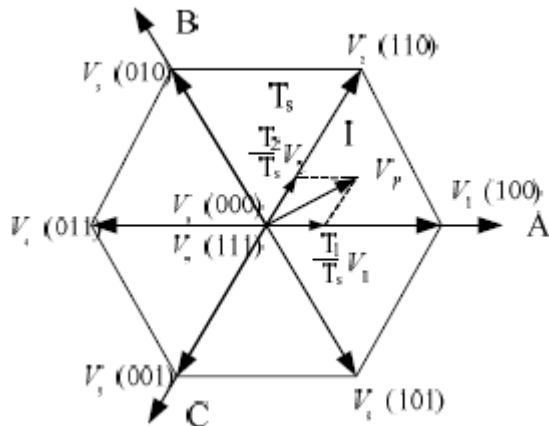


Fig. 3.1. Space Vector Sketch

$$T_1 = \sqrt{3} V_r T_s \sin\left(\frac{\pi}{3} - \theta\right) \quad (3.1)$$

$$T_2 = \sqrt{3} V_r T_s \sin(\theta) \quad (3.2)$$

$$T_0 = T_s - T_1 - T_2$$

The SVPWM switching signals of traditional VSI are shown in Fig. 3.2(a). It can be applied to ZSI by appropriate modification [4]. The modified switching signals are shown in Fig. 3.3(b).

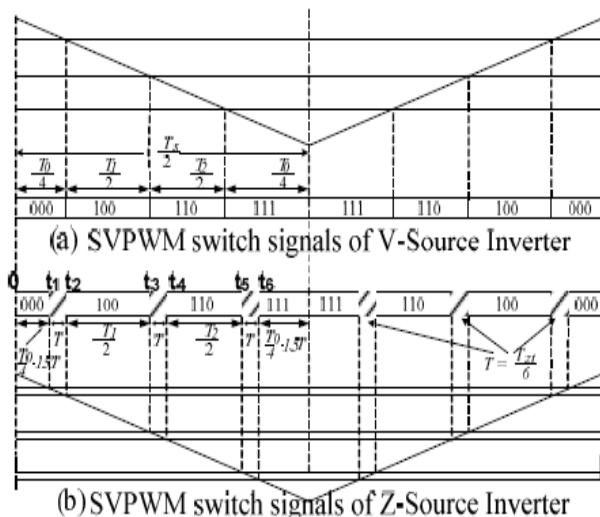


Fig. 3.2 SVPWM switching signals

For symmetry, the shoot-through time is divided into three equal parts in half switch period (each part T equals one sixth of shoot-through time in one switch period T), then insert them into transits between V_0

and V_1 , V_1 and V_2 , V_2 and V_7 , respectively. Ensuring that the working times of V_1 and V_2 after inserting shoot-through state are equal to that before inserting, working times of V_0 and V_7 are equal to each other, and switching moments in half switching period are calculated as (2). According to the six switching moments and the peak value of triangle carrier, the six modulation waves are achieved. As a result, the SVPWM strategy of ZSI is achieved.

4. Proposed PWM Strategy with Minimum Inductor Current Ripple

A PWM strategy with minimum inductor current ripple is proposed. For ZSI, the boost factor is determined by the total shoot-through time. Therefore, the boost ability and ac output voltage of ZSI keeps the same while maintaining the same total shoot-through time. The arrangement of the shoot-through influences the inductor current obviously; thus, by careful allotment of the shoot-through time in three phase legs, the inductor current ripple can be optimized. The switching sequence of the proposed PWM strategy is shown in Fig. 4.1. The shoot-through time of the phases is reassigned as T_a , T_b , T_c , respectively, while keeping the sum of the three unchanged to get the same voltage boost. T_a , T_b , T_c is designed according to the active state time and zero state time to minimize the inductor current ripple. The active state time, the total shoot-through time, and zero state time can be calculated instantaneously and is definite; therefore, the decreased value of inductor current in active state and zero state is also definite. The inductor current ripple is shown in Fig. 4.2.

The instantaneous value of inductor current meets the following rules:

$$\begin{aligned} |i(t_2) - I_L| + |i(t_3) - I_L| &= a \\ |i(t_4) - I_L| + |i(t_5) - I_L| &= b \\ |i(t_1) - I_L| + |i(t_6) - I_L| &= c/2 \end{aligned}$$

where a , b , c is the decreased value of the inductor current in active state 1, active state 2, and zero state, respectively.

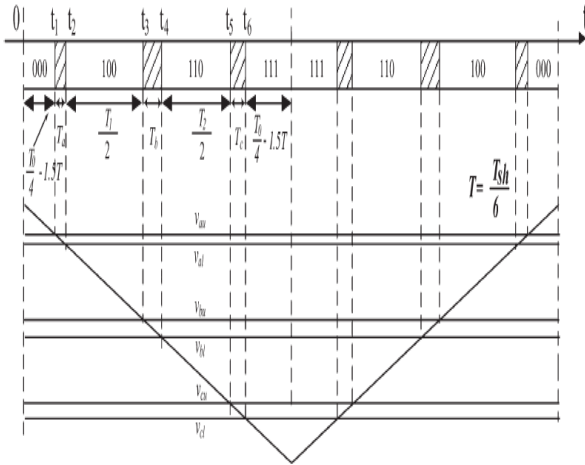


Fig4.1 Switching sequence of proposed PWM strategy

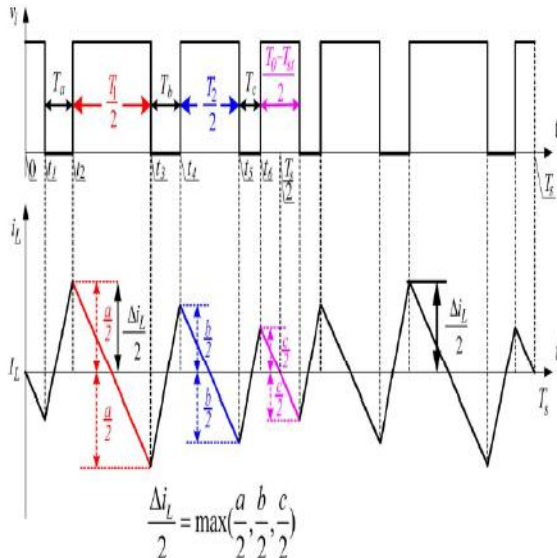


Fig4.2 Inductor current ripple with proposed PWM strategy.

The inductor current ripple can be expressed as:

$$\Delta I_L = 2\max(|i(t_1) - I_L|, |i(t_2) - I_L|, |i(t_3) - I_L|, |i(t_4) - I_L|, |i(t_5) - I_L|, |i(t_6) - I_L|) = 2\max(|i(t_2) - I_L|, |i(t_3) - I_L|, |i(t_4) - I_L|, |i(t_5) - I_L|, c/2]$$

$$\Delta I_L \geq 2\max(a/2, b/2, c/2)$$

When $|i(t_2) - I_L| = |i(t_3) - I_L| = a/2$ &

$|i(t_4) - I_L| = |i(t_5) - I_L| = b/2$.

The current ripple reaches its minimum value:

$$\Delta I_{L \min} = \max(a, b, c)$$

Therefore, to get the minimum inductor current ripple, the shoot-through time of the three phases T_a, T_b, T_c is designed to guarantee that

$$i(t_2) - I_L = I_L - i(t_2) = a/2$$

$$i(t_4) - I_L = I_L - i(t_5) = b/2$$

$$\Delta I_{L_Ta} = c/2 + a/2$$

$$\Delta I_{L_Tb} = a/2 + b/2$$

$$\Delta I_{L_Tc} = b/2 + c/2$$

the shoot-through time of the three phases T_a, T_b, T_c can be,

$$T_a = \frac{c/2 + a/2}{(a+b+c)/2} \frac{T_{sh}}{6}$$

$$T_b = \frac{a/2 + b/2}{(a+b+c)/2} \frac{T_{sh}}{6}$$

$$T_c = \frac{a/2 + b/2}{(a+b+c)/2} \frac{T_{sh}}{6}$$

$$T_c = \frac{a/2 + b/2}{(a+b+c)/2} \frac{T_{sh}}{6}$$

$$T_c = \frac{a/2 + b/2}{(a+b+c)/2} \frac{T_{sh}}{6}$$

$$a:b:c = T_1/2 : T_2/2 : (T_0 - T_{sh})/2$$

By combining the above two equations, T_a, T_b, T_c can be derived as,

$$T_a = \frac{T_{sh}}{4(T_s - T_{sh})} (T_0 + T_1 - T_{sh}) = K(T_0 + T_1 - T_{sh})$$

$$T_b = \frac{T_{sh}}{4(T_s - T_{sh})} (T_1 + T_2) = K(T_1 + T_2)$$

$$T_c = \frac{T_{sh}}{4(T_s - T_{sh})} (T_0 + T_2 - T_{sh}) = K(T_0 + T_2 - T_{sh})$$

Where, where k is proportional to the ratio of the shoot-through time to non-shoot-through time, expressed as:

$$K = \frac{T_{sh}}{4(T_s - T_{sh})}$$

5.Simulation and Experiment Verification

For verifying the correctness of inductor design, simulations and experiments are carried out. The working conditions are as same as that in the part of design example. The circuit parameters are shown as follows:

Z-source inductance $L=1.06mH$;

Z-source capacitance $C=100\mu F$;

Load resistance $R=12\Omega$.

$V_{dc} = 24V$ Figure 5.1 shows the simulation block of ZSI for proposed system and 5.2 shows the new strategy of PWM implemented in ZSI.

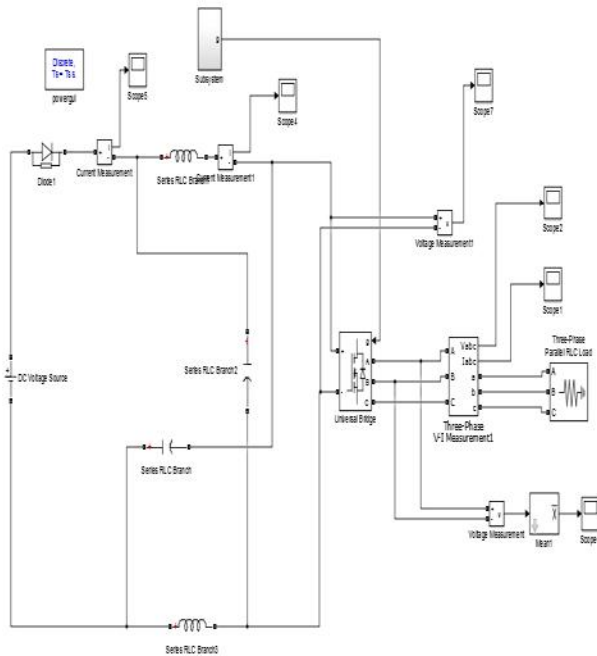


Fig 5.1 Simulation block of ZSI

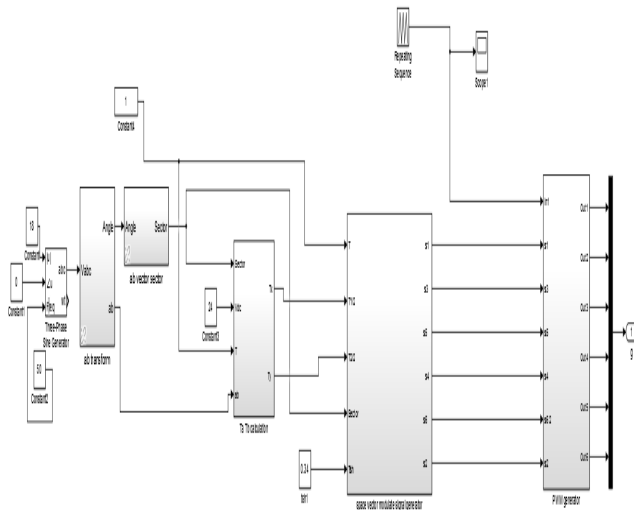


Fig 5.2 Proposed PWM technique

Outputs are displayed based on power frequency and switch frequency respectively. It can also be seen from Fig. 5.6 that there are 6 equal shoot-through states in each switching period, which is in accordance with shoot-through in SVPWM strategy. Fig.5.5 shows the simulation waveforms when the input voltage is 24V. It can be seen from Fig. 8 that the largest ripple is about 0.15A. Figure 5.3 shows the pulse generation waveform.

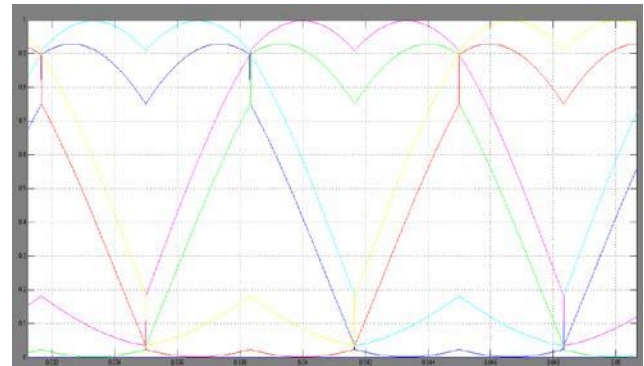


Fig 5.3 Reference waveforms

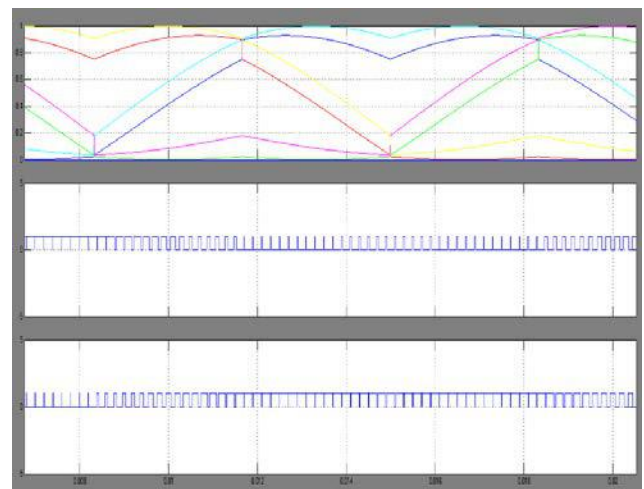


Fig 5.4 Pulse generation

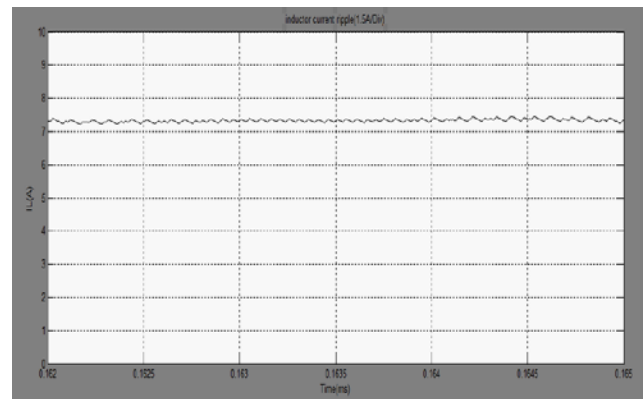


Fig 5.5 Inductor current ripple

Figure 5.1 shows the reference waveform and 5.4 shows the pulse generation. From figure 5.5 it can be understood that the current ripple is 0.15.

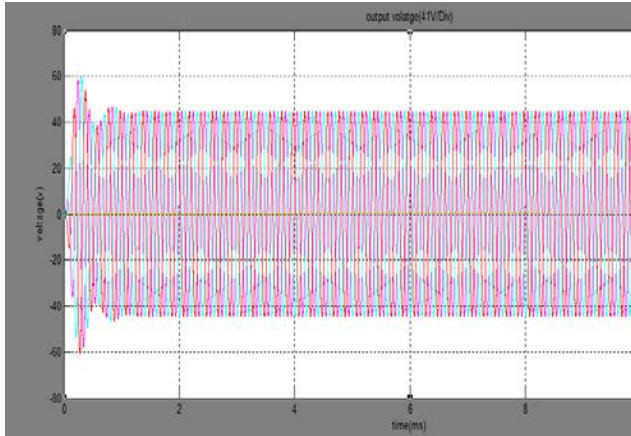


Fig 5.6 Output voltage waveform

Here an output of 41V is obtained from 24V DC source. The theoretical analysis is verified by the accordance with the simulation results. Seen from the experiment waveforms above, the experiment results are in accordance with theoretical analysis and simulation results.

6. Conclusion

In this paper, the ripple of Z-source inductor current based on shoot-through of SVPWM strategy is analyzed, and then the quantitative expression of the ripple is presented. The inductor is designed for a ZSI prototype. Experimental results show that the ripple of Z-source inductor current is inversely proportional to the inductance; the ripple decreases when the input voltage rises; the ripple reaches maximum when the reference vector is in the same phase with the six effective vectors. It is verified that the ripple of the designed inductor current satisfies the constraints, the design method proposed in this paper is feasible.

Acknowledgments

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DESIGN AND FABRICATION OF MULTIPURPOSE SOWING MACHINE

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ABSTRACT:

India is an agricultural country cultivating more number of ground nuts, corns, etc., in the village sides of the country. The available sowing machines are imported from foreign countries. The imported machines are not only bulk in size but also costing around rupees one lakh. In this project an attempt has been made for the design and fabrication of maintenance free multipurpose sowing machine exclusively for small farmers at cost not exceeding rupees 6000 per unit. The different components of above multipurpose sowing machine are modeled using one of the end parametric modeling software Pro-E creo parametric 2.0. The modeled components are fabricated and assembled together to form a complete machine.

Key words: Hopper; Seed metering mechanism; Ground wheel; Power transmission system; Seed distributor; Tiller; Pro-E creo parametric 2.0.

1. INTRODUCTION

The production and productivity of ground nuts, corns, etc., were quite low, when India became independent in 1947. The production was not sufficient to feed the Indian population. The country used to import them in large quantities for fulfilling the needs of our people from many countries. The reasons of low production and productivity were unavailability of machines in the cultivation field. In India most of the farming work is done manually when compared with foreign countries. There were no machines for sowing the seeds like ground nuts, corns then and it is done by man power only. The cost spent for man power was more and the speed of the operation was very less. When small farmers with minimal physical resources or financial assets attempt to improve their productivity, they have a limited choice. The only resource they can maximize is knowledge in which they are not poor. To prove the above statement, Mr.Shivraj was invented the first bullock driven sowing machine in the year 1987 at Madhya Pradesh to improve his productivity. It was light weight and can perform up to six agricultural operations. India is a world leader in groundnut farming with 8 million hectare of cultivated area in the year 2003. Groundnut cultivation has increased from 6.8 million hectare in 1980 to 8 million hectares in the year 2003. Groundnut is grown mostly in five states namely Andhra Pradesh, Gujarat, Tamilnadu, Karnataka and Maharashtra and together they account for about 90 percent of the crops total. The sowing time is the most

important non-monetary input influencing productivity. Delay in sowing by one week result in considerable yield losses. Results obtained from all India coordinated research projects revealed that in most parts of the country, sowing should be done between the first week of June and the last week of July. Advancement of sowing by a fortnight with pre-sowing irrigation was found to increase the yield substantially. The government of India appointed a commission to assess the feasibility of increasing the crop productivity under prevailing Indian ecological conditions. In order to develop the standard of living of small farmers we should make the machines with low cost. Then only small farmers can implement the recent modern machines for farming purposes. Our proposed multipurpose sowing machine is used to sowing different types of seed like groundnuts, corns, etc. So in this work an attempt has been made to provide the multipurpose sowing machine at low cost.

2. MATERIAL SELECTION

Selection of material is based on stiffness, cost, availability and suitability of materials for heat treatment. Hopper is made up of G.I sheet of 20G material. The tiller is made by square steel pipe of 16G light weight material. The other parts which are essentially required for make the metering mechanism and ground wheel are mild steel. All parts are suitably heat treated and necessary precautionary steps are taken to prevent corrosion.

S.NO	COMPONENTS	QTY	MATERIALS
1	Hopper	1	GI Sheet 20G
2	Tiller	1	Steel pipe 16G
3	Bolts Nuts	1	C45 Steel
4	Bevel Gears	2	Hardened Steel
5	Seed Distributor	4	Nylon pipes
6	Sliding plate	1	Mild Steel
7	Ground Wheel	1	Mild Steel
8	Bearings	4	Stainless Steel

3. EXISTING SOWING MACHINES- PROBLEMS

The existing seed sowing machine is too cost. It is not abundantly available in India. It has a complex design. Every seed distributor has the individual seed storage place. Hence, it leads to increase the cost of the machine. It is not compact in size and weight. Hence, it is difficult to transportation from one place to another place.

The existing sowing machine is shown in figure 1(a) and 1(b) to understand the pictorial parts of the machines and also the problem associated with them. In the existing sowing machine every seed distributor needs separate seed storage place and seed metering mechanism. In this work we have taken this as problem because it leads to add the weight of the machine, increases cost of the machine, bulky in size.



Fig.1 (a) Existing Machine



Fig.1 (b) Metering mechanism

3.1 JUSTIFICATION FOR THE PROBLEM

The cost of the machine is going to be reduced by introducing the common seed storage place in the machine. Common seed storage needs a single metering mechanism instead of number of mechanisms in the existing machine. If it is removed design is going to be simple and easy to fabricate. The size of the machine, production cost, transportation, everything will be reduced.

3. MAJOR COMPONENTS IN THE PROPOSED SOWING MACHINE

The proposed Multipurpose sowing machine consists of the following components,

HOPPER

It is an arrangement to store the seeds. Hopper capacity varies according to customers demand from 20kg to 80kg. Due to the concentrated hopper very low quantity of seeds can also be sown. Here our hopper is truncated rectangular prism in shaped so the wastage of seeds can be avoided. Here hopper is made up of galvanized iron 20G sheet it reduces the weight of the hopper. Hence the weight and cost of sowing machine can be reduced.

SLIDING PLATE

The base of the hopper consists of a sliding plate with holes spacing in equal distance. The sliding plate reciprocates to and fro above the base of the hopper. It is made up of 1 mm thick mild steel plate.

SEED METERING MECHANISM

This mechanism is used to metering - in the seeds to the required seed distributor .When the ground wheel rotates the main shaft also rotates with the help of power transmission system. The seeds are sowed through the holes present in the sliding plate.

GROUND WHEEL

Ground wheel is the power generation device. It is attached with tiller. It has a circular disc. Teeth's are provided on the periphery of the disc. It is provided to make a fine grip with the land. When the tractor is moved, ground wheel also rotated. This motion can be transferred to the main shaft through power transmission system. It is made up of mild steel.

POWER TRANSMISSION SYSTEM

It consists of a pair of bevel gear which is connected to the ground wheel through a shaft. Hence the power is transmitted from the ground wheel to the sliding plate through the pair of bevel gears.

SEED DISTRIBUTOR

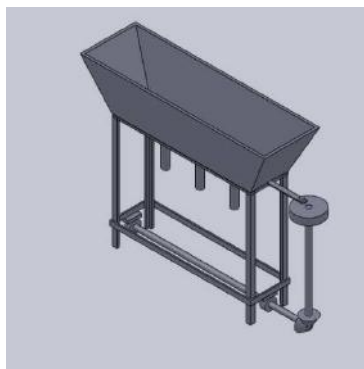
A number of flexible pipes are used as a seed distributor. It receives the seeds from the hopper. After receiving the seeds the distributor leaves the seeds in the prepared land through the pipes. The pipes are fitted in the legs of the tiller.

TILLER

It is a device used to stirring the soil to a greater depth for sowing the seeds. It has the main frame. The hopper is located in this main frame. It has the number of legs corresponding to the number of pipes.

5. 3D MODEL DEVELOPMENT USING PRO-E

Pro-E is the world leading 3D product development solution which is developed by PTC (Parametric Technology Corporation – US based company). It takes care of entire product development process from creative concept through detailed product definition to serviceability. Pro-E plays a vital role in creation of 3D models of all complicated components both in small scale and large scale industries not only in India but also in all western countries. This image represents 3D model of the



sowing machine

Fig.5.1 Entire 3D model



Fig.5.2 Hopper

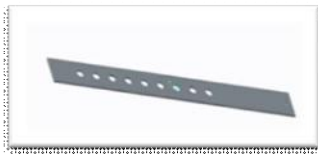


Fig.5.3 Sliding plate

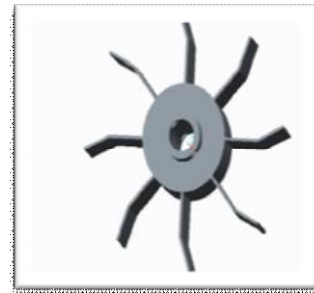


Fig.5.4 Ground wheel

6. PROPOSED MULTIPURPOSE SOWING MACHINE

In this chapter, it is proposed to explain how the seeds are sown with very little effort. Normally it is preferable to use for small farmers. The fabricated proposed sowing machine is shown. The entire arrangement of the multipurpose sowing machine is connected together with the tractor through the provision provided in the machine. When the tractor moves forward, the ground wheel will be rotated. The rotary motion of the ground wheel will be transmitted to the metering mechanism through the power transmission system. The bottom of the hopper consists of a sliding plate. The sliding plate is used to drive out the seeds from the hopper and leave the seeds in the seed distributor pipes. The flexible seed distributors are connected in the legs of the tiller. Here, tiller is used to prepare the land which will be ready for sowing the seeds. So, the seeds are delivered in the prepared land. Depending upon the nature of seeds, we can change the metering mechanism arrangement. The provisions are provided to change the metering mechanism easily. Thus, we can use this multipurpose sowing machine for sowing different kinds of seeds with very less cost.



Fig.6.1 Proposed sowing machine

7. CORROSION PREVENTION

The following methods are used for corrosion prevention of the various components of the Multipurpose sowing machine.

RUST CLEANING

Oxidation creates a scale formation on the surface of the material. Scale formation gives rough structure of surface of iron oxide. This iron oxide formation penetrates into the surface and makes the metal weak and reduces the life of the components. Different grades of emery sheets are used to remove the rust formed on the surface of the steel and cleaned properly.

RED OXIDE COATING

This Red Oxide Paint Coating is to prevent the action of corrosion and protect the Surface of the components from atmospheric corrosion. Red Oxide Paint and Thinner liquid are mixed in proper proportion and coated on the surface of the components. The purpose of thinner is to reduce the viscosity of the paint and free flow of the paint over the surface of the components.

ZINC CHROMATE YELLOW COATING

This coating is also to protect the surface still further more effectively. This is also applied to the surface of the components after mixing with the Thinner in proper proportion. It also plays a major role in increasing the corrosion prevention to a larger extent.

FINISH COATING

Milky white color paint is applied over the surface of the machine after the application of the above coatings in a smooth manner using a paint sprayer. This final finish coating of the milky white color of the paint gives good pleasing appearance and effective corrosion prevention.

8. MERITS

- It is simple in operation.
- Maintenance cost is low.
- No seed loss in terms of remaining in the hopper.
- Low cost.
- It is more suitable for small farmers.
- Reduced size and complexity when compared to existing machine.
- Simple mechanism.

9. SCOPE FOR FUTURE IMPROVEMENT

Top priority is given only for safety operation lost reduction; the multipurpose sowing machine is fabricated with safety operation and reduced cost. Since, top priority is given only for cost reduction and safety operation it is noted that we should improve the strength of the machine members such as tiller and seed metering mechanism. No priority is given for strength and rigidity at the time of initial design. After installation and establishing successful working of the machine, it is proposed to concentrate on value engineering to increase the future value of the machine in all aspects. Presently, full focus is given only to design modification in seed metering mechanism for the benefit of the small farmers. At present, seed metering mechanism is used for sowing different types of seeds with single metering mechanism. We can use separate metering mechanism for every seeds. Thus, we can increase the value of the machine in future.

10. CONCLUSION

A multipurpose sowing machine is designed for small farmers to improve their productivity. In this machine a common seed storage place is introduced to reduce the cost of the machine. The existing sowing machine had the individual storage place and separate seed metering mechanism which leads to more cost. The drawbacks in the existing sowing machine are rectified successfully in our machine. It will be more useful for small farmers and the agricultural society. The cost of the machine comes around Rs 6000/- INR

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2. Agricultural Expo 2010 at Trichy
3. Agricultural Expo 2010 at Madurai

GUDIYATTAM BLOCK ENERGY PLANNING - POTENTIAL OF BIOGAS FROM LIVESTOCK FOR HOUSEHOLD COOKING

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Abstract:

Among the renewable, Biogas (livestock dung) energy has good potential in rural areas of TamilNadu. A study to explore potential of Biogas for cooking in households of panchayat villages was conducted. Union of panchayat villages is a block and in this study defined as a region. Gudiyattam is a designated rural block in the state of TamilNadu and consists of 44 panchayat villages and 1 town. This study was conducted using available variety of Livestock in each panchayat village and aggregated to Block level. Among the 44 panchayat villages,it is observed that 5 having high potential, 18 having moderate and 22 with no potential. An analysis was carried out to identify potential biomass and forest land saved in panchayat villages of Gudiyattam block. Potential household beneficiary's panchayat village wise identified. This study has found Regional Energy planning through Biogas for household cooking is a reliable alternative and has potential for replication in other blocks.

Key words: Biogas,Panchayat village,Live stock,Forest land, households.

I Introduction:

1.1 Conventional fuel use for household cooking and its impact on Health

Ezzati M et al (2004) stated that in the year 2000 World Health Organization (WHO) estimated about 420 thousand premature deaths per year in India because of the household fuel air pollution. Smith KR(1993) stated that in rural India, due to use of fuel wood adverse health impacts on women are observed. According to Census of India 2011, 62.5% of Indian rural households still use firewood as a primary fuel for cooking with inefficient energy extraction and other health-environmental hazards. Bates et al (2005) confirmed that the use of solid fuel in indoor stoves is associated with an increased risk of cataracts in women. This conclusively proves that alternative fuels for household cooking that are pollution free, environmental friendly are desirable in rural households. Biogas is One of the renewable and is environmentally friendly fuel.

1.2 Potential environmental benefits of Biogas

Wise DL et al (1986) state that Out of world’s total primary energy, renewable energy constitutes 13% and amongst bioenergy contribution is 77%. Bhattacharyya SC(2006) observed that Not only electricity but villages get minor supply of all energy sources as they are mainly dependent on kerosene, fire wood and dung etc for cooking and lighting. Borjesson P(2008) noted that Not only climate change but also biogas has the potential to combat environmental problems such as eutrophication, acidification and air pollution. Ansari(2012) highlighted the potential of Biogas as it solves major environmental problems such as soil degradation, deforestation, desertification, CO2 emission, indoor air pollution, organic pollution and social problems such as women occupation etc. by replacing wood and fossil fuels. Smith KR et al(2000) reported that a kg of Acacia wood burned in a traditional mud stove generates 318 gm of Carbon (g-C) equivalent of Carbon emission. Smith KR et al (2000) observed that for cooking efficiency of combustion is more in case of biogas stoves than the traditional biomass or fossil fuel stoves (kerosene / LPG stoves) and biogas stoves will contribute the lowest to GHGs. Slurry from 1 kg of digested dung can yield up to extra 0.5 kg Nitrogen compared to fresh manure [Sasse LV 1998]. It is estimated that the use of bio-slurry annually saves 39 kg of Nitrogen, 19 kg Phosphorus and 39 kg Potassium per household [East Consult,2004] Bioenergy can be a good and sustainable option to minimize greenhouse gases (GHGs) emissions.(Bilgen S et al,2008)

1.3 Current state of biogas energy in India

In India, the energy consumption patterns in rural areas have been largely towards using firewood and other traditional biomass fuels such as chips, charcoal and dung cake. (Husain, 2005).As per Ministry of New and Renewable Energy, Government of India, Among the Decentralized Energy Systems at national level, Family Type Biogas Plants accounts to 42.40 Lakh as on 31.03.2010.(MNRE,2011). According to TEDA (2009), Tamil Nadu ranks 1st in the country in the co-generation of power from sugar mills; 3 co-operative and 16 private sugar mills have installed the cogeneration plant. The total installed capacity under cogeneration is 446.10 MW which is 30 % of the installed capacity in the entire country and the exportable surplus is 256.11 MW as on 31.03.2008.In TamilNadu, community type bio-gas plants, and toilet linked bio-gas plants using Biodegradable waste, were installed during 2002-05 as shown in Table 1.0.

Table 1.0 Biogas plants installed in Tamil Nadu during 2002-05

Year	Plant type	Numbers installed
2002-03	Community type Biogas plants	129
	Toilet linked Biogas plants	2
2003-04	Toilet linked Biogas plants with integrated sanitary complexes	25
2004-05	integrated sanitary complexes	16
	Other institutions	2

(Source: TEDA 2009) <http://www.teda.in/site/index/id/1T9t8D5n1t> accessed on 9.9.2014

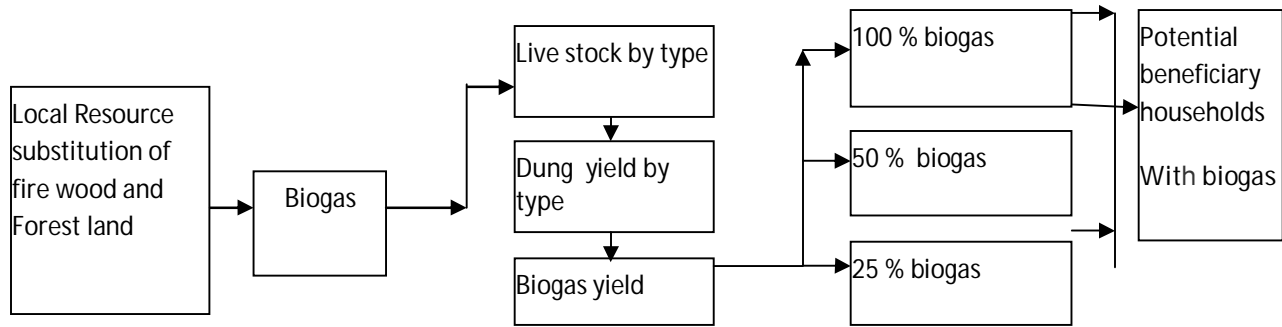


Fig 1.0 Flow chart of Energy planning with Biogas from Live stock Dung for household cooking.

The flowchart using Energy planning with Biogas for household cooking is shown in Figure 1.0.

1.2 Location of the Gudiyattam Block

Gudiyattam block is located in the northern part of the district of Vellore. It lies between 12° 15' 00" and 13° 15' 00" North latitudes and 78° 20' 00" and 79° 50' 00" East longitudes in TamilNadu state of India. It constitutes 44 panchayat villages and Gudiyattam town as illustrated in Figure 2.0. About 54% of the panchayat villages have populations between 1000 and 3000 persons (Census of India 2001).

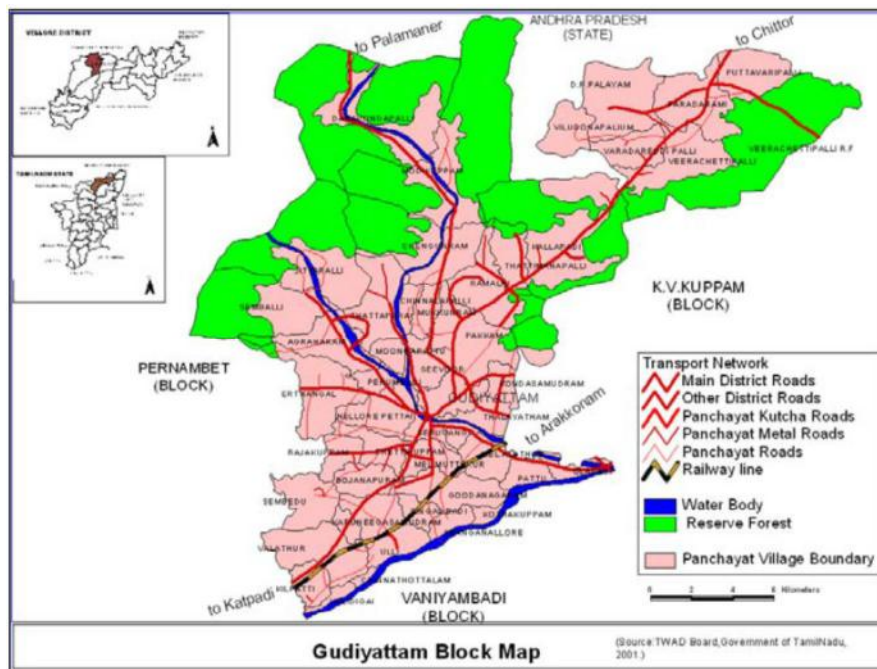


Fig 2.0 Gudiyattam block Map
 (Source:TWAD Board 2001)

2.0 Methodology:

Gudiyattam Block as a case study:

The study area is primarily agriculture based and secondary activity is animal husbandry and has significant amount of different livestock as illustrated in Table 2.0. Currently, dung from the live stock is used inefficiently as dry dung cakes and manure. This paper attempts to study the potential of Biogas from live stock dung for Cooking in panchayat villages of Gudiyattam block.

Table 2.0 Number,type of live-stock and Biogas yield in panchayat villages, Gudiyattam block -2007.

Panchayat village name	Cow (Nos)	Buf Falo (Nos)	Goat (Nos)	Sheep (Nos)	Hen (Nos)	Pig (Nos)	Total (Nos)	Total annual biogas yield (cu.m)
i	ii	iii	iv	v	vi	viii	ix	x
Agraharam	465	70	197	266	342	166	1569	41389.03
Ananganallore	601	6	70	600	3115	0	4413	40146.64
Bojanapuram	502	7	405	1800	3150	0	5880	41046.08
Chengundram	480	5	510	417	490	6	1930	33425.27
Chettikuppam	406	0	112	600	3112	65	4317	28152.98
Chinnalapalli	284	10	277	295	264	0	1150	20953.44
Chinnathattalam	551	0	0	0	2010	54	2637	33350.11
Dakshina pathapalayam	742	10	589	672	984	10	3031	51288.97
Danakondapalli	512	10	420	342	515	9	1828	35396.53
Ertangal	435	16	285	217	225	96	1309	30955.61
Goodanagaram	216	19	167	276	265	25	1032	17877.89
Gudiyatham	0	0	0	0	0	0	0	0
Jittapalli	0	0	0	0	0	0	0	0
Kallapadi	568	15	305	365	355	22	1650	39080.07
Karuneeaka samudram	421	10	55	265	1700	0	2465	28284.51
Kilpatti	923	11	420	1120	2620	12	5135	63694.57
Kondasamudram	696	30	266	175	265	23	1472	48016.45
Kothakuppam	632	0	101	401	1715	0	2868	39971.49
Kulidikai	702	6	155	80	3720	0	4694	44482.19
Melalathur	177	10	135	285	307	87	1093	14331.4
Melmuttukur	25	0	0	0	0	0	25	1478.25
Modikuppam	972	27	712	585	740	21	3075	67754.31
Moongapattu	387	6	85	120	370	5	983	24844.46
Mukkunram	240	2	100	80	380	4	821	15420.58
Nellorepettai	369	54	150	130	263	110	1107	32130.72
Olakasi	305	20	142	269	245	22	1038	23135.07
Pakkam	0	0	0	0	0	0	0	0

Paradarami	592	12	437	422	786	12	2288	40941.48
Pattu	252	7	147	205	286	14	941	17680.26
Perumpadi	296	35	256	300	267	106	1314	26003.8
Puttavaripalli	822	7	732	620	690	12	2897	55917.01
Raja Kuppam	657	0	120	1100	4430	0	6326	45189.77
Ramalai	545	10	259	498	305	14	1648	37167.94
Sempalli	342	89	365	478	395	88	1862	38441.46
Sempedu 897	897	237	1182	4120	32	32	6500	113320.9
Singalpadi	931	12	410	1155	3420	0	5959	64583.1
Thalayatham	307	15	110	100	190	30	803	21628.44
Thattaparai	941	22	760	620	732	10	3110	65449.55
Thattimanapalli	506	0	376	486	300	10	1697	33816.05
Ulli	820	4	80	310	3150	0	4400	51616.55
Valathur	621	0	0	252	2002	16	2911	38376.95
Varadha reddipalli	632	10	682	587	784	8	2723	44793.47
Veerichettipalli	318	12	520	430	524	8	1827	25068.49
Seevur	688	17	150	263	391	28	1567	45385.56
Cheruvanki	307	40	142	159	343	164	1244	26604.56
Viludonapaliam	0	0	0	0	0	0	0	0
Total	22060	873	12386	21465	46179	1289	105514	1608592

(Source: Veterinary clinic, Gudiyattam 2007 and primary survey 2006-07)

Ramachandra TV (2000) reported the production of dung per day in Kg on an average for cattle is 4.5, Buffalo is 12. Kishore et al (2000) reported the dung production per day in Kg for swine is 0.34, sheep is 0.32, Goat is 0.35 and Poultry is 0.02. This data was used to compute the potential livestock dung yield by live stock type in the study area.

In this study, the annual total dung produced by livestock was computed, based on the total number of livestock by type and dung production per live stock in a panchayat village. Then from the total annual dung production, the total annual biogas yield potential was computed as shown in table 2.0 using the formula in table 3.0.

Scenarios were generated based on variations in the availability of dung from live stock for the production of biogas. Three scenarios were generated based on the availability of 100 %, 50 % and 25 % Biogas on annual basis and the number of households that could be supported in each panchayat village.

Table 3.0 Total annual biogas production assessment

Live stock by type (nos) per Panchayat village	X average dung yield/day by live stock type	X 365 days	X dung to biogas conversion factor (Kg to Cu.m)	= total annual Biogas production (Cu.m/year)
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(Source: Satyamoorthy K 1999 ,p 59)

2.2 Cooking energy supply with 100 % Biogas availability assessment

The Biogas cooking energy supply was computed per panchayat village applying the formula as shown in Table 3.0. It is clear from Figure 3.0 that the cooking energy supply with 100% Biogas availability in percentage for the year 2007 varies primarily between 0 % and 50 %. Among the panchayat villages, five scored more than 50 %, seventeen scored in the intermediate range of 25 % - 50 %, and the remaining scored less than 25 %.

It is noted that panchayat villages with a high score are dispersed, one on the northern side along the Chittor road, one on the south-western side of Gudiyattam town, one in the middle of the Gudiyattam block and three on the southern side of Gudiyattam town. Panchayat villages with a moderate score are clustered and dispersed. One cluster is on the south-western side of Gudiyattam town, one on the northern side of Gudiyattam town along the Palamaner road. Among the dispersed, one is on the south-eastern side, two adjacent to Gudiyattam town, two on the northern side along the Chittor road, and one adjacent to the Kallapadi Reserve forest. Panchayat villages with a low score are predominant and concentrated in the middle of the Gudiyattam block, on the southern side and northern side of Gudiyattam town along the Chittor road.

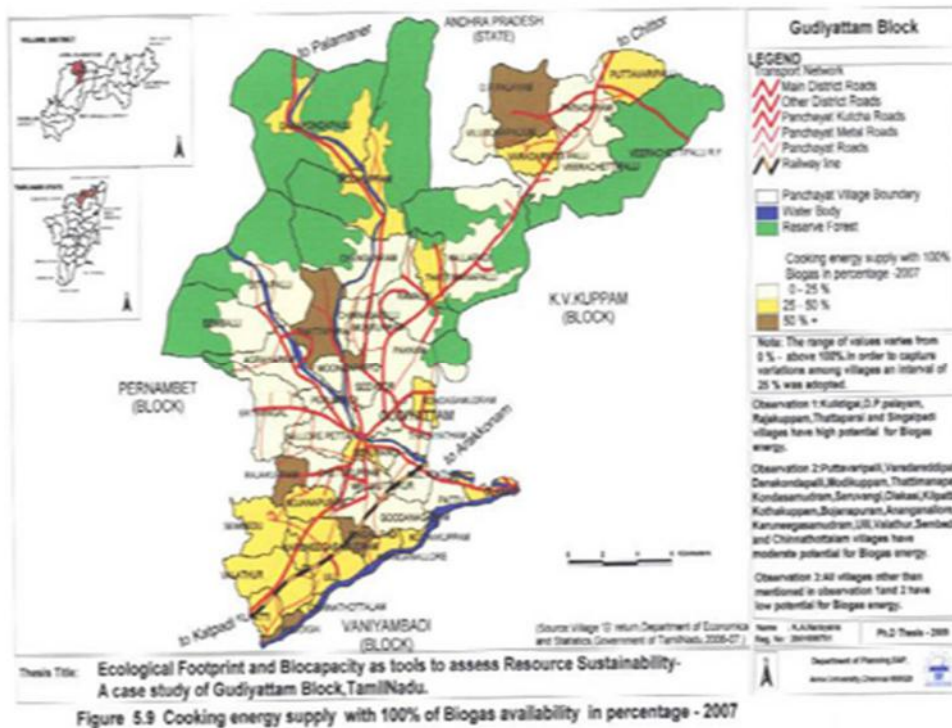


Fig 3.0 Cooking Energy supply with 100% Biogas availability in percentage -2007.

Table 4.0 Comparative assessment of scenarios of 100%,50% and 25%Biogas energy for cooking in the panchayat villages of the Gudiyattam block

Scenario	high	moderate	low	Percentage of the total
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Biogas use				panchayat villages
100 %	5	18	22	11 % with high score 40 % with moderate score 49 % with low score
50 %	2	3	40	4 % with high score 7 % with moderate score 89 % with low score
25 %	0	2	43	0 % with high score 4 % with moderate score 96 % with low score

3.0 Scenario synthesis of biogas energy

A comparative assessment across scenarios using 100 %, 50 % and 25 % biogas cooking energy reveals a high score with a range of 0 % - 11 %, a moderate score with a range of 4 % - 40 %, and a low score with a range of 49 % - 96 % among the panchayat villages as shown in Table 4.0.

This assessment with 100% biogas energy among panchayat villages proves that 11 % (5) have high potential and 40 % (18) have moderate potential and the remaining with low to no potential in Gudiyattam block. The households benefitted by Biogas substitution for cooking panchayat village wise in percentage is shown in table 4.0. The assessment with biogas cooking household beneficiaries across panchayat villages varies between 0 - 31%. There are 5 villages less than 0, 24 villages in the range of 1 -10%, 11 villages in the range of 11%-20%, and the remaining 5 are above 30%.

4.0 Forest land/Energy plantation – saving of Biogas equivalent fire wood

The equivalent fire wood saved annually by the substitution with 100% Biogas panchayat village wise is shown in table 5.0. Ramachandra TV (2000) used the value of 1 m³ biogas as equivalent to 3.5 kg of firewood in Kolar district energy study, Karnataka. Annually 20 tons per hectare for fire wood yield was assumed. The forest land/Energy plantation in hectares saved by the adoption of 100% Biogas for household cooking panchayat village wise and the number of household beneficiaries panchayat village wise in percentage was shown in table 5.0.

Table 5.0 Annual Biogas fire wood equivalent, forest land and potential household beneficiaries in percentage in panchayat villages, Gudiyattam block -2007.

Panchayat village name	Total annual biogas fire wood equivalent (tons)	Forest land (hectares)	% of households benefitted village wise
Agraharam	144.86	7.24	6

Ananganallore	140.51	7.03	12
Bojanapuram	143.66	7.18	13
Chengundram	116.99	5.85	5
Chettikuppam	98.54	4.93	5
Chinnalapalli	73.34	3.67	10
Chinnathattalam	116.73	5.84	19
Dakshinapathapalayam	179.51	8.98	10
Danakondapalli	123.89	6.19	8
Ertangal	108.34	5.42	4
Goodanagaram	62.57	3.13	3
Gudiyatham	0.00	0.00	0
Jittapalli	0.00	0.00	0
Kallapadi	136.78	6.84	4
Karuneekasamudram	99.00	4.95	21
Kilpatti	222.93	11.15	16
Kondasamudram	168.06	8.40	3
Kothakuppam	139.90	7.00	31
Kulidikai	155.69	7.78	18
Melalathur	50.16	2.51	4
Melmuttukur	5.17	0.26	0
Modikuppam	237.14	11.86	9
Moongapattu	86.96	4.35	7
Mukkunram	53.97	2.70	7
Nellorepettai	112.46	5.62	7

Olakasi	80.97	4.05	9
Pakkam	0.00	0.00	0
Paradarami	143.30	7.16	4
Pattu	61.88	3.09	10
Perumpadi	91.01	4.55	11
Puttavaripalli	195.71	9.79	16
Raja Kuppam	158.16	7.91	23
Ramalai	130.09	6.50	4
Sempalli	134.55	6.73	5
Sempedu	396.62	19.83	29
Singalpadi	226.04	11.30	29
Thalayatham	75.70	3.78	2
Thattaparai	229.07	11.45	11
Thattimanapalli	118.36	5.92	16
Ulli	180.66	9.03	12
Valathur	134.32	6.72	6
Varadhareddipalli	156.78	7.84	12
Veerichettipalli	87.74	4.39	4
Seevur	158.85	7.94	4
Cheruvanki	93.12	4.66	7
Viludonapaliam	0.00	0.00	0
Total	5630.07	281.50	

4.0 Conclusion:

In Rural areas, predominantly firewood is used for cooking. It is the cause of indoor air pollution and associated health hazards in rural households. A study was conducted to substitute firewood with biogas from livestock dung in the panchayat villages of Gudiyattam block. An analysis with different scenarios was generated and amongst, 100% biogas for cooking found to be effective with a total of 36% of the panchayat villages have good potential for substitution. A total of 281.50 hectares of forestland/Energy plantation in Gudiyattam block is saved by the use of biogas cooking. This land could be potentially used for agriculture. This study was conducted in year 2006-07 and Gudiyattam is a rural block and as per TamilNadu Government data for 2015, the spatial and temporal change for the period of 2007-14 in land use and population are very marginal. Hence, the data of 2006-07 was used for assessment of potential of Biogas for analysis.

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EFFECT ON MECHANICAL PROPERTIES DUE TO ALLOYING ELEMENTS

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Abstract— The present study pertains to changes in mechanical properties of Plain carbon & Alloy steel. An experimental study has been made on Plain carbon and Alloy steel. Two main studies have been carried out. In the first study, Plain carbon steel was prepared in Electric Arc Furnace and subjected to all the heat treatment operation like Annealing, Hardening, Tempering and Stress-relieving. Later on the hardness was also listed for the specimen prepared which was found to be 203 BHN in cast 1 & 207 BHN in T.P. The mechanical properties were also listed and found yield strength 41.99 TSI, 53.85 UTS, 24% Elongation and Impact 70, 71, 72 Ft .Lb. And 5 different readings have been taken on different cast from 1 to 5 to know the exact value. In the second study, alloying elements were added to 5 castings and Heat Treatment process operation were carried out like Normalizing, Hardening, Tempering, and stress-relieving operation for Test piece sample. After that checked the hardness of Cast was found their Cast no 1A 314 BHN and T.P. 320 BHN. Mechanical properties were also checked and the cast no 1A - 87.92 Y.S., 112.4 kgf/mm sq UTS, 22%E, and Impact property 8.56, 8.77, 8.77 mm Kgf in alloy steel. And same procedure was carried out for five heat cast heat samples.

Key Words: - *Ultimate Tensile Strength, Yield Strength & Hardness.*

Introduction

Steel is an alloy of iron and one or more of other elements like carbon, chromium, silicon, vanadium, tungsten, molybdenum and so on with definite percentage of carbon ranges from 0.15-1.5% [1],

plain carbon steels are those containing 0.1-0.25% [2]. There are two main reasons for the popular use of steel: (1) It is abundant in the earth's crust in form of Fe₂O₃ and little energy is required to convert it to Fe. (2) It can be made to exhibit great variety of microstructures and thus a wide range of mechanical properties. If one or more elements, other than carbon, are added to steel to ensure specific properties, such as better mechanical strength ductility, electrical properties, magnetic properties and so on. Alloy steels are also broadly divided into three different types. Low-alloy steels: total alloying content is less than about 5%. Medium-alloy steels: total alloying content is in the range of 5-10%. High-alloy steels: total alloying content is above 10%. The main constituents of plain carbon steel are iron and carbon. The properties of carbon steels are directly related to the percentage of carbon present. In addition to carbon, plain carbon steels also contain other elements such as, manganese, silicon, sulphur and phosphorus in the amounts shown above

Table 1.1 Composition Range Of Carbon Steels

Sr. No.	Elements	Percent By Weight
1	Carbon	0.04 to 1.20/1.70
2	Manganese	0.30 to 1.00/1.70
3	Silicon	0 to 0.30
4	Sulphur	0.04 MAX.
5	Phosphorus	0.05 MAX.
6	Iron	BALANCE

Steel can be hardened to resist cutting action and prevent abrasion .the rate of cooling and the manner of cooling are the controlling factor in heat treatment process .heat treatment not only increases

the hardness but also increases the tensile strength and toughness. Hardness is an important mechanical property of the machinery components. Higher hardness material has higher wear and abrasion resistance. Hardening process increases the hardness but it affects the other mechanical properties, like fatigue strength (or fatigue life), impact strength, ultimate tensile strength (UTS) etc.[3]. In hardening, the steel or its alloy is heated to a temperature high enough to promote the formation of austenite, held at that temperature until the desired amount of carbon has been dissolved and then quenched in oil or water at a suitable rate [4].

There are various heat treatment processes. Heat Treatment process operation which we have adopted for testing like Normalizing, Hardening and stress-relieving operation. There are many tests to measure mechanical properties, but we shall discuss some of the important and common tests, such as hardness test, tensile test and impact test.

1.1 Effect of Alloying Elements

Alloying elements affect the constitution, characteristics, and behavior of carbon steels in many ways. Some of the major effects of alloying elements are, strengthening of ferrite, formation of special carbides and compounds, shifting of critical temperatures and compositions, and lowering of critical cooling rate.

2. Experimental Procedure:

In the study of mechanical properties and their testing there are certain things which are considered basic or fundamental. A test almost universally employed to express mechanical properties and supply the most useful fundamental information regarding behaviour of materials is the tensile test. In practically tensile testing machine consists essentially of two parts: (1) the unit for applying a load to the specimen, and (2) the measuring device for the measurement of the load on the specimen.

The material to be tested is machined to standard dimension and attached to the jaws of tensile testing machine. Before commencing the test two gauge marks are made on the specimen longitudinally usually 50mm or 200 mm apart according to the size of the test piece. Take the specimen for this test may be either round or flat.

In a tensile test, the round or rectangular specimen is deformed by the action of a smoothly increasing load up to the point of rupture. The amount of elongation in the test piece caused by the load is measured accurately by a mechanical, electrical or optical device called extensometer. As the loading of the test piece progresses, load and deformation readings are recorded simultaneously. The readings are made to obtain data for plotting a tensile test diagram. Such a diagram shows the relation between the force applied to the specimen and its resulting deformation. On the diagram the values of the applied load are plotted as ordinates and the absolute elongation corresponding to each load is plotted as an abscissa. Since both the stress and strain are obtained by dividing the load and elongation by constant factors, the load elongation curve will get the same shape as engineering stress-strain curve. The two curves are frequently used interchangeably.

The shape and magnitude of a stress-strain curve of a material will depend on its composition, heat treatment, prior history of plastic deformation and strain rate, temperature, and the state of stress imposed during the testing. The parameters which are used to describe the stress-strain curve of a material are the elastic limit, proportional limit, yield strength or yield point, tensile or ultimate strength, percent elongation and reduction of area.

Table 2.1 Chemical Composition and Mechanical Testing Properties of M. C. Steel on different cast

CAST NO	C% MAX.	Si% MAX.	Mn% MAX.	S% MAX.	P% MAX.	Y. S. 65% TSI	UTS 40MIN	E% 20MM	IMPACT 20MM	CAS 179-229	T.B. 179-229
Specific VALUES	0.33	0.50	1.70	0.040	0.040	OF UTS	TSI		FT.LB	HARDNESS	HARDNESS
CAST NO 1	0.19	0.467	1.408	0.0121	0.023	41.99	53.85	24	70,71,72	203	207BHN
CAST NO 2	0.24	0.376	1.35	0.006	0.022	33.20	42.57	24	62.64,64	210	207BHN
CAST NO 3	0.32	0.47	1.13	0.009	0.019	39.5	47.35	24	67,67,68	201	207BHN
CAST NO 4	0.19	0.42	1.30	0.0061	0.021	36.64	46.98	30	67,63,70	201	217BHN
CAST NO 5	0.24	0.43	1.045	0.009	0.018	36.05	46	24	65,67,60	203	207BHN

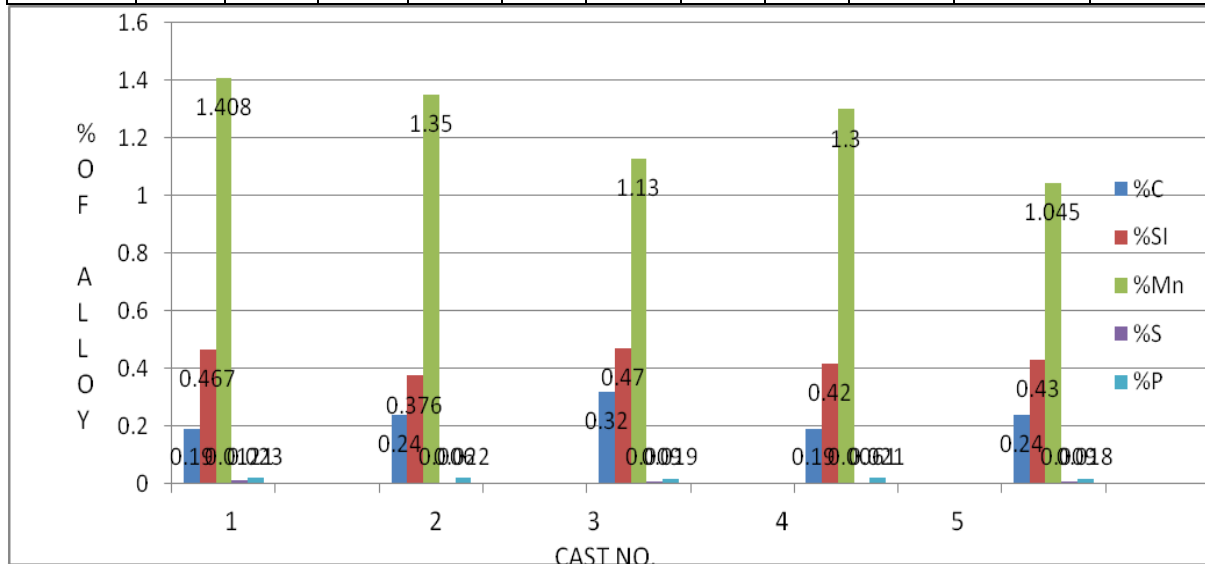


Fig.1.1 Graph of mild carbon steel of the alloying elements on five different cast

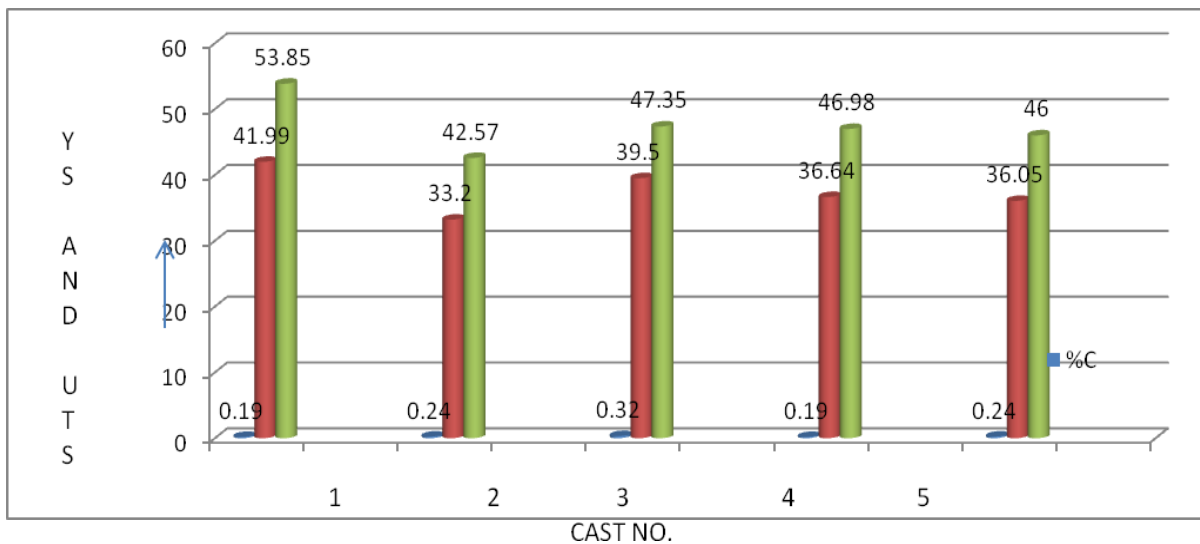


Fig.1.2 Graph between the yield-strength, ultimate tensile strength and five different casts after mix up with add alloying elements during the process of making steel.

Table 2.2 Chemical and Mechanical Properties of Alloy Steels on different cast

CAST NO	C %	Si%	Mn %	S%	P%	Ni%	Cr %	Mo %	Y.S	UTS	E %	IMPACT	CAS T	T.P.
Specified Values	0.28 to 0.33	0.30 MA X	1.30 to 1.50	0.030 MA X.	0.030 MA X.	0.75 to 1.25	0.60 to 1.00	0.35 to 0.55	85Kgf/mmsq	100Kgf/mm sq		30mm Kgf	300-340 BHN	300-340 BHN
Cast No 1A	0.28	0.29	1.39	0.015	0.027	0.75	0.60	0.40	87.92	112.46	22	8.56,8.77,8.77	314	320
CAST NO 2A	0.30	0.27	1.44	0.007	0.27	0.78	0.63	0.37	98.65	126.47	20	7.54,7.75,7.95	308	320
CAST NO 3A	0.32	0.15	1.31	0.10	0.020	0.75	0.65	0.43	87.82	111.89	16	7.54,7.75,7.95	308	320
CAST NO 4A	0.31	0.26	1.40	0.009	0.017	0.87	0.66	0.37	87.23	109.42	16	7.24,7.34,7.54	308	320
CAST NO 5A	0.29	0.20	1.30	0.011	0.021	0.80	0.67	0.37	85	112.31	20	7.95,8.15,7.90	333	320

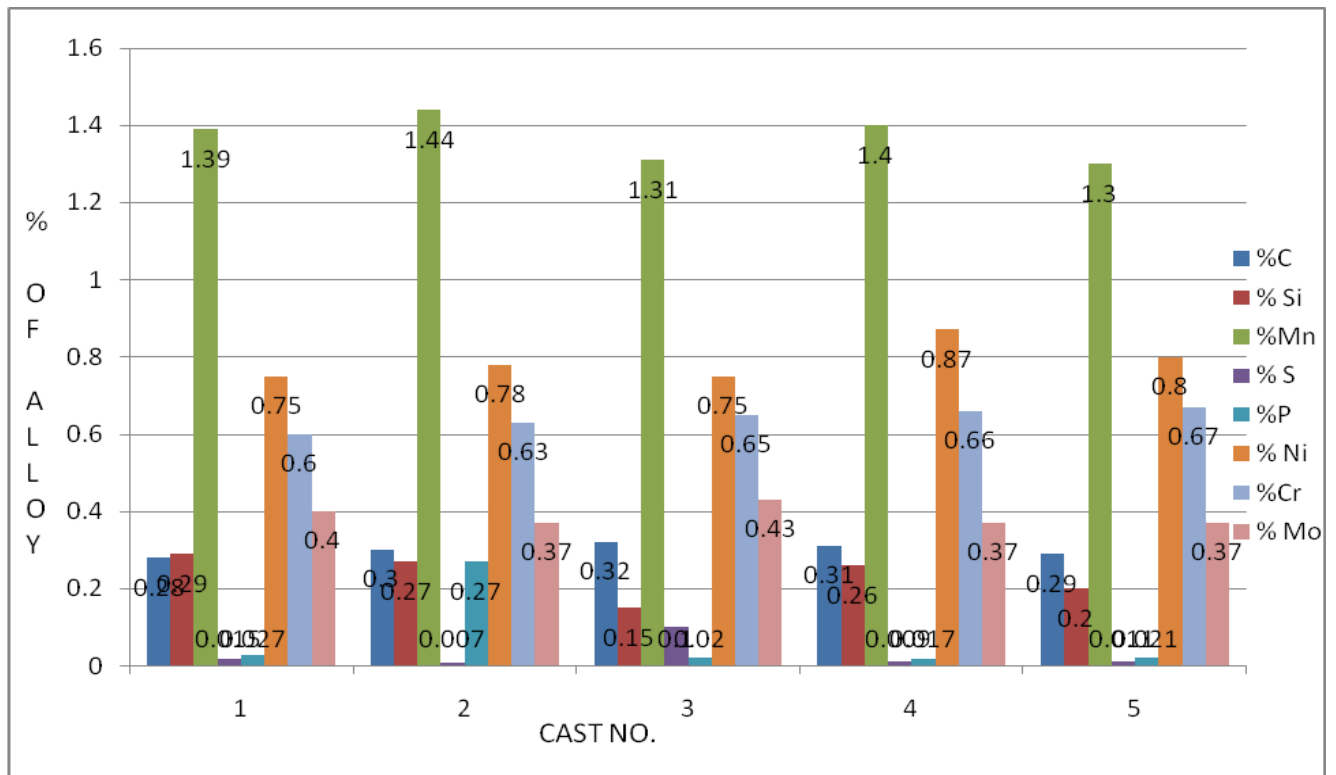


Fig.1.3 Graph of alloy carbon steel of the alloying elements on five different cast

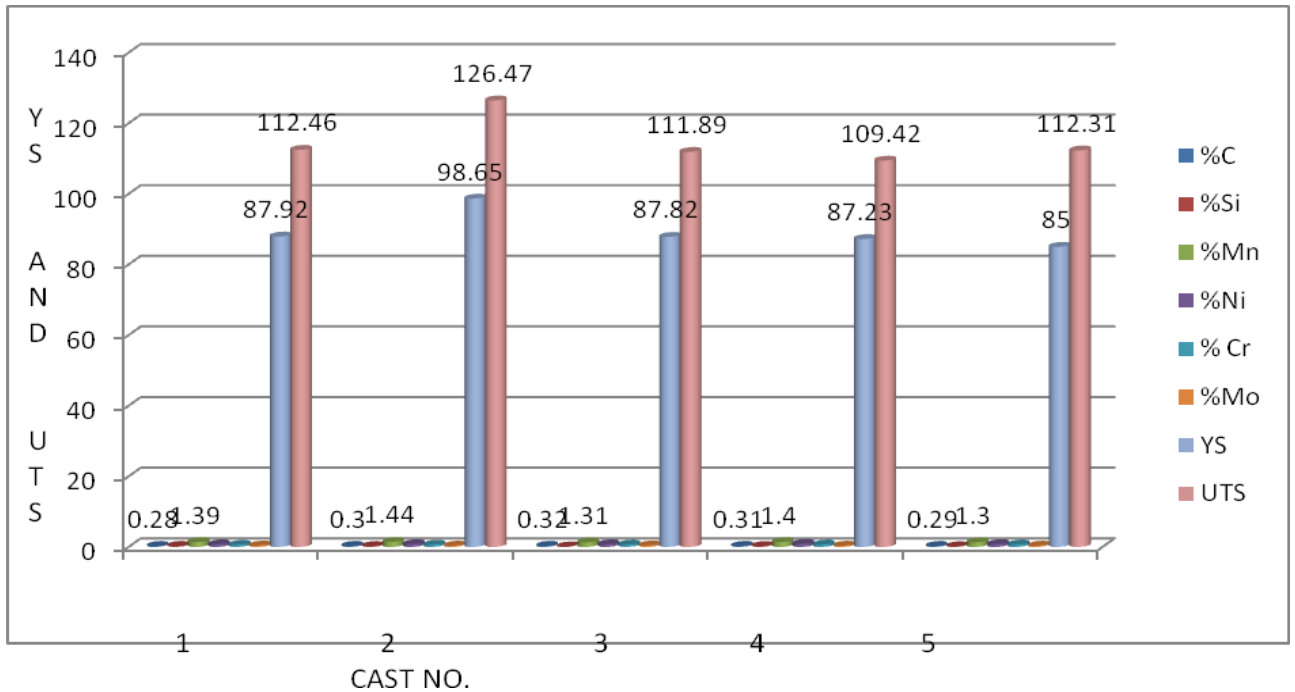


Fig.1.4 Graph of alloy steel between the yield-strength, ultimate tensile strength and five different casts after mix up with add alloying elements during the process of making steel.

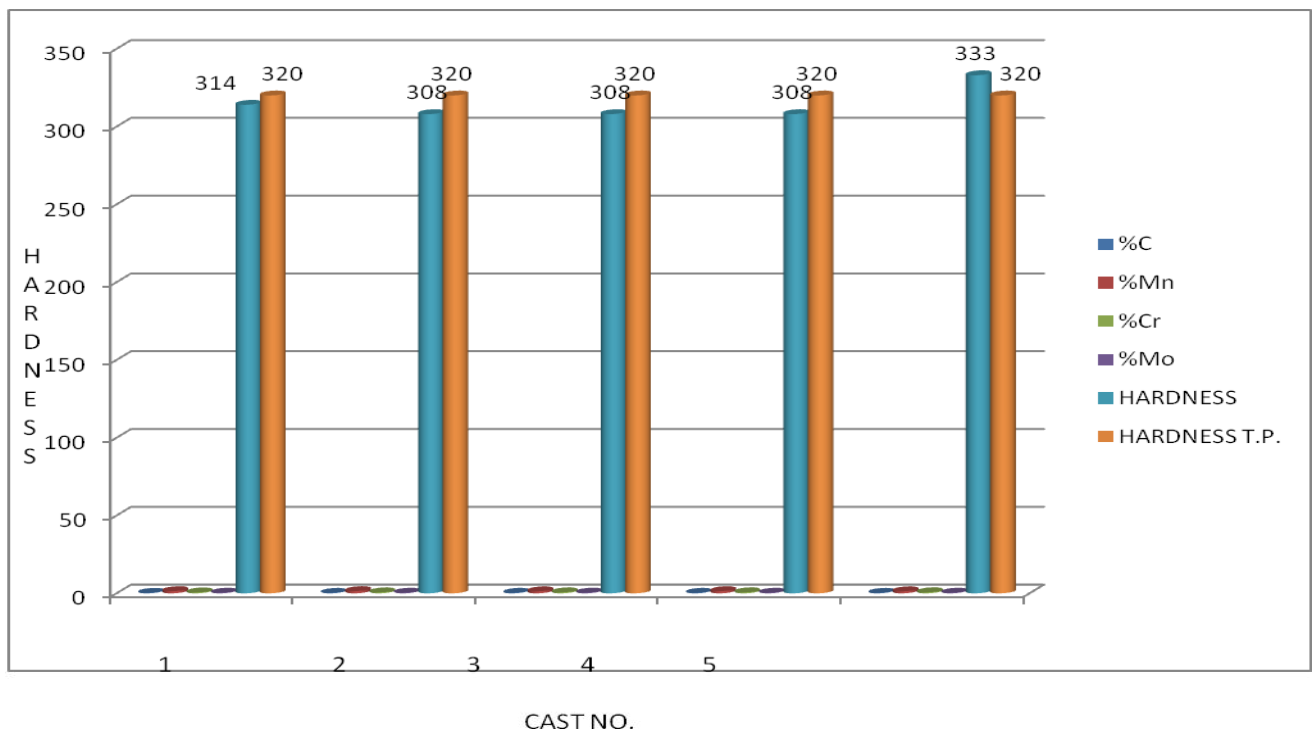


Fig.1.5 Graph of alloy steel with increases alloying elements between the hardness on different casts

CONCLUSION

1. Based on the analysis of result of this investigation and interpretations the following main conclusions are drawn:-

R. NO.	PLAIN CARBON STEEL	Y.L./LOAD (KN).	UTL/LOAD (KN.)	HARDNESS T.P (BHN)	CAST/HAR. (BHN)	BAR/ELONG (MM)/F.L.-OL.
CAST1	P.C.	104.44	133.90	207	203	62-50=12
CAST2	P.C.	82.68	106.00	207	210	62-50=12
CAST3	P.C.	91.96	117.90	207	201	62-50=12
CAST4	P.C.	91.26	117.00	217	201	65-50=15
CAST5	P.C	100.77	129.20	207	203	62-50=12

2. Based on the tested result shown in the given chart YS and UTS sample loads found more as compared to plain carbon steel. And sample was tested normalized, hardened and tempered condition.

3. On the basis of above investigated results it is observed that alloy steel gets more mechanical properties like yield-strength, ultimate tensile-strength and hardness also. All results are shown in both the above charts.

4. On the analysis of both above steel results it is found that mechanical properties has increased if you add alloying elements during the process of making steel.

5. When alloy elements added to steel, perform different functions depending upon their characteristic, amounts and the subsequent heat treatment. Some important functions and application of different alloying elements properties is shown in chart and results.

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Synthesis of Carbon nanotubes by catalytic decomposition of Ethyne using Co supported on CaO

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Carbon nanotubes were synthesized by catalytic chemical vapor deposition (CCVD) over cobalt catalysts on calcium oxide support. The catalyst was synthesized by co-precipitation of the metal nitrates. Scanning Electron Microscopy (SEM), thermo gravimetric (TGA) and energy dispersive spectroscopy (EDS) indicate the presence of carbon nanotubes.

Introduction

Carbon nanotubes, long thin cylinders of carbon, were discovered in 1991 by Iijima's. Carbon nanotubes (CNTs) are allotropes of carbon which are members of the fullerene structural family[1]. Carbon nanotubes are one of the most important materials of nanotechnology. With one hundred times the tensile strength of steel, thermal conductivity better than all but the purest diamond, and electrical conductivity similar to copper, but with the ability to carry much higher currents, they are considered as a superior material.

Synthesis of carbon nanotubes can be done by different methods such as Arc discharge method Laser ablation method ,Chemical vapor deposition method ,plasma enhanced chemical vapor deposition ,Thermal chemical vapor deposition ,Vapor phase growth[2]. The CVD process is easy to scale up and also the growth can be controlled[3]. Among the parameters affecting the growth of the carbon nanotubes is the support, as the type of the support affect the final morphology of the obtained carbon nanotubes.[4]. Different supports have been used in preparation of the catalysts such as alumina, zeolite, magnesium oxide and calcium oxide.[5]. However Calcium containing supports have been shown to increase the yield of the obtained carbon nanotube[6].The other fact which should be considered is the gas as well, different carbonous gas has been reported and the most common are methane, ethylene , acetylene [7]and also carbon dioxide[8] and carbon monoxide[9] as well. Depending on the all mentioned factors carbon nanotubes from cobalt transition metals catalysts can be single walled [10],multi walled [11] or even using tri metallic forms of cobalt and its transition metals groups it has formed

bamboo shaped carbon nanotubes[12].So in this study Cobalt supported on CaO has been reported to produce Carbon nanotubes.

Experimental

All the materials were bought from Sigma Aldrich and used as received. The synthesis methodology was modified method of Allaedini et al [13, 14] 20 mmol cobalt salt ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$) and 20 mmol CaO was dissolved into deionized water containing dispersant polyethylene glycol (PEG), then drops of NH_4OH was added with electromagnetic stirring at 50°C . A certain volume of 30% H_2O_2 was dropped into the above suspension. Finally, these solutions were transferred into a centrifuge. Then they were put into an oven to be heated at 100°C and finally Calcined at 600°C . The Calcination was done as its reported affecting the morphology of the obtained Carbon nanotubes[15].

In order to obtain Carbon nanotubes the prepared catalyst boat was placed in the centre of the quartz tube. The reaction was carried at atmospheric pressure with ethyne gas as the carbon source. Decomposition of the hydrocarbon source was at 800°C . The Nitrogen gas flowing at 100 ml min^{-1} was passed through the reactor for approximately 45 min., and after it was .The Ethyne gas with a flow rate of 150 mL min^{-1} ,controlled by mass flow meter ,was then passed through the reactor for 60 min.Then the reactor was cooled down with nitrogen flowing at 20 mL min^{-1} for 1hour. The samples were collected and characterized.

Characterization

The SEM micrograph of the obtained cobalt catalyst is shown in figure 1. The catalyst has spherical morphology. The image shows homogeneous dispersity of the catalyst with large surface area suitable for catalytic reaction.

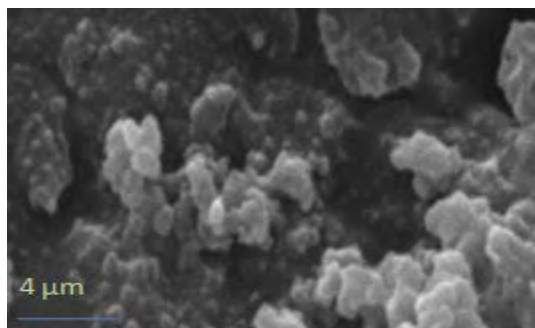


Figure 1- SEM image of the obtained Co/CaO

Figure 2 shows the EDS spectra of the obtained sample after the reaction .As cab be seen the Peak for the carbon is sharp. The element weight percentage has also been shown in table 1 illustrating the weight percent of the 41.67% indicating quite a high yield of carbon deposition .

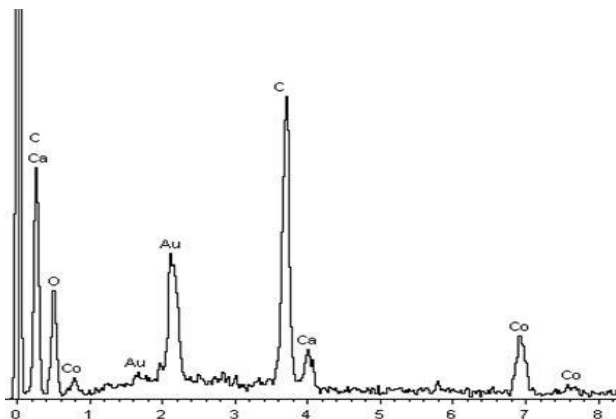


Figure 2- EDS spectra of the obtained sample after reaction.

Element	Weight%	Atomic%
C K	41.67	59.86
O K	26.49	28.56
Ca K	16.37	7.05
Co K	15.48	4.53
Totals	100.00	

Table 1- Weight and atomic % of the obtained sample after reaction.

Figure 3 shows the SEM micrograph of the obtained carbon nanotubes. The tube- like structures which are grown amidst the catalysts is the carbon nanotubes. The TGA of the obtained carbon nanotubes is illustrated in figure 4. Oxidative temperatures more than 450 C were reported to be mainly attributed to crystalline carbon with a high degree of graphitization[16] .So no weight loss is noted below 450 C. The TGA Graph shows about 12% of the weight loss for the obtained CNT and about 88% for the metals and the support.

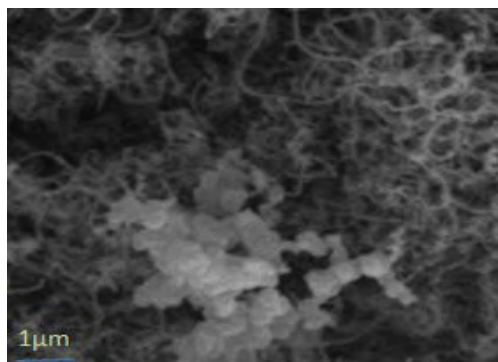


Figure 3- SEM image of the grown Carbon nanotubes amidst the Co/CaO catalysts.

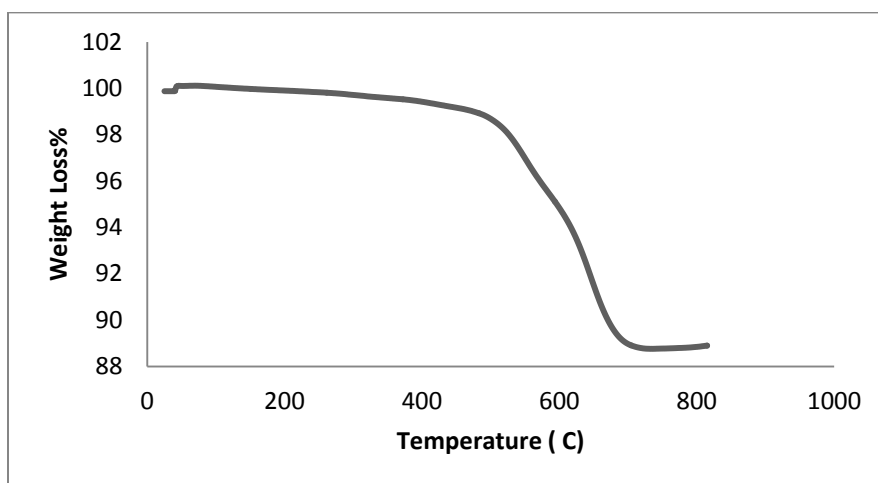


Figure 4- TGA of the obtained sample after reaction

Conclusion

In this work Co supported on CaO catalyst was synthesized, and employed for carbon nanotube production. The carbon nanotubes have been synthesized by the decomposition of ethyne over Co/CaO catalyst. The SEM, EDS and TGA results confirmed the structural properties and the presence of the carbon nanotubes showing that Co/Cao can be used successfully for production of carbon nanotubes by decomposition of ethyne.

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PARAMETRIC EFFECT OF LEAN MANUFACTURING IMPLEMENTATION IN CORRUGATION INDUSTRY

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ABBREVIATION

DSR: Diagnostic Study Report
MBR: Milestone Based Report
LMC: LEAN Manufacturing Consultant
SPV: Special Purpose Vehicle
NMIU: National Monitoring & Implementing Unit
QCI: Quality Council of India
ISO: International Standardization for Organization
IQS: International Quality System
QC: Quality Control
LFF: Lean Factory Fundamentals
VSM: Value Stream Mapping
OEE: Overall Equipment Efficiency
OPL: One Point Lesson
GWI: General Work Instruction
PPE: Personnel Protective Equipment
FG: Finish Goods
RM: Raw Material
SOP: Standard Operating Procedures



NPD: New Product Development

SMED: Single Minutes Exchange of Die

PM: Preventive Maintenance

MRM: Management Review Meeting

FIFO: First In First Out

PPC: Production Planning Control

ITR: Inventory Turnover Ratio

FTR: First Time Right

JIT: Just In Time

PDCA: Plan, Do, Check, Act

5S: Sorting, Set in Order, Shine, Standardize, Sustain

C/T: Cycle time

C/O: Changeover Time

ABSTRACT

Lean Manufacturing (LM) is widely accepted as a world-class manufacturing paradigm, its currency and superiority are manifested in numerous recent success stories. Most lean tools including Just-in-Time (JIT) were designed for repetitive serial production systems. This resulted in a substantial stream of research which dismissed a priori the suitability of LM for non-repetitive non-serial job-shops. This Study material is prepared and structures for Developing Knowledge on Improvements in Shop Floor & it's better Management and for **Lean Manufacturing Implementation** to the Production Managers and Supervisors. These concept will the benefit the units in the areas of Productivity, Quality and Manpower Management. Areas in the Study Materials may look as if it exclusively covered for Members Practicing in the Plant in the Shop Floor for leading organization those are leading in Quality, Productivity and Management Systems. But this Study Material may be used for conceptual up-date of the Production Managers and Supervisor about the World-wide latest Practicing Tools in the Shop-Floor. **“Lean manufacturing is a management philosophy focusing on reduction of waste through over production, waiting time, process time, transportation, inventory, motion and scrap in any business. By eliminating waste, quality is improved and production time and costs are reduced to satisfy the customer needs”**. Though lean manufacturing practices are now being practised in many sectors, it's implementation in Corrugation industry in India pose a special challenge because of nature of industry. This industry is characterized by large number of standard and nonstandard varieties based on customer requirement. Each variety has a comparatively shorter life cycle. Further each product goes through a number of short cycled processing steps. Batch production is commonly used mode of processing. However, some of the units are well organized and professionally run.

I. INTRODUCTION

Lean manufacturing techniques are used in Corrugation Industry to increase profitability by reducing costs. By understanding how customers define value, costs that do not add value are reduced or eliminated. Traditional View: $Cost + Profit = Sales Price$ In the above example the cost to bring your product to market plus profit dictates the selling price of a product. Particularly in our global economy this model is rarely reflective of current practices. Competition and customer demand will often set selling prices. By controlling your costs through eliminating non value-added activities, a lean manufacturing environment will directly affect your bottom line. Lean View: $Profit = Sales Price - Cost$ When you implement and follow a lean path you should see direct cost savings by driving out waste. You will also see significant improvements in other areas: • Employee morale and productivity • Customer satisfaction due to reduced defects and improved delivery • Faster time to market Lean manufacturing is customer focused. Since the success of your business as a whole is due in large part on satisfying customer demands, lean allows your manufacturing activities to become more closely aligned with other company goals and activities.

Developed by the most competitive automotive manufacturer in the world, lean manufacturing has been popularized in many western industrial companies since the early 1990s. It has become a universal production method and numerous plants around the world have embraced it in order to replicate Toyota's outstanding performance. The purpose of the Lean study under consideration is to explore implementation of the above approach in Indian MSME sector and learn the necessary lessons. The ultimate objective of such Lean implementation is to enhance the manufacturing competitiveness of MSME's through the application of various Lean Manufacturing (LM) Techniques.

“Lean manufacturing is a management philosophy focusing on reduction of waste through over production, waiting time, process time, transportation, inventory, motion and scrap in any business. By eliminating waste, quality is improved and production time and costs are reduced to satisfy the customer needs”.

Our definition of LEAN- L- Least, E- Efforts, A- Are, N- Needed, means Least effort are needed. Lean is not a short term quick fix, but a long term marathon journey or a movement for any organization. It requires a very serious effort on the part of all the stakeholders of the organization, at all levels. Target of MSME sector through Lean are not only betterment of the units, but to change in the



total health and culture of the organization with sustainable standard path of Improvement. Our Purpose of Lean Study cum Implementation in Cluster is not only Lean Implementation but apply it with systematic and continual assessment with problems and constraints of Implementations, so that the difficulties in the application of functioning Tools and Techniques could be identified and that will help the Industry for future for identifying best Tools. The Team of Implementation wants to generate the confidence among the units about Lean philosophy in their shop-floor as well as in their Strategy making and also in the thinking and planning of the units' Growth.

II. BACKGROUND OF THE STUDY

The Government of India launched the much awaited "Lean Manufacturing Scheme" for the micro, small and medium enterprises to enhance the manufacturing competitiveness of the sector, battling the global economic recession.

The objective of this scheme is to enhance the manufacturing competitiveness of the micro, small and medium enterprises (MSMEs) by applying lean Manufacturing techniques to identify and eliminate waste in the manufacturing process.

Lean Manufacturing is a set of techniques, which have evolved over a long period and are based on various minor to major breakthroughs that helps in reducing cost and hence increases productivity.

There are about 13 million MSME units in the country which employ over 42 million people. The sector contributes over 45 per cent to the country's industrial production and 40 per cent to the total exports.

The Scheme will be implemented under the overall superintendence, control and direction of DC (MSME). A three tier implementing structure will be in place with a group of ten or so MSMEs at the lowest local-tier and a Lean Manufacturing Screening and Steering Committee (SSC) under DC (MSME) at the highest tier.

The middle level tier, National Monitoring and Implementing Unit (NMIU), will be responsible for facilitating implementation and monitoring of the Scheme.

III. GAP ANALYSIS OF THE STUDY

GAPs of the units of the Cluster have developed after the repeated visit as per Monthly schedule of the unit in Lean DSR Project. We have not only observed but discussed repeatedly with Owners or Sr. persons, supervisors and Workers of the concerned units with predesigned blank format of date and inputs and take direct observation from GEMBA. We/ our Team have analysed the existing data, forms, records etc. of the units after visit and made this GAP and on the basis of gap an action plan have developed for NMIU and Cluster for proper Planning and Monitoring of the Lean Implementation.

The Gaps of the units are as follows;

2.1 Factory Fundamentals

In cluster there are poor factory fundamentals in the area of :

- A- Visual Management
- B- Asset Management/ Machine Maintenance
- C- Kaizen Practices

We found the reason of Lack of Management focus and knowledge awareness.

2.2 Space Utilization

Space in the shop-floor of the units are not adequately used due to the following reasons;

- A. Poor Housekeeping and 5S
- B. Failure in customer delivery
- C. Holding Inventory
- D. Work-Stations are not clearly identified
- E. Process flow and flow of work sometimes overlapped
- F. Scrap and defect items blocks in the working areas
- G. Comparatively less shorting and Cleaning attention
- H. PPC are not developed and maintained
- I. Tools and Machined are not properly arranged as per the Flow of work
- J. Workers and Supervisors are not Trained in these Concepts

2.3 Documentation/ Standardization

Standardization in the form of documentation is very weak in the cluster except the units few units. Team found following reasons:

- 2.4 No previous training on ISO/ System
- 2.5 Have feeling of managers documentation is burden
- 2.6 Lack of skills and awareness

2.4 Level of Production and Productivity

Productivity are the main motto of the units in the to MICFO Cluster. Maximum/ optimum utilization of the available Resources should be main focus, but there are low Productivity for the following reasons;

- A. Wastages of Time due to unimproved flow of work
- B. Not Full utilization of Man and Machine
- C. 7 Types of Wastes also one of the Root cause
- D. Productivity norms are not developed
- E. No study ever done on Productivity Improvement areas
- F. Process Flow Chart with Time and Manpower not available

G. Supervisors Training are not conducted in these areas

2.5 Manpower and Skills

Most of the Units have combination of Manpower – semi and Un-skilled or knowledge of work by Practice. Multi-skill are required to develop in the units for the workers.

Apart from Skills, the Knowledge level of worker is very poor. Still there is no concept of Knowledge matrix and Skill matrix.. All supervisors of all units should be Trained on Production, Productivity, Quality, Process and Operations areas etc. with Lean Concept. They also develop the skill of Communication with Management and Workers with Training of Leadership Quality.

2.6 Wastages

Units have major Wastages in the areas with causes;

- A. Time – Due to improper Work-flow in the Lines
- B. Motion – Absence of Standard Workplace Layout
- C. Transportation - Shop-floor Layout
- D. Scrap - Problem of Identification and analysis and Quality problems
- E. Overproduction - Workers/ supervisors knowledge gap
- F. Over-processing - Workers/ supervisors knowledge gap
- G. Defects - Quality Planning Problems

2.7 Scrap

In this Cluster, Major Scraps in most of the units piled up due to long term gap in decision of release and removal problems. Supervisors and owners could not decide the existing scrap is on use or not. So, absence of confidence may be one of the root causes. But our Lean Team justified about the scrap as an unnecessary items blocked the space in the shop floor and helps the units to remove it with Technical assessment.

2.8 Attitude And Awareness

There are required a immense changes in the attitude in the units are requires to forward their Journey to the EXCELLENCE in the following areas;

- i. *Reserve or Conservative Attitude and not confident what to Change, so agent and proactive thinking of all members of the units are outmost required (but it have marked changed after we have started initiative in the units)*
- ii. *Craftsmanship with cordial and fellow feeling Attitude of Supervisors towards Workers*
- iii. *Careful Attitude of Workers towards Supervisors*
- iv. *Supportive Attitude of Owners towards Supervisors and Workers*
- v. *Professional Attitude of Owners towards Consultants and External Change Agents*
- vi. *Long Term relation Attitude of Owners, Supervisors and Workers towards Customers*



vii. *Not focused Layout*

2.9 Strategy and Planning

All changes and Improvement of the units should be on the basis of Strategy and Planning;

- A. *Strategy for Quality Improvement*
- B. *Strategy for Customer's Satisfaction*
- C. *Planning for Short and Long Term Improvement*
- D. *Planning for Growth, Progress and Development*

2.10 Technology, Process and Control of Manufacturing

Planning are there all the units about the Technological Improvement but it should be as per the best suited and applicable Techniques and Technology.

EFFECTIVE TECHNOLOGY MEANS

- A. Comparatively easy Operations and easy to understand
- B. Reduces the Cost of Production
- C. Limited Wastages
- D. Control of all Operations
- E. That take care all critical Production Factors in the Lines
- F. Easy Availability, Reduce lead time for Technology acquisition
- G. Availability of Services
- H. Suitable in our conditions
- I. Cost Effective

Units should Develop and Use of Production Parameters, Ratio Analysis and suitable Measurements for Controlling for Production, Price, Quality and Delivery.

2.11 Delivery

Most of the units in the Cluster have delivery problems and their expectations from Lean are to reduce delivery time.

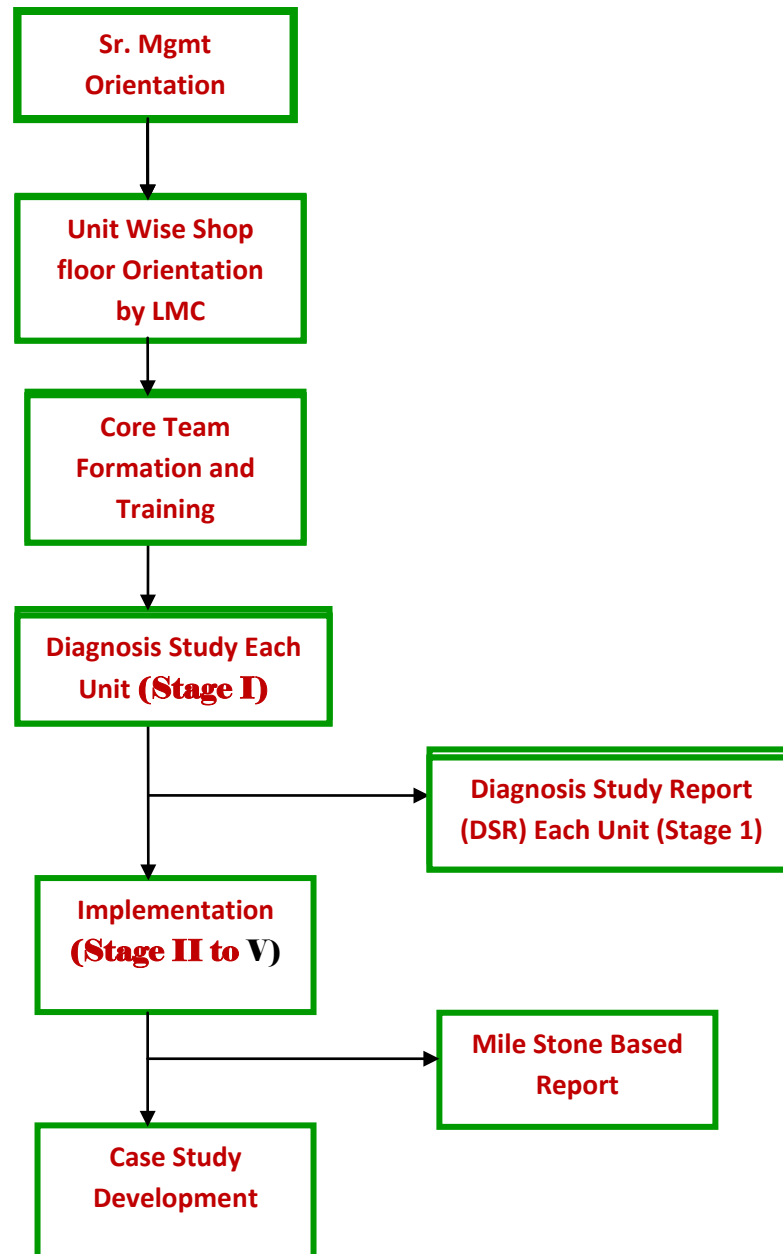
Delivery period problems arises for different problems of the units;

- A. Rework Problems
- B. Delivery from Suppliers
- C. Shop-floor Traditional Management
- D. Space Problems
- E. Scrap, Quality etc.

IV. APPROACH AND METHODOLOGY

4.1. Broad Approach to Methodology:

The overall approach as proposed is given below in a schematic manner-



Stage wise details are given Below:

STAGE – I (DSR –Diagnosis Study Report & TRAINING)

- 1) Visit and details Understanding the Existing Processes, Machines, Tools and Production System
(All the Information of the Implementing units of Lean according the Scope of the Work)
- 2) Analysis about the Implementation and Formulation of Implementation
- 3) Discussions about the Problems and Checking the Existing Data
- 4) Identify the Critical Factors for Implementation
- 5) Prepare Checklist, Diagnosis study report Formats and Charts for Implementing and Guiding the Employees of the concerned units to use (use in Time of Training and Implementation)
- 6) Taking Initial Video shots unit wise
- 7) Planning Steps of Implementation of the LM Tools in Unit-wise
- 8) Identifying employees skills gap ,if required, with the help of matrix,

Training on the Contents and Implementation of the Lean in the Units

- 1) About Lean – Concept, Purpose, Effectiveness and Result
- 2) LM Tools and its Concepts of Utilization (the applicable Tools)
- 3) Process and Activities Related of the Groups in the Units, responsible for Implementation
- 4) Selection of the Effective Team unit wise
- 5) Empowerment of Selective team “Factory with in Factory”

The typical outline of action plan as given in annexure D will be prepared based on the finding of diagnostic study to be made in each unit during this phase.

STAGE – II to IV

A) Initiation

- 1) Project Selection (Based on Company Conditions & Priority) as per made in stage 1 DSR
- 2) Team Formation at Shop Floor
- 3) Facilitation to Teams in implementing projects
- 4) Application of LM Tools in project implementation
- 5) Timely discussion with CEO/Unit heads

B) Follow ups

- 1) Follow and Monitoring of the Activities



- 2) Correction of the Deviations, if any
- 3) Measures of the Effects and Improvements
- 4) Confidence of the Groups and Checking of the Faults
- 5) Contact to the SPV and NMIU any problems and differences

STAGE – V :

C) Completion

- 1) Closing the activities
- 2) Submission of the Report to the Units, NMIU and office of DC-MSME
- 3) Maintenance of Confidentiality of the Repots and organisation process

4.2 Deliverables

- 1) Capability of Employees developed
- 2) Benefits (Quantative and Qualitative) achieved in selected parameters*
- 3) Cultural Change accessed qualitatively
- 4) Reports, Video & Case study Submitted

* Relevant Parameters to be chosen from are as follows:

- Productivity
- Quality
- Response time to customer
- Inventory
- Working capital
- Space Utilizations
- Documentations
- Working Environment
- Employee Morale

V. EXPERIMENTAL PLANNING

5.1 Pilot Value Stream Selection	
Product Families	<i>Corrugated box</i>
Value Streams	<i>INNER & OUTER</i>
Pilot Value Stream	<i>5ply- SWIFT- COMBI</i>
Value Stream Map	Annexure III & IV
Number of Employees	21

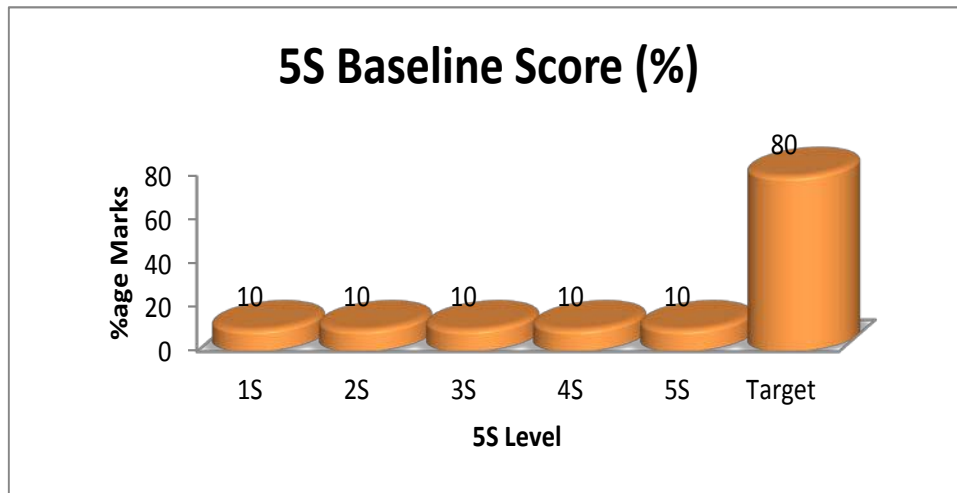
5.2 Value Stream Benchmark				
<i>Factors</i>	<i>Unit</i>	<i>Baseline</i>	<i>After Lean</i>	<i>Improvement</i>
1. Labour Productivity	Tonnage per day/manpower	*0.1	0.11	10% Up(Increase)
2. Capital Productivity	Total Revenue Generated/ Capital Employed	1.07	1.17	10% Up (Increase)
3. Annual Savings (Lean)	Rs.		23 Lakh	23 Lakh
4. Quality Performance	%age (ok pieces/Total no. of pieces)	*90	95	5% up (Increase)
5. Inventory Turn	Net Sales/ Avg. Inventory	11.93	13	10% Up (Increase) by reducing inventory
6. No. of Kaizen	Nos./Month	Not in Practice	Minimum one kaizen Per month/ Zone	One kaizen Per month/ Zone

	NO. Of Projects	Not in Practice	<ol style="list-style-type: none"> 1. LFF 2. 5S 3. Document Standardisation 4. Quality Improvement 5. Productivity Improvement 6. PPC & Inventory Reduction 7. Training 	7
7. Recognition/Certification	Nos.	No	ISO 9001:2008	1
8. HR Development	A.No of HR Intervention	No modern practices	Multi Skilling, Job Responsibility, Skill Matrix, Work Procedures	4
	B. HOURS	Zero	21	21
9. Lead Time	Hours (Dispatch time –Schedule Received Time)	48	43	10% Down (Decrease)
10. Value Add Ratio	%age (Sum of CT/Lead time)x100	0.024	0.026	10% Up (Increase)
11.On-time Delivery	%age (Adherence of Target date)	80	88	10% Up (Increase)
12.Throughput Yield	%age (FTR)	Not in practice	Focus will increase on FTR (First Time Right)	10% Up (Increase)
13.Equipment Availability	%age(Total Available Time-Total Breakdown time/Total Available time) X 100	No Breakdown is recorded	Breakdown data will be calculated for Each Assets, Preventive maintenance practice will start	10% Up (Increase)
14.OEE	%age (Availability X Performance X Quality)	Not in Practice	For Critical machine OEE Will be calculated and Monthly action plan will be made on OEE losses	10% Up (Increase)
15.Floor Area Freed up	Sq Mt. (Area saved through 5 S)	Wanted and unwanted items are mixed up at Gemba	Floor area will be freed through factory fundamental activities	10% Saving

5.3 Value Stream Waste Summary				
Waste	Metrics	Baseline	Improvement Target	Estimated Saving
1. Over production	*Metrics attached (Annexure V)	1	7	Rs 23 lakhs/Year, 30% knowledge & Skill improvement
2. Inventory		4	6	
3. Defects		1	6	
4. Waiting		1	5	
5. Over processing		1	8	
6. Transportation		1	6	
7. Motion		1	5	
8. Unused Talent		1	7	

5.45S Baseline Score:

5S Score is as per Annexure VI audit conducted during Phase I.



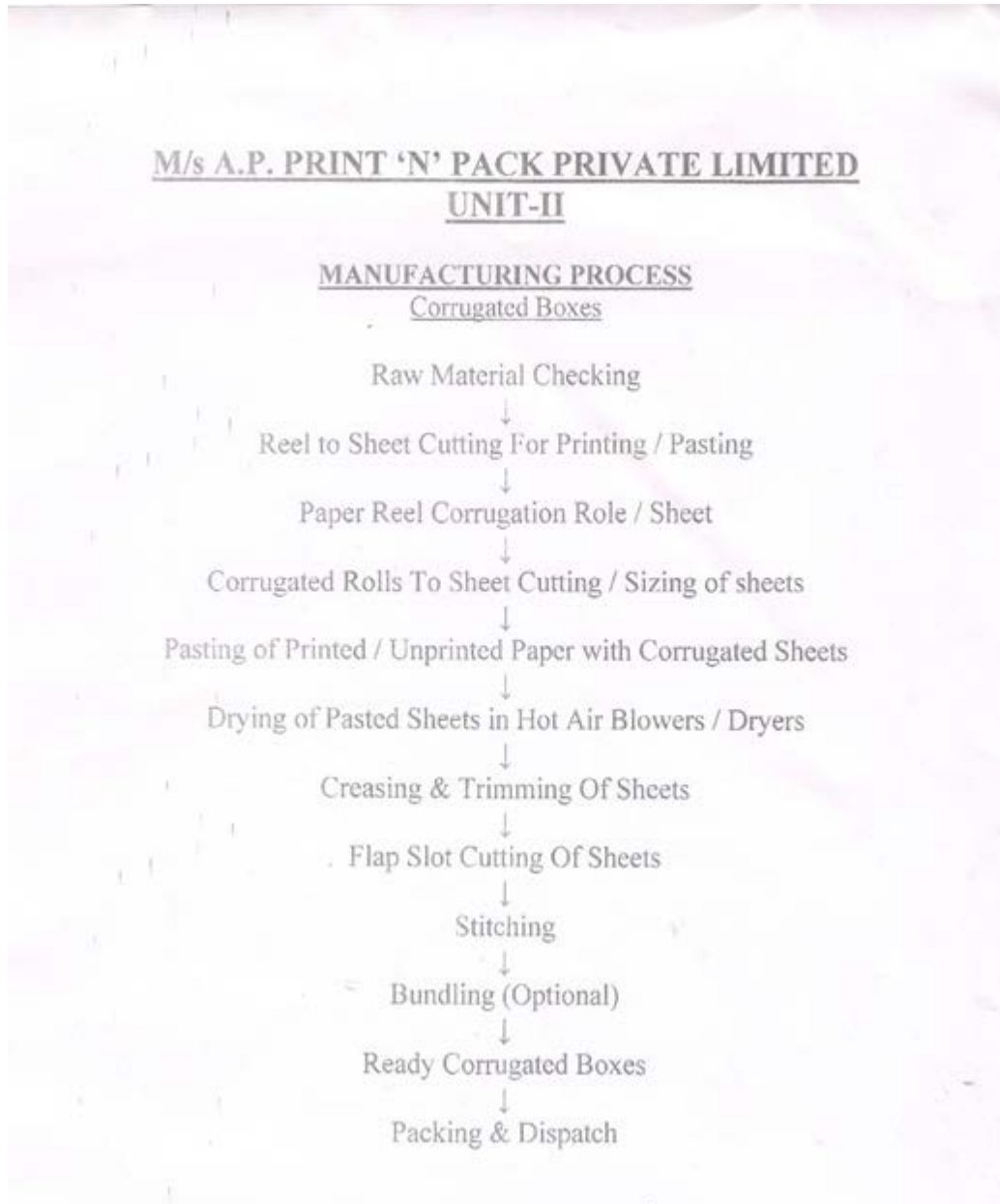
5.6 Phase-wise Milestone Based Implementation Plan						
Phase	Project Details	Current Status (Baseline)	PHASES			
			II	III	IV	V
			Milestone Completion Date			
			Feb 2015 – Apr 2015	May 2015 – Jul 2015	Aug 2015 – Oct 2015	Nov 2015 -Jan 2016
			Targets for Each Parameter			
II-V	<u>Lean Project-1</u> <i>Lean Factory Fundamentals (Visual Management, Kaizen, Asset Management)</i>	Visual Management- Very Poor Kaizen- No Concept in plant Asset Management- No Practices is applying	1. Visual Management- 1.1- Plan- Identify Requirement of Visuals 1.2- Do- Visual Boards fix up at Gemba and in offices 2. Asset Management- Breakdown Recording as per Procedure 3. Audit- LFF and prepare radar chart	1. Visual Management- 1.1- Check- further requirement if any gap 1.2 Act- to meet requirement of visuals 2. Asset Management- Model Machine, choose and make it model, Prepare Preventive Maintenance Plan	1. Kaizen- Kaizen Gallery at Gemba & in office, Kaizen Week conduct, Kaizen Reward Distribution 2. Asset Management- Adherence Preventive Plan	1- Asset Management- Comparison of trends, Amendments of Preventive Plans 2. Zone Competition on Best LFF (Lean Factory Fundamentals)
II-V	<u>Lean Project-2</u> <i>Five S</i>	10%	-Zone & team formation, Zone map, Red Tag Area, - Seiri- Area Freed up, Waste Elimination calculation - Audit-2 Target 20%	- Seiton – Gangway & Marking at floor, Shadow board, Material placement - Seiso- Cleaning, Shining, Painting, Seiso Standard - Audit-3 Target 40%	Sieketsu- Standardize 5S work at company level, 5S Visual Standard Audit-4 Target 60%	-Shitsuke- Cross function Audit, 5S Week, Best Zone Reward - Final Audit-5 Target 80%
II-V	<u>Lean Project-3</u> <i>Document Standardization</i>	Document- Some only Place GWI is displayed	-One Point Lesson -Skill Matrix	-General Work Instruction (GWI) -Job responsibility	-SOP (Standard Operating Procedures) for All department	-MRM Matrix - Conduct MRM (Management Review Meeting)

				y	excluding Finance and NPD	
III-V	<u>Lean Project-4</u> <i>Quality Improvement</i>	90%		Recording of Defects Define-Problems Measure-Defects via graph; pareto Analyze- Root Cause via Fishbone	Improve-Take appropriate action on appropriate root cause Control- Defects and monitoring trends Target 2.5 %	Monthly Defects will analyses and CAPA practices start Target 5 %
III-V	<u>Lean Project-5</u> <i>Productivity Improvements</i>	0.1		- Cycle Time Study through video recording of each operation - Analyses Production Plan & Gap Analyses -Layout Modification	-Line Balancing - Wastage Elimination - Shift Scheduling Target 5 %	-Value Addition ratio Monthly trend comparison -Plant Layout Target 10 %
III-V	<u>Lean Project-6</u> <i>PPC & Inventory Reduction</i>	ITR- FIFO is not in Practice		-Analyze Material Order & Market Order plan, Shift plan, Manpower Plan	Analyse- Inventory Plan, FIFO hindrance Identification Target 5 %	Implement- FIFO, Stock taken, ITR, Prepare PPC System Target 10 %
II-V	<u>Lean Project-7</u> <i>Training</i>		Tr-1: Lean Factory Fundamentals Tr-2:5S	Tr-3:Kaizen Tr-4: Productivity Improvement	Tr-5: SOP & Documentation Tr-6 Quality Improvement Tools	Tr-7 MRM
5.7 Outcome (Benefits) from Lean Projects						
Lean Project	Applicable Lean Tools	Qualitative Benefits	Quantitative Benefits	Annualized Saving		

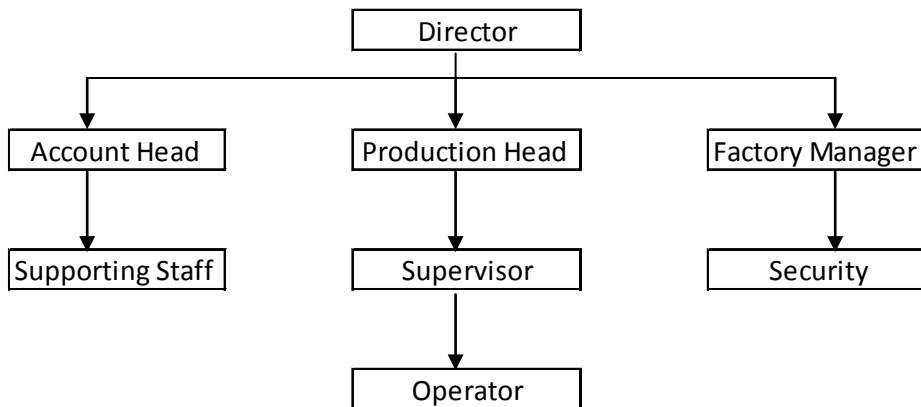
				(Approx. Rs)
<u>Lean Project-1</u> <i>Lean Factory Fundamentals (Visual Management, Kaizen, Asset Management)</i>	<i>Visual Management, Kaizen, Asset Management</i>	Proper visualization and information at Gemba	3 Lakh	3 Lakh
<u>Lean Project-2</u> <i>Five S</i>	Model work Place	Space Saving at Gemba	2 Lakh	2 Lakh
<u>Lean Project-3</u> <i>Document Standardization</i>	SOP, OPL, GWI	Right Information at Right Place, Increasing Awareness to workers on their work	Zero Accident	
<u>Lean Project-4</u> <i>Quality Improvement</i>	Poka Yoke, 7 QC Tools	Natural Resource Saving	3 Lakh/10% Up	3 Lakh/10% Up
<u>Lean Project-5</u> <i>Productivity Improvements</i>	Value Stream Mapping, Cycle time Study, Single Piece Flow		12 Lakh/ 10% up	12 Lakh/ 10% up
<u>Lean Project-6</u> <i>Inventory Reduction</i>	Kanban, FIFO, JIT		3 Lakh/10%Down	3 Lakh/10%D own
<u>Lean Project-7</u> <i>Training</i>	Role Play	Skill Improvements, High Moral, Knowledge Enhancement	30% Skill & Knowledge Improvements	
List of Lean Tools: 1. Value Stream Mapping, 2. Kaizen-DMAIC/PDCA, 3. The 7QC Tools, 4. SMED, 5. JIT & Kanban, 6.Single Piece Flow, 7. Poka Yoke, 8.Standardized Work, 9.Five S, 10.Visual Management, 11.TPM				
Attachments				
<ul style="list-style-type: none"> • Photographs/Video • Project Report • 				

5.8 ANNEXURE

Annexure I: Manufacturing Process Flow

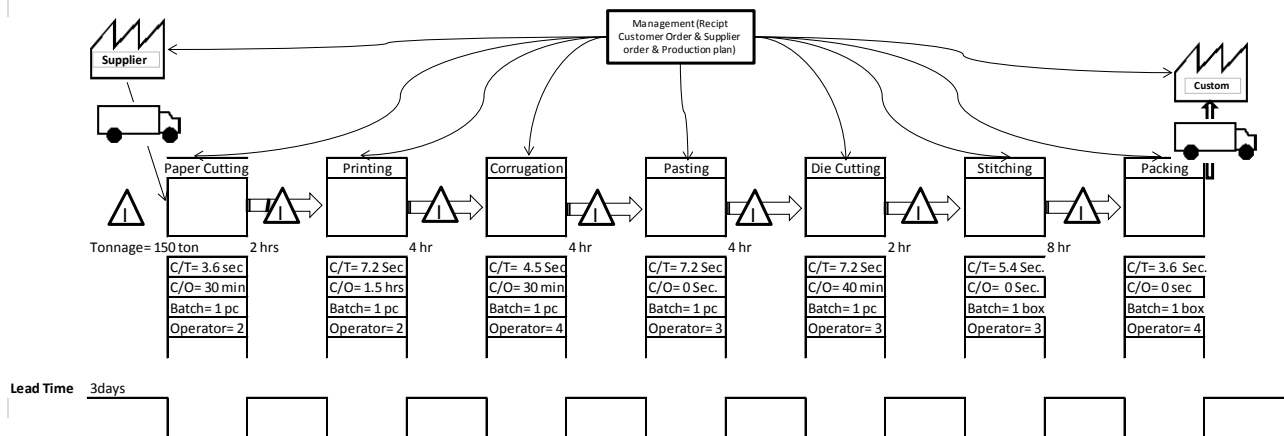


Annexure II: Organization Structure



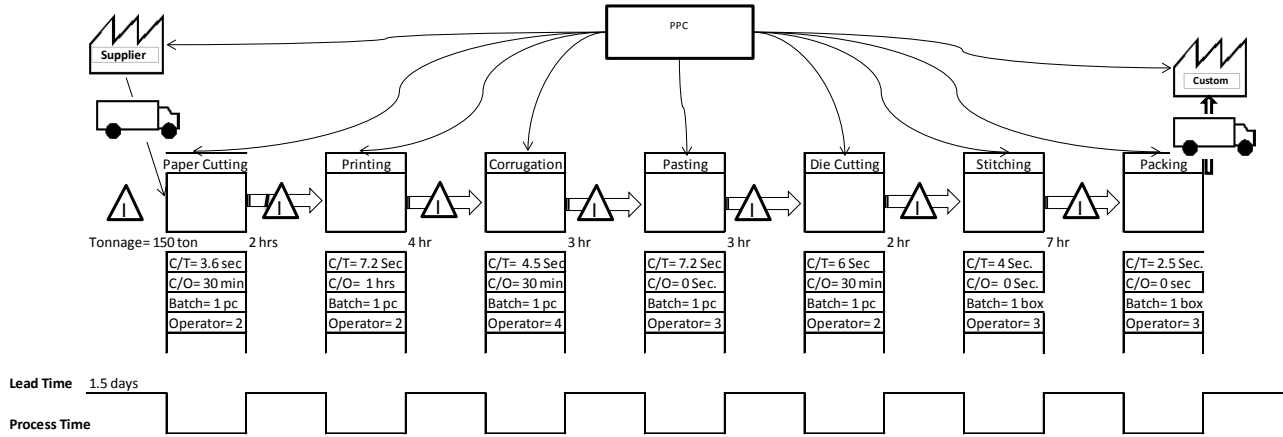
Annexure III: VSM Current State Map

Model: Swift 5PLY
 Current State



Annexure IV: VSM Future State Map

Model: Swift 5PLY
 Future State



Annexure V: Waste Matrix

8 Waste Metrics										
Areas	10 Marks	9 Marks	8 Marks	7 Marks	6 Marks	5 Marks	4 Marks	3 Marks	2 Marks	1 Marks
1. Over production	Having Documentation & Displayed, known & Followed by all (0-2 %)	Having Documentation & Displayed, known & Followed by all (2-3 %)	Having Documentation & Displayed, known & Followed by all (4-5 %)	Having Documentation & Displayed, known & Followed by all (6-7 %)	Having Documentation & Displayed, known & Followed by all (8-9 %)	Having Documentation & Displayed, known & Followed by all (10-11 %)	Having Documentation & Displayed, known & Followed by all (12-13 %)	Having Documentation & Displayed, known & Followed by all (14-15 %)	Having Documentation & Displayed, known & Followed by all (16-17 %)	No Record is available > 18%
2. Inventory	Hourly	Per Shift	1-3 Days	4-6 Days	7-15 Days	16- 29 Days	1-3 Months	4-6 Months	> 6 months	No Record is available
3. Defects	0-2 % (Inhouse) or Zero Customer Complain/month	2-3% (Inhouse) or 1 Customer Complain/month	4-5% (Inhouse) or 2 Customer Complain/month	6-7 % (Inhouse) or 3 Customer Complain/month	8-9% (Inhouse) or 4Customer Complain/month	10-11% (Inhouse) or 5 Customer Complain/month	12-13% (Inhouse) or 6 Customer Complain/month	14-15% (Inhouse) or 7 Customer Complain/month	16-17% (Inhouse) or 8 Customer Complain/month	No Record is available & >8 customer complain or > 18%
4. Waiting	Zero second delay	< 1 Mintue	2 -15 Mint	16-30 Mintues	31-45 Mintues	46-60 Mintues	ween Hour & \$	> Per Shift	Cycle time Exist but not followed	No Cycle time Exist
5. Over processing	No Over Processing, Standards are define for >90 % stations & Followed at Each Station	81- 90 % (Standards are define & Work Accordingly)	71- 80 % (Standards are define & Work Accordingly)	61-70 % (Standards are define & Work Accordingly)	51-60% (Standards are define & Work Accordingly)	41-50 % (Standards are define & Work Accordingly)	31-40 % (Standards are define & Work Accordingly)	21-30 % (Standards are define & Work Accordingly)	11-20 % (Standards are define & Work Accordingly)	No Standards are define / >10%
6. Transportation	For 100- 91 % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	For 81-90% % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	For 71-80 % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	For 61-70 % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	For 51-60 % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	For 41-50 % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	For 31-40 % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	For 21-30 % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	For 11-20 % product are covering minimum distance as per Rout Plan and Displayed & Followed for Man, Material & MHE(Material Handling Equipment)	No Rout Plan Is made/ > 10%
7. Motion	For 91-100 % operators are working as per standard Work combination sheet (SWCS)	For 81-90 % operators are working as per standard Work combination sheet (SWCS)	For 71-80 % operators are working as per standard Work combination sheet (SWCS)	For 61-70 % operators are working as per standard Work combination sheet (SWCS)	For 51-60 % operators are working as per standard Work combination sheet (SWCS)	For 41-50 % operators are working as per standard Work combination sheet (SWCS)	For 31-40 % operators are working as per standard Work combination sheet (SWCS)	For 21-30 % operators are working as per standard Work combination sheet (SWCS)	For 11-20 % operators are working as per standard Work combination sheet (SWCS)	No Record & Layout is displayed / > 10%
8. Unused Talent	For 91-100 % operators & excutive are working as per their Knowledge & Skill Matrix	For 81-90 % operators & excutive are working as per their Knowledge & Skill Matrix	For 71-80 % operators & excutive are working as per their Knowledge & Skill Matrix	For 61-70 % operators & excutive are working as per their Knowledge & Skill Matrix	For 51-60 % operators & excutive are working as per their Knowledge & Skill Matrix	For 41-50 % operators & excutive are working as per their Knowledge & Skill Matrix	For 31-40 % operators & excutive are working as per their Knowledge & Skill Matrix	For 21-30 % operators & excutive are working as per their Knowledge & Skill Matrix	For 11-20 % operators & excutive are working as per their Knowledge & Skill Matrix	No concept is exist / > 10 %









Annexure VI: 5S Baseline Score





Five S Assessment Score Card						
Company: AP Print 'N' Pack						
Level	Beginner (1-2)	Basic (3-4)	Visual (5-6)	Systematic (7-8)	Preventive (9-10)	Score
1 Seiri (Sort)	Needed and un-needed items found in work area.	Needed /un-needed items separated, un-needed tagged.	Red tag area created, all un-needed items removed	List of needed items developed, maintained, posted.	Un-needed items are not allowed in the work place area.	1
2 Seiton (Set in Order)	Needed and un-needed items are placed randomly throughout the	Needed items stored in an organized manner.	Needed items have dedicated positions which are clearly indicated?	Needed items can be retrieved within (cell target) seconds and (cell target)	Method for adding/deleting indicators for needed items	1
3 Seiso (Shine)	Work area and machines are not cleaned on a regular basis.	Area and equipment cleaned daily.	Standard work layout posted and maintained.	Daily inspections of plant and area occur.	Root cause sources of dirt, grease & spillage have been eliminated.	1
4. Seiketsu (Standardize)	Methods of work not completely documented.	Methods of work documented but not consistently used.	Methods of work posted and consistently used by some cell team members.	Methods of work consistently used by all cell team members.	Methods of work are regularly reviewed and improved.	1
5 Shitsuke (Sustain)	Occasional, unscheduled 5S activity.	5S activities conducted on regular basis.	5S assessment conducted occasionally and results posted.	5S assessment conducted on a regular basis and recurring problems	Root causes of problems revealed by 5S assessment are identified and	1
Date: 12.01.2015					Total Score (Max-50)	5

Annexure VII: Base Level “Photographs”

Area: Production	Area: Production
	
Finish Good And Semi Finish Good Are Placed On Floor.	Floor Is Not Clean.
Area: Store	Area: Store

	
<p>No Clear Identification Of Raw Material</p>	<p>Raw Material Not In Proper Order On The Floor.</p>
<p>Area: Production</p>	<p>Area: Production</p>
	
<p>Finish Good And Semi-Finish Good Are Placed Together.</p>	<p>No Proper Place For Drums.</p>

Area: Production	Area: Production
	
Unwanted Items Are On The Floor.	Floor Is Not Clean.
Area: Production	Area: Outskrits

	
<p>Finish Good Are On The Floor</p>	<p>No Red Tag Area.</p>
<p>Area: Production</p>	<p>Area: Production</p>
	
<p>Raw Material Is Not Placed In Proper Way</p>	<p>Material Are Placed In Office</p>

Area: Store	Area: Production
	
Finish Good Are Not Placed In Proper Way	No Work Instruction On Machine
Area: Production	Area: Production
	
Electrical Panel In Unsafe Condition	Material Are Placed In Undefined Area

Area: Production	Area: Production
	
No Visualization For Material	No Red Tag Area

VI. RESULTS AND DISCUSSION
LEAN IN PACKAGING UNIT

LEAN IMPLEMENTATION OPPORTUNITY

Where there are imperfection and disorder, it means the scope is high. So, the units may be performing well in their Business but for better Efficiency and competitiveness it required Lean Techniques for Improvement. As per our visit and subsequent analysis the units, it is required large effort to Implement the Lean in the shop-floor.

LIMITATIONS AND PROBLEMS OF THE IMPLEMENTATION

Our mission is to create Provision for better Implementation of Lean Manufacturing to the units. But success depends upon the how far the constraints cad be eliminated.



- A. Long time and less Technical Studies undertaken by most of the units, so we have to start from the threshold level
- B. High effort required to Change the long Term Traditional Business and Working Culture in the units
- C. Mind and attitude of the Workers and Supervisors
- D. Technical support of the units, some of the Owners are overenthusiastic & courageous and some are comparatively less, so consultants are required to Balance the expectations of both the sides and make them to understand Growth is not one person or limited days program
- E. Most of the units have Single Knowledgeable Head with decision maker – I.e. the Owners – all Heads of all the activities
- F. Customer Focus, Values (corporate and employees) with value assessment should be developed

The results of the study suggest followed by a methodical approach to reduce the time in the process, or project in their implementation of continuous improvement, therefore improving throughput. Manufacturing throughput time reduction can be a daunting task due to the many factors that influence it and their complex interactions. However, there are basic principles that, if applied correctly, can be used to reduce manufacturing throughput time. The report presents the factors that influence manufacturing throughput time at Pharmadule, the actions that can be taken to alter each factor, and to approach the purpose. Introduction of project background and literature search, which focus on lean production and based on project management.

After literature search, based on one week survey work in the factory in Haridwar the following chapter is pay attention to analysis of project data, including production hours and number of workers, and also their relation.

VII. CONCLUSION

The results of successful lean thinking can be observed in various areas of an organization. In order to measure these results, some common performance measures are used. The areas where the biggest improvements through lean thinking should occur, are: Quality and quality improvement, cost and productivity improvement, delivery and service improvement, and business results (financial performance). These categories and most of the performance measures within them are adapted from the Shingo business prize guidelines (2005).

Improvements can be expected in all categories summarized in Appendix A, if an organization is able to successfully and thoroughly apply all, or most of the lean practices and principles described earlier. The enablers (philosophy and HRM) and the resulting lean culture are the most important factors to understand and practice. This will ensure lean thinking on a sustainable, long-term basis.

7.1 Performance measures

7.1.1 Quality & quality improvement

To measure quality and its improvement, metrics such as rework/scrap as a percent of sales or production costs can be used. More examples include customer rejects due to poor quality in parts per million, or finished product first pass yield and percentage. Warranty cost as a percent of sales or production cost can also be used. These are just a few examples and there are more to find in Appendix A. It is important that there is a quality



measurement system in place that is well suited for the particular situation. After all, you can't improve something you do not measure.

7.1.2 Cost & productivity improvement

When it comes to cost and productivity there are also several metrics commonly used. Value added per payroll (sales minus purchased goods and services divided by total payroll dollars) is one example. Manufacturing cycle time (start of product production to completion), physical labor productivity (units/direct hour) are other examples. Not only labor productivity should be measured. Energy productivity and resource utilization (e.g., vehicles, plant and warehouse floor space, etc.) are also important measures of productivity. To quantify improvements, product cost reduction and unit manufacturing cost reduction may be used. There are many more metrics that can measure costs and productivity. It is important to have a sound system in place in order to keep track of improvements and problems.

7.1.3 Delivery & service improvement

The percent of products shipped on-time (define on-time window) and/or percent of complete orders shipped on-time (define on-time window) is one example of a metric to measure delivery and service. Customer lead time (order entry to shipment) is another important variable in a lean system that must be measured and monitored precisely. Mis-shipments, return rates, and stock level and rotation are some more examples how to keep track of delivery and service. Since delivery and service takes place right at the front end of the organization and is the part that deals the most with customers it is very important to improve and maintain the highest level of service and quality in order to offer customers a positive experience with the organization and its products.

7.1.4 Business results

Business results refer to bottom line measures of firm performance. These can be customer satisfaction, or more quantitative metrics such as market share. Other examples include operating income on sales ratio, reduction in fixed and/or variable costs, administrative efficiency, cash flow, and product line margins. More examples are shown in Appendix A. These business metrics are very important since they show how profitable an organization is. They might also be helpful to identify areas that need special attention. Positive business results should be the outcome of successful lean implementation.

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Periodic Solution for Non-linear System of Integro-differential Equations Of Volterra Type

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Abstract

In this paper, we investigate the existence and approximation of periodic solutions of non-linear systems of integro-differential equations of Volterra type by using the numerical-analytic method which were introduced by Samoilenko.

The study of such integro-differential equations leads to extend the results obtained by Butris for changing the system of non-linear integro-differential equations to periodic system of non-linear integro-differential equations of the Volterra type.

1. Introduction

In recent years, Samoilenko assumes that the numerical analytic method to study the periodic solutions for ordinary differential equations and their algorithm structure. In the original works of Samoilenko [12], the approach used and described here had been referred to as the numerical-analytic based upon successive approximations. The idea of the method, originally aimed at the investigation of periodic solutions only, had been later applied in studies [1,4,7,9].

Also, it should be noted that appropriate versions of the method considered can be applied in many situations for handling periodic in the case of systems of first or second order ordinary differential equations, integro-differential equations, equations with retarded arguments, systems containing unknown parameters, and countable systems of differential equations. A survey of the investigations on the subject can be found in the studies and researches [3,6,8,10].

In this paper, we investigate the existence and approximation of the periodic solutions for non-linear system of integro-differential equations. The numerical-analytic method is used to study the periodic solutions of ordinary differential equations introduced by Samoilenko [12].

Consider the following system of non-linear integro-differential equations which has the form :

$$\frac{dx(t)}{dt} = (A + B(t))x(t) + f(t, x(t), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t,s)x^i(s)ds)^i) \quad (1.1)$$

where $x \in D \subseteq R^n$, D is a closed and bounded domain.

Let the vector function $f(t, x, y) = (f_1(t, x, y), f_2(t, x, y), \dots, f_n(t, x, y))$,

is defined and continuous on the domain ,

$$(t, x, y) \in R^1 \times D \times D_1 = (-\infty, \infty) \times D \times D_1, \quad (1.2)$$

where D_1 is a bounded domain subset of Euclidean space R^m .

Let $G(t, s)$ is $(n \times n)$ continuous positive matrix and periodic in t, s of period T provided that :

$$\left. \begin{aligned} \int_{-\infty}^t \|G(t, s)\| ds &\leq K, K > 0 \\ S_3 &= \sum_{i=1}^{\infty} K^i M_4^{i-1} \\ S_4 &= \sum_{i=1}^{\infty} i K^i M_4^{i-1} \end{aligned} \right\} \quad (1.3)$$

where S_3 and S_4 are convergent series.

We define the non-empty sets as follows:

$$\left. \begin{aligned} D_f &= D - M_3 \\ D_{1f} &= D_1 - M_4 \end{aligned} \right\} \quad (1.4)$$

and

$$V = [(H + L_1)B_1(t)Q + L_2S_4Q_1] < I, \quad (1.5)$$

where $M_3 = \frac{T}{2}Q(H\delta_0 + M)$ and $M_4 = QN\delta_0 + Q_1(H\delta_0 + M)$.

By using lemma 3.1[12], we can state and prove the following lemma

Lemma 1. Let the vector function $f(t, x, y)$ be defined and continuous in interval $[0, T]$, then the inequality

$$\|K_1(t, x_0)\| \leq B_1(t)Q(H\delta_0 + M) \quad (1.6)$$

Satisfies for $0 \leq t \leq T$ where $B_1(t) \leq \frac{T}{2}$

and

$$B_1(t) = \left[\frac{t(2e^{\|A\|(T-t)} - e^{\|A\|} - \|E\|) + T(e^{\|A\|T} - e^{\|A\|(T-t)})}{e^{\|A\|T} - \|E\|} \right]$$

Provided that:

$$K_1(t, x_0) = \int_0^t e^{A(t-s)} [B(s)x_0 + f(s, x_0) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_0 + f(s, x_0)] ds] ds$$

(For the proof see [1]).

2. Approximate Solution of (1.1)

In this section, we study the periodic solution for the system (1.1) by proving the following theorem.

Theorem 1. If the system (1.1) satisfies the inequalities (1.3), (1.4) and Conditions (1.5), (1.6) has a periodic solution $x = x(t, x_0)$, then the sequence of functions:

$$x_{m+1}(t, x_0) = x_0 e^{At} + \int_0^t e^{A(t-s)} [B(s)x_m(s, x_0) + f(s, x_m(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_m(\tau, x_0) d\tau)^i) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_m(s, x_0) + f(s, x_m(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_m(\tau, x_0) d\tau)^i)] ds] ds \quad (2.1)$$

with $x_0(t, x_0) = x_0 e^{At}$, $m = 0, 1, 2, \dots$

is periodic in t of period T , and uniformly convergent as $m \rightarrow \infty$ in the domain:

$$(t, x_0) \in [0, T] \times D_f \quad (2.2)$$

to the limit function $x_{\infty}(t, x_0)$ defined in the domain (2.2) which is periodic in t of period T satisfying the system of integral equations:

$$\begin{aligned}
 x(t, x_0) = & x_0 e^{At} + \int_0^t e^{A(t-s)} [B(s)x(s, x_0) + f(s, x(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}(\tau, x_0) d\tau)^i)] \\
 & - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x(s, x_0) + f(s, x(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}(\tau, x_0) d\tau)^i)] ds] ds
 \end{aligned} \tag{2.3}$$

which is a unique solution on the domain (2.2), provided that :

$$\|x_{\infty}(t, x_0) - x_0\| \leq M_3 \tag{2.4}$$

and

$$\|x_{\infty}(t, x_0) - x_m(t, x_0)\| \leq B_1(t) Q V_1 V^{m-1} (1 - V)^{-1} \tag{2.5}$$

for all $m \geq 1$ and $t \in R^1$.

Proof.

Now, by using Lemma 1 and the sequence of functions (2.1) when $m = 0$, we get:

$$\begin{aligned}
 \|x_1(t, x_0) - x_0\| = & \left\| x_0 e^{At} + \int_0^t e^{A(t-s)} [B(s)x_0 + f(s, x_0, 0)] - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_0 \right. \\
 & \left. + f(s, x_0, 0)] ds] ds - x_0 e^{At} \right\| \\
 \leq & \left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \right] \int_0^t \|e^{A(t-s)}\| [\|B(s)\| \|x_0\| + \|f(s, x_0, 0)\|] ds \\
 & + \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \int_t^T \|e^{A(t-s)}\| [\|B(s)\| \|x_0\| + \|f(s, x_0, 0)\|] ds \\
 \|x_1(t, x_0) - x_0\| \leq & \left[\frac{t(2e^{\|A\|(T-t)} - e^{\|A\|} - \|E\|) + T(e^{\|A\|T} - e^{\|A\|(T-t)})}{e^{\|A\|T} - \|E\|} \right] Q[H\delta_0 + M] \\
 \leq & B_1(t) Q[H\delta_0 + M] \\
 \leq & \frac{T}{2} Q[H\delta_0 + M] = M_3,
 \end{aligned}$$

and hence,

$$\|x_1(t, x_0) - x_0\| \leq M_3 \quad (2.6)$$

i.e. $x_1(t, x_0) \in D$, for all $t \in R^1$, $x_0 \in D_f$.

Suppose that $x_p(t, x_0) \in D$, for all $x_0 \in D_f$, $p \in Z^+$,

when $m = p+1$, we find that:

$$\|x_{p+1}(t, x_0) - x_0\| \leq M_3$$

i.e. $x_{p+1}(t, x_0) \in D$, for all $t \in R^1$, $x_0 \in D_f$, $p \in Z^+$.

Thus, by mathematical induction, we get the following inequality:

$$\|x_m(t, x_0) - x_0\| \leq M_3 \quad (2.7)$$

i.e. $x_m(t, x_0) \in D$, for all $x_0 \in D_f$, and $m = 0, 1, 2, \dots$

In addition to that, we find that:

$$\begin{aligned} \|\dot{x}_1(t, x_0)\| &= \left\| x_0 A e^{At} + e^{A(t-s)} [B(t)x_0 + f(t, x_0, 0) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_0 \right. \\ &\quad \left. + f(s, x_0, 0)] ds \right\| \\ &\leq \|x_0\| \|A\| \|e^{At}\| + \|e^{A(t-s)}\| [\|B(t)\| \|x_0\| + \|f(t, x_0, 0)\|] \\ &\quad + \frac{\|A\|}{e^{\|A\|T} - \|E\|} \int_0^T \|e^{A(T-s)}\| [\|B(s)\| \|x_0\| + \|f(s, x_0, 0)\|] ds \\ &\leq \delta_0 N Q + (Q + \frac{\|A\| T Q^2}{e^{\|A\|T} - \|E\|}) [H \delta_0 + M] \\ &\leq \delta_0 N Q + Q_1 [H \delta_0 + M] = M_4 \end{aligned}$$

and hence,

$$\|\dot{x}_1(t, x_0)\| \leq M_4 \quad (2.8)$$

i.e. $\dot{x}_1(t, x_0) \in D_1$, for all $x_0 \in D_f$.

where

$$Q_1 = Q + \frac{\|A\|TQ^2}{e^{\|A\|T} - \|E\|}$$

Also by induction, we find that:

$$\|\dot{x}_m(t, x_0)\| \leq M_4 \tag{2.9}$$

where

$$\begin{aligned} \dot{x}_{m+1}(t, x_0) = & x_0 A e^{At} + e^{A(t-s)} [B(t)x_m(t, x_0) + f(t, x_m(t, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t, s) \dot{x}_m(s, x_0) ds)^i) \\ & - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_m(s, x_0) + f(s, x_m(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_m(\tau, x_0) d\tau)^i)] ds \end{aligned} \tag{2.10}$$

for all $m = 0, 1, 2, \dots$

We claim that the sequence of function (2.1) is uniformly convergent on the domain (2.2).

By using Lemma 1, and putting $m=1$ in (2.1), we have:

$$\begin{aligned} \|x_2(t, x_0) - x_1(t, x_0)\| = & \|x_0 e^{At} + \int_0^t e^{A(t-s)} [B(s)x_1(s, x_0) + \\ & + f(s, x_1(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_1(\tau, x_0) d\tau)^i) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_1(s, x_0) \\ & + f(s, x_1(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_1(\tau, x_0) d\tau)^i)] ds] ds - x_0 e^{At} - \int_0^t e^{A(t-s)} [B(s)x_0 \\ & + f(s, x_0, 0) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_0 + f(s, x_0, 0)] ds] ds\| \\ \|x_2(t, x_0) - x_1(t, x_0)\| \leq & \left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \right] \int_0^t \|e^{A(t-s)}\| \| [B(s)\| \|x_1(s, x_0) - x_0\| \end{aligned}$$

$$\begin{aligned}
 &+L_1\|x_1(s, x_0) - x_0\| + L_2\left(\sum_{i=1}^{\infty} K^i M_4^{i-1}\right)\|\dot{x}_1(s, x_0)\|]ds \\
 &+ \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|}\right) \int_t^T e^{A(t-s)} \| [B(s)\|x_1(s, x_0) - x_0\| \\
 &+L_1\|x_1(s, x_0) - x_0\| + L_2\left(\sum_{i=1}^{\infty} K^i M_4^{i-1}\right)\|\dot{x}_1(s, x_0)\|]ds \\
 \|x_2(t, x_0) - x_1(t, x_0)\| \leq &\left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|}\right) \right] \int_0^t Q[H\|x_1(s, x_0) - x_0\| + L_1\|x_1(s, x_0) - x_0\| \\
 &+L_2S_3\|\dot{x}_1(s, x_0)\|]ds + \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|}\right) \int_t^T Q[H\|x_1(s, x_0) - x_0\| \\
 &+L_1\|x_1(s, x_0) - x_0\| + L_2S_3\|\dot{x}_1(s, x_0)\|]ds \\
 \|x_2(t, x_0) - x_1(t, x_0)\| \leq &B_1(t)Q(H + L_1)M_3 + B_1(t)QL_2S_3M_4
 \end{aligned}$$

or

$$\|x_2(t, x_0) - x_1(t, x_0)\| \leq B_1(t)Q[(H + L_1)M_3 + L_2S_3M_4]$$

let $V_1 = [(H + L_1)M_3 + L_2S_3M_4]$

so ,

$$\|x_2(t, x_0) - x_1(t, x_0)\| \leq B_1(t)QV_1 \quad (2.11)$$

Also , when $m=1$ in (2.10) , we have :

$$\begin{aligned}
 \|\dot{x}_2(t, x_0) - \dot{x}_1(t, x_0)\| = &\|x_0 A e^{At} + e^{A(t-s)} [B(t)x_1(t, x_0) \\
 &+f(t, x_1(t, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t, s)\dot{x}_1(s, x_0)ds)^i) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_1(s, x_0) \\
 &+f(t, x_1(t, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t, s)\dot{x}_1(s, x_0)ds)^i)]ds] - x_0 A e^{At} - e^{A(t-s)} [B(t)x_0
 \end{aligned}$$

$$\begin{aligned}
 & +f(t, x_0, 0) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_0 + f(s, x_0, 0)] ds \Big\| \\
 \|\dot{x}_2(t, x_0) - \dot{x}_1(t, x_0)\| & \leq \|e^{A(t-s)}\| [\|B(t)\| \|x_1(t, x_0) - x_0\| + L_1 \|x_1(t, x_0) - x_0\| \\
 & + L_2 \left(\sum_{i=1}^{\infty} K^i M_4^{i-1} \right) \|\dot{x}_1(t, x_0)\| + \frac{\|A\|}{e^{\|A\|T} - \|E\|} \int_0^T \|e^{A(T-s)}\| [\|B(s)\| \|x_1(s, x_0) - x_0\| \\
 & + L_1 \|x_1(s, x_0) - x_0\| + L_2 \left(\sum_{i=1}^{\infty} K^i M_4^{i-1} \right) \|\dot{x}_1(s, x_0)\|] ds \Big\|
 \end{aligned}$$

so,

$$\begin{aligned}
 \|\dot{x}_2(t, x_0) - \dot{x}_1(t, x_0)\| & \leq Q[(H + L_1)M_3 + L_2S_3M_4 + \frac{\|A\|TQ}{e^{\|A\|T} - \|E\|} [(H + L_1)M_3 + L_2S_3M_4]] \\
 \|\dot{x}_2(t, x_0) - \dot{x}_1(t, x_0)\| & \leq (Q + \frac{\|A\|TQ^2}{e^{\|A\|T} - \|E\|}) [(H + L_1)M_3 + L_2S_3M_4]
 \end{aligned}$$

and hence,

$$\|\dot{x}_2(t, x_0) - \dot{x}_1(t, x_0)\| \leq Q_1 V_1 . \tag{2.12}$$

Now, when $m=2$ in the sequence of functions (2.1), we get:

$$\begin{aligned}
 \|x_3(t, x_0) - x_2(t, x_0)\| & = \|x_0 e^{At} + \int_0^t e^{A(t-s)} [B(s)x_2(s, x_0) \\
 & + f(s, x_2(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_2(\tau, x_0) d\tau)^i) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_2(s, x_0) \\
 & + f(s, x_2(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_2(\tau, x_0) d\tau)^i)] ds \Big\| - x_0 e^{At} - \int_0^t e^{A(t-s)} [B(s)x_1(s, x_0) \\
 & + f(s, x_1(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_1(\tau, x_0) d\tau)^i) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_1(s, x_0) \\
 & + f(s, x_1(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_1(\tau, x_0) d\tau)^i)] ds \Big\| ,
 \end{aligned}$$

so, by using Lemma 1, we find :

$$\begin{aligned} \|x_3(t, x_0) - x_2(t, x_0)\| &\leq \left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \right] \int_0^t e^{A(t-s)} \| [B(s)] \| \|x_2(s, x_0) - x_1(s, x_0)\| \\ &\quad + L_1 \|x_2(s, x_0) - x_1(s, x_0)\| + L_2 \left(\sum_{i=1}^{\infty} i K^i M_4^{i-1} \right) \|\dot{x}_2(s, x_0) - \dot{x}_1(s, x_0)\| ds \\ &\quad + \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \int_t^T e^{A(t-s)} \| [B(s)] \| \|x_2(s, x_0) - x_1(s, x_0)\| \\ &\quad + L_1 \|x_2(s, x_0) - x_1(s, x_0)\| + L_2 \left(\sum_{i=1}^{\infty} i K^i M_4^{i-1} \right) \|\dot{x}_2(s, x_0) - \dot{x}_1(s, x_0)\| ds \end{aligned}$$

$$\begin{aligned} \|x_3(t, x_0) - x_2(t, x_0)\| &\leq \left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \right] \int_0^t Q[(H + L_1) \|x_2(s, x_0) - x_1(s, x_0)\| \\ &\quad + L_2 S_4 \|\dot{x}_2(s, x_0) - \dot{x}_1(s, x_0)\|] ds \\ &\quad + \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \int_t^T Q[(H + L_1) \|x_2(s, x_0) - x_1(s, x_0)\| \\ &\quad + L_2 S_4 \|\dot{x}_2(s, x_0) - \dot{x}_1(s, x_0)\|] ds , \end{aligned}$$

so, we have:

$$\begin{aligned} \|x_3(t, x_0) - x_2(t, x_0)\| &\leq B_1(t)Q[B_1(t)QV_1H + B_1(t)QV_1L_1 + L_2S_4Q_1V_1] \\ &\leq B_1(t)QV_1[(H + L_1)B_1(t)Q + L_2S_4Q_1] \\ &\leq B_1(t)QV_1V , \end{aligned}$$

and hence,

$$\|x_3(t, x_0) - x_2(t, x_0)\| \leq B_1(t)QV_1V ,$$

where $S_4 = \sum_{i=1}^{\infty} i K^i M_4^{i-1}$, $V = [(H + L_1)B_1(t)Q + L_2S_4Q_1]$,

and with the same , we find :

$$\begin{aligned} \|\dot{x}_3(t, x_0) - \dot{x}_2(t, x_0)\| &\leq \|e^{A(t-s)}\| [\|B(t)\| \|x_2(t, x_0) - x_1(t, x_0)\| + L_1 \|x_2(t, x_0) - x_1(t, x_0)\| \\ &+ L_2 S_4 \|\dot{x}_2(t, x_0) - \dot{x}_1(t, x_0)\| + \frac{\|A\|}{e^{\|A\|T} - \|E\|} \int_0^T \|e^{A(T-s)}\| [\|B(s)\| \|x_2(s, x_0) - x_1(s, x_0)\| \\ &+ L_1 \|x_2(s, x_0) - x_1(s, x_0)\| + L_2 S_4 \|\dot{x}_2(s, x_0) - \dot{x}_1(s, x_0)\|] ds] \end{aligned}$$

So, by using inequalities (3.2.11) and (3.2.12), we get:

$$\begin{aligned} \|\dot{x}_3(t, x_0) - \dot{x}_2(t, x_0)\| &\leq Q[(H + L_1)B_1(t)QV_1 + L_2 S_4 Q_1 V_1 \\ &+ \frac{\|A\|TQ}{e^{\|A\|T} - \|E\|} [(H + L_1)B_1(t)QV_1 + L_2 S_4 Q_1 V_1]] \\ &\leq Q_1 V_1 [(H + L_1)B_1(t)Q + L_2 S_4 Q_1] \\ &\leq Q_1 V_1 V , \end{aligned}$$

and hence ,

$$\|\dot{x}_3(t, x_0) - \dot{x}_2(t, x_0)\| \leq Q_1 V_1 V .$$

Suppose that the inequality

$$\|x_{p+1}(t, x_0) - x_p(t, x_0)\| \leq B_1(t)QV_1 V^{p-1} ,$$

and

$$\|\dot{x}_{p+1}(t, x_0) - \dot{x}_p(t, x_0)\| \leq Q_1 V_1 V^{p-1} ,$$

are holds for $m=p$, then we have to prove the following inequality :

$$\|x_{p+2}(t, x_0) - x_{p+1}(t, x_0)\| \leq B_1(t)QV_1 V^p . \tag{2.13}$$

Now also by using lemma 1, we find :

$$\begin{aligned} \|x_{p+2}(t, x_0) - x_{p+1}(t, x_0)\| &\leq \left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \right] \int_0^t e^{A(t-s)} \| [\|B(s)\| \|x_{p+1}(s, x_0) - x_p(s, x_0)\| \\ &+ L_1 \|x_{p+1}(s, x_0) - x_p(s, x_0)\| + L_2 \left(\sum_{i=1}^{\infty} i K^i M_4^{i-1} \right) \| \dot{x}_{p+1}(s, x_0) - \dot{x}_p(s, x_0) \|] ds \\ &+ \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \int_t^T e^{A(t-s)} \| [\|B(s)\| \|x_{p+1}(s, x_0) - x_p(s, x_0)\| \\ &+ L_1 \|x_{p+1}(s, x_0) - x_p(s, x_0)\| + L_2 \left(\sum_{i=1}^{\infty} i K^i M_4^{i-1} \right) \| \dot{x}_{p+1}(s, x_0) - \dot{x}_p(s, x_0) \|] ds \end{aligned}$$

So, we have:

$$\begin{aligned} \|x_{p+2}(t, x_0) - x_{p+1}(t, x_0)\| &\leq B_1(t)Q[HB_1(t)QV_1V^{P-1} + L_1B_1(t)QV_1V^{P-1} + L_2S_4Q_1V_1V^{P-1}] \\ &\leq B_1(t)QV_1V^{P-1}[(H + L_1)B_1(t)Q + L_2S_4Q_1] \\ &\leq B_1(t)QV_1V^P, \end{aligned}$$

and hence ,

$$\|x_{p+2}(t, x_0) - x_{p+1}(t, x_0)\| \leq B_1(t)QV_1V^P, \quad (2.14)$$

thus, by induction the following inequality holds:

$$\|x_{m+1}(t, x_0) - x_m(t, x_0)\| \leq B_1(t)QV_1V^{m-1}, \quad (2.15)$$

where $V = [(H + L_1)B_1(t)Q + L_2S_4Q_1]$, $m = 1, 2, 3, \dots$

From (2.15), we conclude that for $k > 1$, we have the inequality :

$$\|x_{m+k}(t, x_0) - x_m(t, x_0)\| = \sum_{j=0}^{\infty} \|x_{m+1+j}(t, x_0) - x_{m+j}(t, x_0)\|,$$

such that

$$\begin{aligned} \|x_{m+k}(t, x_0) - x_m(t, x_0)\| &\leq \sum_{j=0}^{\infty} \|x_{m+1+j}(t, x_0) - x_{m+j}(t, x_0)\| \\ &\leq \sum_{j=0}^{\infty} B_1(t)QV_1V^{m-1+j} \end{aligned}$$

$$\begin{aligned} &\leq B_1(t)QV_1V^{m-1}\sum_{j=0}^{\infty}V^j \\ &\leq B_1(t)QV_1(1-V)^{-1}V^{m-1}, \end{aligned}$$

and hence,

$$\|x_{m+k}(t, x_0) - x_m(t, x_0)\| \leq B_1(t)QV_1(1-V)^{-1}V^{m-1}, \quad (2.16)$$

for all $t \in R^1$, and $x_0 \in D_f$.

Since $V < 1$ and $\lim_{m \rightarrow \infty} V^{m-1} = 0$, where $m = 1, 2, 3, \dots$, so that the right side of (3.2.16) tends to zero and, therefore, the sequence of functions (2.1) is convergent uniformly on the domain (2.2) to the limit function $x_{\infty}(t, x_0)$ which is defined on the same domain.

Let

$$\lim_{m \rightarrow \infty} x_m(t, x_0) = x_{\infty}(t, x_0) \quad (2.17)$$

Also, by the lemma 1, and the inequality (2.16) the inequalities (2.4) and (2.5) hold for all $m \geq 1$.

By using the relation (2.17) and proceeding in (2.1) to the limit, when $m \rightarrow \infty$, this shows that the limiting function $x_{\infty}(t, x_0)$ is the periodic solution of the integral equation (2.3).

Finally, we have to prove that $x(t, x_0)$ is a unique solution of (1.1), assume that $r(t, x_0)$ is another solution for the system (1.1), i.e.

$$\begin{aligned} r(t, x_0) = &x_0 e^{At} + \int_0^t e^{A(t-s)} [B(s)r(s, x_0) + f(s, r(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{r}(\tau, x_0) d\tau)^i)] ds \\ &- \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)r(s, x_0) + f(s, r(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) r(\tau, x_0) d\tau)^i)] ds ds. \end{aligned}$$

Now, we find the difference between them:

$$\begin{aligned} \|x(t, x_0) - r(t, x_0)\| &= \|x_0 e^{At} + \int_0^t e^{A(t-s)} [B(s)x(s, x_0) \\ &+ f(s, x(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}(\tau, x_0) d\tau)^i) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x(s, x_0) \\ &+ f(s, x(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}(\tau, x_0) d\tau)^i)] ds] - x_0 e^{At} - \int_0^t e^{A(t-s)} [B(s)r(s, x_0) \\ &+ f(s, r(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{r}(\tau, x_0) d\tau)^i) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)r(s, x_0) \\ &+ f(s, r(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{r}(\tau, x_0) d\tau)^i)] ds] ds \|. \end{aligned}$$

Thus

$$\begin{aligned} \|x(t, x_0) - r(t, x_0)\| &\leq \left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \right] \int_0^t e^{A(t-s)} \| [B(s)] \| \|x(s, x_0) - r(s, x_0)\| \\ &+ L_1 \|x(s, x_0) - r(s, x_0)\| + L_2 \left(\sum_{i=1}^{\infty} i K^i M_4^{i-1} \right) \|\dot{x}(s, x_0) - \dot{r}(s, x_0)\| ds \\ &+ \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \int_t^T e^{A(t-s)} \| [B(s)] \| \|x(s, x_0) - r(s, x_0)\| \\ &+ L_1 \|x(s, x_0) - r(s, x_0)\| + L_2 \left(\sum_{i=1}^{\infty} i K^i M_4^{i-1} \right) \|\dot{x}(s, x_0) - \dot{r}(s, x_0)\| ds \\ \|x(t, x_0) - r(t, x_0)\| &\leq \left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \right] \int_0^t Q[H] \|x(s, x_0) - r(s, x_0)\| \\ &+ L_1 \|x(s, x_0) - r(s, x_0)\| + L_2 S_4 \|\dot{x}(s, x_0) - \dot{r}(s, x_0)\| ds \\ &+ \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \int_t^T Q[H] \|x(s, x_0) - r(s, x_0)\| \\ &+ L_1 \|x(s, x_0) - r(s, x_0)\| + L_2 S_4 \|\dot{x}(s, x_0) - \dot{r}(s, x_0)\| ds, \end{aligned}$$

and hence,

$$\|x(t, x_0) - r(t, x_0)\| \leq B_1(t)Q[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\|]$$

(3.2.18)

Also, we find :

$$\begin{aligned} \|\dot{x}(t, x_0) - \dot{r}(t, x_0)\| &\leq \|e^{A(t-s)}\|[\|B(t)\|\|x(t, x_0) - r(t, x_0)\| + L_1\|x(t, x_0) - r(t, x_0)\| \\ &+ L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\| + \frac{\|A\|}{e^{\|A\|T} - \|E\|} \int_0^t e^{A(t-s)}\|B(s)\|\|x(s, x_0) - r(s, x_0)\| \\ &+ L_1\|x(s, x_0) - r(s, x_0)\| + L_2S_4\|\dot{x}(s, x_0) - \dot{r}(s, x_0)\|]ds \\ &\leq Q[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\| \\ &+ \frac{\|A\|TQ}{e^{\|A\|T} - \|E\|}[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\|]] \\ &\leq (Q + \frac{\|A\|TQ^2}{e^{\|A\|T} - \|E\|})[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\|], \end{aligned}$$

and hence,

$$\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\| \leq Q_1[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\|].$$

(2.19)

From inequality (2.18) and (2.19), we obtain:

$$\begin{aligned} \|x(t, x_0) - r(t, x_0)\| &\leq B_1(t)Q[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\|] \\ &\leq B_1(t)Q\{(H + L_1)B_1(t)Q[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\|] + \\ &\quad + L_2S_4Q_1[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + L_2S_4\|\dot{x}(t, x_0) - \dot{r}(t, x_0)\|]\} \\ &\leq B_1(t)Q((H + L_1)B_1(t)Q + L_2S_4Q_1)[(H + L_1)\|x(t, x_0) - r(t, x_0)\| + \end{aligned}$$

$$+L_2S_4\|\dot{x}(t,x_0) - \dot{r}(t,x_0)\|]$$

$$\leq C_1V ,$$

and hence ,

$$\|x(t,x_0) - r(t,x_0)\| \leq C_1V ,$$

where $C_1 = B_1(t)Q[(H + L_1)\|x(t,x_0) - r(t,x_0)\| + L_2S_4\|\dot{x}(t,x_0) - \dot{r}(t,x_0)\|]$,

so, by induction , we get :

$$\|x(t,x_0) - r(t,x_0)\| \leq C_1V^m \tag{2.20}$$

From inequality (2.20) and by using (1.4), when $m \rightarrow \infty, V^m \rightarrow 0$, we obtain:

$\|x(t,x_0) - r(t,x_0)\| \leq 0$, thus, we find that:

$$x(t,x_0) = r(t,x_0) ,$$

hence, $x(t,x_0)$ is a unique periodic solution of non-linear integro-differential equation(1.1) , for all $t \in R^1, x_0 \in D_f$.

3. Existence of a periodic Solution of the System (1.1).

The problem of existence of periodic solution of period T of the system (1.1) is uniquely connected with the existence of zero of the function $\Delta(x_0)$

which has the form:

$$\Delta: D_f \rightarrow R^n$$

$$\Delta(x_0) = \frac{A}{e^{AT} - E} \int_0^T e^{A(T-t)} [B(t)x_\infty(t,x_0) + f(t,x_\infty(t,x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t,s)\dot{x}_\infty(s,x_0)ds)^i)] dt \tag{3.1}$$

where $x_\infty(t, x_0)$ is the limiting function of the sequence of functions $x_m(t, x_0)$.

$$\Delta_m : D_f \rightarrow R^n$$

$$\Delta_m(x_0) = \frac{A}{e^{AT} - E} \int_0^T e^{A(T-t)} [B(t)x_m(t, x_0) + f(t, x_m(t, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t,s)\dot{x}_m(s, x_0)ds)^i)] dt$$

(3.2)

where $m = 0, 1, 2, 3, \dots$

Theorem2. . Let all assumptions and conditions of theorem1. be satisfied, then the following inequality hold :

$$\|\Delta(x_0) - \Delta_m(x_0)\| \leq N_1 N_2 Q^2 (H + L_1) B_1(t) \mathcal{V}^{m-1} (1 - V)^{-1} V_1 = \rho_m \quad , \quad (3.3)$$

where $N_1 = \frac{\|A\|T}{e^{\|A\|T} - \|E\|}$, $N_2 = [1 + L_2 S_4 Q_1 (1 - Q_1 L_2 S_4)^{-1}]$ and $Q_1 = (Q + N_1 Q^2)$

Proof. By using the relations (3.1) and (3.2), we have :

$$\|\Delta(x_0) - \Delta_m(x_0)\| \leq \left(\frac{\|A\|}{e^{\|A\|T} - \|E\|} \right) \int_0^T \|e^{A(T-t)}\| [\|B(t)\| \|x_\infty(t, x_0) - x_m(t, x_0)\| + L_1 \|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2 (\sum_{i=1}^{\infty} i K^i M_4^{i-1}) \|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|] dt$$

$$\begin{aligned} \|\Delta(x_0) - \Delta_m(x_0)\| &\leq \left(\frac{\|A\|}{e^{\|A\|T} - \|E\|} \right) \int_0^T Q [(H + L_1) \|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2 S_4 \|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|] dt \\ &\leq \left(\frac{\|A\|T}{e^{\|A\|T} - \|E\|} \right) Q [(H + L_1) \|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2 S_4 \|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|] \\ &\leq N_1 Q [(H + L_1) \|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2 S_4 \|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|] \end{aligned}$$

so,

$$\|\Delta(x_0) - \Delta_m(x_0)\| \leq N_1 Q [(H + L_1) \|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2 S_4 \|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|] \quad (3.4)$$

Also

$$\|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\| \leq Q [(H + L_1) \|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2 S_4 \|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|]$$

$$\begin{aligned}
 & +N_1Q[(H + L_1)\|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2S_4\|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|] \\
 & \leq (Q + N_1Q^2)[(H + L_1)\|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2S_4\|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|] \\
 & \leq Q_1[(H + L_1)\|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2S_4\|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|]
 \end{aligned}$$

and hence,

$$\|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\| \leq Q_1[(H + L_1)\|x_\infty(t, x_0) - x_m(t, x_0)\| + L_2S_4\|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\|]$$

From the last inequality, we have:

$$\|\dot{x}_\infty(t, x_0) - \dot{x}_m(t, x_0)\| \leq (1 - Q_1L_2S_4)^{-1}Q_1(H + L_1)\|x_\infty(t, x_0) - x_m(t, x_0)\|, \quad (3.5)$$

By substituting inequality (3.5) in (3.4), we get:

$$\begin{aligned}
 \|\Delta(x_0) - \Delta_m(x_0)\| & \leq N_1Q(H + L_1)\|x_\infty(t, x_0) - x_m(t, x_0)\| + \\
 & +N_1Q(H + L_1)L_2S_4Q_1(1 - Q_1L_2S_4)^{-1}\|x_\infty(t, x_0) - x_m(t, x_0)\|
 \end{aligned}$$

And hence:

$$\begin{aligned}
 \|\Delta(x_0) - \Delta_m(x_0)\| & \leq N_1Q(H + L_1)B_1(t)QV_1V^{m-1}(1 - V)^{-1} \\
 & +N_1Q(H + L_1)L_2S_4Q_1(1 - Q_1L_2S_4)^{-1}B_1(t)QV_1V^{m-1}(1 - V)^{-1} \\
 & \leq N_1N_2Q^2(H + L_1)B_1(t)V_1V^{m-1}(1 - V)^{-1},
 \end{aligned}$$

Thus

$$\|\Delta(x_0) - \Delta_m(x_0)\| \leq N_1N_2Q^2(H + L_1)B_1(t)V_1V^{m-1}(1 - V)^{-1} = \rho_m,$$

I.e. the inequality (3.3) will be satisfied for all $m \geq 1$.

Theorem 3. Let the system (1.1) be defined in the interval $[a, b]$ on R^1 and periodic in t of period T . Suppose that the sequence of functions (2.1) satisfies the inequalities:

$$\left. \begin{array}{l} \min \Delta_m(x_0) \leq -\rho_m, \\ a + M_3 \leq x_0 \leq b - M_3 \\ \max \Delta_m(x_0) \leq \rho_m. \\ a + M_3 \leq x_0 \leq b - M_3 \end{array} \right\} \quad (3.6)$$

then, the system (1.1) has a periodic solution $x(t, x_0)$ for which $x_0 \in [a + M_3, b - M_3]$,

where $\rho_m = N_1 N_2 Q^2 (H + L_1) B_1(t) V_1 V^{m-1} (1 - V)^{-1}$, $M_3 = \frac{T}{2} Q (H \delta_0 + M)$.

Proof. Let x_1, x_2 be any two points in the interval $[a + M_3, b - M_3]$ such that :

$$\left. \begin{array}{l} \Delta_m(x_1) = \min \Delta_m(x_0), \\ a + M_3 \leq x_0 \leq b - M_3 \\ \Delta_m(x_2) = \max \Delta_m(x_0). \\ a + M_3 \leq x_0 \leq b - M_3 \end{array} \right\} \quad (3.7)$$

By using the inequalities (3.3.3) and (3.3.6), we have :

$$\left. \begin{array}{l} \Delta(x_1) = \Delta_m(x_1) + (\Delta(x_1) - \Delta_m(x_1)) \leq 0, \\ \Delta(x_2) = \Delta_m(x_2) + (\Delta(x_2) - \Delta_m(x_2)) \geq 0. \end{array} \right\} \quad (3.8)$$

It follows from the inequalities (3.3.8) and the continuity of the function $\Delta(x_0)$ that there exists an isolated singular point $(x_\infty) = (x_0)$, $x_\infty \in [x_1, x_2]$, such that $\Delta(x_0) = 0$. This means that the system (3.3.1) has a periodic solution $x(t, x_0)$ for which $x_0 \in [a + M_3, b - M_3]$.

Remark 1[5]. Theorem 2 is proved when x_0 is a scalar singular point which should be isolated, thus we have :

Theorem 3. If the function $\Delta(x_0)$ is defined by $\Delta: D_f \rightarrow R^n$, and

$$\Delta(x_0) = \frac{A}{e^{AT} - E} \int_0^T e^{A(T-t)} [B(t)x_\infty(t, x_0) + f(t, x_\infty(t, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t, s)x_\infty(s, x_0)ds)^i)] dt \quad (3.9)$$

where $x_\infty(t, x_0)$ is a limit of the sequence of functions (2.1), then the following inequalities hold :

$$\|\Delta(x_0)\| \leq M_6 \quad , \quad (3.10)$$

where

$$M_5 = (1 - \frac{T}{2}QH)^{-1} \quad , \quad M_6 = N_1Q(H\delta_0QM_5 + \frac{T}{2}QHMM_5 + M)$$

and

$$\|\Delta(x_0^1) - \Delta(x_0^2)\| \leq (F_5F_7(Q + \frac{T}{2}E_3QNF_4) + F_6)\|x_0^1 - x_0^2\| \quad (3.11)$$

is satisfies for all x_0, x_0^1, x_0^2 , where $E_1 = Q(H + L_1)$, $E_3 = QL_2S_4$.

Proof. From the properties of the function $x_\infty(t, x_0)$ as in the theorem 1, the function $\Delta(x_0)$ is continuous and bounded by M_6 in the domain (2.2).

From the relation (3.9), we find that:

$$\|\Delta(x_0)\| \leq \frac{\|A\|}{e^{\|A\|T} - \|E\|} \int_0^T e^{A(T-t)} \left\| \left[B(t)\|x_\infty(t, x_0)\| + \left\| f(t, x_\infty(t, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t, s)x_\infty(s, x_0)ds)^i \right\| \right] \right\| dt$$

so, we have :

$$\|\Delta(x_0)\| \leq \frac{\|A\|T}{e^{\|A\|T} - \|E\|} Q[H\|x_\infty(t, x_0)\| + M]$$

$$\|\Delta(x_0)\| \leq \frac{\|A\|T}{e^{\|A\|T} - \|E\|} QH\|x_\infty(t, x_0)\| + \frac{\|A\|T}{e^{\|A\|T} - \|E\|} QM \quad (3.12)$$

Since the function $x_\infty(t, x_0)$ satisfies the integral equation (2.3), then we have:

$$\begin{aligned} \|x_\infty(t, x_0)\| &= \|x_0\| \|e^{At}\| + \left\| \int_0^t e^{A(t-s)} [B(s)x_\infty(s, x_0) \right. \\ &+ f(s, x_\infty(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_\infty(\tau, x_0) d\tau)^i) - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x_\infty(s, x_0) \\ &+ f(s, x_\infty(s, x_0), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}_\infty(\tau, x_0) d\tau)^i)] ds] ds \Big\| . \end{aligned}$$

Now , by using lemma 3.1.1 , we get :

$$\|x_\infty(t, x_0)\| = \delta_0 Q + \frac{T}{2} Q [H \|x_\infty(s, x_0)\| + M]$$

so,

$$\|x_\infty(t, x_0)\| = \delta_0 Q M_5 + \frac{T}{2} Q M M_5 \quad . \quad (3.13)$$

Thus, substituting inequality (3.13) in (2.12) , we get the inequality (3.10).

By using relation (3.9) , we have :

$$\begin{aligned} \|\Delta(x_0^1) - \Delta(x_0^2)\| &= \left\| \frac{A}{e^{AT} - E} \int_0^T e^{A(T-t)} [B(t)x_\infty(t, x_0^1) \right. \\ &+ f(t, x_\infty(t, x_0^1), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t, s) \dot{x}_\infty(s, x_0^1) ds)^i)] dt - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-t)} [B(t)x_\infty(t, x_0^2) \\ &+ f(t, x_\infty(t, x_0^2), \sum_{i=1}^{\infty} (\int_{-\infty}^t G(t, s) \dot{x}_\infty(s, x_0^2) ds)^i)] dt \Big\| \end{aligned}$$

$$\begin{aligned} \|\Delta(x_0^1) - \Delta(x_0^2)\| &\leq \frac{\|A\| T}{e^{\|A\| T} - \|E\|} Q [H \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| + L_1 \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| \\ &+ L_2 S_4 \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\|] \end{aligned}$$

so,

$$\|\Delta(x_0^1) - \Delta(x_0^2)\| \leq N_1 E_1 \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| + N_1 E_3 \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\| \quad .$$

(3.14)

Now, we find that:

$$\begin{aligned} \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\| &\leq \|x_0^1 - x_0^2\| \|A\| \|e^{At}\| + \|e^{A(t-s)}\| [\|B(t)\| \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| \\ &\quad + L_1 \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| + L_2 S_4 \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\|] \\ &\quad + \frac{\|A\|}{e^{\|A\|T} - \|E\|} \int_0^T \|e^{A(T-s)}\| [\|B(s)\| \|x_\infty(s, x_0^1) - x_\infty(s, x_0^2)\| \\ &\quad + L_1 \|x_\infty(s, x_0^1) - x_\infty(s, x_0^2)\| + L_2 S_4 \|\dot{x}_\infty(s, x_0^1) - \dot{x}_\infty(s, x_0^2)\|] ds \end{aligned}$$

$$\begin{aligned} \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\| &\leq \|x_0^1 - x_0^2\| NQ + Q[(H + L_1) \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| \\ &\quad + L_2 S_4 \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\| + N_1 Q[(H + L_1) \|x_\infty(s, x_0^1) - x_\infty(s, x_0^2)\| \\ &\quad + L_2 S_4 \|\dot{x}_\infty(s, x_0^1) - \dot{x}_\infty(s, x_0^2)\|]] \\ &\leq \|x_0^1 - x_0^2\| NQ + Q_1[(H + L_1) \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| \\ &\quad + L_2 S_4 \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\|], \end{aligned}$$

and hence ,

$$\begin{aligned} \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\| &\leq \|x_0^1 - x_0^2\| NQ(1 - Q_1 L_2 S_4)^{-1} \\ &\quad + Q_1(H + L_1)(1 - Q_1 L_2 S_4)^{-1} \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| \\ \|\dot{x}_\infty(t, x_0^1) - \dot{x}_\infty(t, x_0^2)\| &\leq \|x_0^1 - x_0^2\| NQF_4 + F_4 Q_1(H + L_1) \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| , \end{aligned} \tag{3.15}$$

where $F_4 = (1 - Q_1 L_2 S_4)^{-1}$.

By substituting inequality (3.15) in (3.14), we get :

$$\|\Delta(x_0^1) - \Delta(x_0^2)\| \leq N_1 E_1 \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| + N_1 E_3 NQF_4 \|x_0^1 - x_0^2\|$$

$$\begin{aligned}
 & +N_1 E_3 F_4 Q_1 (H + L_1) \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| \\
 & \leq (N_1 E_1 + N_1 E_3 Q_1 F_4 (H + L_1)) \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| + N_1 E_3 N Q F_4 \|x_0^1 - x_0^2\|.
 \end{aligned}$$

Putting

$$F_5 = (N_1 E_1 + N_1 E_3 Q_1 F_4 (H + L_1)) \quad \text{and} \quad F_6 = N_1 E_3 N Q F_4$$

so, the last inequality becomes :

$$\|\Delta(x_0^1) - \Delta(x_0^2)\| \leq F_5 \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| + F_6 \|x_0^1 - x_0^2\|, \quad (3.16)$$

where $x_\infty(t, x_0^1)$ and $x_\infty(t, x_0^2)$ are the solutions of the integral equation :

$$\begin{aligned}
 x(t, x_0^k) &= x_0^k e^{At} + \int_0^t e^{A(t-s)} [B(s)x(s, x_0^k) + f(s, x(s, x_0^k), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}(\tau, x_0^k) d\tau)^i) \\
 & - \frac{A}{e^{AT} - E} \int_0^T e^{A(T-s)} [B(s)x(s, x_0^k) + f(s, x(s, x_0^k), \sum_{i=1}^{\infty} (\int_{-\infty}^s G(s, \tau) \dot{x}(\tau, x_0^k) d\tau)^i)] ds ds
 \end{aligned} \quad (3.17)$$

with

$$x_0^k(t, x_0) = x_0^k, \quad \text{where } k = 1, 2.$$

From the equation (3.17) and by using lemma 1, we have:

$$\begin{aligned}
 \|x_\infty(t, x_0^1) - x_\infty(t, x_0^2)\| & \leq \|x_0^1 - x_0^2\| \|e^{At}\| \\
 & + \left[\|E\| - \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \int_0^t e^{A(t-s)} \left[\|B(s)\| \|x_\infty(s, x_0^1) - x_\infty(s, x_0^2)\| \right. \right. \\
 & + L_1 \|x_\infty(s, x_0^1) - x_\infty(s, x_0^2)\| + L_2 S_4 \|\dot{x}_\infty(s, x_0^1) - \dot{x}_\infty(s, x_0^2)\| \left. \left. \right] ds \right. \\
 & + \left(\frac{e^{\|A\|T} - e^{\|A\|(T-t)}}{e^{\|A\|T} - \|E\|} \right) \int_t^T e^{A(t-s)} \left[\|B(s)\| \|x_\infty(s, x_0^1) - x_\infty(s, x_0^2)\| \right. \\
 & \left. + L_1 \|x_\infty(s, x_0^1) - x_\infty(s, x_0^2)\| + L_2 S_4 \|\dot{x}_\infty(s, x_0^1) - \dot{x}_\infty(s, x_0^2)\| \right] ds
 \end{aligned}$$

so that :

$$\begin{aligned} \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| &\leq \|x_0^1 - x_0^2\| Q + \frac{T}{2} Q(H + L_1) \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| \\ &\quad + \frac{T}{2} Q L_2 S_4 \|\dot{x}_{\infty}(s, x_0^1) - \dot{x}_{\infty}(s, x_0^2)\| . \end{aligned} \quad (3.18)$$

Now, by substituting inequality (3.15) in (3.18), we get:

$$\begin{aligned} \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| &\leq \|x_0^1 - x_0^2\| Q + \frac{T}{2} Q(H + L_1) \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| \\ &\quad + \frac{T}{2} Q^2 L_2 S_4 N F_4 \|x_0^1 - x_0^2\| + \frac{T}{2} L_2 S_4 F_4 Q Q(H + L_1) \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| \\ \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| &\leq \left(\frac{T}{2} L_2 S_4 F_4 Q E_1 + \frac{T}{2} E_1\right) \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| \\ &\quad + \left(\frac{T}{2} E_3 Q N F_4 + Q\right) \|x_0^1 - x_0^2\| \end{aligned}$$

so,

$$\begin{aligned} \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| &\leq \left(1 - \left(\frac{T}{2} L_2 S_4 F_4 Q E_1 + \frac{T}{2} E_1\right)\right)^{-1} \left(\frac{T}{2} E_3 Q N F_4 + Q\right) \|x_0^1 - x_0^2\| , \\ \|x_{\infty}(t, x_0^1) - x_{\infty}(t, x_0^2)\| &\leq F_7 \left(\frac{T}{2} E_3 Q N F_4 + Q\right) \|x_0^1 - x_0^2\| . \end{aligned} \quad (3.19)$$

where

$$F_7 = \left(1 - \left(\frac{T}{2} L_2 S_4 F_4 Q E_1 + \frac{T}{2} E_1\right)\right)^{-1}$$

Also, substituting inequality (3.19) in (3.16), we get the inequality (3.11).

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Complexity Analysis Of Improved ECC Algorithm

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ABSTRACT:- The ECC is public key cryptosystem .It based on the discrete logarithm problem. ECC has a high level of security which can be achieved with considerably shorter keys than other conventional public key cryptography. This project focuses on the improvements of ECC algorithm and how they effect on the overall complexity in space and time .The algorithm developed in the minor project on ECC is first improved in terms of security and performance by developing new modules and then comparing previously developed and new improved ECC algorithm. Two different algorithms of ECC are to be implemented and compared on the basis of their overall complexity using MATLAB and Hardware description language.

Index Terms:- Secret Key Cryptography, Elliptic Curve Cryptography (ECC), public key cryptography

INTRODUCTION

Cryptography is the science of keeping information secure. It involves encryption and decryption of messages. Encryption is the process of converting a plain text into cipher text and decryption is the process of getting back the original message from the encrypted text. Cryptography, in addition to providing confidentiality, also provides Authentication, Integrity and Non-repudiation.

There have been many known cryptographic algorithms. The crux of any cryptographic algorithm is the "seed" or the "key" used for encrypting/decrypting the information. Many of the cryptographic algorithms are available publicly, though some organizations believe in having the algorithm a secret. The general method is in using a publicly known algorithm while maintaining the key a secret. Based on the key, cryptosystems can be classified into two categories: Symmetric and Asymmetric. In Symmetric Key Cryptosystems, we use the same key for both Encryption as well as the corresponding decryption. i.e. if K was the key and M was the message, then, we have $D_K(E_K(M)) = M$

Asymmetric or Public key or shared key cryptosystems use two different keys. One is used for encryption while the other key is used for decryption. The two keys can be used interchangeably. One of the keys is made public (shared) while the other key is kept a secret. i.e. let k_1 and k_2 be public and private keys respectively. Let M be the message, then $D_{k_2}(E_{k_1}(M)) = D_{k_1}(E_{k_2}(M)) = M$ In general, symmetric key cryptosystems are preferred over public key systems due to the following factors:

PROPOSED METHOD DESCRIPTION

Because ECC helps to establish equivalent security with lower computing power and battery resource usage, it is becoming widely used for mobile applications. An elliptic curve is usually defined to be the graph of an equation

$$y^2 = x^3 + Ax + B$$

where x, y, A and B belong to a specified field. These curves are of great use in a number of applications, largely because it possible to take two points on such a curve and generate a third. In fact, we will show that by defining an addition operation and introducing an extra point, 1 , the points on an elliptic curve form an additive abelian group. Such a group can then be used to create an analogue of the discrete logarithm problem which is the basis for several public key cryptosystems. This project will introduce the mathematics behind elliptic curves and then demonstrate how to use them for cryptography.

Finite Fields

A field of a finite number of elements is denoted F_q or $GF(q)$, where q is the number of elements. This is also known as a Galois Field.

The order of a Finite field F_q is the number of elements in F_q . Further, there exists a finite field F_q of order q iff q is a **prime power**, i.e. either q is prime or $q = p^m$, where p is prime. In the latter case, p is called the characteristic of F_q and m is called the extension degree of F_q and every element of F_q is a root of the polynomial

Let us consider two classes of Finite fields F_p (Prime Field, p is a prime number) and F_{2^m} (Binary finite field). The efficient implementation of finite field arithmetic is an important prerequisite in elliptic curve system because curve operations are performed using arithmetic operations in the underlying field. Three kinds of fields that are especially amenable for the efficient implementation of elliptic curve systems are prime fields, binary fields, and optimal extension fields. Efficient algorithms for software implementation of addition, subtraction, multiplication and inversion in these fields are discussed at length.

2.1.2) Elliptic Curves

Elliptic curves have, over the last three decades, become an increasingly important subject of research in number theory and related fields such as cryptography. They have also played a part in numerous other mathematical problems over hundreds of years. For example, the congruent number problem of finding which integers n can occur as the area of a right angled triangle with rational sides can be expressed using elliptic curves. In this chapter we set out the basic mathematics of elliptic curves, starting with their derivation and definition followed by the proof that points upon them form an additive abelian group. Elliptic curves are not ellipses, instead, they are cubic curves of the form

$$y^2 = x^3 + Ax + B$$

Elliptic curves over R^2 (R^2 is the set $R \times R$, where R = set of real numbers)

is defined by the set of points (x, y) which satisfy the equation

$$y^2 = x^3 + Ax + B$$

along with a point O , which is the point at infinity and which is the additive identity element. The curve is represented as $E(R)$.

The following figure is an elliptic curve satisfying the equation $y^2 = x^3 - 3x + 3$.

PROPOSED ALGORITHM

genPoints (a, b, p)

{

```

x=0;
While(x < p)
y2=(x3+ ax + b) mod p;
if ( y2 is a perfect square in GF(p))
output[(x,√y) , (x, -√y)];
x=x+I;
}
{

```

Key Distribution

Let U_A and U_B be legitimate users
 $U_A = \{P_A, n_A\}$ --Key pair for U_A
 $U_B = \{P_B, n_B\}$ -- Key pair for U_B
 Send the Public key of U_i , to U_A
 Send(P_B, U_A);
 Send the Public key of U_x to U_B
 Send (P_A, U_B);

Encryption at A

$P_{ml} = aP_m$
 -- a: Ascii value of text
 -- P_m : random point on EC
 $P_B = n_B * G$
 -- G is the base point of EC
 -- n_B is the private key
 CipherText = { $k_G, P_{ml} + k * P_B$ }

Decryption at B

Let k_G be the first point and
 $P_{ml} + k * P_B$ be the second point
 $n_B k_G = n_B * \text{first point}$;
 Calculate $P_{ml} = P_{ml} + kP_B - n_B k_G$;
 Calculate the P_m value from P_{ml}
 using discrete logarithm.

Improved Algorithm

Let $x(i)$ be the point computed by algorithm, lying on the Curve.
 for $i = 0$ to $k-1$
 $x(i) = m * k + i$
 if ($X == x(i)$)
 else $i = i+1$
 Point on the curve to map the ASCII value is calculated.

IMPLEMENTATION OF THE PROPOSED ALGORITHM

ECC Arithmetic Operations

An elliptic curve $E(F_p)$ over a finite field F_p is defined by the parameters $a, b \in F_p$ (a, b satisfy the relation $4a^3 + 27b^2 \neq 0$), consists of the set of points $(x, y) \in F_p$, satisfying the equation $y^2 = x^3 + ax + b$. The set of

points on $E(F_p)$ also include point O , which is the point at infinity and which is the identity element under addition.

The Addition operator is defined over $E(F_p)$ and it can be seen that $E(F_p)$ forms an abelian group under addition.

The addition operation in $E(F_p)$ is specified as follows.

- $P + O = O + P = P, \forall P \in E(F_p)$
- If $P = (x, y) \in E(F_p)$, then $(x, y) + (x, -y) = O$. (The point $(x, -y) \in E(F_p)$ and is called the negative of P and is denoted $-P$)
- If $P = (x_1, y_1) \in E(F_p)$ and $Q = (x_2, y_2) \in E(F_p)$ and $P \neq Q$, then $R = P + Q = (x_3, y_3) \in E(F_p)$, where $x_3 = m^2 - x_1 - x_2, y_3 = m(x_1 - x_3) - y_1$, and (m is slope)

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

i.e. the sum of 2 points can be visualized as the point of intersection $E(F_p)$ and the straight line passing through both the points.

- Let $P = (x, y) \in E(F_p)$. Then the point $Q = P + P = 2P = (x_1, y_1) \in E(F_p)$, where $x_1 = m^2 - 2x, y_1 = m(x - x_1) - y$, where $m = (3x^2 + a) / 2y$.

This operation is also called doubling of a point and can be visualized as the point of intersection of the elliptic curve and the tangent at P .

We can notice that addition over $E(F_p)$ requires one inversion, two multiplications, one squaring and six additions. Similarly, doubling a point on $E(F_p)$ requires one inversion, two multiplication, two squaring and eight additions. if given a point $P(x, y)$ on an EC, one needs to compute kP , where k is a positive integer.

This is achieved by a series of doubling and addition of P .

Say, given $k = 13$, entails the following sequence of operations, by which the efficiency of the scalar multiplication of the points is improved

ELLIPTICAL CURVE DISCRETE LOGARITHM PROBLEM

The strength of the Elliptic Curve Cryptography lies in the Elliptic Curve Discrete Log Problem (ECDLP). The statement of ECDLP is as follows.

Let E be an elliptic curve and $P \in E$ be a point of order n . Given a point $Q \in E$ with

$$Q = mP, \text{ for a certain } m \in \{2, 3, \dots, n-2\}.$$

Find the m for which the above equation holds.

When E and P are properly chosen, the ECDLP is thought to be infeasible. Note that $m = 0, 1$ and $m - 1, Q$ takes the values O, P and $-P$. One of the conditions is that the order of P i.e. n be large so that it is infeasible to check all the possibilities of m .



DISCUSSIONS & CONCLUSION

In this paper, a text based Elliptic Curve Cryptosystem is implemented. The Lookup table consisting of the ASCII values mapped with the points on the ECC curve has been replaced by an algorithm. It is Concluded in this report that new Improved ECC provides greater security also the new ECC is more dynamic , flexible in terms data formats and inputs.The new algorithm has two base point two level encryption technique.The implementation of the ECC algorithm on hardware using vhdl provides an insight on the performance of the algorithm on the hardware

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Assessment of GSM Network Failures, Quality of Service Evaluation and Its Impacts on E-Learning

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Abstract

This study provides information on GSM network failures and quality of its service evaluation and some of the challenges been faced by e-learning which includes infrastructural provisions in forms of electricity, broadband, computers and inter-connectivity. GSM network performance on the basis of massive data records and application is presented. The available measurements are divided into variable set describing the performance of the different GSM networks in Nigeria. The report also identifies the components of Quality of Service (QoS), locate bottlenecks in network performance and available mechanism to analyze and evaluate them. Statistical analysis and customer complaint were used to identify problems. Finally, the most common QoS shortfalls and possible solutions discussed.

Keywords: GSM, Quality of Service, Performance, Interconnectivity.

1. Introduction

The GSM revolution begun in Nigeria in August 2001, under the democratic government and it changed the face of information and communication technology in Nigeria, this heralded the dawn of a new era “the era of GSM technology” which has completely changed the face of doing business in Nigeria and this includes e-learning. The emergency and proliferation of new information and communication technologies (ICT), had introduced an unstoppable revolution into education particularly in the areas of teaching and learning. The internet and web have further raised the revolutionary tempo especially through the enhancement of e-learning. E-learning is one that encompasses a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivering of content via internet, intranet/extranet (LAN/WAN), audio and video tape, satellite broadcast, interactive TV, and CD-ROM. E-learning according to [1], is the use of electronic technology to deliver education and training applications, monitor learners performance and reports learners progress. The actualization of e-learning depends on the quality of service provided by GSM network operators, hence the importance of this study.

[2] said information technology ICT can generate employment both directly and indirectly, thus reducing the number of unemployment in the nation. It also increases distant learning opportunities thus reducing the illiteracy level in the nation. However, [3] stated that improving the network coverage tends to diminish the network capacity, considering the fact that most valuable and limited resources of the GSM is the available frequency spectrum which limits the system capacity.

Global System for Mobile Communication (GSM) operation in Nigeria has many network failures and this is due to the competition among operators to acquire more subscribers. In Nigeria for instance, MTN provided network coverage to 88.8% of Nigeria land mass, while 86.2% of the population subscribe to the service [4]. Through different marketing strategies, more subscribers are being added to the different networks without considerations to the available infrastructures. Consequently, on the part of the subscribers, the euphoria of owing a phone and accessing the internet is gradually giving way to complaints associated with network failures which includes: drop calls, blocked calls, poor voice clarity, call jamming and network congestions. Some of the network failures are call dropping; congestion.

This paper describes how Quality of Service (QoS) evaluation mechanism and statistical data organization analysis are used to study the failures on GSM network and possible means to mitigate the problem are discussed.

2. History of GSM

Global System of Mobile communication (GSM) originally and formerly known as Global Special Mobile is the most popular standard for mobile telephony system in the world. According to the GSM association, over 93% of the global market uses the standard [5]. Over 4.3 billion people use GSM across more than 212 countries and territories [6].

Cellular telephone commonly known as a cell phone is one of the fastest and most demanding telecommunication applications. It is designed to give the user maximum freedom of movement so because of this freedom, the number of mobile user kept growing at an alarming rate. Cellular system came into existence firstly, in the united

state with the release of the advanced mobile phone service (AMPS) system in 1983.

[7] in a report to GSM association opined that the development of GSM has helped the analog inability to cover more grounds and helped brought modern telecommunication service to under-served communities in Africa, Asia and Latin America and the key to the success of GSM is that it's development was founded from the onset on delivering a specific user benefit i.e. international roaming [4].

2.1 Challenges in Network Service Delivery

The main challenge in network service delivery, is network failures which can be attributed to lack of modernized equipment, non upgrading of the existing network and boosting of its overall capacity for network quality delivering.

2.2 Failures in GSM Network

The following are the failures experienced by subscribers of GSM network: call dropped, call failure, blocked channel request, failed handover, poor voice clarity and call blocking.

2.3 Call Dropping/Dropped

Call dropped can be defined as a mobile phone's call terminated before the mobile subscriber in technical perspective ends it. It can also be described as terminated calls after voice traffic channel used. However, the service may be abnormally interrupted due to several reasons. The following are some of the reasons for call dropping: blank spot, co-channel and adjacent interface, Radio Frequency Loss and handover failure.

2.4 Call Failure

Call failure is the inability of a call to access the trunk usually due to full trunk occupancy. When the trunk has been fully occupied, then majority of the calls made to the GSM network will usually fail. The following can cause call failures on GSM network: Non-availability of trunk is the cause of deficiency in switch to cope with demands and inadequate number of trunks.

Call made in the odd hours of 2330 and 1430, the rate of call failures are outrageously high. These unusually high call failures rates during odd hours are the incidence of signal outages and the irregularity of traffic pattern are manifestation of several congestion attributed to either of the two: Poor network dimensioning or infrastructural inadequacies.

2.5 Block Channel Request

The number of blocked channel request (reject) measures the networks ability to satisfy the demand generated by the

network users. Blocking occurs when there are too many users on the network.

2.6 Call Setup Failures

These are failures that occur during the setting of calls. Users request is not served due to problems on the resource allocation of a signaling channel in which the negotiation for the actual traffic is performed.

2.7 Handover Failures

This is the process of transferring outgoing or data session from one channel connected to the core network to another. Handover failures can be cause by the following: interference, hardware faults, location area code and limitation in coverage area.

2.8 Causes of GSM Networks' Congestion in Nigeria

2.8.1 Poor network dimensioning

Poor network dimension, poor traffic prediction can result into poor channel allocation. This naturally has the potential of causing network congestion and its attendant call failure/drop rate.

2.8.2 Infrastructural Inadequacies

Overloading of the base station due to increase in subscriber rate can lead to congestion in the network. The aftermath of this can also lead to breakdown of the existing infrastructure which includes the power supply system. Lack of constant power supply has the potential of resulting into congestion in the following ways. If a transceiver breaks down in a network, there is break in transmission resulting in higher rate of call failure.

2.8.3 Lack of Adequate Base Stations

It has been discovered from research that, the Nigerian network operators do not have adequate base stations to contain enough subscribers on each base station. Number of subscribers increases daily drastically due to a landslide reduction in the price of their network SIM card. It is doubtful if their base station has a matching increase. The present ratio is probably about 10,000 subscribers to one base station.

2.8.4 Lack of Adequate Channels

Since there is no enough base stations, automatically, there will be lack of adequate channel to support the subscribers and the service rolled out by these operators. The channels determine the total number of subscribers that can be allowed to use a base station simultaneously at any point in time. This trend remains the same because any time a base station is added to their network; a high-level of promotion will be rolled out in order to attract more customers.

2.8.5 Competition for Subscribers among Operators

The highest priority of the GSM operators in Nigeria is the total sum of money they will make from the subscriber base and not the overall quality of service. So, they have

catchy advertisements and often make false declarations to attract customers to their network whereas they do not have infrastructures to satisfy customers' demand.

2.8.6 Lack of End-to-End System

The GSM operators in Nigeria are still depending on radio waves to transfer speech and data from base stations to mobile switching centers. Radio wave signals are subject to interference from other electromagnetic waves generating system such as radio and television. When such occurs, it could lead to call setup failures, call drop or other distortions.

2.8.7 Lack of Good Communication Terms between Different Networks

One of the reasons for poor inter-network communication is the inability to agree on the sharing ratio of the revenue between the network operators. As a result the numbers of lines that are open for interconnectivity are small compared to the total number of lines. A situation can occur when there is congestion on the connecting network like when a subscriber from a network A is calling from a network that is less congested to network B, which is filled to capacity. In such a case, the call will not pass through the network.

2.9 Marketing Strategies and Pricing Schemes

This also affects traffic behaviour since this would have increased the number of subscribers on the network.

2.10 Quality of Service Evaluation

The term quality of service QoS is used to designate a set of parameters, which are intended to represent measurable aspects of the subjective "Perceived quality", but not on the causes of this perception. [8] defines, Quality of Service as how happy the telephone company (or other common carrier) is keeping the customer. The transmission engineer calls QoS customer satisfaction, which is commonly measured by how well we can hear the calling party.

The ITU defines the QoS as the collective effect of service performance, which determines the degree of satisfaction of a user of the service. The terminal will also have a strong influence on the subjective perceived quality. It is the obligation of network providers to provide reliable and available networks for their customers. Therefore, the network providers must find mechanisms to protect and detect all defects and errors that might occur during their services in order to maintain their quality of service (QoS) or service capabilities.

2.11 Factors Affecting the Quality of Service (QoS)

Currently, quality of service (QoS) is a significant issue for all network providers [9]. The success or failures of QoS are the main responsibility of the network administrator consequently; the network administrators are

responsible for a qualified network management policy. For a mobile service, the most significant are call set up delay, probability of blocking and effective bandwidth. These factors can be both network terminal dependent.

i. The Call Set up Delay

This can be defined as the time interval from the instant the user initiates a connection request until the complete message indicating call disposition is received by the calling terminal. The lack of network resources at the user plane as well as the control plane can cause unsuccessful call attempts. The probability of End-to-End blocking can occur at radio link, at the inter-networking units between the mobile and the fixed networks or at the transit network.

The concept of effective bandwidth has been developed over recent years to provide a measure of resource usage, which adequately represents the trade-off between sources of different types, taking account of their varying statistical characteristics and the QoS requirement.

ii. Measurements of QoS parameters

The unit for measuring how well we can hear a distant party on the telephone is loudness rating, measured in decibels [8]. From the network and switching viewpoints, the percentage of lost calls (due to blockage or congestion) during the BH certainly constitutes another measure of service quality. Remember, this item is denominated grade of service. One target figure for grade of service is 1 in 100 calls lost during the busy hour. Other elements to be listed under QoS are

- iii. Delay before receiving dial tone (dial tone delay);
- iv. Availability of service tones (e.g., busy tone, telephone out of order, time out, and all trunks busy (ATB);
- v. Correctness of billing;
- vi. Reasonable cost of service to the customer;
- vii. Responsiveness to servicing requests;
- viii. Responsiveness and courtesy of operators; and
- ix. Time to installation of a new telephone and, by some, the additional services offered by the telephone company.

QoS parameters are not always directly measurable. The fundamental concept about QoS measurement is based on the traffic over the network. The relative weight of their influence in the user's evaluation depends on the nature of the service.

3. Materials and Method

The data used for this study was obtained through interview of subscribers and use of questionnaires. The survey was carried out by administering a well structured questionnaire to telephone subscribers, GSM operator power team and professionals in the field. A total of one thousand and five hundred questionnaires were distributed at some selected areas in Lagos state and Ekiti state. [10] puts the population of Lagos state to be 21 million and that of Ekiti state by population figure - Ekiti state is 1,750,000. The questionnaires were based on some of the popular network operators. Out of the number administered, 1350 questionnaires were returned by the respondents thus making 90% of the total questionnaire administered. The network covered includes: MTN, GLOBACOM, AIRTEL and ETISALAT.

4. Results and Discussion

In the performance index of service carried out, the findings are presented in tables 1-6. Table 1 shows the performance evaluation from the field of study of some selected networks. The whole assessment being summarized using four major headings: accessibility (A), interconnectivity (B), through switch (C), and service availability (D).

The result on tables 2 and 3 show that MTN, GLO, Airtel and Etisalat networks are averagely good in terms of interconnectivity, accessibility and through switch. From table 6 it can be deduced that MTN has the overall best performance being ranked satisfactory and others fair. This shows that the QoS delivered by the GSM networks operators is averagely under the required quality that should be delivered. But the test results do not just show accidental congestions but enormous percentage failures. This is primarily because the operators proliferated the SIM cards without making sure that the infrastructures can cope with the number of issued or sold SIM cards.

5. Conclusion

In this research, networks service performance; in terms of connectivity, accessibility, through switch and interconnectivity of the four GSM network providers in Ekiti and Lagos State were explored. Analyses were made on the GSM networks failures and QoS.

The result shows that inadequate infrastructure and proliferation of SIM cards by the service providers. The results of the analysis showed that the overall network performance of the four GSM network providers in Nigeria is average and below the standard required for a graded QoS.

6. Recommendations

The following recommendations are hereby presented;

1. The service providers are advised to place adequate infrastructure in prorate to increase in SIM proliferation.

2. Abide by the ITU regulation as it reminds us, we live “in an age that places increasing importance on” ‘any-to-any’ interconnection.
3. Service operators are advised to take regular checks on the systems, upgrade where necessary.
4. The GSM network operators are enjoined to try and prepare for 4G/3G evolution that is about to dominate the mobile industry.

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Table 1: Performance Evaluation from Selected Network

Network	A	B	C	D
MTN	90	105	117	105
GLO	54	45	42	39
AIRTEL	54	30	45	36
ETISALAT	27	33	15	27

A = Interconnectivity B = Accessibility
 C = Service availability D = through switch

Networks	A	B	C	D	Total Score
MTN	2	2	2	2	8
GLO	1	1	1	1	4
AIRTEL	1	1	1	1	4
ETISALAT	1	1	1	1	4

Table 2: Performance Evaluation in Percentage

Network	A%	B%	C%	D%
MTN	30	35	39	35
GLO	18	15	14	13
AIRTEL	18	10	15	12
ETISALAT	9	11	5	9

Table 3: Score table for the Field Assessment of the Networks

Rating%	Score	Remark
81-100	5	Excellent
61-80	4	Very Good
41-60	3	Good
21-40	2	Fair
0-20	1	Poor

Table 4: Field Score of the Performance Evaluation of the Network.

Table 5: Overall Ranking Table

Ranking	Remark
9-11	Best
6-8	Satisfactory
3-5	Fair
0-2	Poor

Table 6: Comparison of the Network Performance

Network	Remark
MTN	Satisfactory
GLO	Fair
AIRTEL	Fair
ETISALAT	Fair

Advanced Honeypot Architecture for Network Threats Quantification

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Abstract: Today's world is increasingly relying on computer networks. The increase in the use of network resources is followed by a rising volume of security problems. New threats and vulnerabilities are discovered everyday and affect users and companies at critical levels, from privacy issues to financial losses. Monitoring network activity is a mandatory step for researchers and security analysts to understand these threats and to build better protections. Honeypots were introduced to monitor unused IP spaces to learn about attackers. The advantage of honeypots over other monitoring solutions is to collect only suspicious activity. However, current honeypots are expensive to deploy and complex to administrate especially in the context of large organization networks. This study addresses the challenge of improving the scalability and flexibility of honeypots by introducing a novel hybrid honeypot architecture. This architecture is based on a Decision Engine and a Redirection Engine that automatically filter attacks and save resources by reducing the size of the attack data collection and allow researchers to actively specify the type of attack they want to collect. For a better integration into the organization network, this architecture was combined with network flows collected at the border of the production network. By offering an exhaustive view of all communications between internal and external hosts of the organization, network flows can 1) assist the configuration of honeypots, and 2) extend the scope of honeypot data analysis by providing a comprehensive profile of network activity to track attackers in the organization network. These capabilities were made possible through the development of a passive scanner and server discovery algorithm working on top of network flows. This algorithm and the hybrid honeypot architecture were deployed and evaluated. This study marks a major step toward leveraging honeypots into a powerful security solution. The contributions of this study will enable security analysts and network operators to make a precise assessment of the malicious activity targeting their network.

Keyword: Honeypots, Network Security, Network Attack, Network Threat, Darknet

1. Introduction

Today's world increasingly relies on computer networks. The use of network resources is growing and network infrastructures are gaining in size and complexity. This increase is followed by a rising volume of security problems. New threats and vulnerabilities are found every day, and computers are far from being secure. In the first half of 2008, 3,534 vulnerabilities were disclosed by vendors, researchers and independents. Between 8 and 16% of these vulnerabilities were exploited the day they were released by malicious programs. The consequences affect users and companies at critical levels, from privacy issues to financial losses.

To address this concern, network operators and security researchers have developed and deployed a variety of solutions. The goal of these solutions is two-fold: first to monitor, and second to protect network assets. Monitoring allows researchers to understand the different threats. Data are being collected to better characterize and quantify malicious activity. The goal of this dissertation is to introduce an innovative framework to better measure malicious threats in the organization network. The framework is based on a flexible hybrid honeypot architecture that we integrate with the organization network using network flows.

2. Background

2.1. Network Security

Network malicious activity can be quantified and characterized through two distinct approaches: the first is to monitor production networks, where live hosts and devices are actually used by people; the second is to monitor an unused address space that nobody uses. The advantage of the second approach over the first is that there is no user traffic to filter out. Indeed, the traffic received by unused addresses falls into three categories: malicious activity, misconfiguration, and backscatter from spoofed addresses. On the other hand, the disadvantage of the second approach is to rely on the assumption that malicious activity destined to unused addresses is similar to the one targeting production machines.

Tools used in these two different approaches can be divided into two groups: passive and active tools. When monitoring production networks, passive security tools include intrusion detection systems (IDSs) such as Snort,

and network traffic sniffers such as Tcpcdump or Netflow. Active tools include firewalls such as Netfilter, intrusion prevention systems (IPSs) such as Snort Inline, and vulnerability scanners such as Nessus. When monitoring an unused address space, passive tools are similar, but active tools are specific sensors developed with the only goal of better investigating the malicious activity received. Historically, unused address spaces were only passively monitored. Then researchers had the idea of actively replying to the traffic received to discover the exact threat behind each connection attempt. To understand the research challenges introduced with this new idea, we will now describe the different existing types of active sensors.

2.2. Honeypots

2.2.1. Definitions

_ We define a **network sensor** as an unused IP address instrumented to collect information about suspicious traffic. We separate sensors into two categories: *passive sensors*, which simply collect data without any interaction with the source of traffic; and *active sensors*, which can interact with the source of traffic to collect additional information.

_ We define a **honeypot** as a network device that provides a mechanism for completing network connections not normally provided on a system and logging those connection attempts. We note that honeypot and active network sensor are synonyms.

_ We define a **darknet** as a network of passive sensors.

_ Similarly, we define a **honeynet** as a network of honeypots.

_ By **honeypot architecture**, we mean a specific combination of software solutions to administrate a honeynet.

_ Finally by **honeypot framework**, we mean the combination of a honeypot architecture and a data processing solution to analyze malicious network activity.

2.2.2. Honeypot Attributes and Classification

The main goal of honeypots is to provide information about network attacks. A large variety of honeypots have been proposed by researchers to collect various types of security threats. These honeypots can be organized according to three main attributes:

_ *Fidelity*: honeypots have different levels of interaction, whether they offer emulated or real services to attackers. The more interactions a honeypot has with an attacker, the more knowledge is gained about the attack. Hence, three different levels of interaction are defined:

1. A *high-interaction honeypot* is a conventional network resource, such as a computer or router, with no active user and no specific task other than getting attacked. From an attacker's point of view, this type of honeypot can hardly be differentiated from another production machine. The advantage is to gain as much information as possible about the attack. Of course, with such a genuine exposure, the risk of being effectively compromised is real. Consequently, these honeypots should be closely monitored and data control mechanisms, such as a reverse firewall, should be configured to prevent an attacker from using the honeypot to damage other production resources. The Honeynet Project provides tools and documentation to deploy and administrate this type of honeypot.

2. A *low-interaction honeypot* provides limited interaction with the attacker by emulating a set of services. The goal of low-interaction honeypots is to gather information about the first steps of an attack. Information about the motivation of the threats received is rarely captured because the level of interaction is too low for the honeypot to be effectively compromised. A well-known implementation of a low-interaction honeypot is Honeyd.

3. A *zero-interaction sensor* is no longer a honeypot but a passive sensor that does not respond to attackers. Such sensors are called darknets and are nonetheless able to collect important information about how attackers probe networks and what services they target.

_ *Scalability*: the level of interaction of honeypots affects the number of IP addresses on which the honeypots can be deployed as well as the maximum bandwidth they can sustain. Indeed, a darknet is more scalable than a set of high-interaction honeypots because, from a resource perspective, passively monitoring thousands of network addresses is less demanding than deploying and administrating a few high-interaction honeypots. As a result, current honeypot architectures offer either large scalability or high interaction but not both.

_ *Security*: as explained for high interaction honeypots, deploying honeypots to actively collect malicious traffic is not a safe activity. Honeypots can be compromised and so several protection systems currently exist to avoid attackers from using honeypots to relay malicious activity.

Honeypots are governed by these three contending attributes: *scalability*, *fidelity* and *security*. Researchers have to balance these attributes according to their needs and their resources. They can either study the first steps of an attack by deploying a large number of low interaction honeypots. Or they can study the full attack process by deploying high interaction honeypots. This last option requires constant monitoring and important software and hardware resources.

2.2.3. Honeypots and Network Attack Processes

To better understand how honeypots can be used, it is important to first describe how network attacks proceed to spread and to compromise computers. For this purpose, we define an attack process as a sequence of network communications between an attacker and a victim, with a malicious purpose. We divide the network attack process in three phases:

1. The first phase is to reach a victim, which means to send a communication attempt to a specific service hosted on a network device. For example, a technique for an attacker to discover a large number of victims is to scan incrementally all network addresses within a specific subnet. The attacker goes to the next phase only if the victim replies and the service is open to the attacker.

2. The second phase is to exploit the service found on the victim's machine by launching an attack payload. There is not always a clear boundary between the first and second phase, because some attacks are made of a single network packet, so communication attempts and attack payload overlap. Moreover, attackers often use the connection initialized during the scan to send the attack payload.

The attacker goes to the next phase only if the service is successfully compromised by the attack launched.

3. The third phase is to use the newly corrupted victim's machine. The attacker can be someone who wants to gain access to a specific resource, or a worm that is simply spreading from one vulnerable machine to another. In such case, the worm installed on the newly corrupted machine will start probing for other victims and will create a new attack process starting with phase one again.

From this model we can map the different phases of network attack with the different types of honeypots. Figure 1 details this mapping and explains how honeypots attributes are related.

The probing phase of an attack can be detected by all types of sensors (zerointeraction sensors, low and high-interaction honeypots). However, to gather significant statistical results about scanning techniques and services targeted, one needs to monitor large address space. Therefore, darknets are the most suitable solution to study this attack phase because of their high scalability.

The second phase of an attack can be detected only by sensors which can reply to probes. The reason is that an attack payload can be sent by the attacker to the sensor only if a network connection is correctly established between the two peers. As we just saw when explaining the second phase of an attack, we can find some exceptions to this requirement, because some attacks are made of a single network packet that does not need first an acknowledgment from the victim to be sent. Low interaction honeypots are well suited to gather exploits sent during the second phase of an attack, because they are scalable and provide enough interaction for the attacker to send its attack payload.

However, emulated scripts hosted by low interaction honeypots will not always satisfy the level of interaction required by complex attacks. This threshold between simple and complex attacks is represented by the level of emulation on Figure 1. Furthermore, low interaction honeypots cannot be compromised by attackers, so the third phase of the attack process is never collected by this type of architecture.

As a result, the full attack process requires high interaction honeypots to be analyzed in detail. High interaction honeypots are not only able to collect complex exploits, they can also collect the third phase of an attack, which is how the attacker will use the compromised resource. This phase gives information regarding the motivation of the attack. For example, attacks can lead to the installation of a rogue software to provide illicit services to the attacker community, such as a botnet client, illegal file sharing or hidden remote control. Of course, high interaction honeypots should be closely monitored to learn enough of the attacker's actions while staying under control. The risk is to have an attacker being able to use the honeypot to attack external production resources. Thus, the amount of information gathered on the attack will depend on the level of control deployed in the honeypot architecture. This level of control is represented on Figure 1 as the boundary between high interaction honeypots and vanilla systems such as live hosts. This requirement to closely monitor and control honeypots directly reduces the scalability. Moreover, high interaction honeypots, even if ran on virtual machines such as VMWare, need important hardware resources.

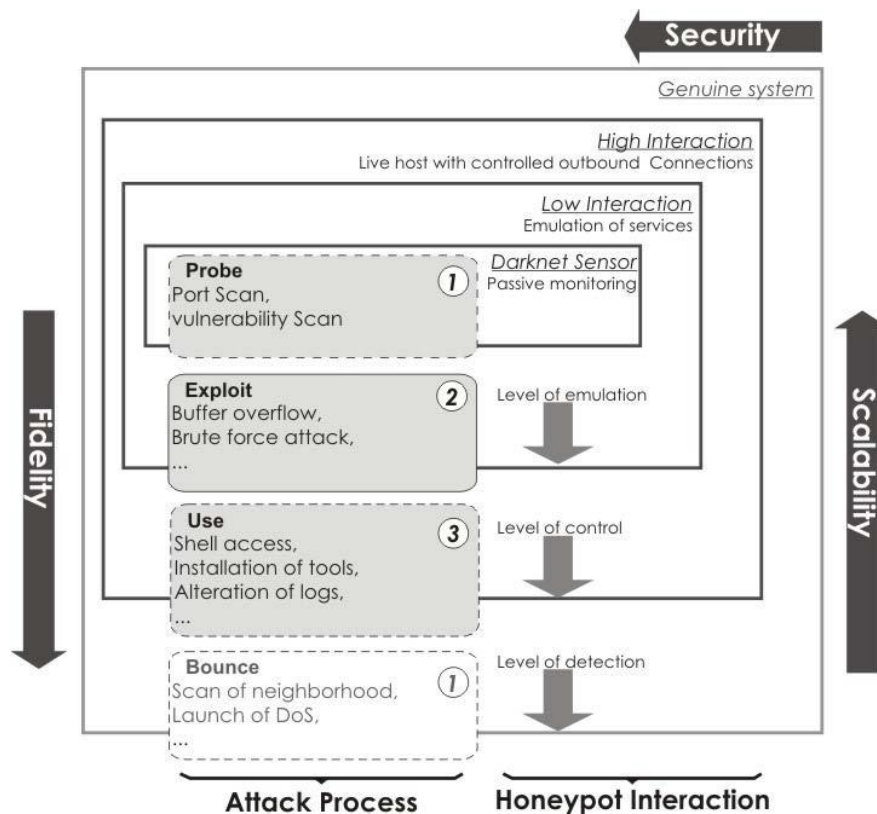


Figure 1: Different honeypot architectures to collect different phases of network attack process

3. Related Work

This section provides a broad overview of relevant solutions to collect attack processes using passive sensors and honeypots.

3.1. Darknets

The idea of passively monitoring unused IP space to learn about suspicious traffic has spread through several research projects with various names. First, the Network

Telescope has pioneered the use of darknets to learn about denial of service attacks. Another project called Blackholes was able to collect traffic from 16.8 million IP addresses (1/256th of the Internet) to study global trends of worm activity. The Darknet project [29] provides a full guide to learn how to configure a darknet and start monitoring malware traffic. While darknets offer the greatest scalability of all monitoring solutions, they are greatly limited by the lack of active responders. The Internet Motion Sensor and iSink are two research projects that implemented stateless active responders to darknets.

As a result, they were able to keep a high scalability while capturing the first attack payloads sent by attackers. These two architectures provided important discoveries on the attributes of unused IP space to understand the differences in traffic collected. They are at the transition between passive darknets and active honeypots.

3.2. Low Interaction Honeypots

The most widely used low interaction honeypot is Honeyd. Honeyd can create a population of virtual hosts on a network using unassigned IP addresses. Each host can be configured with a set of emulated services and a specific operating system behavior. The simplicity and flexibility of Honeyd makes it a relevant solution to host a complete low interaction honeynet. However, attacks collected depend on the interaction provided by the emulated services, and developing these services is often a difficult challenge.

Another well-known low interaction honeypot is Nepenthes. Nepenthes was designed to automatically capture malware that spread from one computer to another. It consists of a set of emulated vulnerabilities that give enough interaction to capture the infection attempt of malware. Then Nepenthes examines the attack payload and tries to download the remaining part of the malware.

3.3. High Interaction Honeypots

The HoneyNet Project has developed a variety of tools to help researchers deploying their honeynet and analyzing suspicious network traffic. One of these tools called Honeywall was especially designed to administrate high interaction honeypots. It provides a web interface to monitor the data collection, and a reverse

firewall to control outgoing connections from potentially compromised honeypots. Honeywall also integrates system monitoring capabilities through the Sebek kernel module.

The more cost efficient solution to host high interaction honeypots is to use virtual machines. Compared to genuine systems, virtual environments have the important advantage of being easier to monitor, to save and to clean after a successful compromise.

3.4. Hybrid Honeypots

The need to collect detailed attack processes on large IP spaces has pushed researchers to invent more scalable and intelligent architectures. Collapsar simplifies the deployment and administration of high interaction honeypots on large IP spaces by using GRE tunnels to route traffic from distributed networks into a centralized farm of honeypots. The limitation of Collapsar is to not provide any filtering mechanism that can prevent high interaction honeypots from being overloaded.

Another project called Potemkin is based on the idea that idle high interaction honeypots do not even need to run. As a result, the architecture saves resources by starting a new virtual machine for each active IP address. As soon as an IP address becomes inactive, the virtual machine is destroyed to save physical memory and CPU resources. Such a system allows hundreds of virtual machines to run on a single physical host.

4. Problem Statement

When deploying honeypots, researchers have to precisely define three elements: a location, an architecture, and a configuration. Data collected by honeypots is critically affected by these three keys. Therefore, they need to be carefully selected. We will now detail the different problems related to each of these elements.

The **location** is the set of IP addresses used by honeypots to receive and collect network traffic. The current addressing protocol deployed on the Internet is IPv4, which is made of 4.3 billions unique addresses. The volume and the nature of attacks can greatly change from one IP address to another. Some attack threats such as the Slammer worm are globally distributed, while others such as Denials of Service target precise locations. So the location of honeypots can greatly affect the data it will receive.

Recent studies started to compare attack data from different locations and defined network characteristics such as reachability or proximity to production networks that could partially explain the differences observed. Moreover, not only the location but the size of the network of honeypots is important to collect significant attack results.

The honeypot **architecture** refers to the type of honeypot. We saw in the previous section that the different types of honeypots were governed by three attributes: fidelity, scalability and security. There is currently no solution available that offers both scalability and a high level of interaction. As a result, researchers and network operators who want to deploy honeypots cannot collect and analyze datasets which have both detailed attack processes and large network space coverage.

The **configuration** defines the set of services offered to attackers and thus the behavior of the honeypot. By set of services we mean the set of opened ports and software listening for network connections on the honeypot. These services can be emulated or real. They can be host-specific resources or vulnerabilities to study specific categories of attack. The problem when deploying honeypots in a large organization network is that there is a very large number of possible configurations to choose from.

There is currently no solution to determine whether the configuration of a network of honeypots is optimal to collect malicious threats; and to make sure that the fingerprint of the network of honeypots is small enough to prevent attackers from detecting it.

The last major issue of current honeypots is that even if they actively reply to attackers with more or less interaction, they do not allow researchers to select the type of attack they want to study. This means that because honeypots collect attacks randomly, the information collected is not often the information researchers were really looking to analyze. From such point of view, existing honeypots are collecting attack traffic passively. We believe that if honeypots adopt a more active approach when receiving illegitimate connections, they could 1) provide better results on the exact threat expected to be studied, and 2) reduce the resources spent to analyze and filter data collected.

5. Approach

The purpose of our study is to develop efficient solutions to overcome current honeypot limitations. We addressed the issue of the size and the location of honeynets by correlating network flows with darknet data. We solved the problem of scalability of high interaction honeypot by implementing an advanced hybrid honeypot architecture called Honeybrid. We solved the problem of configuring honeynets in large organization network by using a server and scanner discovery program based on network flows.

Finally we addressed the challenge of cost effectively analyzing large volumes of malicious data by implementing an aggregation process that integrates network flows and honeypot data. These solutions are integrated into a complete framework to facilitate honeypot deployment and attack data analysis. The overall goals are 1) to provide to the security community an advanced honeypot solution that can be better integrated

into the landscape of security tools used by researchers and network operators, and 2) to deploy such architecture to better quantify malicious activity occurring on the campus network. The cornerstone of this architecture is a hybrid gateway that offers both advantages of high and low interaction honeypots: fidelity and scalability.

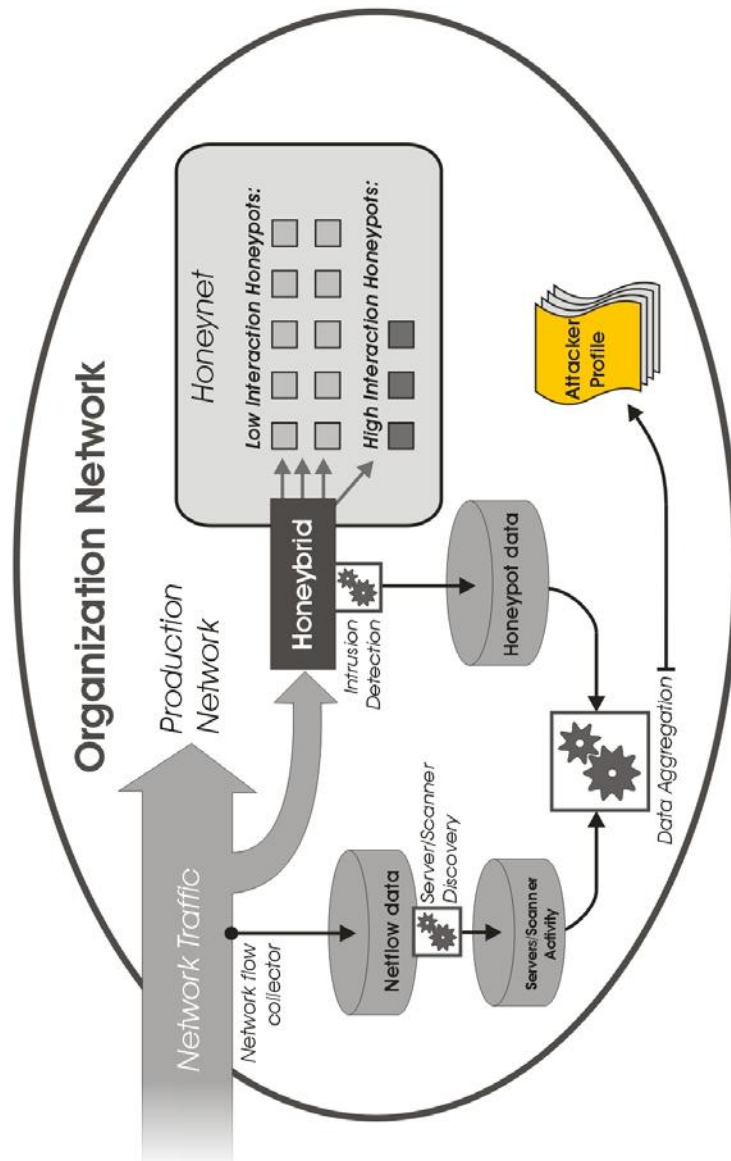


Figure 2: Overview of our malicious traffic analysis framework

6. Contributions

The contributions of this work are:

- _ *Honeybot classification and mapping with attack process*: we provide a detailed classification of current honeypot solutions and we link this classification with the different phases of attack collected. We outline the different properties and limitations of honeypots.
- _ *Hybrid architecture*: we describe an innovative honeypot solution that provides both a high scalability and a high level of interaction. We also introduce the concept of an attack event, to differentiate network attacks worth of analysis from the noise of malicious traffic. Our architecture is designed to be able to harvest large IP spaces while actively filtering attack events from attack traffic for detailed focused analysis.
- _ *Dynamic configuration engine*: we address the problem of honeypot configuration by combining network flows and automated honeypot management. From an exhaustive monitoring of the existing attack patterns targeting the organization network, we infer the required honeypot configuration to assess the malicious activity.
- _ *Architecture integration*: we provide the first open source implementation of an hybrid honeypot architecture. We integrate this architecture with network flows to provide a complete attack assessment framework. Finally, we deploy this framework and we show how it can be used to accurately detect compromised computers inside the organization network.

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A COMMON FIXED POINT THEOREM FOR FOUR SELF MAPS ON AN INTUITIONISTIC FUZZY METRIC SPACE

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1. INTRODUCTION

Atanassov [3] introduced and studied the concept of intuitionistic fuzzy sets as a generalization of fuzzy sets. In 2004, Park [7] defined the notion of intuitionistic fuzzy metric space with the help of continuous t-norm and continuous t-conorm. Recently, in 2006, Alaca et al. [2] using the idea of intuitionistic fuzzy sets, defined the notion of intuitionistic fuzzy metric space with the help of continuous t-norm and continuous t-conorm as a generalization of fuzzy metric space due to Kramosil and Michalek [5]. In 2006, Turkoglu et al. [9] proved Jungck's common fixed point theorem [4] in the setting of intuitionistic fuzzy metric spaces for commuting mappings. For more details, one can refer to papers ([1], [6], [10], [11]).

In this paper, we prove a common fixed point theorem for four self mappings satisfying contractive condition in intuitionistic fuzzy metric spaces. We observe that the result of Manro [12] follows as a corollary.

2. PRELIMINARIES

Definition 2.1(Zadeh, [13]): Fuzzy set A in X is a function with domain X and values in $[0, 1]$

Schweizer and Sklar [8] defined the following notion:

Definition 2.2 A binary operation $*$: $[0,1] \times [0,1] \rightarrow [0,1]$ is a continuous t-norm if $*$ satisfies the following conditions:

- (i) $*$ is commutative and associative
- (ii) $*$ is continuous
- (iii) $a * 1 = a$ for all $a \in [0,1]$
- (iv) $a * b \leq c * d$ whenever $a \leq c$ and $b \leq d$ for all $a, b, c, d \in [0,1]$

Definition 2.3 A binary operation \diamond : $[0, 1] \times [0, 1] \rightarrow [0, 1]$ is a continuous t-conorm if \diamond satisfies the following conditions

- (i) \diamond is commutative and associative
- (ii) \diamond is continuous

- (iii) $a \diamond 0 = a$ for all $a \in [0,1]$
- (iv) $a \diamond b \leq c \diamond d$ whenever $a \leq c$ and $b \leq d$ for all $a, b, c, d \in [0,1]$

Alaca et al. [2] defined the notion of a intuitionistic fuzzy metric space as follows:

Definition 2.4 A 5-tuple $(X, M, N, *, \diamond)$ is said to be an intuitionistic fuzzy metric space if X is a non empty set, $*$ is a continuous t-norm, \diamond is a continuous t-conorm and M, N are fuzzy sets on $X^2 \times [0, \infty)$ satisfying

- (i) $M(x, y, t) + N(x, y, t) \leq 1 \forall x, y \in X$ and $t > 0$;
- (ii) $M(x, y, 0) = 0 \forall x, y \in X$
- (iii) $M(x, y, t) = 1 \forall x, y \in X$ and $t > 0$ if and only if $x = y$;
- (iv) $M(x, y, t) = M(y, x, t) \forall x, y \in X$ and $t > 0$;
- (v) $M(x, y, t) * M(y, z, s) \leq M(x, z, t + s) \forall x, y \in X$ and $s, t > 0$
- (vi) $\forall x, y \in X, M(x, y, \cdot): [0, \infty) \rightarrow [0, 1]$ is left continuous;
- (vii) $\lim_{t \rightarrow \infty} M(x, y, t) = 1 \forall x, y \in X$
- (viii) $N(x, y, 0) = 1 \forall x, y \in X$
- (ix) $N(x, y, t) = 0 \forall x, y \in X$ and $t > 0$ if and only if $x = y$
- (x) $N(x, y, t) = N(y, x, t) \forall x, y \in X$ and $t > 0$;
- (xi) $N(x, y, t) \diamond N(y, z, s) \geq N(x, z, t + s) \forall x, y \in X$ and $s, t > 0$
- (xii) $\forall x, y \in X, N(x, y, \cdot): [0, \infty) \rightarrow [0, 1]$ is right continuous;
- (xiii) $\lim_{t \rightarrow \infty} N(x, y, t) = 0 \forall x, y \in X$.

Then (M, N) is called an intuitionistic fuzzy metric on X . The functions $M(x, y, t)$ and $N(x, y, t)$ denote the degree of nearness and the degree of non nearness between x and y with respect to t , respectively.

Remark 2.5 Every fuzzy metric space $(X, M, *)$ is an intuitionistic fuzzy metric space of the form $(X, M, 1-M, *, \diamond)$ such that t-norm $*$ and t-conorm \diamond are associated as $x \diamond y = 1 - ((1-x) * (1-y)) \forall x, y \in X$

Remark 2.6 In an intuitionistic fuzzy metric space $(X, M, N, *, \diamond)$, $M(x, y, \cdot)$ is non-decreasing and $N(x, y, \cdot)$ is non-increasing $\forall x, y \in X$.

Definition 2.7 Let $(X, M, N, *, \diamond)$ be an intuitionistic fuzzy metric space. Then a sequence $\{x_n\}$ in X is said to be (i) convergent to a point $x \in X$ if

$$\lim_{n \rightarrow \infty} M(x_n, x, t) = 1 \text{ and } \lim_{n \rightarrow \infty} N(x_n, x, t) = 0 \forall t > 0$$

(ii) Cauchy sequence if

$$\lim_{n \rightarrow \infty} M(x_{n+p}, x_n, t) = 1 \text{ and } \lim_{n \rightarrow \infty} N(x_{n+p}, x_n, t) = 0 \forall t > 0, \text{ and } p > 0$$

Definition 2.8 An intuitionistic fuzzy metric space $(X, M, N, *, \diamond)$ is said to be complete if and only if every Cauchy sequence in X is convergent.

Turkoglu et al. [10] defined the following notions:

Definition 2.9 Let A and S be self-mappings of an intuitionistic fuzzy metric space $(X, M, N, *, \diamond)$. Then the pair (A, S) is said to be commuting if

$$M(ASx, SAx, t) = 1 \text{ and } N(ASx, SAx, t) = 0 \forall x \in X, t > 0$$

Definition 2.10 Let A and S be self-mappings of an intuitionistic fuzzy metric space $(X, M, N, *, \diamond)$. Then the pair (A, S) is said to be weakly commuting if

$$M(ASx, SAx, t) \geq M(Ax, Sx, t) \text{ and } N(ASx, SAx, t) \leq N(Ax, Sx, t) \forall x \in X, t > 0.$$

Definition 2.11 Let A and S be self-mappings of an intuitionistic fuzzy metric space $(X, M, N, *, \diamond)$

Then the pair (A, S) is said to be compatible if

$\lim_{n \rightarrow \infty} M(ASx_n, SAx_n, t) = 1$ and $\lim_{n \rightarrow \infty} N(ASx_n, SAx_n, t) = 0 \forall t > 0$ whenever $\{x_n\}$ is a sequence in X such that $\lim_{n \rightarrow \infty} Ax_n = \lim_{n \rightarrow \infty} Sx_n = u$ for some $u \in X$

Definition 2.12 (D.Turgoklu et.al., [9]) Let A and S be self-mappings of an intuitionistic fuzzy metric space $(X, M, N, *, \diamond)$

Then the pair (A, S) is said to be point wise R -weakly commuting if given $x \in X$, there exists $R > 0$ such that

$$M(ASx, SAx, t) \geq M(Ax, Sx, t/R) \text{ and } N(ASx, SAx, t) \leq N(Ax, Sx, t/R) \forall x \in X \text{ and } t > 0.$$

Clearly, every pair of weakly commuting mappings is point wise R -weakly commuting with $R = 1$.

Definition 2.13 (S.Muralisankar, G.Kalpana, [6]) Let A and S be self-mappings of an intuitionistic fuzzy metric space $(X, M, N, *, \diamond)$

Then the pair (A, S) is said to be reciprocally continuous if

$ASu_n \rightarrow Az$ and $SAu_n \rightarrow Sz$, whenever $\{u_n\}$ is a sequence such that $Au_n \rightarrow z$ and $Su_n \rightarrow z$, for some $z \in X$ as $n \rightarrow \infty$.

If A and S are both continuous, then they are obviously reciprocally continuous, but converse is not true.

Lemma 2.14 ([2], [9]) Let $\{u_n\}$ be a sequence in an intuitionistic fuzzy metric space $(X, M, N, *, \diamond)$. If there exists a constant $k \in (0, 1)$ such that

$$M(u_n, u_{n+1}, kt) \geq M(u_{n-1}, u_n, t) \text{ and } N(u_n, u_{n+1}, kt) \leq N(u_{n-1}, u_n, t)$$

for $n = 1, 2, 3, \dots$ then $\{u_n\}$ is a Cauchy sequence in X .

Lemma 2.15 [2] [9] Let $(X, M, N, *, \diamond)$ be an intuitionistic fuzzy metric space. If there exists a constant $k \in (0, 1)$ such that

$$M(x, y, kt) \geq M(x, y, t) \text{ and } N(x, y, kt) \leq N(x, y, t) \text{ for all } x, y \in X \text{ and } t > 0, \text{ then } x = y.$$

Now we state the Lemma and Theorem of Manro [12]

Lemma 2.16 [12] Let $(X, M, N, *, \diamond)$ be a complete intuitionistic fuzzy metric space with $t * t \geq t$ and $(1-t) \diamond (1-t) \leq (1-t) \forall t \in [0,1]$. Further, let A, B, S and T be four self mappings of X satisfying

(C1) $A(X) \subset T(X)$ and $B(X) \subset S(X)$,

(C2) there exists a constant $k \in (0, 1)$ such that

$$\begin{aligned} & [1 + aM(Sx, Ty, kt)] * M(Ax, By, kt) \\ \geq & a[M(Ax, Sx, kt) * M(By, Ty, kt) * M(By, Sx, kt)] + M(Ty, Sx, t) * M(Ax, Sx, t) * M(By, Ty, t) \\ & * M(By, Sx, \alpha t) * M(Ax, Ty, (2-\alpha)t) \end{aligned}$$

and

$$\begin{aligned} & [1 + aN(Sx, Ty, kt)] \diamond N(Ax, By, kt) \\ \leq & a[N(Ax, Sx, kt) \diamond N(By, Ty, kt) \diamond N(By, Sx, kt)] + N(Ty, Sx, t) \diamond N(Ax, Sx, t) \diamond N(By, Ty, t) \\ & \diamond N(By, Sx, \alpha t) \diamond N(Ax, Ty, (2-\alpha)t) \end{aligned}$$

for all $x, y \in X, a \geq 0, \alpha \in (0,2)$ and $t > 0$.

If the pairs (A, S) and (B, T) are point wise R -weakly commuting then continuity of one of the mappings in compatible pair (A, S) or (B, T) implies their reciprocal continuity.

Theorem 2.1 [12] Let $(X, M, N, *, \diamond)$ be a complete intuitionistic fuzzy metric space with $t * t \geq t$ and $(1-t) \diamond (1-t) \leq (1-t) \forall t \in [0,1]$. Further, let A, B, S and T be four self mappings of X satisfying (C1) and (C2). If the pairs (A,S) and (B,T) are compatible and point wise R -weakly commuting and one of the mappings in compatible pair (A,S) or (B,T) is continuous, then A,B,S and T have a unique common fixed point.

3. MAIN RESULTS

Lemma 3.1 Let $(X, M, N, *, \diamond)$ be a complete intuitionistic fuzzy metric space with $t * t \geq t$ and $(1-t) \diamond (1-t) \leq (1-t) \forall t \in [0,1]$. Further, let A, B, S and T be four self mappings of X satisfying

(C1) $A(X) \subset T(X)$ and $B(X) \subset S(X)$,

(C2)^l there exist constants $k \in (0,1)$ and $q \in (0,1)$ such that $0 < k < q$

$$M(Ax, By, kt) \geq M(Ty, Sx, t) * M(Ax, Sx, t) * M(By, Ty, t) \\ * M(By, Sx, (1 + q)t) * M(Ax, Ty, qt); q \in (0,1)$$

and

$$N(Ax, By, kt) \leq N(Ty, Sx, t) \diamond N(Ax, Sx, t) \diamond N(By, Ty, t) \\ \diamond N(By, Sx, (1 + q)t) \diamond N(Ax, Ty, qt)$$

for all $x, y \in X$ and $t > 0$.

If the pairs (A, S) and (B, T) are compatible then continuity of one of the mappings in compatible pair (A, S) or (B, T) implies their reciprocal continuity.

Proof: First, assume that A and S are compatible and S is continuous. We show that A and S are reciprocally continuous. Let $\{u_n\}$ be a sequence such that $Au_n \rightarrow z$ and $Su_n \rightarrow z$, for $z \in X$ as $n \rightarrow \infty$.

Since S is continuous, we have $SAu_n \rightarrow Sz$ and $SSu_n \rightarrow Sz$, for $z \in X$ as $n \rightarrow \infty$ and since (A, S) is compatible, we have

$$\lim_{n \rightarrow \infty} M(ASu_n, SAu_n, t) = 1$$

This implies that

$$\lim_{n \rightarrow \infty} M(ASu_n, SAz, t) = 1 \quad \forall t > 0$$

That is $ASu_n \rightarrow Sz$ as $n \rightarrow \infty$. By (C1) for each n , there exists $u_n \in X$ such that $ASu_n = Tv_n$. Thus we have $SSu_n \rightarrow Sz, SAu_n \rightarrow Sz, ASu_n \rightarrow Sz$ and $Tv_n \rightarrow Sz$ as $n \rightarrow \infty$, whenever $ASu_n = Tv_n$.

Now we claim that $Bv_n \rightarrow Sz$ as $n \rightarrow \infty$. In (C2)¹ put $x = Su_n$ and $y = v_n$

$$M(ASu_n, Bv_n, kt) \geq M(Tv_n, SSu_n, t) * M(ASu_n, SSu_n, t) * M(Bv_n, Tv_n, t) \\ * M(Bv_n, SSu_n, (1 + q)t) * M(ASu_n, Tv_n, qt); q \in (0,1)$$

and

$$N(ASu_n, Bv_n, kt) \leq N(Tv_n, SSu_n, t) \diamond N(ASu_n, SSu_n, t) \diamond N(Bv_n, Tv_n, t) \\ \diamond N(Bv_n, SSu_n, (1 + q)t) \diamond N(ASu_n, Tv_n, qt)$$

$$M(Sz, Bv_n, kt) \geq M(Sz, Sz, t) * M(Sz, Sz, t) * M(Bv_n, Sz, t) \\ * M(Bv_n, Sz, (1 + q)t) * M(Sz, Sz, qt); q \in (0,1)$$

and

$$N(Sz, Bv_n, kt) \leq N(Sz, Sz, t) \diamond N(Sz, Sz, t) \diamond N(Bv_n, Sz, t) \\ \diamond N(Bv_n, Sz, (1 + q)t) \diamond N(Sz, Sz, qt); q \in (0,1)$$

$$M(Sz, Bv_n, kt) \geq M(Bv_n, Sz, t) \text{ and } N(Sz, Bv_n, kt) \leq N(Bv_n, Sz, t)$$

$$M(Sz, Bv_n, kt) \rightarrow 1 \text{ and } N(Sz, Bv_n, kt) \rightarrow 0$$

Therefore $Bv_n \rightarrow Sz$. Also $ASu_n = Tv_n$ implies $Tv_n \rightarrow Sz$

Again by (C2)¹ substitute $Su_n = z$, we get

$$M(Az, Bv_n, kt) \geq M(ASu_n, Sz, t) * M(Az, Sz, t) * M(Bv_n, ASu_n, t) \\ * M(Bv_n, Sz, (1+q)t) * M(Az, ASu_n, qt); q \in (0,1)$$

and

$$N(Az, Bv_n, kt) \leq N(ASu_n, Sz, t) \diamond N(Az, Sz, t) \diamond N(Bv_n, ASu_n, t) \\ \diamond N(Bv_n, Sz, (1+q)t) \diamond N(Az, ASu_n, qt)$$

$$M(Az, Bv_n, kt) \geq M(Az, Sz, t) * M(Az, Sz, t) * M(Bv_n, Az, t) \\ * M(Bv_n, Sz, (1+q)t) * M(Az, Az, qt)$$

and

$$N(Az, Bv_n, kt) \leq N(Az, Sz, t) \diamond N(Az, Sz, t) \diamond N(Bv_n, Az, t) \\ \diamond N(Bv_n, Sz, (1+q)t) \diamond N(Az, Az, qt)$$

$$M(Az, Bv_n, kt) \geq M(Az, Sz, t) * (Bv_n, Az, t) \text{ and } N(Az, Bv_n, kt) \leq N(Az, Sz, t) \diamond N(Bv_n, Az, t)$$

$$M(Az, Bv_n, kt) \geq M(Az, Sz, t) \text{ and } N(Az, Bv_n, kt) \leq N(Az, Sz, t)$$

By Lemma 2.14, $Az = Sz$. But $ASu_n \rightarrow Sz = Az$, implies $ASu_n \rightarrow Az$ and $SAu_n \rightarrow Sz$

Hence (A, S) is reciprocally continuous on X.

Similarly, if the pair (B, T) is compatible and T is continuous then the proof is similar. This completes the proof.

Now we prove our main theorem.

Theorem 3.1 Let $(X, M, N, *, \diamond)$ be a complete intuitionistic fuzzy metric space with $t * t \geq t$ and $(1-t) \diamond (1-t) \leq (1-t) \forall t \in [0,1]$. Further, let A, B, S and T be four self mappings of X satisfying (C1) and (C2)¹. If the pairs (A, S) and (B, T) are compatible and one of the mappings in compatible pairs (A, S) or (B, T) is continuous, then A, B, S and T have a unique common fixed point.

Proof By (C1) since $A(X) \subset T(X)$, for any point $x_0 \in X$, there exists a point $x_1 \in X$ such that $Ax_0 = Tx_1$. Since $B(X) \subset S(X)$, for this point $x_1 \in X$, we can choose a point x_2 in X such that $Bx_1 = Sx_2$ and so on. Inductively, we can define a sequence $\{y_n\}$ in X such that for $n = 0, 1, 2, \dots$

$$y_{2n} = Ax_{2n} = Tx_{2n+1} \text{ and } y_{2n+1} = Bx_{2n+1} = Sx_{2n+2}$$

In (C2)¹ substitute $x = x_{2n+1}$; $y = x_{2n+1}$

$$\begin{aligned}
 &M(Ax_{2n+2}, Bx_{2n+1}, kt) \\
 &\geq M(Tx_{2n+1}, Sx_{2n+2}, t) * M(Ax_{2n+2}, SBx_{2n+2}, t) * M(Bx_{2n+1}, Tx_{2n+1}, t) \\
 &\quad * M(Bx_{2n+1}, Sx_{2n+2}, (1+q)t) * M(Ax_{2n+1}, Tx_{2n+1}, qt)
 \end{aligned}$$

and

$$\begin{aligned}
 &N(Ax_{2n+2}, Bx_{2n+1}, kt) \\
 &\leq N(Tx_{2n+1}, Sx_{2n+2}, t) \diamond N(Ax_{2n+2}, SBx_{2n+2}, t) \diamond N(Bx_{2n+1}, Tx_{2n+1}, t) \\
 &\quad \diamond N(Bx_{2n+1}, Sx_{2n+2}, (1+q)t) \diamond N(Ax_{2n+1}, Tx_{2n+1}, qt)
 \end{aligned}$$

$$\begin{aligned}
 &M(y_{2n+2}, y_{2n+1}, kt) \\
 &\geq M(y_{2n}, y_{2n+1}, t) * M(y_{2n+2}, y_{2n+1}, t) * M(y_{2n+1}, y_{2n}, t) * M(y_{2n+1}, y_{2n+1}, (1+q)t) \\
 &\quad * M(y_{2n+1}, y_{2n}, qt)
 \end{aligned}$$

and

$$\begin{aligned}
 &N(y_{2n+2}, y_{2n+1}, kt) \\
 &\leq N(y_{2n}, y_{2n+1}, t) \diamond N(y_{2n+2}, y_{2n+1}, t) \diamond N(y_{2n+1}, y_{2n}, t) \diamond N(y_{2n+1}, y_{2n+1}, (1+q)t) \\
 &\quad \diamond N(y_{2n+1}, y_{2n}, qt)
 \end{aligned}$$

$$M(y_{2n+2}, y_{2n+1}, kt) \geq M(y_{2n}, y_{2n+1}, t) * M(y_{2n+2}, y_{2n+1}, t) * M(y_{2n+1}, y_{2n}, qt) \rightarrow (3.1.1)$$

and

$$N(y_{2n+2}, y_{2n+1}, kt) \leq N(y_{2n}, y_{2n+1}, t) \diamond N(y_{2n+2}, y_{2n+1}, t) \diamond N(y_{2n+1}, y_{2n}, qt) \rightarrow (3.1.2)$$

$$(3.1.1) \text{ implies } M(y_{2n+2}, y_{2n+1}, kt) \geq M(y_{2n+1}, y_{2n}, qt)$$

$$\text{So that } M(y_{2n+2}, y_{2n+1}, \frac{k}{q}qt) \geq M(y_{2n+1}, y_{2n}, qt)$$

$$(3.1.2) \text{ implies } N(y_{2n+2}, y_{2n+1}, kt) \leq N(y_{2n+1}, y_{2n}, qt)$$

$$N(y_{2n+2}, y_{2n+1}, (k/q)qt) \leq N(y_{2n+1}, y_{2n}, qt)$$

Case-I: Suppose $y_n = y_{n+1}$ for some n

Then $y_0 = Ax_0 = Tx_1$ and $y_1 = Bx_1 = Sx_2$ so that $Ax_0 = Tx_1 = Bx_1 = Sx_2$

Now $y_2 = Ax_2 = Tx_3$; put $x = x_2$; $y = x_1$ in (C2)¹

$$\begin{aligned}
 &M(Ax_2, Bx_1, kt) \\
 &\geq M(Tx_1, Sx_2, t) * M(Ax_2, Sx_2, t) * M(Bx_1, Tx_1, t) * M(Bx_1, Sx_2, (1+q)t) \\
 &\quad * M(Ax_2, Tx_1, qt)
 \end{aligned}$$

and

$$\begin{aligned}
 &N(Ax_2, Bx_1, kt) \\
 &\leq N(Tx_1, Sx_2, t) \diamond N(Ax_2, Sx_2, t) \diamond N(Bx_1, Tx_1, t) \diamond N(Bx_1, Sx_2, (1+q)t) \\
 &\quad \diamond N(Ax_2, Tx_1, qt)
 \end{aligned}$$

$$M(y_2, y_1, kt) \geq M(y_0, y_1, t) * M(y_2, y_1, t) * M(y_1, y_0, t) * M(y_1, y_1, (1 + q)t) * M(y_2, y_1, qt)$$

and

$$N(y_2, y_1, kt) \leq N(y_0, y_1, t) \diamond N(y_2, y_1, t) \diamond N(y_1, y_0, t) \diamond N(y_1, y_1, (1 + q)t) \diamond N(y_2, y_1, qt);$$

$$M(y_2, y_1, kt) \geq M(y_2, y_1, t) * M(y_2, y_1, qt) \text{ and } N(y_2, y_1, kt) \leq N(y_2, y_1, t) \diamond N(y_2, y_1, qt)$$

$$M(y_2, y_1, kt) \geq M(y_2, y_1, qt) \text{ and } N(y_2, y_1, kt) \leq N(y_2, y_1, t)$$

Therefore $y_2 = y_1$, and so on $y_3 = y_2$; i.e the sequence converges to y_0

Since (A,S) are compatible $ASx_2 = SAx_2 \Rightarrow ABx_1 = SBx_1$ since $Sx_2 = Bx_1$ and $Ax_2 = Bx_1$

Put $x = Bx_1, y = x_1$ in (C2)¹

$$M(ABx_1, Bx_1, kt) \geq M(Tx_1, SBx_1, t) * M(ABx_1, SBx_1, t) * M(Bx_1, Tx_1, t) * M(Bx_1, SBx_1, (1 + q)t) * M(ABx_1, Tx_1, qt)$$

and

$$(ABx_1, Bx_1, kt) \leq N(Tx_1, SBx_1, t) \diamond N(ABx_1, SBx_1, t) \diamond N(Bx_1, Tx_1, t) \diamond N(Bx_1, SBx_1, (1 + q)t) \diamond N(ABx_1, Tx_1, qt)$$

$$M(ABx_1, Bx_1, kt) \geq M(Bx_1, ABx_1, t) * M(ABx_1, ABx_1, t) * M(Bx_1, Bx_1, t) * M(Bx_1, ABx_1, (1 + q)t) * M(ABx_1, Bx_1, qt)$$

and

$$N(ABx_1, Bx_1, kt) \leq N(Bx_1, ABx_1, t) \diamond N(ABx_1, ABx_1, t) \diamond N(Bx_1, Bx_1, t) \diamond N(Bx_1, ABx_1, (1 + q)t) \diamond N(ABx_1, Bx_1, qt)$$

$$M(ABx_1, Bx_1, kt) \geq M(ABx_1, Bx_1, qt) \text{ And } N(ABx_1, Bx_1, kt) \leq N(ABx_1, Bx_1, qt) \text{ since } 0 < k < q$$

Therefore $ABx_1 = Bx_1$. Hence Bx_1 is fixed point of A.

Since (B, T) are compatible $BBx_1 = TBx_1$ (since $Bx_1 = Tx_1$)

Therefore $SBx_1 = ABx_1 = Bx_1 \Rightarrow Bx_1$ is a fixed point of S. But $Ax_0 = Tx_1 = Bx_1 = Sx_2 = Ax_2$ and $ABx_1 = Bx_1$.

$$\Rightarrow ATx_1 = Tx_1, ASx_2 = Sx_2; AAx_2 = Ax_2, AAx_0 = Ax_0$$

Now put $y = Bx_1$ and $x = Bx_1$, in (C2)¹ put $x = y$, then

$$M(ABx_1, BBx_1, kt) \geq M(TBx_1, SBx_1, t) * M(ABx_1, SBx_1, t) * M(BBx_1, Tx_1, t) * M(BBx_1, SBx_1, (1 + q)t) * M(ABx_1, TBx_1, qt)$$

and

$$N(ABx_1, BBx_1, kt) \leq N(TBx_1, SBx_1, t) \diamond N(ABx_1, SBx_1, t) \diamond N(BBx_1T, Bx_1, t) \diamond N(BBx_1, SBx_1, (1+q)t) \diamond N(ABx_1, TBx_1, qt)$$

$$M(Bx_1, BBx_1, kt) \geq M(TBx_1, SBx_1, t) * M(Bx_1, SBx_1, t) * M(BBx_1T, Bx_1, t) * M(BBx_1, SBx_1, (1+q)t) * M(Bx_1, TBx_1, qt)$$

and

$$N(Bx_1, BBx_1, kt) \leq N(TBx_1, SBx_1, t) \diamond N(Bx_1, SBx_1, t) \diamond N(BBx_1T, Bx_1, t) \diamond N(BBx_1, SBx_1, (1+q)t) \diamond N(Bx_1, TBx_1, qt)$$

$$M(Bx_1, BBx_1, kt) \geq M(Bx_1, TBx_1, qt) \text{ and } N(Bx_1, BBx_1, kt) \leq N(Bx_1, TBx_1, qt)$$

$$M(Bx_1, BBx_1, kt) \geq M(Bx_1, BBx_1, qt) \text{ and } N(Bx_1, BBx_1, kt) \leq N(Bx_1, BBx_1, qt)$$

Therefore $BBx_1 = Bx_1$. Hence Bx_1 is a fixed point of B. Similarly Bx_1 is affixed point of T.

Therefore Bx_1 is a common fixed point for A, B, S and T and we are through.

CASE II Assume that $y_n \neq y_{n+1} \forall n$. Then

$$M(y_{m+1}, y_m, kt) \geq M(y_m, y_{m-1}, qt) \text{ and } N(y_{m+1}, y_m, kt) \leq N(y_m, y_{m-1}, qt)$$

By continuing, from Lemma 2.1.3 $\{y_n\}$ is convergent. Let $\{y_n\} \rightarrow z$.

Now suppose (A, S) is compatible and S is continuous then by Lemma 3.1 A and S are reciprocally continuous so that $ASx_n \rightarrow Az$ and $SAx_n \rightarrow Sz$

As (A, S) is compatible, we have

$$\lim_{n \rightarrow \infty} M(ASx_n, SAx_n, t) = 1 \text{ and } \lim_{n \rightarrow \infty} N(ASx_n, SAx_n, t) = 0$$

$$\lim_{n \rightarrow \infty} M(Az, Sz, t) = 1 \text{ and } \lim_{n \rightarrow \infty} N(Az, Sz, t) = 0$$

Hence $Az = Sz$. Since $A(X) \subset T(X)$ there exists $p \in X$ such that $Az = Tp = Sz$

In (C2)¹ put $x = z$ and $y = p$

$$M(Az, Bp, kt) \geq M(Tp, Sz, t) * M(Az, Sz, t) * M(Bp, Tp, t) * M(Bp, Sz, (1+q)t) * M(Az, Tp, qt)$$

and

$$N(Az, Bp, kt) \geq N(Tp, Sz, t) \diamond N(Az, Sz, t) \diamond N(Bp, Tp, t) \diamond N(Bp, Sz, (1+q)t) \diamond N(Az, Tp, qt)$$

$$M(Az, Bp, kt) \geq M(Az, Bp, t) \text{ and } N(Az, Bp, kt) \leq N(Az, Bp, t) \forall t > 0$$

Therefore $Az = Bp$, thus $Az = Bp = Sz = Tp$.

In (C2)¹ put $x = Az$; $y = p$

$$\begin{aligned} M(AAz, Bp, kt) &\geq M(Tp, SAz, t) * M(AAz, Sz, t) * M(Bp, Tp, t) * M(Bp, SAz, (1 + q)t) \\ &* M(AAz, Tp, qt) \end{aligned}$$

and $N(AAz, Bp, kt) \geq N(Tp, SAz, t) \diamond N(AAz, SAz, t) \diamond N(Bp, Tp, t) \diamond N(Bp, SAz, (1 + q)t) \diamond N(AAz, Tp, qt)$

$$M(AAz, Bp, kt) \geq M(Tp, SAz, t) * M(AAz, Bp, qt)$$

$$N(AAz, Bp, kt) \leq N(Tp, SAz, t) \diamond N(AAz, Bp, qt)$$

$$M(AAz, Bp, kt) \geq M(AAz, Bp, qt) \text{ and } N(AAz, Bp, kt) \leq N(Bp, AAz, t)$$

Then $AAz = Bp = Az$ implies $AAz = Az = SAz$. Therefore Az is a common fixed point for A and S

Similarly by (C2)¹ we get that Az is a common fixed point of B and T . Hence Az is a common fixed point of A, B, S and T .

Uniqueness: Let x and y be two fixed points of A, B, S and T . Then by (C2)¹

$$M(Ax, By, kt) \geq M(Ty, Sx, t) \text{ \& } N(Ax, By, kt) \leq N(Sx, Ty, qt)$$

Therefore $x = y$.

Now we show that the result of Manro [12] follows as a corollary of our theorem

Corollary 3.1: If (C2) in Theorem 2.1 is replaced by (C2)¹ in theorem 3.1, then A, B, S and T have unique fixed point.

Proof: Since (C2) implies (C2)¹ the result follows.

Note: It may be noted that the pointwise R-weak commutativity of the pairs (A, S) and (B, T) imposed in theorem 2.1 is successfully avoided.

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STUDIES ON POLYESTER ELASTOMERS USING PALM OLEIN FOR DRUG DELIVERY

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ABSTRACT

The objective of this study is to assess whether a biodegradable elastomer, poly(1,2-ethanediol-co-polyol citrate) and poly(1,6-hexanediol-co-polyol citrate), would be a suitable material to engineer elastomeric scaffolds for cartilage tissue engineering. Polyester elastomers obtained from palm olein are biopolymers in the sense that they are generated from renewable natural sources. In this work, polyesters were obtained by thermal poly condensation method on the effect of palm olein-derived polyols with non-toxic monomers such as citric acid, 1,6-hexanediol, 1,2-ethanediol without addition of catalyst or solvents. The prepared epoxy resin and polyol were characterized using FT-IR and ¹H-NMR. Newly synthesized polyesters were characterized by FT-IR, ¹H-NMR, Solubility studies, TG-DTA, SEM analysis, Soil burial method and mechanical analysis. These polyesters exhibit wide range of mechanical and degradation profiles that can be tuned by the choice of monomers.

KEY WORDS : palm olein; epoxidation; polyol; biopolyester; tissue engineering

1.0 INTRODUCTION

Palm olein is a liquid fraction of palm oil consists of mainly mono-unsaturated triacylglycerol (TAG), POP (42.8%) and di-unsaturated TAG, POO (35.7%). Epoxidation is a simple and efficient method for introducing a new reactive group and useful properties and wide use in a variety of applications. Due to the high reactivity of the oxirane ring, epoxides can also act as raw materials for synthesis of polyesters [1]. Synthetic polyesters have become an integral part of various biomedical and engineering fields, such as tissue scaffolding and therapeutic delivery. In recent years, biodegradable polyesters have attracted much attention as green materials in biomedical engineering, soft tissue engineering and drug delivery, where cell-seeded constructs are designed to replace damaged or diseased tissues [2, 3]. Vegetable oils are excellent renewable source of raw materials for the manufacture of polyesters have high strength, stiffness, environmental resistance and long life [4]. Citric acid was chosen as a multifunctional monomer to enable network formation. It was found that the citric acid can be reacted with a variety of hydroxyl containing monomers at relatively mild conditions [5]. Mean while, it can also participate

in hydrogen bonding interactions within a polyester network [6]. This work refers initially bio-polyesters have the advantage of mimicking many features of extracellular matrix and the polymerization of palm olein via peroxide linkages during the use of this polymeric peroxide in the polymerization of ethylene glycol to obtain palm olein derived polyols refers to conversion of double bonds to hydroxyl groups [7]. Herein we report the synthesis and studies of polyesters: Poly (1,2-ethanediol-co-polyolcitrate) (PPEC) and Poly (1,6-hexanediol-co-polyolcitrate) (PPHC).

2.0 EXPERIMENTAL

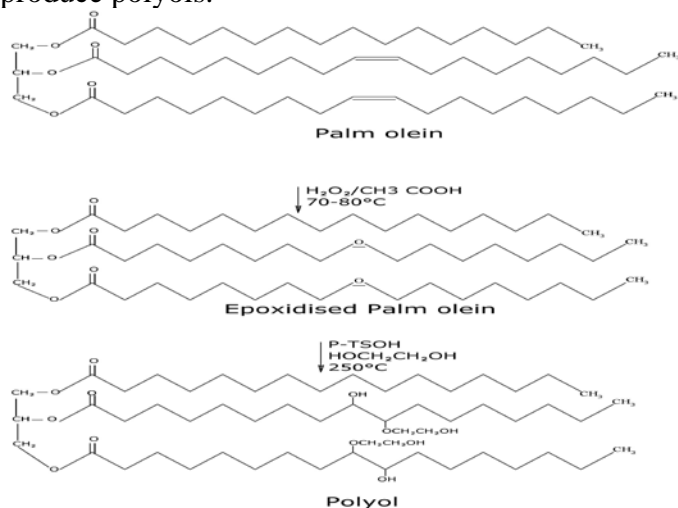
2.1 MATERIALS AND METHODS

The oil used in this study was food grade (Gold Winner) refined palm olein commercially available in supermarkets. Citric acid (100%), H₂O₂ (99.9%), glacial acetic acid(100%) were purchased from Sigma Aldrich chemical Co. and used as such. 1,6-hexanediol and 1,2-ethanediol (100%) monomers were supplied by Sigma Aldrich Co. and used as such.

2.2 PREPARATION OF EPOXIDISED PALM OLEIN

Palm olein was epoxidised using glacial acetic acid with H₂O₂ (50%) were placed in a 250 ml round bottomed flask and the mixture was heated

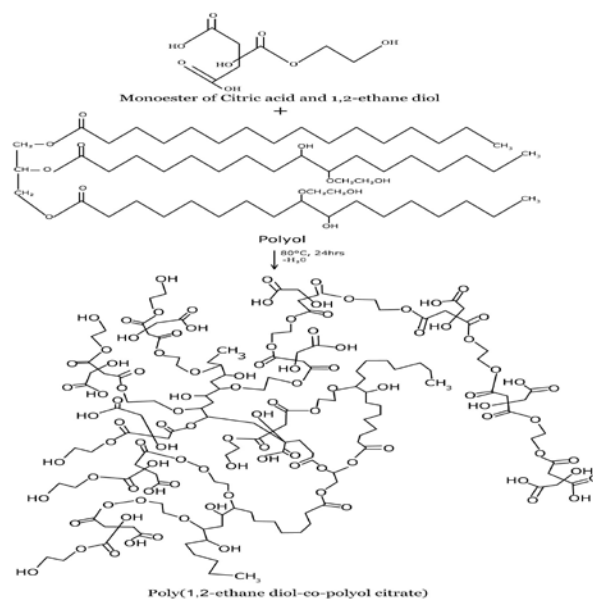
upto 70°C - 80°C for 10h. In order to remove excess H₂O₂, warm water was added to the mixture and the organic phase of the mixture was separated using separating funnel and were collected in a beaker. Thus obtained epoxidised palm olein were treated with ethylene glycol in presence of p-toluenesulphonic acid at 250°C to produce polyols.



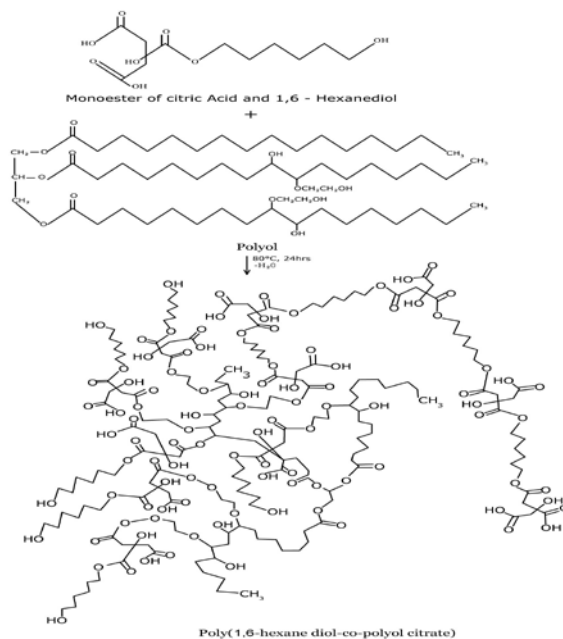
Scheme 1. Synthesis of Polyol from Palm Olein

2.3 SYNTHESIS OF POLYESTERS

Synthesis of aliphatic polyesters was carried out by two stage thermal poly condensation technique. At first stage a prepolymer was prepared by carrying out equimolar amount of diol and acids were placed in a 250 ml round bottomed flask and the mixture was heated upto 140°C -145°C for 30 minutes under a constant stream of nitrogen. At second stage the resultant prepolymer was postpolymerized by crosslinking with polyol at different molar ratios, films were cast into glass plate and placed in an air oven maintained at 80°C for 24 h, polyesters were obtained.



Scheme 2. Synthesis of Poly (1, 2-ethanediol-co-polyol citrate)



Scheme 3. Synthesis of Poly (1, 6-hexanediol-co-polyol citrate)

2.4 POLYMER CHARACTERISATION

Fourier transform infrared (FTIR) spectra of polymers were obtained using THERMO NICOLET, AVATAR 370 FTIR SPECTROMETER with KBR crystal in the range of 4000 - 400 cm⁻¹ at 27°C. The ¹H-NMR spectra for epoxy resin, polyols and pre-polymers were dissolved in DMSO and recorded using BRUKER AVANCE III, 400 MHz FT NMR SPECTROPHOTOMETER. The chemical shift

in ppm for ^1H NMR Spectra were obtained relative to TMS as internal reference. TG/DTA thermo grams of the post-polymers were obtained at a scanning speed of $10^\circ\text{C min}^{-1}$ in the range of $40^\circ\text{C} - 700^\circ\text{C}$ under the flow of nitrogen gas using PERKIN ELMER, DIAMOND TG/DTA. The SEM analysis of the post polymers were obtained using JOEL MODEL JSM 6390 LV at $5 \times$ to $300,000 \times$ SEI magnification. The mechanical property of polyester films were measured using the UTM equipped with 500N load cell. The dog bone shaped polymer film strips were cut according to ASTM standard ($45 \times 5 \times 2\text{mm}$, length \times width \times thickness) and pulled at a strained rate of 10 mm min^{-1} . Values obtained were used to construct stress strain curve. Young's modulus were calculated from the initial slope of the curve.

2.5 SOIL BURIAL METHOD

Garden soil (1200 g) was taken in different pots. A weighed amount (0.5 g) of each of the samples that is, PPEC and PPHC were placed in the beaker such that the soil covered the polymer from all the sides. The pots were covered with the aluminum foil and kept at room temperature. The weight of all the samples PPEC and PPHC were taken at regular interval of time (10 days) to check for any weight loss. Percent weight loss as a function of number of days was determined as total percent weight loss after 2 months was calculated as:

$$\% \text{ Weight loss} = \frac{\text{Initial weight at the beginning} - \text{Final weight after ten days}}{\text{Initial weight at the beginning}} \times 100\%$$

Weight Loss after every 10 days =

$$\frac{\text{Initial weight before ten days} - \text{Final weight after ten days}}{\text{Initial weight before the 10 days}} \times 100$$

2.6 SOLUBILITY STUDIES

The solubility content of the polyesters was measured in various organic and inorganic solvents. Cylindrical disc of about 7cm were cut using cork borer from cross linked polymer film. The discs were pre-weighed to know the initial mass (W_0) and suspended into 15 ml of solvent

at room temperature (27°C). The films were removed from the solvent after one week blotted dry with filter paper and weighed (W_s). The dried samples were weighed to find the dry mass (W_d). The sol-gel fraction was calculated using the formula:

$$\text{Sol}\% = [(W_0 - W_D) / W_D] \times 100$$

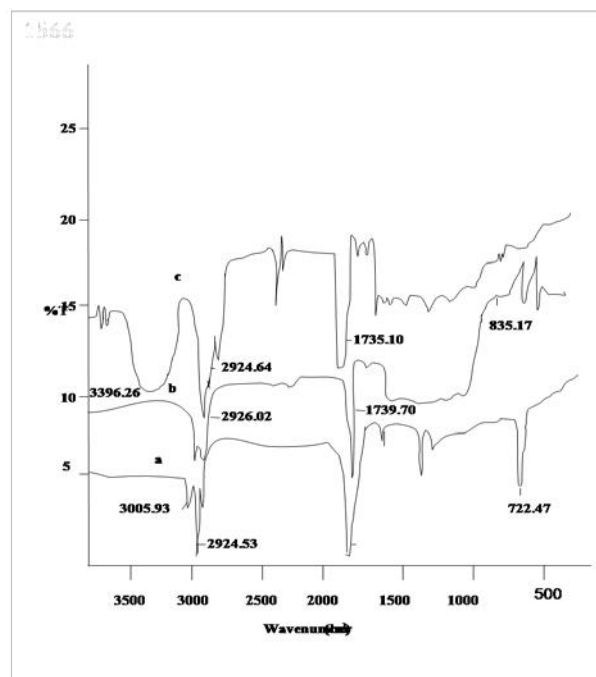


Fig 1. FTIR spectra of Palm Olein (a) Epoxidised Palm Olein (b) and Polyol (c)

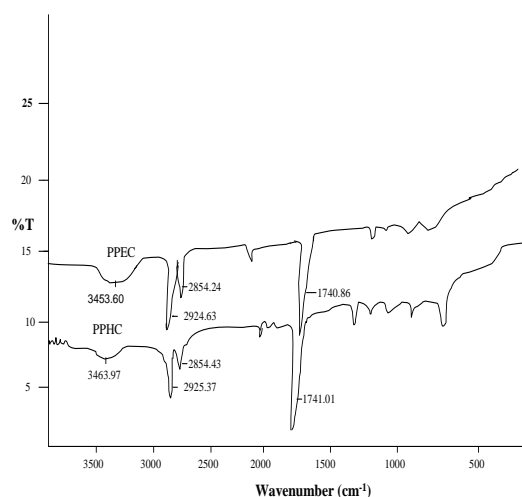


Fig 2. FTIR spectra of PPEC and PPHC

3.0 RESULTS AND DISCUSSIONS

3.1 FT-IR ANALYSIS

The FT-IR Spectra of palm olein, epoxidised palm olein and the prepared polyol are shown in

fig.1. As can be noted, the signature of the double bonds, C=C-H stretch at 3005.93 cm^{-1} and C=C stretch at 1463.14 cm^{-1} completely disappear in the epoxidised oil. The spectra of epoxidised oil clearly shows the epoxy groups C-O band at 835.17 cm^{-1} . The other peaks are 724.54 (methylene in-phase rocking), 1170.54 (ester, antisymmetric stretch), 1458.51 (methyl antisymmetric deformation) and 1739.07 (esters, aliphatic C=O stretch) cm^{-1} . The epoxy group (C-O band at 835.17 cm^{-1}) disappear in the spectra of polyol, confirming the oxirane opening [8]. Most importantly, the spectra of polyol shows broad hydroxyl stretching peak at around 3396.26 cm^{-1} , confirming the incorporation of the hydroxyl groups. The FTIR spectra of all the synthesized prepolymers and polyesters show a strong absorption band at around 1740.86 cm^{-1} , 1741.01 cm^{-1} (esters, aliphatic C=O stretch) thus confirmed the formation of polyesters [9,10] are shown in Fig 2. The bands shows at around 1173.27 cm^{-1} , 1171.06 cm^{-1} were assigned to C-O stretching of ester group. The band shows at 1462.42 cm^{-1} due to aliphatic C-C stretching. The band shows at 2854.24 cm^{-1} , 2924.63 cm^{-1} , 2854.43 cm^{-1} and 2925.37 cm^{-1} were assigned to methylene (-CH₂-) groups for the diacids/diols and aliphatic C-H stretching of the polyesters. The broad stretch at 3453.60 and 3463.97 cm^{-1} was attributed to the stretching vibrations of the hydrogen bonded carboxyl and hydroxyl groups [11, 12].

3.2 ¹H-NMR ANALYSIS

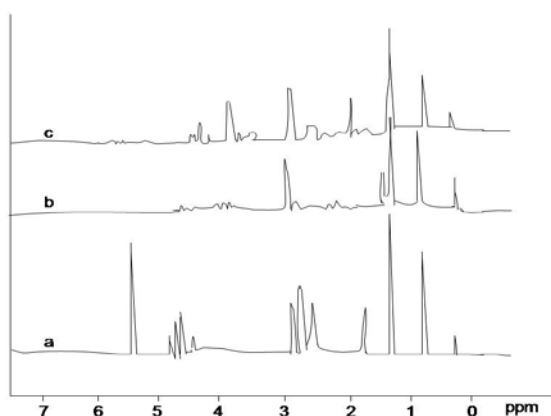


Fig 3. ¹H-NMR Spectra of Palm Olein (a),

Epoxidised Palm Olein (b) and Polyol (c)

The ¹H-NMR spectra recorded from palm olein, epoxidised palm olein and polyol are shown in Fig 3. The spectra shows the double bond hydrogen olefinic proton (-H-C=C-H-) between 5.2 - 5.4 ppm. This peak almost disappeared for epoxidised palm olein due to the conversion of double bonds from palm olein [13]. The peak at 5.2 - 5.4 ppm is observed to almost disappear in the spectra of polyol and it shows appearance of new peaks between 3.6 - 4.27 ppm correspond to the methylinic proton (-H-C-OH) and the proton associated with -OH groups [14].

3.3 THERMAL ANALYSIS

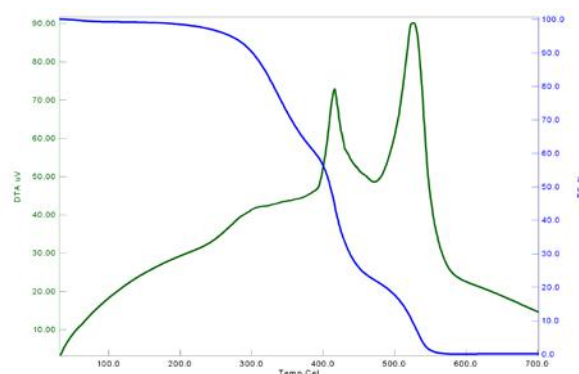


Fig 4. TG/DTA thermogram of PPEC

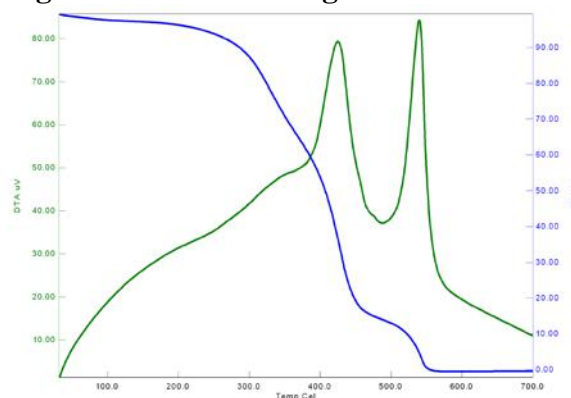


Fig 5. TG/DTA thermogram of PPHC

Figures 4 and 5 reveals the TG/DTA thermogram of polyesters PPEC and PPHC. In the TGA trace of polyesters PPEC and PPHC, the first mass loss upto 5% corresponds to dehydration and is complete around 250°C and the second stage decomposition takes place between 250°C and 500°C [15]. The weight loss around 100% in the last stage of thermal degradation may be due to the depolymerisation. Differential thermal analysis shows two isotherms a weak one around

400°C and a strong one around 550°C. The thermal studies showed that the synthesized polyesters were thermally stable.

3.4 SEM ANALYSIS

Scanning electron micrograph of PPEC and PPHC at x3000 magnification represented in figures 6 and 7 respectively. Surface sem images of the polyesters are homogeneously distributed which can be attributed to the well adhesion of the cells on the surface and so it meet the varying requirements of biomedical field [16, 17].

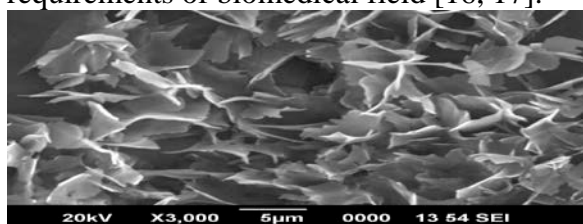


Fig 6. SEM image of PPEC before Soil Burial

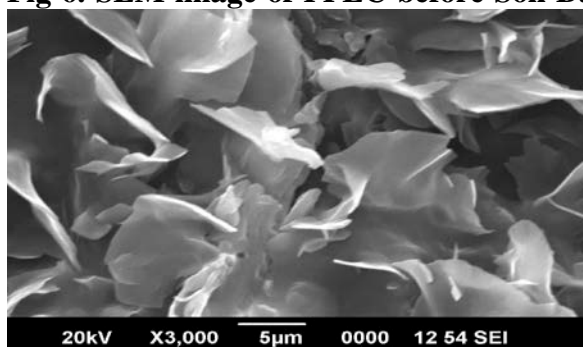


Fig 7. SEM image of PPHC before Soil Burial

3.5 SOLUBILITY STUDIES

The polyesters PPEC and PPHC are soluble in chloroform, carbon tetrachloride and sodium hydroxide. The prepared polyesters are insoluble in hexane, ethanol and acetone. The low sol content indicates the successful incorporation of crosslink network during post polymerization, since inter- molecular forces and strong hydrogen bonding exist in the polyesters as evidenced by FTIR analysis [10].

3.6 SOIL BURIAL METHOD

Scanning electron micrograph of PPEC and PPHC at x3000 magnification represented in figures 8 and 9 respectively. After two months of

soil burial, the sem images of the polyesters were unevenly distributed and also increases the gap when compared to fig 6 and 7. The polyesters PPEC degraded faster than PPHC. This was due to diols with decreasing number of methylene units faster the degradation rate [18, 19].

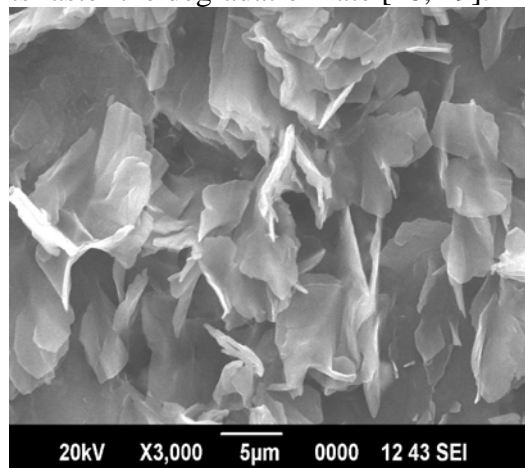


Fig 8. SEM image of PPEC after Soil Burial

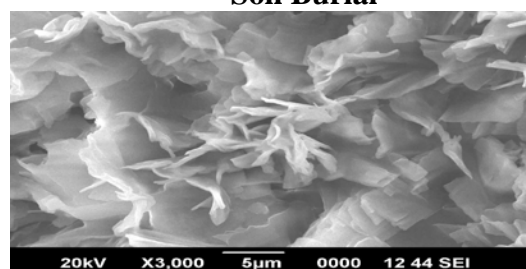


Fig 8. SEM image of PPHC after Soil Burial

3.6 MECHANICAL ANALYSIS

The mechanical properties of PPEC and PPHC were evaluated in Table1. The mechanical properties of amount of citric acid increased, the ultimate tensile strength and young's modulus increases and elongation at break decreases. This explains a strong hydrogen bonding between -COOH and -OH group contribute to the strength of the elastomer. From Table 1, the sample PPEC possess more elastomeric than PPHC due to higher percentage of elongation.

Table 1. Mechanical Properties of PPEC and PPHC (Ratio = polyol : prepolymer)

Name of the Polyesters	Ratio	Tensile Strength (MPa)	Elongation at Break (%)	Young's Modulus(MPa)
------------------------	-------	------------------------	-------------------------	----------------------

	1:1	0.823	59.7	1.378
PPEC	1:2	0.853	57.5	1.483
	1:2.5	0.876	56	1.564
	1:1	0.914	55.1	1.658
PPHC	1:2	0.952	52.8	1.803
	1:2.5	0.990	48.8	2.028

3.7 ANTIMICROBIAL ACTIVITY

Antimicrobial activity of polyesters do not show any activity against to test bacteria and fungi. This may be due to the presence of electron releasing group and cannot readily diffuse across the bacterial cell walls [20].

4.0 CONCLUSION

Citric acid-based biodegradable polyesters namely Poly(1,6-hexanediol-co-polyol citrate) and Poly(1,2-ethanediol-co-polyol citrate) were synthesized by melt condensation technique without using any catalysts. The thermal studies revealed that the elastomers were thermally stable. The thermal and mechanical properties of the polyesters showed that PPHC had better crosslinking than that of PPEC. The sem images shows that the samples can be used in tissue engineering due to their cell adhesion. The two copolyesters were found to be freely soluble in chloroform, carbon tetrachloride and sodium hydroxide. The prepared polyesters are insoluble in water, hexane, ethanol and acetone. Thus it is indicated that the choice of monomers influence the physical properties of the elastomers so it can potentially meet the requirements of various biomedical applications.

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Design, Analysis and Weight Optimization of Belt Conveyor for Sugarcane Industries

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ABSTRACT:

The aim of this thesis is to study existing conveyor system and optimize the critical parts like Roller, Support Bracket, Roller Shaft, Base frame to minimize the overall weight of assembly and material saving. Thesis also involves geometrical and finite element modelling of existing design and optimized design. Geometrical modelling was done by using CATIA V5 R20 and finite modelling was done by using ANSYS14.5. Results of Linear static analysis of existing design and optimized design are compared to prove design is safe. Optimization gives optimum design for same loading condition with huge amount of weight reduction. Using this procedure and using practical available structure 39.25% weight reduction is achieved.

Key Words: Optimized design, Weight reduction, material handling systems.

1. Introduction:

Material handling is an important sector of industry, which is consuming a considerable proportion of the total power supply. For instance, material handling contributes about 10% of the total maximum demand in India. Belt conveyors are being

employed to form the most important parts of material handling systems because of their high efficiency of transportation. Conveyors are able to safely transport materials from one level to another, which when done by human labor would be strenuous and expensive. They can be installed almost anywhere, and are much safer than using a forklift or other machine to move materials. They can move loads of all shapes, sizes and weights. Also, many have advanced safety features that help prevent accidents.

There are a variety of options available for running conveying systems, [3] including the hydraulic, mechanical and fully automated systems, which are equipped to fit individual needs. Conveyor systems are commonly used in many industries, including the automotive, agricultural, computer, electronic, food processing, aerospace, pharmaceutical, chemical, bottling and canning, print finishing and packaging. Although a wide variety of materials can be conveyed, some of the most common include food items such as beans and nuts, bottles and cans, automotive components, scrap metal, pills

Sr.	Component	Material	Qty.
1	Rollers	Mild Steel	22
2	Rollers Shafts	Mild Steel	22
3	Bearings	STD	44
4	Support Brackets	Mild Steel	44
5	Base frame	C-10	-

and powders, wood and furniture and grain and animal feed.

1.1 Principle of working:

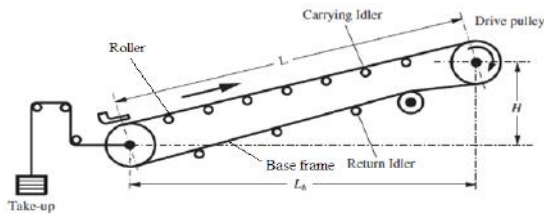


Fig. 3.1 Profile of Belt conveyors

Belt conveyor is commonly used equipment for continuous transport, as it has a high efficiency, large conveying capacity, simpler construction, small amount of maintenance. Such type of conveyors are used in sugarcane industries for transportation purpose in this project we did work on the various parts of conveyor for the **Shreenath Mhaskoba Sakhar Karkhana Ltd.,A/P Patethan,Tal-Daund.**

2. Problem statement

The aim of this project is to redesign existing belt roller conveyor system by designing the critical parts (Roller, Shaft,

Bearing & Frame), to minimize the overall weight of the assembly and to save considerable amount of material.

Table No. 2.1 Critical components for design

3. Objective of the Study:

The following are the objectives of the study:

1. Check design of existing conveyor system.
2. ANSYS APDL codes applied for linear static, modal, transient and optimization analysis.
3. Simulations for linear static Analysis.
4. Simulations for Modal Analysis.
5. Optimization of conveyor assembly for weight reduction.
6. Comparison between existing and optimized design.

4. Design and Study of the Existing Assembly of Conveyor System

4.1 Design of Roller

4.1.1 Material – MS

$E = 2.10 \times 10^5 \text{ Mpa}$, $\rho = 7860 \text{ Kg/m}^3$, $S_{yt} = 590 \text{ Mpa}$

Considering uniformly distributed load & FOS = 3

Allowable Stress (σ_{all}) = $S_{yt} / F_s = 590/2 = 196.67 \text{ Mpa}$

4.1.2 Maximum Stress Calculation for given condition

$W = 100 \text{ kg}$

$D_1 = \text{Outer diameter of roller} = 61 \text{ mm}$

$D_2 = \text{Inner diameter of roller} = 51 \text{ mm}$

$w = \text{Width of roller} = 730 \text{ mm}$

$y = \text{Distance from neutral axis} = 0.061/2 = 0.0305$

Considering uniformly distributed load,
 Maximum Moment (Mmax) = $W \cdot L^2 / 8$
 $= (100 \cdot 9.81 \cdot 0.73^2) / 8$
 Mmax = 65.35 N-m
 Moment of Inertia (I) = $\Pi (D_1^4 - D_2^4) / 64$
 $= \Pi (0.061^4 - 0.051^4) / 64$
 I = $3.476 \cdot 10^{-7} \text{ m}^4$
 Maximum bending stress $\sigma_b = M_{\max} \cdot y / I$
 $= 65.35 \cdot 0.0305 / 3.476 \cdot 10^{-7}$
 $\sigma_b = 5.74 \text{ Mpa}$

4.1.3 Checking Factor of Safety for design-

$$F_s = \sigma_{all} / \sigma_b = 196.67 / 5.74 = 34.26$$

As Calculated F_s is greater than assumed F_s , Selected Material can be considered as safe.

4.1.4 Maximum Deflection (Y_{\max}) =
 $5 \cdot W \cdot L^3 / 384EI$
 $= (5 \cdot 100 \cdot 9.81 \cdot 0.73^3) / (384 \cdot 2.10 \cdot 10^{11} \cdot 8.7179 \cdot 10^{-7})$
 $Y_{\max} = 0.1142 \text{ mm}$

As compared to length 500 mm deflection of 0.1142 mm is very negligible. Hence selected channel can be considered as safe.

4.1.5 Weight of Rollers -
 $= \text{cross-section area} \cdot \text{width} \cdot \text{mass density} \cdot \text{number of rollers}$
 $= \Pi (0.061^2 - 0.051^2) \cdot 0.73 \cdot 7860 \cdot 15 / 22$
 $= 111.039 \text{ Kg}$

Table 4.1 Total Weight of Existing Conveyor Assembly

Sr. No.	Name Of Component	Weight(Kg.) Existing Design
1	Rollers	111.039
2	Roller shaft	39.65
3	Support Bracket	13.10
4	Base frame	11.57

5	L-Support Channel	165.06
6	Bearing	4.28
	Total=	343.69

4.2 Geometric model of existing roller:

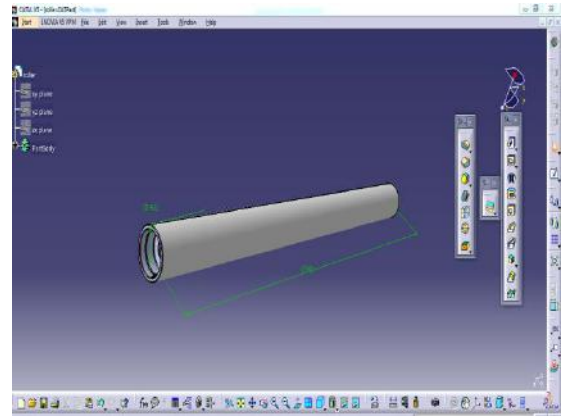


Fig. 4.1. Geometric model of existing roller

4.3 ANSYS Results for Existing roller:

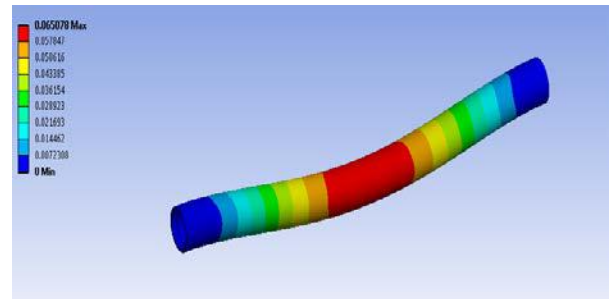


Fig.4.2. Deformation in existing roller

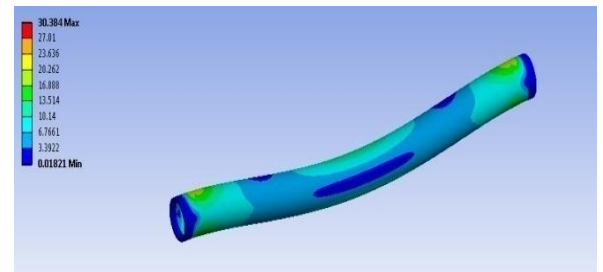


Fig.4.3. Stress on existing roller

5. Need of Optimization

As factor of safety of Rollers is very high there is scope of weight reduction in this component.

5.1 Selection of Critical Parameter

Roller Outer diameter

Roller Inner diameter

6. Design and Study of the Existing Assembly of Conveyor System

6.1 Design of Roller

6.1.1 Material – MS

$E = 2.10 \times 10^5 \text{ Mpa}$, $\rho = 7860 \text{ Kg/m}^3$, $S_{yt} = 590 \text{ Mpa}$

Considering uniformly distributed load & FOS = 3

Allowable Stress (σ_{all}) = $S_{yt} / F_s = 590/2 = 196.67 \text{ Mpa}$

6.1.2 Maximum Stress Calculation for given condition

$W = 100 \text{ kg}$

$D_1 = \text{Outer diameter of roller} = 57 \text{ mm}$

$D_2 = \text{Inner diameter of roller} = 47 \text{ mm}$

$w = \text{Width of roller} = 730 \text{ mm}$

$y = \text{Distance from neutral axis} = 0.057/2 = 0.0285$

Considering uniformly distributed load, Maximum Moment (M_{max}) = $W \cdot L^2 / 8 = (100 \cdot 9.81 \cdot 0.73^2) / 8$

$M_{max} = 65.35 \text{ N-m}$

Moment of Inertia (I) = $\Pi (D_1^4 - D_2^4) / 64 = \Pi (0.057^4 - 0.047^4) / 64$

$I = 2.35 \times 10^{-5} \text{ m}^4$

Maximum bending stress $\sigma_b = M_{max} \cdot y / I$

$= 65.35 \cdot 0.0285 / 2.35 \times 10^{-5}$

$\sigma_b = 28.374 \text{ Mpa}$

6.1.3 Checking Factor of Safety for design-

$$F_s = \sigma_{all} / \sigma_b$$

$$= 196.67 / 28.374$$

$$F_s = 6.39$$

As Calculated F_s is greater than assumed F_s , Selected Material can be considered as safe.

6.1.4 Maximum Deflection (Y_{max}) = $5 \cdot W \cdot L^3 / 384EI$

$$= (5 \cdot 100 \cdot 9.81 \cdot 0.73^3) / (384 \cdot 2.10 \cdot 10^{11} \cdot 2.35 \cdot 10^{-5})$$

$$Y_{max} = 0.1975 \text{ mm}$$

As compared to length 500 mm deflection of 0.1975 mm is very negligible. Hence selected channel can be considered as safe.

6.1.5 Weight of Rollers -

= cross-section area * width * mass density * number of rollers

$$= \Pi (0.057^2 - 0.047^2) \cdot 0.73 \cdot 7860 \cdot 15/4$$

$$= 64.3275 \text{ Kg}$$

Table.6.1. Total Weight of Existing Conveyor Assembly

Sr. No.	Name Of Component	Weight(Kg.) Optimized Design
1	Rollers	64.32
2	Roller shaft	39.65
3	Support Bracket	8.066
4	Base frame	11.57
5	L-Support Channel	165.06
6	Bearing	4.28
	Total=	282.94

6.2 Geometric model of optimized roller:

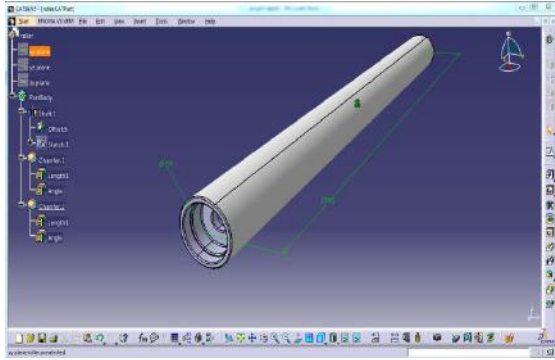


Fig. 6.1. Geometric model of existing roller

6.3 ANSYS Results for Existing roller:

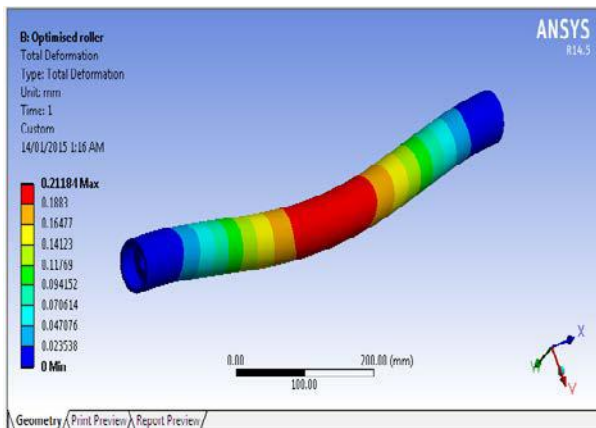


Fig.6.2. Deformation in optimized roller

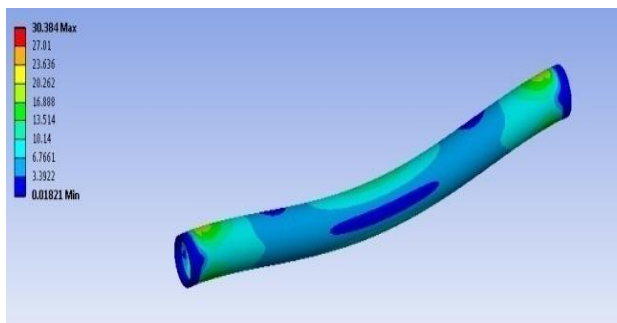


Fig.6.3. stresses of optimized roller

7. Results:

7.1 Effect of optimized design compared with existing design

Sr. No.	Name Of Component	Weight(Kg.) Existing Design	Weight(Kg.) Optimized Design
1	Rollers	111.039	64.32
2	Roller shaft	39.65	39.65
3	Support Bracket	13.10	8.066
4	Base frame	11.57	11.57
5	L-Support Channel	165.06	165.06
6	Bearing	4.28	4.28
	Total=	343.69	282.94

Design	Weight (Kg)	%Material required compared to existing design	% Material save compared to Existing design
Existing	343.69	100	--
Optimized	282.94	60.75	39.25

7.2. Weight reduction due to Optimization

8. CONCLUSIONS:

- Existing design calculations shows the factor of safety is very greater than requirement and there is a scope for weight reduction.
- Critical parameters which reduce the weight are roller, support bracket.
- Though value of deflection, stress is more in case of optimized design, but its allowable.
- 39.25% of weight reduction achieved by optimized design than existing design.
- 60.75 kg. weight reduction achieved by optimize design than existing design.

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4. D. Nazzal, J. A. Jimenez, H. J. Carlo,
A. L. Johnson, and V. Lasrado “*An
Analytical Model For Conveyor-*

RFID Technology at Central Library, IIT Madras

An Overview *By*

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Abstract: - This paper gives brief idea about the emerging Radio Frequency Identification (RFID) technology, its importance in the library management system and its working. It also describes about the basic components required for smooth working of the exercise. It outlines various advantages and disadvantages of RFID technology in libraries. Besides, it gives focus on the implementation of RFID technology at central library, IITM. This will provide new insight for other libraries to implement RFID system.

Keywords: - RFID, Components of RFID, Advantages & Disadvantages, Implementation of RFID

1. INTRODUCTION

The **Indian Institutes of Technology (IITs)** is an autonomous public institutes of higher education, located in India. They are governed by the *Institutes of Technology Act, 1961* which has declared them as "institutions of national importance", and lays down their powers, duties, framework for governance etc. The Institutes of Technology Act, 1961 lists sixteen institutes located at Kharagpur, Bombay, Delhi, Kanpur, Madras, Guwahati, Roorkee, Hyderabad, Patna, Bhubaneswar, Ropar, Jodhpur, Gandhinagar, Indore, Mandi and Varanasi. Each IIT is an autonomous institution, linked to the others through a common IIT Council, which oversees their administration. Among these above sixteen institutes the **Indian Institute of Technology, Madras** was recognised as the third Indian Institute of Technology that was established by the Government of India through an Act of Parliament, to provide education and research facilities in engineering and technology. The **Indian Institute of Technology Madras (IIT Madras)** or IIT-M is a premier autonomous public engineering and research institution located in Chennai (formerly Madras), Tamil Nadu in front of Anna University. It is recognised as an Institute of National Importance by the Government of India.

The Central Library is well equipped with modern facilities and resources in the form of CD-ROMs, On-line databases, audio video cassettes, books, e-journals, patents, e-standards, theses, reports, mono-graphs etc. The Central Library is to provide information services and access to bibliographic and full text digital and printed resources to support the scholarly and informational needs of the Institute Community. The Central Library has also implemented Integrated RFID Technology, Smart Card, ISO-9001:2000 Standards, Contactless Smart Card Enabled Access Control System, Virtual Reference Desk, Electronic Book Drop System, Auto Check in and Check out Systems, Z39.50, Web Portal, Research Carrels, Media Resource Centre with 200 seating capacity, Students Discussion Hall, Automatic Bindery and world-class facilities, services, multi format resources. The various services includes OPAC, Self Check in/Check out, Self-Renewal of Books, Electronic Book Drop, Book Bank, Access to Abstracts of Publications through I-Portal, Translation, Book Reservation, Video Viewing, Inter- Library loan, Document Delivery, Reading, Access to E-Resources, Bibliographical Compilation, Patents Information, Standards Information Service, Technical Consultancy, Photocopying, JCCC.

2. INTRODUCTION TO RFID TECHNOLOGY

RFID (Radio Frequency Identification) invented in 1969, patented in 1973, first used in harsh industrial environment in 1980s', and standards presented in 2001, is the latest addition of technology to be used in the libraries for a combination of automation and security activities in the well maintenance of documents either inside the library or goes out-of library. RFID uses wireless radio communications to uniquely identify objects or people, and is one of the fastest growing automatic data collection (ADC) technologies, which is comprising one or more reader/interrogators and RF transponders in which data transfer is achieved by means of suitably modulated inductive or radiating electro-magnetic carriers.

RFID is a combination of radio-frequency and microchip. RFI chips are of particular interest, because they have become smaller and smarter to the point where they can be added every kind of document and can be read and updated from a distance .

RFID is an innovative automated library system for automatic identification and tracking of library material. It is combination of radio-frequency-based technology and microchip technology and can be used to identify, track, sort or detect library holdings. This is an

effective way of managing collections of the library and providing enhanced services to the users having benefits like: to control increasing theft, to find misplaced reading material, inventory accuracy, stock verification procedures, security control, etc. It is an automatic data capture technology that uses tiny microchips and miniature antennas affixed to products. RFID plays a vital role in redefining the library processes to make everyone's job easier right from the users to library staff. It provides a platform to automate most of the processes performed by the library staff like check in-check out, sorting, stock management, etc. An RFID system consists of three components: a tag (or multiple tags), a reader or interrogator and the necessary supporting infrastructure (both hardware and software). An RFID reader, or interrogator, is a device to communicate with the RFID tag. It also broadcasts a radio signal, which is received by the tag. The tag then transmits its information back to the reader. Readers can either be portable handheld terminals or fixed devices that can be positioned at strategic places.

The main aim for today's libraries in adopting RFID is to improve library operations by increasing the efficiency of library transactions, reducing workplace injuries, and improving services for library users. Library manpower can be utilized to provide more value added services. RFID enables savings in costs-materials and manpower and ensures more efficient operations. RFID helps the librarian in providing the users with optimum utilization of available resources.

3. RFID CONCEPTS

RFID is an acronym for radio frequency identification, which is a wireless communication technology that is used to uniquely identify tagged objects. (Daniel et al., 2007)

According to Wikipedia, Radio-Frequency Identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID. (www.wikipedia.com)

Technovelgy.com has defined RFID as a small electronic device that consist of a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes of data or less. (www.technovelgy.com).

According to Automatic Identification and Data Capture (AIDC), "Radio Frequency identification is a technology that uses radio waves to transfer data between a reader and an

electronic tag which is attached to a particular object. Typical uses are for object identification and tracking".

According to Harrods's Librarians' Glossary and Reference Book, "Radio Frequency Identification, an alternative to the Bar Code that uses tiny microchips in tags to hold and transmit detailed data about the item tagged. RFID has advantages over bar codes such as the ability to hold more data, the ability to change the stored data as processing occurs, it does not require line-of-sight to transfer data and is very effective in harsh environments where bar code labels may not work". RFID thus is a generic term for technologies that use radio waves to automatically identify people or objects.

Radio frequency identification is a system that facilitates the tracking of objects, primarily for inventory tracking, via a three part technology comprised of a reader, a transceiver with decoder and a transponder (Radio Frequency-Tag). RFID is a wireless system that works in conjunction with an organization's information technology infrastructure to improve business processes such as inventory management and efficiency in supply chain management (Nisha et al., 2006).

Hence, RFID is a means of identifying a person or object using a radio frequency transmission. These wireless automatic identification data capture system allows for noncontact reading or writing of data and are highly effective in environments where barcode labels cannot survive. "RFID is a combination of radio frequency based and microchip technology. An RFID system consists of an antenna and a transceiver, which read the radio frequency and transfer the information to a processing device, and a transponder, or tag, which is an integrated circuit containing the Radio Frequency circuitry and information to be transmitted.

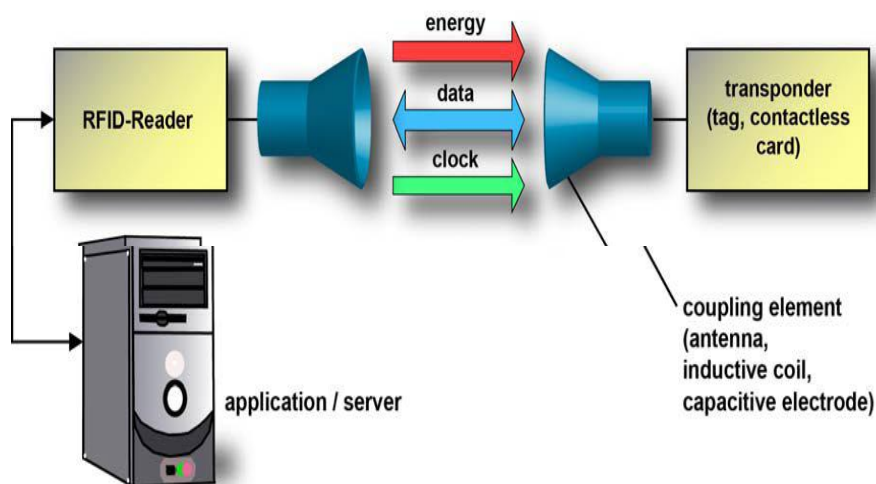
4. COMPONENTS OF RFID SYSTEM

RFID system has mainly four components:

- **RFID Tag:** An RFID tag is a tiny radio device that is also referred to as transponder, smart tag, smart label, or radio barcode. There are two main components present in the RFID tag. Firstly, a small silicon chip or integrated circuit which contains a unique identification number (ID). Secondly, an antenna that sends and receives radio

waves. The antenna consists of a flat, metallic conductive coil and the chip which is less than half a millimetre. Tags are of three basic types: Passive, Active & Semi-passive tags. They can also be read-only or provide read-write capability.

- **Readers and Antenna:** The second component in a basic RFID system is the interrogator or reader. Technically, reader units are transceivers (i.e., a combination of transmitter and receiver) and their usual role is to query a tag and receive data from it. RFID reader converts radio waves from RFID tags into a form that can be passed to middleware software. An RFID tag reader use antennas to communicate with the RFID chip. It can read information stored in the RFID tag and also update RFID tag with the new information. Hence, RFID reader accomplishes two tasks: it receives commands from the application software and communicates with tags.
- **Middleware:** Both middleware and software applications are required in an RFID environment. Middleware manages the flow of information between the readers and the backend. In addition to extracting data from the RFID tags and managing data flow to the backend, middleware perform functions such as basic filtering and reader integration and control. RFID middleware assist with retrieving data from readers, filtering data feeds to application software, generating inventory movement notifications, monitoring tag and reader network performance, capturing history and analyzing tag-read events for application tuning and optimization.
- **Server:** A server may be configured with an RFID system. It is a communication gateway among the various components. It receives the information from one or more readers and checks the information against its own database or exchanges information with the circulation database of the library integrated management system. The server typically includes a transaction database so that the reports can be produced.



5. LITERATURE REVIEW

A **literature review** is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Radio Frequency Identification (RFID) is an upcoming technology which has recently attracted the interest of the research community because of the extraordinary benefits it offers over the other existing identification and data capturing technologies.

A significant number of RFID studies were devoted to the technical improvement of RFID technologies. Mechanisms to reduce collision among RFID readers in dense and dynamic RFID environments suggested by Eom, et al (2009), Hsu, et al. (2009) and Chen, et al. (2009). Lin and Ho (2009) suggested that there is a positive relationship between the willingness to adopt RFID technology and supply chain performance for logistics service providers. Lee et al. (2009) developed a framework for automating the processes in a manufacturing environment using RFID. Venable (2006), Pries-Heje, Baskerville and Venable (2008) pointed out that that design science research has two primary forms: artificial and naturalistic evaluation. Artificial evaluation evaluates a solution technology in a contrived and nonrealistic way, while naturalistic evaluation explores the performance of a solution technology its real environment. It was also highlighted that naturalistic evaluation is critical as it tests the —real proof the pudding. This concept is in harmony with this paper as it describes a set of experimental procedures to evaluate the performance of a RFID reader in

its operating environment. Curran and Porter (2007) have proposed and outlined a library prototype that utilizes Radio Frequency Identification (RFID) to enhance and speed up the current customer book search and identification processes. The hardware used in the design and implementation of the prototypes are a laptop to host the server, a router to create the wireless network, a PDA to host the applications, RFID tags and an RFID reader to carry out the RFID communication. The user can search for a book on the shelf by entering the book information in any of the search criteria text boxes and pressing the Search button. The system has to search the database to return the appropriate book. The functionality and benefits offered by the RFID systems match the needs and areas of improvement for libraries. The development and evaluation of the library application has demonstrated that RFID can be successfully integrated into library systems. Dai Yu (2011) in his case study on the Turku City Library on implementing RFID Technology in Library Systems focused on the management aspect of a library particularly the self service support system for patrons by introducing RFID system. Based on a comparative study between the barcode and RFID applications, it is stressed on the many benefits of RFID. However, challenges are many and are pointed out as those of tracking and hot listing. Moreover, depending on the strength of the RFID reader it is possible to either greatly hinder or completely block the tag signal by wrapping an item, embedded with several layers of aluminum or tin foil. This combined with a weak gate sensor, makes risk of item getting stolen quite high. Syed Md Shahid (2005) considers RFID applications in circulation, tracking, inventorying and security of library materials as well as discusses on the various components of the RFID system in details followed by its installation features. At the same time, he states that it is important to educate library staff and library users about RFID technology before implementing a program.

Serge Vaudenay (2001) deals in preparing a model based purely on the security and privacy of the RFID tags and assumes a powerful adversary who can control all communications mandating the use of some public key cryptography techniques while discussing on tag corruptions and availability of side channels. David Alexander Molnar studies the security and privacy in deployments of RFID technology and proposes novel mechanism for improving RFID privacy for library books and electronic passport and deals with private authentication. He also discuss broadly on the different eavesdropping ranges, repetitive

stress injuries, streamline mechanism and RFID as an enabler for automatic sorting on book check-in.

The most appropriate method of adopting RFID (Cheung, Chu & Du Timon, 2009; Lee, Cheung, Kwok, Chan, Chan & Leung, 2009; Lee & Chan, 2009). For example, Lee et al. (2009) developed a framework for automating the processes in a manufacturing environment using RFID while Lee and Chan (2009) suggested the use of RFID to support reverse logistic system by counting the quantities of collected items in collection points and sending the signal to the central return centre.

Kapoor et al. (2009) identified and discussed critical issues in the implementation of RFID in supply chain management such as ownership transfer, privacy/security, computing bottleneck, and read error. They also discussed cost-benefit issues such as opportunity cost, risk of obsolescence, information sharing, and interoperability standards.

6. ADVANTAGES AND DISADVANTAGES OF RFID SYSTEM

Advantages:-

The main advantages of RFID system are as follows:-

- **Rapid charging/discharging:** The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. While initially unreliable, the anti-collision algorithm that allows an entire stack to be charged or discharged now appears to be working well.
- **Simplified patron self-charging/discharging:** For patrons using self-charging, there is a marked improvement because they do not have to carefully place materials within a designated template and they can charge several items at the same time. Patron self-charging shifts that work from staff to patrons. Staff is relieved further when readers are installed in book drops.

- **High reliability:** The readers are highly reliable. Some RFID systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library. Were a patron to run out of the library and not be intercepted, the library would at least know what had been stolen. If the patron card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them. This is done by designating a bit as the "theft" bit and turning it off at time of charge and on at time of discharge.
- **High-speed inventorying:** unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order.
- **Automated materials handling:** Another application of RFID technology is automated materials handling. This includes conveyor and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for reshelving. Given the high cost of the equipment, this application has not been widely used.
- **Long tag life:** Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.
- **Fast Track Circulation Operation:** The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. While initially unreliable, the anti-collision algorithm that allows an entire stack to be charged or discharged now appears to be working well.

Disadvantages:-

The main disadvantages of RFID system are as follows:-

- **High cost:** The major disadvantage of RFID technology is its cost.
- **Vulnerability to compromise:** It is possible to compromise an RFID system by wrapping the household foil to block the radio signal. It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.
- **Removal of exposed tags:** The RFID Tags cannot be concealed in either spine or gutter of the books and are exposed for removal. If a library wishes, it can insert the RFID tags in the spines of all except thin books; however, not all RFID tags are flexible enough. A library can also imprint the RFID tags with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.

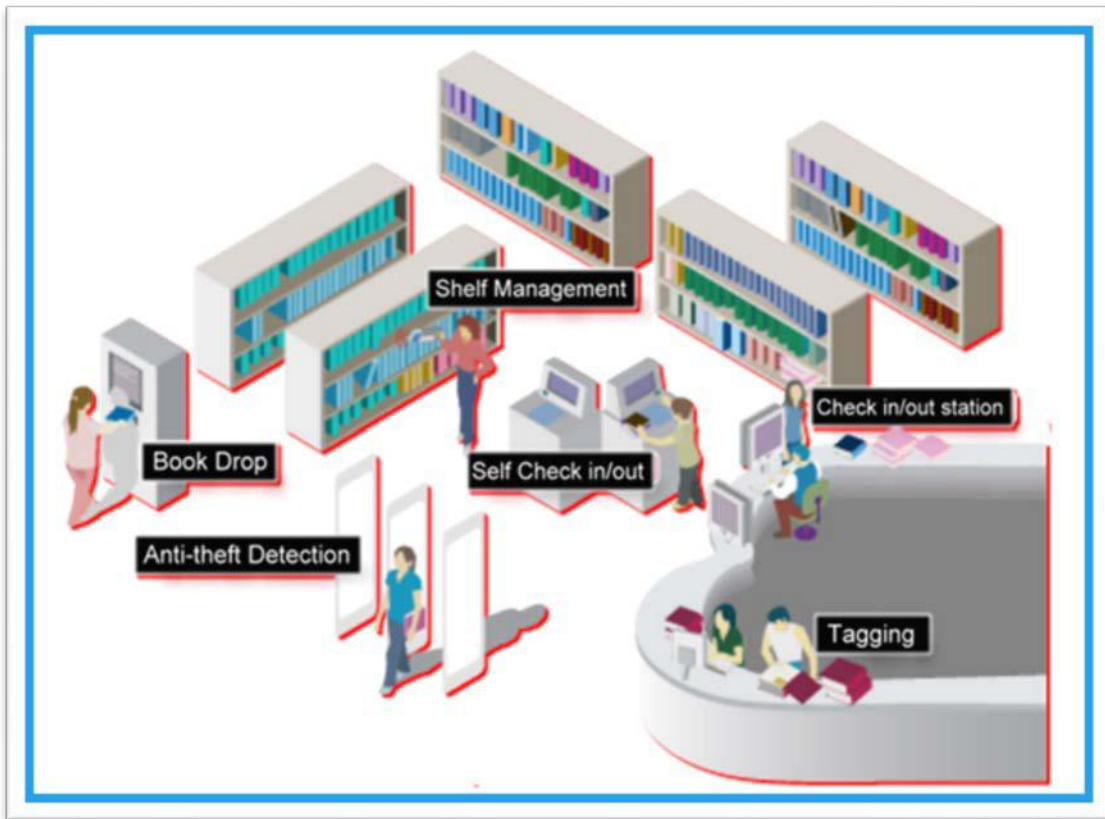
7. IMPLEMENTATION OF RFID SYSTEM AT CENTRAL LIBRARY, IIT MADRAS

RFID has implemented in Central library, IITM in 2004. The vendors M/s Edutech had implemented RFID in IITM in 2004 but after 2011 onwards Central library, IITM deals with ST Logitrack Singapore. The VIRTUA (VTLS) LMS software used for RFID in IITM. The hardware used for RFID technology in IITM- 2 Book drop box, 3 self check out station, 2 inventory and 1 sorting station. Around 100000 books tagging were completed initial in 2004 through 5 trained staff of IITM. Now almost 4 lakhs books & more are tagging of RFID.

RFID technology is involved in various modules in libraries, such as tagging station to tag the RFID label to each library material; patrons self check-out station to borrow the books using the self service; book drop station is used to return the books; and anti-theft security gates ensure the items are checked-out before leaving the library by detecting if the RFID label that are attached in the item is activated; and finally as to the self management, for example patrons can track the searching items that were mis-shelved by the use of RFID handheld reader.

The main library adopts RFID technology aim of improving the self service. Patrons can borrow and return the items using automatic lending machines, which require a library smartcard and a PIN. Self service becomes much easier with this new technology. Besides,

sorting the returned books greatly reduces the library staffs manual work. As RFID label has anti-theft function; there is no need for an extra alarm strip to be attached to the item, which makes the borrowing and tagging tasks a lot easier accordingly. The whole system is very clearly shown in the below figure:



7.1 HARDWARE PRODUCTS

In this section, the hardware products based on RFID technology used in the IITM central library has introduced.

- **RFID Tags:** - RFID tags allow materials to be accurately identified and tracked. Specific object information is stored in the memory of tags and is accessed via the radio signal of RFID



readers. All materials are attached with 3M™ RFID tags. Tag model D7 is used for books, periodicals and videos, and tags model CD8 are applied to CDs and DVDs.

- **Table Readers:** - Table readers in libraries are mainly used for check-in/checkout units to achieve the fast and efficient reading functions. RFID table readers can read library cards through barcode or RFID chip, and it is possible to read max. 3 items at the same time within a range of 54.5cm length and 30cm width on the table reader. High Frequency 13.56 MHZ domain interface is used in Table Reader.
- **Handheld Readers:** - Handheld readers are applied with High Frequency 13.56 MHZ. The handheld device is light and its reading speed is fast and there is no angle restriction while reading. However, the reading distances are small; only one item can be read per time. Besides, misreading or disable reading can't be 100% avoided. Handheld readers are mainly used for shelving in libraries.
- **RFID Security Gates:** - RFID Security gates are used to detect RFID tags to ensure that all items leaving the library are checked out. Each library item is embedded in a RFID tag and the AFI (Application Family Identifier) status in the tag is activated until the item is checked out. The RFID tag triggers the alarm system if the AFI status is not deactivated. However, RFID readers may not be able to detect items if there are metals surrounded or tags embedded in items are been squeezing when passing by the security gate.
- ❖ **SIP2 Protocol** is a communication protocol that provides a standard interface between a library's integrated library system (ILS) and library automation devices (e.g., check-out devices, check in devices, etc.). The protocol can be used by any application that has a need to retrieve information from an ILS or process circulation transactions via the ILS. There are two versions of SIP, version 1.0 and 2.0. SIP2 is based on a



proprietary protocol, but has been opened for use by all parties providing systems for library circulation.

- ❖ **RFID Tagging Station:-**A tagging station consists of a network PC, reader and antenna. All library materials must be tagged and programmed and the tagging station is used to affix the tags to the materials and program them. As the system is now still barcode based in Central library, IITM thus RFID tagged items must connect to the system through barcode. To build the connections, first the staff station reader checks if the item that are on it has already RFID tag attached or not, and if it doesn't, attach it first, then the system will formulate the connection by using handheld reader to scan the item's barcode. After that, information can be added into RFID label using the system. And one RFID label can be used for only one item, so if the barcode destroyed, RFID label needs to be changed too. However, the library is planning to change the system from the barcode based to RFID based, which will achieve the inventory and localization functions in the near future.
- ❖ **Patron Self-Check-out Stations:-**The Self-check-out unit greatly improves customer service and increases operational efficiency while providing a strategic competitive advantage. The patron Self Check-out unit benefits both patrons and the librarian. To patrons, it reduces their time for waiting lines and provides them privacy. To librarian, they can be relieved from heavy work of daily routine so as to better service patrons. The Central library, IITM used ELiMS Self Check-out Station which is consists of a PC with a touch screen monitor, a built-in RFID reader, and completes with a receipt printer.

7.2 ABOUT ELIMS

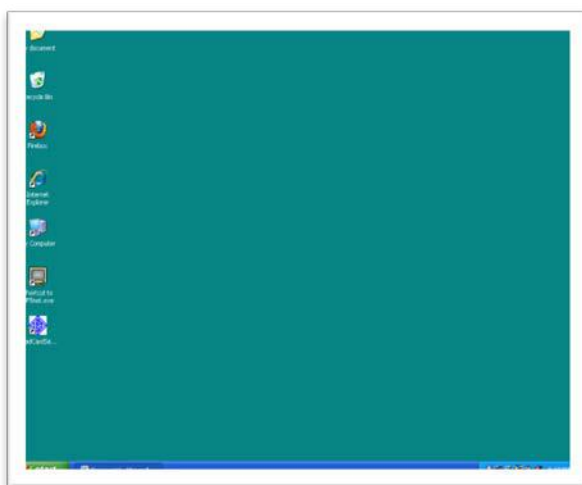
ELiMS® is the RFID- based Electronic Library Management System that is designed to manage the tracking, distribution, circulation and flow of library materials. It facilitates multiple, automatic object identification, tracking, sorting as well as speedier data collection, which tremendously improves the efficiency of libraries, thereby freeing librarians to provide other value-add services, such as assisting in library material search.

ELiMS[®] is a state-of-the art library automation system that caters to the needs of both library patrons and librarians. In its basic configuration, ELiMS[®] facilitates self-help as well as counter assisted check-outs and check-ins of all library materials such as print materials, CDs, video tapes and audio tapes. ELiMS[®] family of products has expanded to include auto-sorters, 24/7 return stations, smart dispensers and smart shelves. ST LogiTrackPte Ltd is the registered owner of the patent in many countries including Singapore, USA, Australia, Taiwan, Malaysia, Canada, Indonesia, Norway, Vietnam, New Zealand, Russia and Korea with the application pending grants in other countries.

7.3 PATRON SELF-CHECKOUT PROCESSES

Firstly, the patron chooses one service language from the touch screen monitor, and then the patron will be identified with a library card and its PIN code. After identified, the patron can place items to be borrowed on the reading table, and then the monitor shows the items status, borrowed or not. Once items are successfully borrowed, the receipt will be printed. However, the patron can always asks help from the librarian if they need guidance to get started of using the checkout unit or if some items cannot be read for some reason. The Self-check-out unit is easy to use as shown in below figure.

Data flow diagram, as shown below presents the whole self-checkout processes at Central library, IITM



Here we get ELiMS software



This is the home page of ELiMS Self check



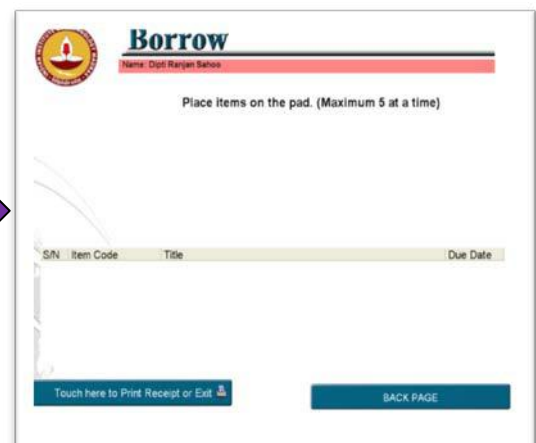
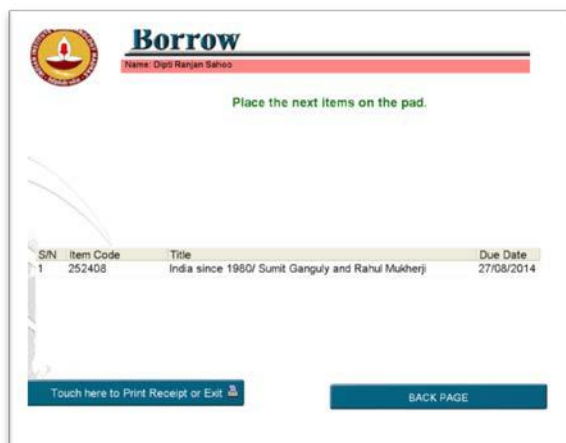
Here, we have to insert library card



Here, we have to give membership number



Here, we get two options:- Borrow & Renew



Hence, in this way the whole self-checkout process goes on.

7.4 SELF SERVICE CHECK-IN STATION AT CENTRAL LIBRARY, IITM

Check-in station consists of a PC with a touch screen monitor, a built-in RFID reader, and completes with sorters. The self-service check-in process basically works same as the self-service checkout process, but a lot simpler as identifying the library card step is not required. Items are reactivated security when returned and the returned information is shown in computer screen and receipt can be then optional printed.

8. CONCLUSION

Although, the RFID technology is quite expensive, still it has yielded excellent results for many libraries throughout the world. It has the capability of making the management processes in the library more convenient. The only barrier in the journey is high cost of it, but every new technology implementation somewhat dearer. Moreover, RFID applications lead to significant savings in staff costs, enhance service and provide efficient results, which leads to fool proof security and access control. It not only provides a constant update of library collections, proper holding management, but also accomplishes real-time services.

Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and faster processing. The interest in RFID as a solution to optimize further the automation and tracking of documents are gathering momentum at an increasing pace, with more libraries joining the trails. "RFID is increasing in popularity among libraries, as the early adopters of this technology have shown that, it makes good economic sense, both for large and small libraries."

RFID offers considerable advantages in library management as compared to conventional bar codes and magnetic stripes. RFID technology at Central library, IITM is fully adopted so far such as intelligent inventory or tracking the books; etc. Around 100000 books tagging were completed in IITM.

In the future, it is expected that this technology will be adopted also in the book publishing industry, meaning that books are going to be tagged with RFID labels already before shipping

them to libraries. This will make RFID's future in library management more apparent and positive.

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STUDY AND ANALYSIS OF ACCIDENTS ON NH 71-A

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ABSTRACT

India is a developing country and safety of road is still in a premature stage. Accident severity is increasing in increasing order due to increasing in vehicle population. Accident leads to disablement, death, damage to health and property, social suffering and general degradation of environment. The road accident situation in India is alarming. Records show that there is one death at every 2.75 minutes because of road accidents. The high accident rate is largely attributed to the inadequacy of the highways and other main roads to meet the traffic demands, road user behavior, vehicle defects, poor road geometrics and visibility. Road accidents inflict heavy economic loss to the country. Road safety is necessary to reduce accident involving both human and vehicles there by making the road more safe and user friendly to traffic. NH-71A is one of the major connectivity from Panipat to Bawal which caters to the need of transportation of light goods to heavy goods and passengers. Study area was undertaken on road NH-71A from Panipat to Rohtak.

1. INTRODUCTION

Accident is an event, occurring suddenly, unexpectedly and inadvertently under unforeseen circumstances. Road traffic accidents can be defined as “An accident that occurred on a way or street open to public traffic; resulted in one or more persons being killed or injured, and at least one moving vehicle was involved. Road crashes take away the right to life of 3,000 people every day. This is a global humanitarian disaster, and it is man-made. (Global Road Safety Partnership Annual Report 2014) Road Safety is one of the most important problems in or society. Every year 1.2 million of people are killed and between 20 and 50 million people are injured in road

accidents. If current trends continue road traffic accidents are predicted to be third leading contributor to the global burden of Disease and injury by 2020. More than 10 lakh people in India have lost their lives to road accidents in the last 10 years. India has the dubious distinction of leading the world in road crash fatalities – 10% of total global road deaths occur here. In 2013 alone, almost 1,40,000 people were killed and close to 5,00,000 were seriously injured or permanently disabled. To minimize the number of crashes by any kind and severity expected to occur on the entity during a specific period is known as road safety

Various Causes Of Accident:

Road Traffic safety refers to methods and measures for reducing the risk of a person using the road network being killed or seriously injured. The users of a road include pedestrians, cyclists, motorists, their passengers, and passengers of non-road public transport, mainly buses and trams.

- Road Characteristics
- Weather Impacts
- Transportation-Related Factors
- Human-Related Factors

2. METHODOLOGY

Road Selected For Study:

National highway from Panipat to Jhajjar on NH-71A was chosen for study. The following stretches was selected for data collection. The study area is shown in Fig. 3.1

- i. Panipat to Naultha, Km 0-Km13.6
- ii. Israna to Gohana Km26
- iii. Rohtak to Jhajjar Km34

Data Collection

The only information available for accident studies is the FIR (First Information Report) lodged in the police stations and data from PWD. The data from these records of last ten years (2006-2015) were extracted from the FIR record field under IPCno.279/337/338/304(A).

➤ **Data Collected From Police Records:**

With the prior permission of the concerned S.P, the accident data were collected on two-lane highways from three police stations

Accident details during 2006-2015 on this road section are shown in Table 1.1. Accident data were collected year wise from each police station records then sorted out year wise.

Table 1.1 Details of Accidents

YEAR	FATAL	MAJOR INJURY	MINOR INJURY
2006	15	14	37
2007	16	32	50
2008	10	24	45
2009	25	30	39
2010	22	35	40
2011	17	45	84
2012	5	25	61
2013	14	33	81
2014	16	32	84
2015	18	28	58
Total	159	297	579

➤ **Data Collected From P.W.D Records:**

P.W.D (Public Works Department) records are the main source if details of road. The Performa used to record these details is shown in Table 1.2

Table 1.2 Performa for Details Of Road Section

Width Of Carriage Way in Mt.	7
Width Of Formation in Mt.	12
Width of Land in Mt.	45

3. ANALYSIS OF DATA AND DISCUSSION

Accident Investigation:

Accident Number: 1

Accident type: Head-on collision

Location: Govt. High School, Naultha (Panipat)

Date and Time: NOV.11, 2014; 05:00AM

Vehicle 1: Truck No. HR-13-GA-4916

Vehicle 2: Tata Indica car No. PB-29-E-1334

Fatalities/Injuries: 8 person died on the spot.

Description: On 11 nov. 8 persons were died in a road accident when an Indica car collided head on with a truck Govt. High school at Naultha, national highway-71 Haryana on Tuesday morning. There are three children and two women among the eight died on the spot. All eight occupants of the car, residents of Valtoha village near Patti in Tarn Taran district, died on the spot. The incident took place at around 5 am when the Indica Vist car no. PB-29-E-1334 were

traveling collided head on with a truck No. HR-13-GA-4916. The Indica car was badly damaged in the accident while the truck was also damaged partially. Police party headed by SHO Bhadaur rushed to the spot while villagers also called an ambulance but it was too late. The accident diagram is shown in Fig 1.1.



Fig. 1.1 Accident diagram and photos

Annual Variation In Accidents:

Fig. 1.3 shows the annual variations in accidents of total stretches during year 2006-2015. It is observed that percentage accidents are increasing relatively in the most of the year. In the year 2011 accident rate was high and low in year 2006. It may be due to increase in no. of vehicles, bad traffic environment, and increase in population.

Table 1.3 Annual Variation In Accidents Of Total Stretch

YEARS	FATAL	MAJOR	MINOR	TOTAL NO OF ACCIDENTS
-------	-------	-------	-------	-----------------------

2004				
2006	18	18	38	48
	12	36	50	60
2008	15	23	45	52
	20	35	40	58
2010	20	36	40	63
	19	40	82	105
2012	3	22	60	60
	17	35	80	95
2014	19	36	83	85
	12	35	55	65
2016				

Vehicles Involved In Fatalities:

Vehicles users related to facilities during 2006-2015 are shown in pie chart in percent. The result indicate that 59 % of fatalities are due to truck drivers followed by 26% by unknown driver, 7% by motorcycles, 5% by car and jeep, 3% by bus respectively as shown in Fig. 1.4. They consume alcohol and drugs in long driving. As a result reaction time increases and loss of control occurs during speed driving leads to fatalities.

Table 1.4 Vehicle Involved In Fatalities

VEHICLES	VEHICLE INVOLVED
Truck	59
Bus	3
Jeep/Car	5
Bike	7
Others	16

Trends Of Accidents:

The trend of accidents per million vehicle- kilometer-year (MVKY) on the road is shown in Fig. 1.2 from the figure it is found that accidents rate per MVKY increases in each subsequent year. The increase trend in accident rate may be due to increase in population due to town growth, industry growth, poor maintenance of shoulder, electric poles on road, transformer station on the

shoulder, old girth trees on the shoulder, sight distraction obstruction due to trees, unsignalized intersection, on street parking of vehicles and lack of general awareness of road safety among road users.

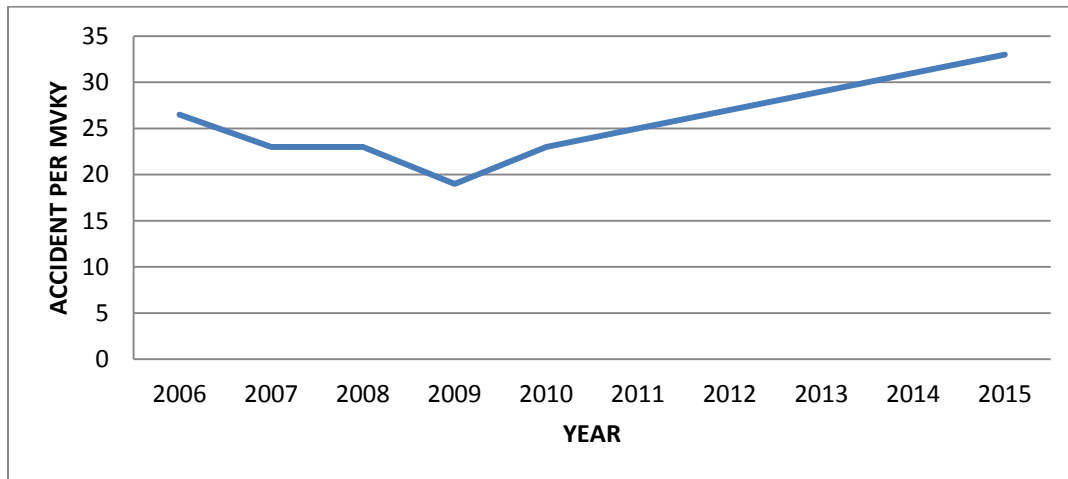


Fig.1.2 Trend Of Accidents (2006-2015)

CONCLUSION

(1) The available literatures on accidents analysis indicates that 77.5 percent of road accidents in India are caused due to driver's error.

(2) Heavy vehicles like truck are involved in maximum no of accident on two-lane roads. It is estimated that fatalities caused by truck is 59% followed by other (26%) and bike (7%) and jeep (5%) and bus (3%).Road safety awareness should be raised among road user.

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OVERVIEW OF THE EFFECTIVE PETROLEUM PRODUCTS TRANSPORTATION AND DISTRIBUTION SYSTEMS IN NIGERIA

ENGR. DR. C.I. C. ANYADIEGWU

1. INTRODUCTION

Overview of petroleum products transportation and distribution system in Nigeria is presented. Petroleum products are the different types of fuels processed from crude petroleum which are used for power generation. They are extracted from crude petroleum in processing units by thermal cracking in the refineries. Nigeria through Nigerian National Petroleum Corporation (NNPC) has four functional refineries with total refining capacity of 445000 bbl/d of crude oil (NNPC, 2015). These are transported and distributed with the aid of pipelines from processing plants to the loading depot, and by Tankers from the refinery and depot to the filling stations.

The most commonly used here among the fuels are; Premium Motor Spirit (PMS), Automotive Gas Oil (AGO or Diesel), Household Kerosene (HHK), Aviation Turbine Kerosene (ATK or jet-A1), Liquefied petroleum Gas (LPG).

Petroleum products distribution is concerned with the movement of refined petroleum from the refinery to the final consumers across various locations of delivery in the country. In the Nigeria situation, the Pipelines and Products Marketing Company (PPMC) is responsible for the wholesale supply, distribution and marketing of petroleum products in Nigeria.

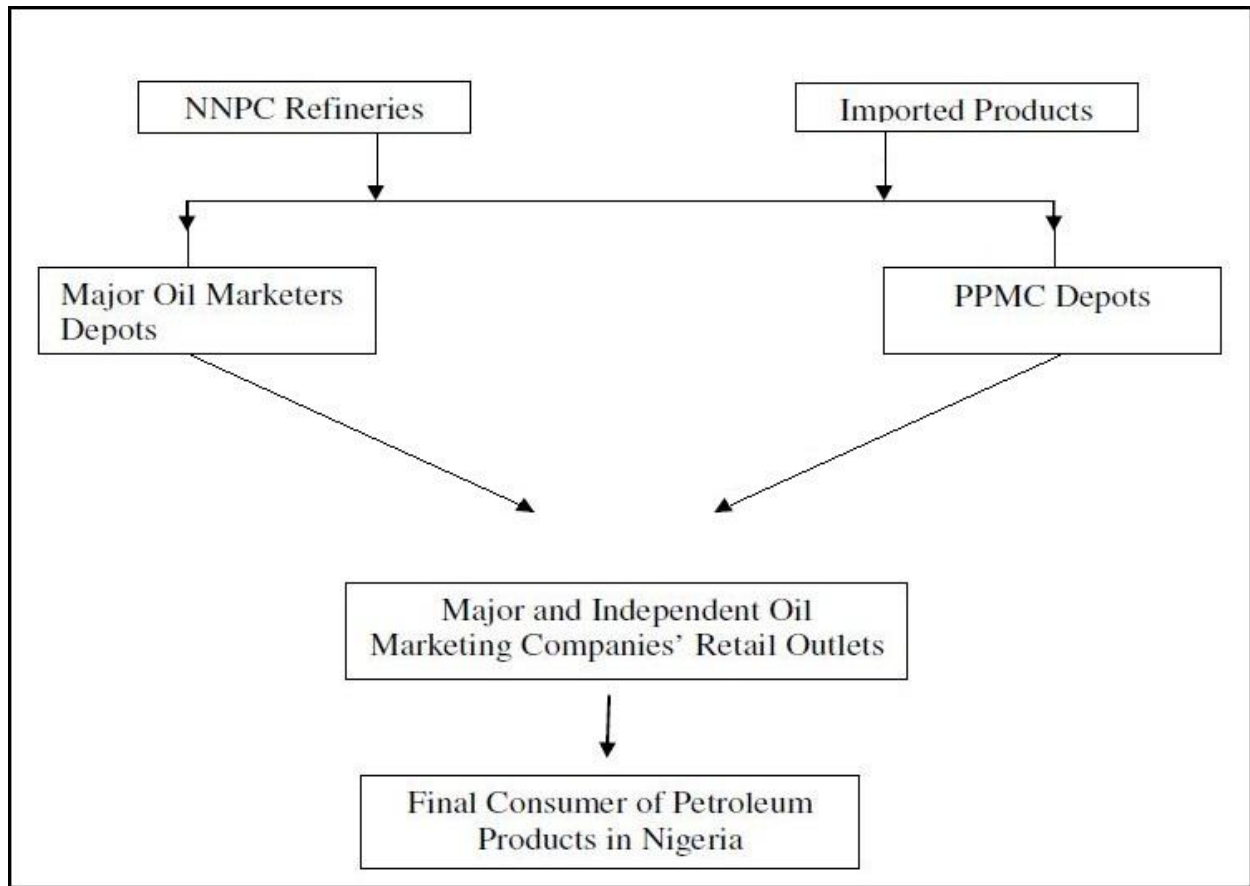


Figure 1: The physical flow of products: the retail route used by major and independent companies in Nigeria. Source: NNPC/PPMC Bulletin, 2010.

Therefore for the distribution and transportation to be effectively carried out, there must be safety in the loading, transportation, delivery, storage and sales stages for the products in the filling station. That means, our watch word should be “safety”. But we need to look at the above measures individually since there are relatively a number of hazards associated with each of them at any stage of the distribution system.

This paper is therefore geared towards achieving effective ways of handling these products right from the loading terminal to the discharge station during the era of scarcity. Loading terminal could be the refinery, depot and/or Jetty in the case of importation.

2. SCARCITY

This is the condition of insufficiency in which case the product is not enough with respect to the number of users. As a result, supply becomes very low and with constraints. Scarcity could be natural or artificial depending on the cause. During this period, either that the plants are not producing in full capacity or that the plants are shut down and the alternative now becomes importation through sea. There is no doubt, during this scarcity situation, the dealers and the users go to any length to make sure they get the products, while the government keeps sleepless nights to make sure they bring the situation back to normalcy. It is true that the above expression is the traditional thing that is supposed to happen, but the fact remains that the parties involved see the situation as an avenue to get quicker, thereby making the masses suffer by paying huge sums to have the products.

As a result, the handling of the product becomes unsafe since the business of distribution has been taken over by untrained persons. Basically, an average Nigerian wants to get rich quick overnight, hence selling of products has turned to be a money spinner in the era of scarcity. As a result, it becomes the booming business of the day once you can face the rigors involved, which include but not limited to touting in one way and cash flow, the other way. You will agree that during this period, very many wrong people jump into the business and so no safety measures are imbibed, quality control of the product is neglected and also the price has no control. This is due to the fact that the only thing that interests every man who is on the business is how much money he makes from the “golden liquid” at the end of the day.

Pipeline and products marketing company (PPMC) is the government agency that is in charge of selling these products to the licensed marketers whether processed here or imported. The marketers load the products from the refinery, depot or from the jetty in the case of importation, and then transport and distribute the products to the stations where the masses can now buy them. This happens in an ideal situation, but what

actually happens during scarcity is rather ridiculous, which is associated with numerous hazards.

During scarcity, right from the refinery, depot and/or jetty, the funny situations commence whereby the scarce product is sold to a typical Nigerian businessman who doesn't even know the difference between one type of fuel and the other. This is to the detriment of the licensed marketers, who must have been waiting with their tankers to reach their turn to load, simply because he adds money on the approved liter price. Once this happens, the pandemonium has started, since the man lifts the product only to transport and dump at the wrong place without any safety measures. At times the only alternative dumping place if he has no underground tanks is an abandoned filling station whose tanks have not been calibrated for a long time, thereby creating the hazard of leakages and possible fire outbreaks. Whether it is licensed dealer that lifts the products at a price different from the approved price, and even though he dumps at a perfectly functioning filling station, the price at which he sells to the buyers will still be higher than the approved price.

3. CALIBRATION

This is gauging the storage tanks and the lifting tankers based on the original construction specification to ascertain the actual quantity of product pumped into them and/or to know when they are due for replacement or re-enforcement due to wear and tear. Calibration is also used to rectify confirmation of the original graduation of the tanks and to mark out the scale of the tanks or any measuring instrument so that the content can be measured.

We are going to look at the transportation and distribution of these products together with the dangers associated with them from the point of loading to the discharge station. Taking PMS as an example, we consider the right facilities and people involved for the achievement of efficiency and effectiveness during the period of scarcity. Also we look at the possible sources of error and ways of preventing and correcting their occurrences as regards to the effective transportation and distribution of the product.

4. QUALITY CONTROL AND ASSURANCE

According to Agbola (1987), one of the tasks performed by the Petroleum Inspectorate is monitoring of Quality of Products in the oil Industry. This task spans the entire spectrum of the industry from Crude Production through the process plants down to storage depots Petrol Filling Stations. It is of great importance to maintain the quality of products throughout various phases of the distribution network from the Refinery to consumers. The Refineries manufacture Petroleum Products to specification standards approved by the Standard Organization of Nigeria. The Oil marketing companies also have established procedures for handling various grades of Petroleum Products to prevent contamination with other grades, water or sediments. The petroleum Inspectorate therefore monitors the operations of the Refineries to ensure that products manufactured meet specification standards and are accurately accounted for through joint participation in all stock taking exercise.

The petroleum Inspectorate also monitors shipment of these products by Sea, Rail, Road and network of Pipeline to bulk Storage Deposits. The activities of the oil marketing companies are monitored to ensure correct volume of products are sold at approve prices and that products sold meet specification standards.

5. LOADING TERMINAL

This is the point at which the processed product is lifted with tanker for discharge at the filling station. In the first place, the government ought to constitute a task force (if this is not already in place) to include trained security personnel, experienced products handlers, safety officers, and health officers to work from the loading terminal to the filling station. The task force shall inspect the tankers to give approval for their lifting of products by issuing them nomination certificate with which the dealers go to the loading terminal for lifting products. Prior to the issuing of the nomination certificate, the tankers must have undergone recent calibration. For the right product requested to be delivered, the task force shall test the product before loading and make sure that a bill of quantity and quality is issued to the dealer to avoid illegal price increase, adulteration, and

preventing dealers from lifting toxic product that is dangerous to health. They also make sure that the PPMC officials work with consumption statistics to enable them ascertain the quantity to be allocated to a particular direction based on the consumption rate. There are six petroleum exportation terminals in the country. Shell owns two, while Mobil, Chevron, Texaco, and Agip own one each. Shell also owns the Forcados Terminal, which is capable of storing 13 million barrels (2,100,000 m³) of crude oil in conjunction with the nearby Bonny Terminal. Mobil operates primarily out of the Qua Iboe Terminal in Akwa Ibom State, while Chevron owns the Escravos Terminal located in Delta State and has a storage capacity of 3.6 million barrels (570,000 m³). Agip operates the Brass Terminal in Brass, a town 113 km southwest of Port Harcourt and has a storage capacity of 3,558,000 barrels (565,700 m³). Texaco operates the Pennington Terminal (Nigeria Business Info, 2015). A terminal is pictured in Fig 2 below.



Fig 2: An oil terminal (Wikimedia, 2015)

6. TRANSPORTATION

After loading, security personnel in the task force shall escort the tanker out of the loading terminal to some kilometers away from the point of lifting. This is to avoid the act of re-selling which is practiced by the dealers in collaboration with the touts. During the trip, the tanker stops at designated points for routine check/inspection by the field personnel (members of the task force), who are stationed at strategic positions to avoid diversion of the product. A schematic of an offshore oil shipping vessel is shown in Fig 3.



Fig 3: Oil shipping vessel (Wikimedia, 2015)

7. FILLING STATION

This is the right place for the discharging of the product by the tanker into the underground tanks. The task force is to ensure that the product is sold to the users at the right time and at the approved price per liter. They are to make sure that the pump attendants do not collect bribes from some impatient buyers who would want to jump the queue. Selling of the product in jerry-cans shall be avoided, (except in 4-liter containers for use in generators), in order to check hoarding and road side marketeering. To ensure smoothness, each of the pumps at any particular point in time shall play host to the attendant, a single buyer, and a task force personnel. All customers must remain in their cars, although they could be allowed to stand beside the cars. This helps to check the congestion around the pump by desperate buyers and

touts that that always results to confusion and exchange of words and sometimes fighting. The product sample from the tanks with known quality and quantity is re-examined on a daily basis to ensure that the quality remains constant, since some dealers indulge in product adulteration during the night. Also a record of the sold quantity before the close of the business for the day must be compared with the certified remaining quantity in order to check the selling of products in drums at nights. This operation is carried out by members of the task force posted to the filling station, who also ensure that the dealer continues selling the product until it finishes to check the situation whereby there will be products in the tanks but the dealers go on to deceive motorists by hanging a big sign post stating “NO FUEL”. A picture of a filling station is as shown in Figure 4 below.



Fig 4: A picture of a filling station (Unigas, 2015)

8. SAFETY FACILITIES

These are the built-in gadgets that help to ensure smooth & efficient selling operation. They include safety gadgets, security and health gadgets. It shall be the duty of the combined team of the task force and PPMC officials to carry out inspection of the newly constructed filling station and to give approval before any product is discharged into the tanks of the filling station. This will go a long way to ensure that the safety, health, security and communication facilities are functioning effectively. Telephone, portable fire

extinguishers and fire buckets as well as complete first aid kits are indispensable facilities in a filling station. For a station to get approval to store products, the pump meters and tanks shall be calibrated and proved at specified intervals of time. This helps to know when the pump meters start giving error and also to know when the tanks and pumps are due for replacement.

9. ENVIRONMENTAL ISSUES

According to Williams (2012), transportation pipelines have been constructed for many decades and there is a great deal of information on how to mitigate their standard environmental effects, such as those on fish habitat associated with river crossings. For example, pipeline routes can be changed to avoid vulnerable areas; project design and construction can be specific to circumstances (such as trenchless river crossings); and habitat can be compensated for, if necessary. However, assessing the cumulative impacts of multiple aspects of a project that may occur in a single ecological unit (such as multiple crossings throughout a river basin) is more difficult. As a result, the necessary mitigation efforts are less well understood.

The environmental impact of shipping includes greenhouse gas emissions, acoustic, and oil pollution. The International Maritime Organization (IMO) estimates that Carbon dioxide emissions from shipping were equal to 2.7% of the global human-made emissions in 2007 and expects them to rise by as much as 2 to 3 times by 2050 if no action is taken (IMO, 2009). Ballast water discharges by ships can have a negative impact on the marine environment. Cruise ships, large tankers, and bulk cargo carriers use a huge amount of ballast water, which is often taken on in the coastal waters in one region after ships discharge wastewater or unload cargo, and discharged at the next port of call, wherever more cargo is loaded. Ballast water discharge typically contains a variety of biological materials, including plants, animals, viruses, and bacteria. These materials often include non-native, nuisance, invasive, exotic species that can cause extensive ecological and economic damage to aquatic ecosystems along with serious human health problems. Noise pollution caused by shipping and other human

enterprises has increased in recent history (The Hindu, 2010). The noise produced by ships can travel long distances, and marine species who may rely on sound for their orientation, communication, and feeding, can be harmed by this sound pollution (Simpson et al, 2010). Marine mammals, such a whales and manatees, risk being struck by ships, causing injury and death. For example, if a ship is traveling at a speed of only 15 knots, there is a 79 percent chance of a collision being lethal to a whale (Vanderlaan et al, 2007). One notable example of the impact of ship collisions is the endangered North Atlantic right whale, of which 400 or less remain. The greatest danger to the North Atlantic right whale is injury sustained from ship strikes. Between 1970 and 1999, 35.5 percent of recorded deaths were attributed to collisions (Ward-Geiger et al, 2005). During 1999 to 2003, incidents of mortality and serious injury attributed to ship strikes averaged one per year. In 2004 to 2006, that number increased to 2.6. Deaths from collisions has become an extinction threat (Reilly et al, 2008). Exhaust gases from ships are considered to be a significant source of air pollution, both for conventional pollutants and greenhouse gases.

10. ALTERNATIVE FUELS

The alternative fuel shall be provided for each of the fuel types since all the fuels may not necessarily be scarce at the same time. This enables the users to switch over to the more available fuel even though it may be more expensive. This will reduce the rush to get the usual but scarce product. For example the compressed natural gas which has been confirmed to be an alternative to PMS and AGO for vehicles can be utilized. Furthermore, it is even cheaper.

11. PAYMENT

This includes the payment for the product by the dealers before lifting from the loading terminal and also the payment for the served quantity by the vehicle owners at the filling the station. Both the dealers and the buyers are faced with the hazard of robbery attacks due to the fact the loading terminals, as well as the filling station are usually congested by hoodlums and touts who pretend to be there for business. As a result, it

becomes difficult to identify the genuine customers both at the depot and at the service stations.

All the parties involved must be ready to accept security payments like bank cheques, smart cards, credit cards, traveler's cheques and other computerized means of payment. This makes it easier and more convenient for the dealers and also the buyers and thereby preventing the act of carrying cash which attracts the robbers.

12. CONCLUSION

Finally, the discussion is not complete without mentioning the human factor. The aforementioned measures are only possible when the human factor has been taken care of and in a strict manner.

Legal punishment must be given apart from dismissal, to any corrupt personnel from PPMC, Task force, tanker drivers, dealers and pump attendants who go contrary to the assigned duty.

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NOMENCLATURE

AGO = Automotive Gas Oil

ATK = Aviation Turbine Kerosene

Bbl/d = barrel per day

HHK = Household Kerosene

LPG = Liquefied Petroleum Gas

m³ = cubic metre



NNPC = Nigerian National Petroleum Corporation

PMS = Premium Motor Spirit

PPMC = Pipelines and Products Marketing Company

SUITABILITY OF GAS CHROMATOGRAPHY FLAME IONIZATION DETECTOR (GC-FID) FOR FINGERPRINTING RESERVOIR FLUIDS IN MATURE AND MARGINAL FIELDS OF NIGER DELTA

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Abstract

Identification and allocation of reservoir fluids are major challenges faced by Petroleum engineers especially when being related to cost, management and time. As highlighted in this work, there are various Geo-chemical techniques used in identifying crude oil samples. Some of these techniques include; Gas Chromatography, High Temperature Gas Chromatography, 2-Dimensional Gas Chromatography, Gas Chromatography Flame Ionization Detector and Gas Chromatography Mass Spectrometry. And each of these techniques has different areas of application depending on the reservoir fluids characteristic. Of these techniques mentioned, the suitability of Gas Chromatography Flame Ionization Detector for fingerprinting reservoir fluids in the Niger delta is discussed. This work therefore analyzed and compared two crude samples from two oil fields of Niger Delta, using analytical techniques for source identification purposes. Normal alkanes and isoprenoids distribution showed nC_7 to nC_{37} carbon atoms. Low molecular weight hydrocarbons less than nC_7 were not observed probably due to evaporative losses during sample processing. Visual comparison of the chromatograms also showed that samples were similar. The hydrocarbon ratios were able to deduce the source, maturity, depositional environment and extent of biodegradation. Normal paraffin and Isoprenoid peak height profiles, when subjected to measurement error, provided quantitative evaluations of the relative likelihood that the samples were from source rocks containing mixed organic compounds deposited in an Oxic Paleoenvironment.

1.0 Introduction

Geochemical fingerprinting is a rapidly expanding discipline in the earth and environmental sciences and is anchored in the recognition that geological processes leave behind chemical and isotopic patterns in the rock record. Each source crude oil therefore has a unique fingerprint that can potentially be determined by varieties of instrumental and non-instrumental techniques. Many of these patterns informally referred to as geochemical fingerprints differ only in fine detail from each other. For this reason, the approach of fingerprinting requires analytical data of high precision and accuracy. It is therefore not surprising that the advancement of geochemical fingerprinting occurred alongside progress in analysis techniques. For real time applications of geochemical fingerprinting, in which large sample throughput, reasonable cost and fast turnaround are key requirements, combined geochemical techniques are employed.

Some of the applications of fingerprinting technology to the oil and industry include;

- a. To develop an understanding of source rock and crude oil relationships
- b. To identify the sources of oil spills especially at the surface
- c. Allocation of commingled fluids during production
- d. Reservoir characterization
- e. Study of environmental pollution

2.0 Objective

This paper seeks to attain the following objectives:

- i. Review different geochemical techniques used in identifying crude oil samples
- ii. Review field data of crude samples in Niger delta using GC-FID technique
- iii. Determine the suitability of GC-FID technique for identifying crude samples in the Niger Delta
- iv. Determine potential problems and proffer solutions on how they can be managed or utilized

Geochemical fingerprinting approach is based on the well-established proposition that crude oil spills (weathered or unweathered), or separate reservoirs tend to differ from one another in composition due to the chemical record of all the processes that have affected it before, during and after reaching the trap. When there is sufficient (even small) difference in the composition of the fluids, periodic geochemical monitoring can be done to determine their sources or production from each zone. To trace the source of any environmental sample, one must be able to specify the differences between source sample and spill sample that can be expected to arise from weathering (Blumer et al 1972). Any significant differences not attributable to weathering, establish that the samples are different.

3.0 Geochemical Techniques Used In Identifying Crude Oil Samples

Crude oil is a naturally occurring mixture consisting predominantly of hydrocarbons [alkanes (paraffins), alkenes (olefins), and aromatics] with other elements such as Sulphur, Nitrogen and Oxygen appearing in the form of organic compounds which in some cases form complexes with metals. The mixture of crude oil is highly complex and the complexity increases with boiling range. The instrumental techniques of chromatography, ultraviolet and infra-red spectroscopy together with mass spectrometry facilitate knowledge of the detailed hydrocarbon type, composition, concentrations and molecular species of crude oil.

3.1 Gas Chromatography (GC):

GC has the advantages of high column efficiency, high sensitivity, fast analysis, speed and ease to be combined with other analytical methods (mass spectrometry). Thus it is widely used to analyze crude oil and its products. However, because of thermal instabilities of capillary column and the stationary phase, the maximal column temperature of conventional GC is about 325⁰C, and the analysis limited to hydrocarbons with carbon number less than 35. This fact limits the application of GC on the analysis of alkanes with high carbon numbers (C40+) which are

important for some areas including organic chemistry. The GC separation then is based on molecular weights and boiling points.

3.2 High Temperature Gas Chromatography (HTGC):

HTGC is a complement for the limitations of 1D-GC, developed to supplement the low temperatures of GC, which can then be used for components of high molecular weight in crude oil. It has excellent mechanical properties at high temperature, but it also has a very strong catalytic and absorptive effect. The most frequently used detection method for HTGC is Ionization flame detector (FID). Other detection methods have also been used; mass spectrometry (MS), Atomic Emission Detection (AED) and inductively coupled plasma mass spectrometry (ICP-MS).

3.3 2 - Dimensional Gas Chromatography (2D-GC):

Since Liu and Philips depicted comprehensive 2-dimensional gas chromatography in 1990s (Liu & Philips, 1991; Vendevre et al, 2007), the technology of 2D-GC has developed rapidly and has been applied in the areas such as biological, environmental, food, forensics, petroleum, pharmaceuticals and fragrances. 2D-GC employs two capillary columns of different selectivity coupled by a modulator. The advantages of 2D-GC include;

- i. Structured Chromatograms: in a 2D-GC, the chromatograms of the compound are well ordered, allowing a better interpretation than disordered ones. The pattern of peak placement is itself informative and may make it possible in many mixtures to identify most or all of the components with good reliability (Adahchour et al 2008).
- ii. Better separation: 2D-GC separates components along primary dimensions and also along secondary dimension. Sometimes, compounds co-eluted with conventional 1D-GC technology can be separated by 2D-GC along the secondary dimension.
- iii. Larger capacity: 2D-GC peaks are distributed in the whole plane rather than in one line. This therefore makes its capacity larger than that of conventional 1D-GC.
- iv. Higher sensitivity: compared with 1D-GC, the sensitivity of 2D-GC is increased by 1.5-50 folds. The trace amount of analytes can be detected with 2D-GC.

All these characteristics make 2D-GC a particular useful technique for analyzing complex mixture, for example Petroleum. The ordered distribution of the effluent has been used for quick screening of oil, recognizing the difference between individual oils.

3.4 Gas Chromatography Flame Ionization Detector (GC-FID)

Flame ionization detector (FID) is a scientific instrument that measures the concentration of organic species in a gas stream. It is frequently used as a detector in gas chromatography. The first Flame ionization detector was developed in 1957 by scientists working for CSIRO in Melbourne, Australia. It is the most sensitive gas chromatographic detector for the hydrocarbons such as butane or hexane. The FID is the most widely and successfully used gas chromatography detector for volatile hydrocarbons and many carbon containing compounds.

3.5 Gas Chromatography Mass Spectrometry (GC-MS)

Mass spectrometry is an invaluable identification technique. It is characterized by high repeatability of quantitative results, already the difference of one unit in atomic mass unit is recorded by the mass detector (Onyeabor J.O 2014). Although the retention time of peaks in the GC column serves as a means of qualitative analysis, confirmation of individual peaks can be made by using Mass spectrometry. This is partly because retention time is a function of carrier gas, column temperature, column pressure drop, stationary phase, void volume between injection port and detector. Thus to confirm the identities of the above compounds, GC-MS is most appropriate.

4.0 Methodology

The overall methodology to identifying a source is to compare the properties of the oil in question to properties of known sources until a positive identification beyond reasonable doubt is found or until the oils are demonstrated to be from other sources. Depending on the oil samples involved, the analytical requirements may range from only a GC analysis to an extensive assortment of tests.

In the case of GC analysis, the normal paraffin and isoprenoids are analyzed and compared in approximate range from C₇-C₃₅ depending on the GC capabilities. The difficulty in comparing oils depends largely on their degree of similarity in the range of comparison, as such certain hydrocarbon ratios are employed in analyzing the oil compositions.

Two crude samples were collected and analyzed from fields OML 124 and OML 126 been operated by Addax petroleum Exploration Nigeria, of the Niger delta field. OML124 contain sample labeled IZOMBE while the sample from OML 126 was labeled OKWORI. The API gravity and the specific gravity of the samples are:

Table 1- API and Specific gravity of oil samples

Sample	API gravity	Specific Gravity
IZOMBE	29.3	0.880
OKWORI	37.6	0.837

Gas chromatographic (GC) technique was used for the analysis of the oil samples received. This was done using Hewlett Packard 6890 GC equipped with a 50mm × 0.25mm × 0.5µm film thickness of PONA (cross linked Methyl Siloxane capillary column). A flame ionization detector detected and separated the components. The carrier gas was helium flowing at a rate of 40ml/s and the oven was programmed from 35°C to 320°C at 3.00°C/min. the initial and final temperatures were held for 5min and 20min respectively. The peak areas were electronically integrated and identification was based on retention times and comparison with authentic standards. The peak integration was achieved using the HP Chemstation software.

5.0 Whole oil fingerprinting results

The samples were analyzed for whole oil fingerprinting using GC-FID. The GC chromatograms represent the total hydrocarbon make up of the oil samples

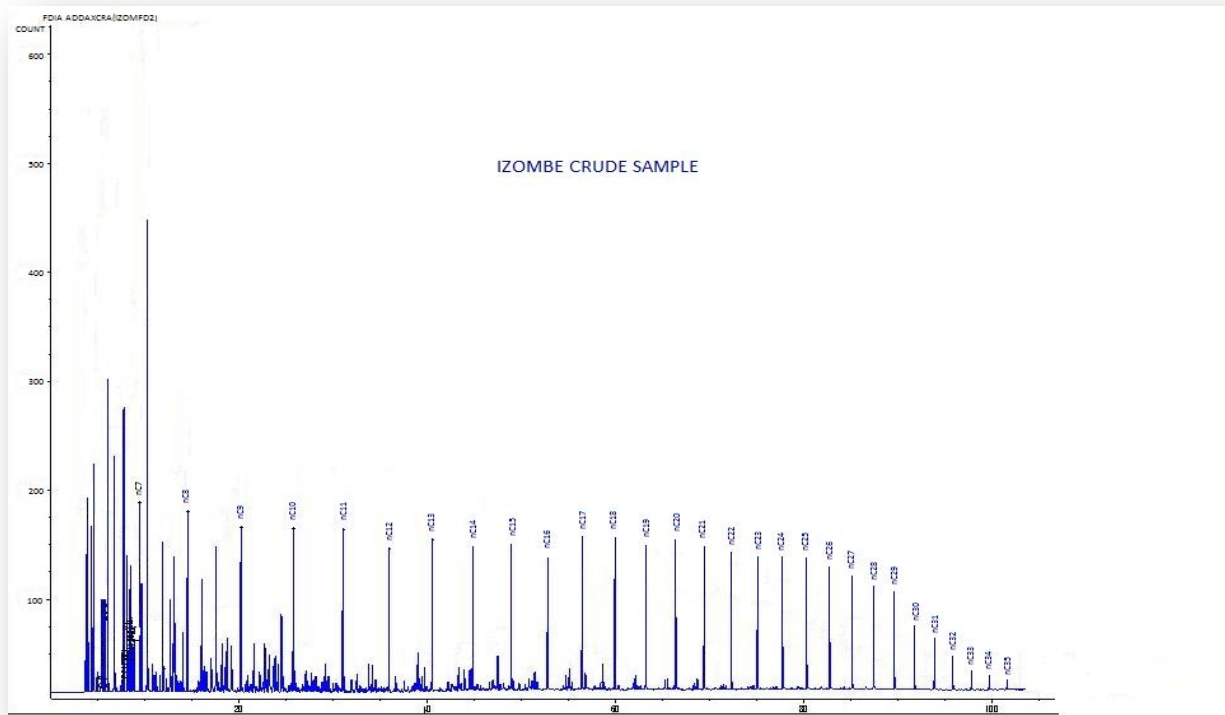


Figure 1- Gas Chromatogram for Izombe crude sample

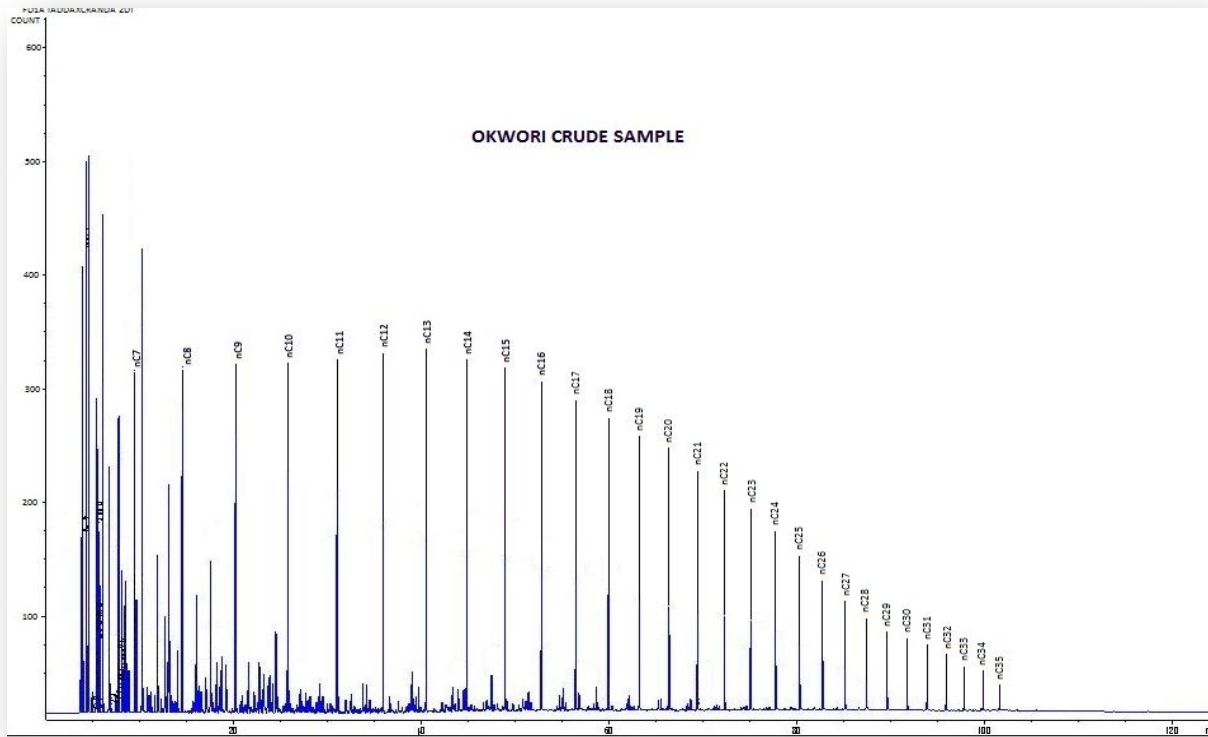


Figure 2- Gas Chromatogram for Okwori crude sample

Analysis shows that both Izombe and OKWORI crude samples contained detectable hydrocarbons with chain length of 35 carbon atoms.

6.0 Radar plots

The radial plots of the straight chained hydrocarbon composition (SCHC) versus Abundance of the crude samples from OML 124 and OML126 fields showed the following distribution:

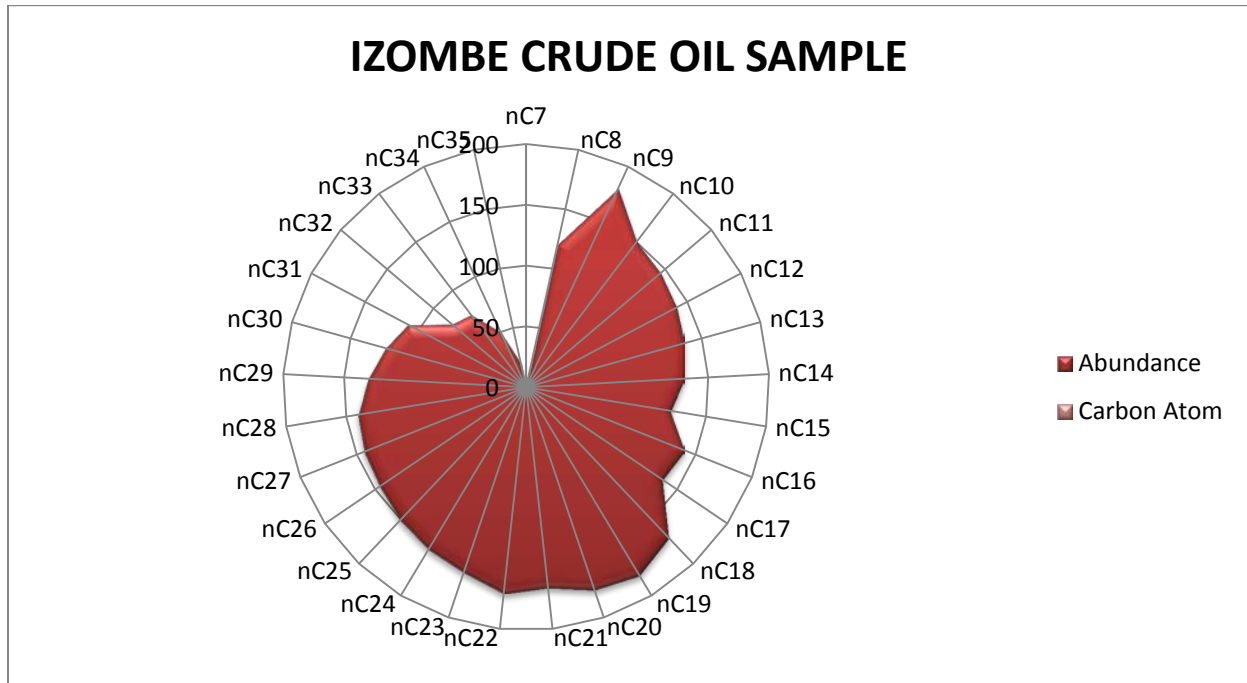


Figure 3- Radial plot for Izombe crude sample

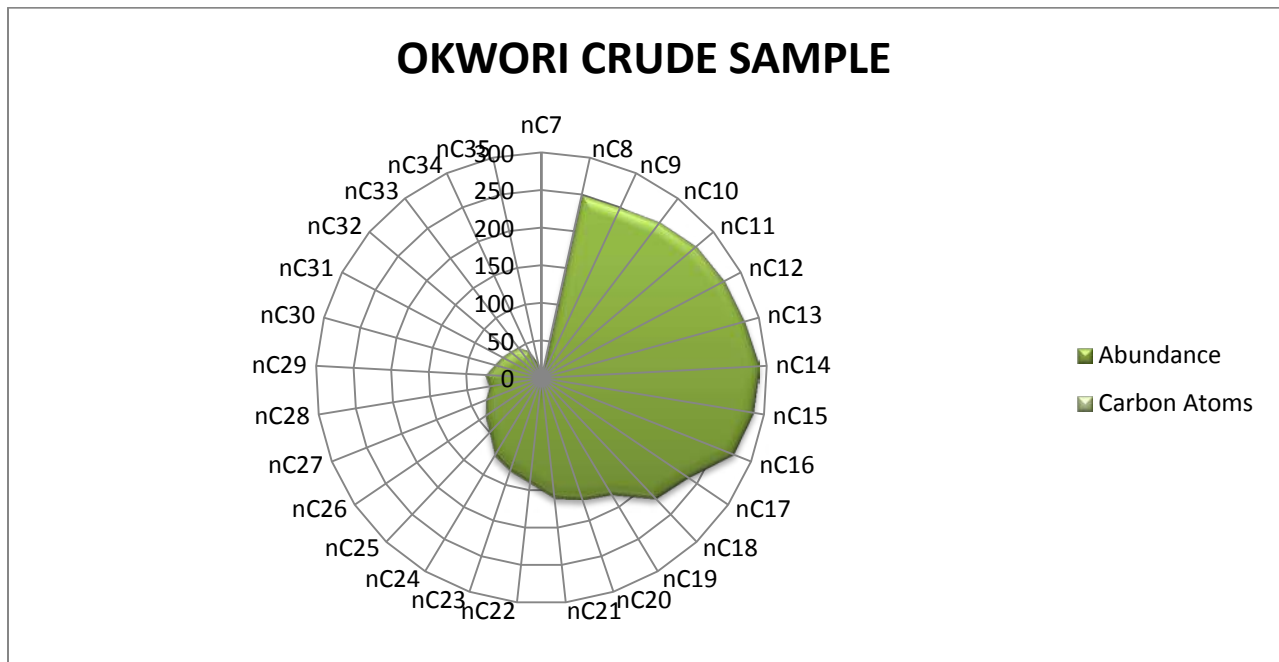


Figure 4- Radial plot for OKWORI Crude Sample

7.0 Carbon Abundance

The plot of carbon atoms versus abundance showed that Izombe crude sample from OML 124 had a relatively high abundance of heavy ends (C16-C35) than the light end (C7-C15) carbon atoms. Whereas OKWORI crude sample from OML 126 has relatively high abundance of light ends (C7-C15) carbon atoms than the heavy ends (C16-C35).

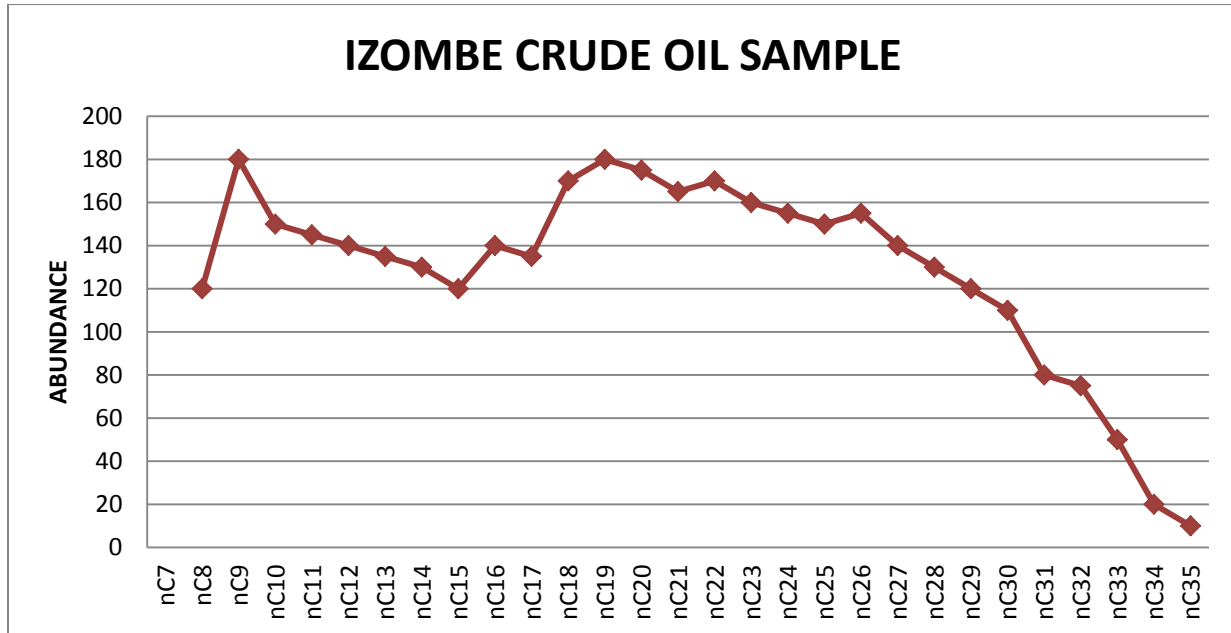


Figure 5-Plot of Carbon atom versus Abundance for Izombe

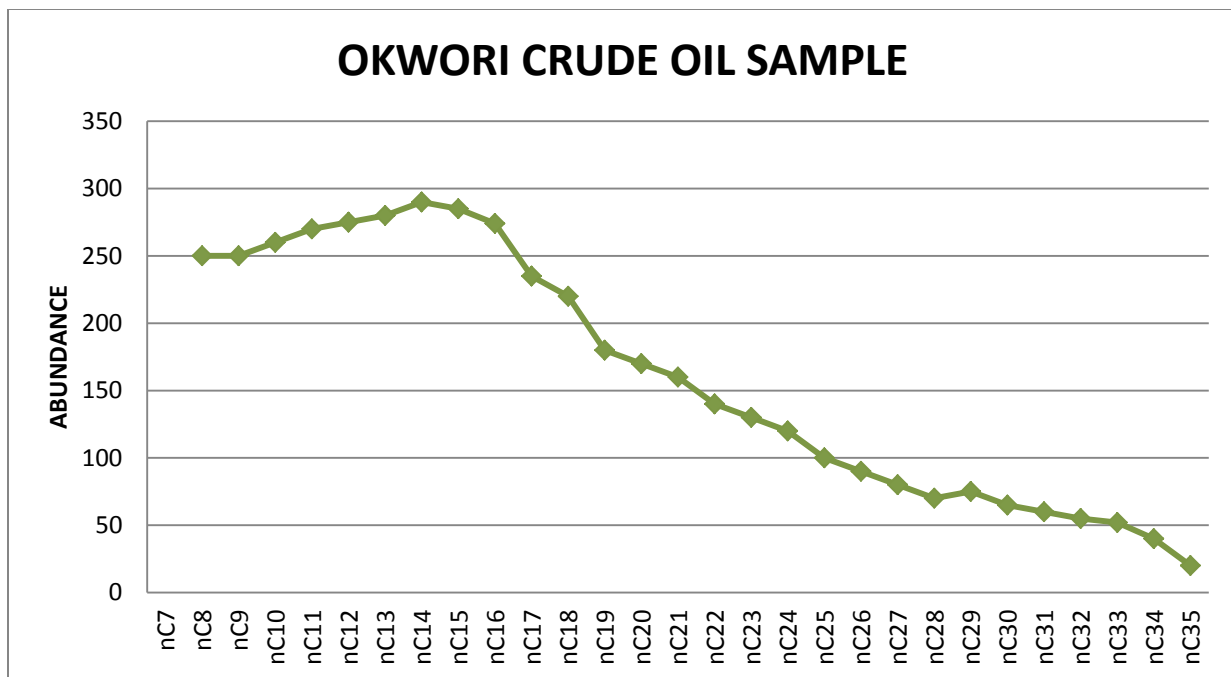


Figure 6 - Plot of Carbon Atom versus Abundance for OKWORI

8.0 Pristane / Phytane Ratio

The cross plots of P_r/nC_{17} versus P_h/nC_{18} and the P_r/P_h ratios for Izombe and OKWORI are shown below. The plots confirm the observed profile of the chromatograms.

Crude samples	P_r	nC_{17}	P_n	nC_{18}	P_r/nC_{17}	P_h/nC_{18}	P_r/P_h
IZOMBE	198	166	80	176	1.2	0.5	2.5
OKWORI	157	226	57	195	0.7	0.3	2.8

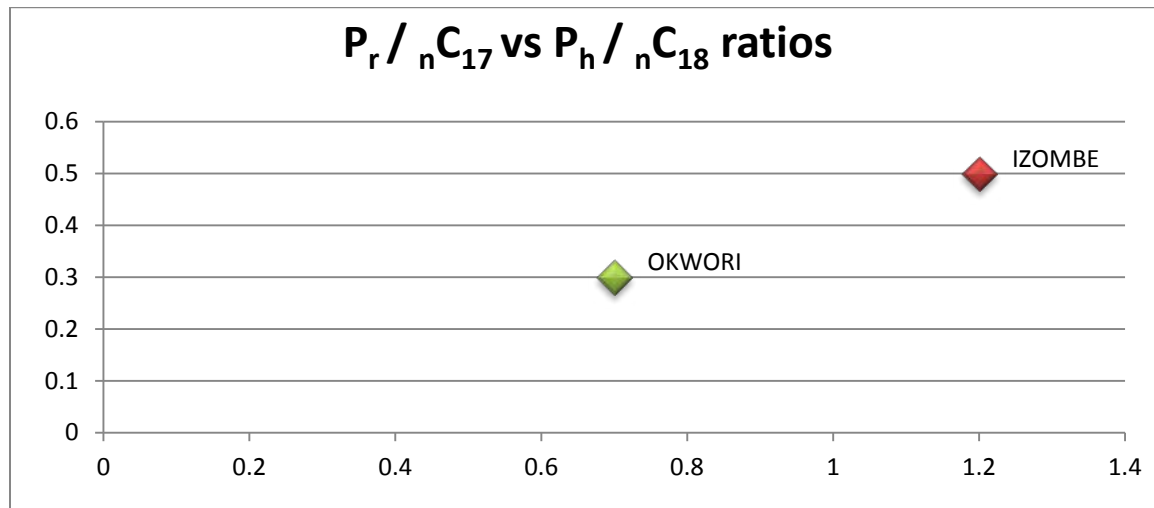


Figure 7-Plot of P_r/nC_{17} versus P_h/nC_{18} for Izombe and Okwori

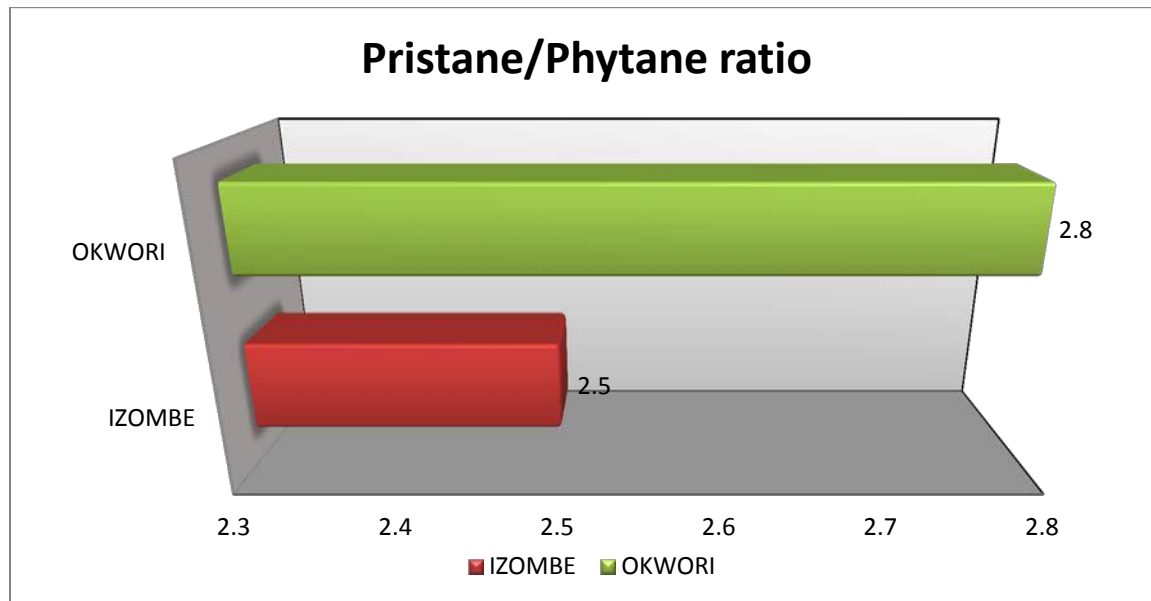


Figure 8-Clustered bars showing Pr/Ph ratios for Izombe and Okwori

Considering the samples, the Pr/Ph ratios range from 2.5 (Izombe) to 2.8 (OKWORI). The average Pr/Ph ratio is 2.7. The P_r/nC_{17} ratio ranged from 0.7 for OKWORI to 1.2 for Izombe and averaging 1.0, whereas the P_h/nC_{18} ratio ranged from 0.3 for OKWORI to 0.5 for Izombe with the average being 0.4.

9.0 Analysis

The methods and result discussed thus far shows that in order for 2 crude samples to be considered to be from a common source, they should appear common by a number of measures as illustrated by the normal paraffin and Isoprenoid profiles of GC-FID and radial plot analyses. If any of these measures indicates a low probability of commonality, then they might be considered to be from different sources.

The distribution pattern of the chromatogram for OKWORI is mono-modal while that of IZOMBE shows a bimodal distribution of n-alkanes indicating an input of mixed marine and terrestrial organic matter. Low molecular weight hydrocarbons were not observed, probably because of evaporative loss during sample processing.

Normal alkanes from n-C7 to n-C35 are seen in the chromatograms of the two oil samples, and these are confirmed by their respective radial plots. In crude oil correlation, the ratio of isoprenoids to n-paraffins is often used for oil source correlation, maturation and biodegradation studies. The crude samples have low Pr/Ph ratios which range from 2.5 to 2.8. The Pr/Ph ratios were used to access depositional environment of the crude oil. The low Pr/Ph ratios suggest that the oil samples were derived from source rock with a significant marine contribution. Values less than 1.0 are indicative of non-biodegraded oils. Both Pr/nC_{17} and Ph/nC_{18} decrease with maturation due to increasing prevalence of the n-paraffin.

10.0 Conclusion

Although the GC-FID used in this work runs on a low cost, low maintenance requirement, relatively resistant to misuse and can measure concentrations at very high and low levels, yet it is limited to the basic hydrocarbon information and degree of weathering, cannot detect inorganic substances and oxidizes all compounds that pass through it.

Gas Chromatography Flame Ionization detector (GC-FID) is majorly used when there is need to fingerprint crude oil with light hydrocarbon compounds devoid of other substances like Sulphides, Nitrides and oxygenated compounds. From this analysis, it is thus safe to conclude that GC-FID is suitable for use in the analysis of crude from Niger Delta fields.

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Nomenclature

- AED = Atomic Emission Detection
FID = Ionization Flame Detector
GC = Gas Chromatography
GC-FID = Gas Chromatography Flame Ionization Detector
HTGC = High Temperature Gas Chromatography
ICP-MS = Inductively Coupled Plasma Mass Spectrometry
Mm = Millimetre
MS = Mass Spectrometry
OML = Oil Mining Lease
 P_r/P_h = Pristane / Phytane Ratio
1D-GC = 1 - Dimensional Gas Chromatography
2D-GC = 2 - Dimensional Gas Chromatography



$^{\circ}\text{C}$ = Degree Celsius
 μm = Micrometre

Detection of *Ca. Liberibacter* associated with Huanglongbing (HLB) in citrus plants-*Citrus Medica* (Lemon), *Citrus Indica* (Orange), *Citrus Reticulata* (Narangi)

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Abstract

This study aimed at the detection of *Candidatus liberibacter asiaticus* in the citrus plants viz *Citrus Medica* (Lemon), *Citrus Indica* (Orange), *Citrus Reticulata* (Narangi). The infected plant samples *Citrus Medica* (Lemon), *Citrus Indica* (Orange), *Citrus Reticulata* (Narangi) were collected from the nurseries of Kozhikode (Kerala), Bangalore and Jaunpur (U.P) respectively. The sample processing was then done by a series of washing of roots with 70% ethanol, 8% sodium hypochlorite and sterile distilled water. Aliquots from five consecutive washing was collected and spread onto TYA media. Bacteria were identified using various biochemical tests i.e., Oxidase test, Nitrate reductase test, McConkey test and Gram staining. The culture was then used for bacterial DNA isolation. The qualitative and quantitative determination of the extracted DNA was then done. The amplified product was then sequenced and the sequence obtained was further analyzed using BLAST (www.ncbi.nlm.nih.gov/BLAST/) and CLUSTALW2 (www.ebi.ac.uk) tool. The study helped to identify the *Ca. Liberibacter* bacteria in the samples from the infected plants. Thus study can be used to derive that

yellowing of leaves in citrus plants viz., *Citrus Medica* (Lemon), *Citrus Indica* (Orange), *Citrus Reticulata* (Narangi) are caused by the Asian form species i.e *Candidatus Liberibacter Asiaticus*.

Keywords: Amplification, alignment, *Ca. liberibacter*, citrus plants, huanglongbing, phylogenetic tree.

1. Introduction

Huanglongbing (HLB), ex citrus greening, is one of the most serious diseases that occur in citrus. The symptoms include leaf mottling, yellowish shoots, and, frequently, small and lopsided fruit. It is caused by a phloem-limited, gram-negative; nonculturable bacterium designated "*Candidatus Liberibacter*", a member of the alpha- subdivision of the phylum Proteobacteria. Two forms of HLB disease are known, African and Asian [1]. The African form is caused by a heat-sensitive and Trioza erytraeae- vectored bacterium designated "*Ca. L. africanus*", whereas the Asian form is caused by a heat-tolerant and Diaphorina citri vectored bacteria named "*Ca. L. asiaticus*". Both insect vectors can naturally transmit their respective form of bacteria, which infect all Citrus spp. and cultivars. The disease causes severe losses in the production of sweet orange (Citrus

sinensis), mandarin (*C. reticulata*), lemon (*C. limon*), grapefruit (*C. paradisi*), and other economically important citrus species [2]. Various DNA amplification methods, including conventional polymerase chain reaction (PCR), real-time PCR, nested PCR, and loop-mediated isothermal amplification, have been used to detect greening-infected plants [3][4]. Conventional PCR is the preferred method because it is inexpensive and easy to perform. Improved conditions and Las-specific primers for conventional PCR are often reported and applied. In particular, conventional PCR using the Las-specific primer set Las606/LSS, which targets a specific part of Las 16S ribosomal DNA, is a highly sensitive and robust method for Las detection [5]. Polymerase chain reaction (PCR) diagnosis is the more reliable and sensitive diagnostic tool for detecting the greening bacterium, (*Candidatus Liberibacter*) than other conventional approaches like DNA-DNA hybridization, electron microscopy, and immunofluorescence for the detection of citrus greening. Results revealed that sodium sulphite method of DNA isolation provides highest yield and better quality DNA than other previous methods [6]. Many genes involved in the key ecological processes such as carbon fixation, nitrogen cycling, metal homeostasis, phosphorus utilization, were significantly greater in health than in the 'Ca. *L. asiaticus*' infected citrus rhizosphere. Their results showed that the microbial community of 'Ca. *L. asiaticus*' infected citrus rhizosphere has shifted away from using there more easily degraded sources of carbon to more recalcitrant forms. Overall, their

study provides evidence that the change in plant physiology is mediated by 'Ca. *L. asiaticus*' infection which could elicit shifts in the composition and functional potential of the rhizosphere microbial communities. These fluctuations might have important implications for the productivity and sustainability of citrus producing agro ecosystems [7].

2. Materials and Methods:

Plant materials:

Roots of citrus plants showing HLB symptoms were collected in different geographic regions of Kozhikode (Kerala), Bangalore and Jaunpur (U.P.).

Sample Processing:

Sample processing was done using three different solvents of different percentage. 70% ethanol, 8% Sodium hypochlorite and Sterile Water were used for the processing of roots infected with HLB disease.

Biochemical Tests:

Different Biochemical tests were performed to identify the bacterial culture. Oxidase test, McConkey test, Nitrate Reductase test, Kligler's Iron Agar Test, Motility agar test were performed for this study on the cultures obtained on Tryptone Yeast Agar. Gram staining was also done for morphological study of the bacteria.

DNA extraction and Quantification:

DNA extraction was done from the bacterial culture broth (Nutrient broth) using phenol:chloroform, Tris-HCl, detergent Sodium dodecyl Sulphate, Tris-EDTA.

A 0.8% agarose gel stained with ethidium bromide was used to visualize DNA. Quantification of extracted DNA was done spectrophotometrically at 260/280 nm ratio.

PCR Amplification:

Extracted DNA were amplified by PCR using primer pairs:

forward, 5'CCTTGAACAGGTGGAGGCCAG-3',

reverse, 5'-GCGGTGAGAGTGGGGTGGAG-3',

The PCR reaction (total volume 20 µl) was launched with a mixture containing 5µl genomic DNA, 5µl dNTPs, 1µl of each primer and 0.5µl Taq DNA polymerase which was added into 3µl of PCR buffer and added the double distilled water to make up the total volume. PCR conditions were as follows: Initial denaturation step at 94 °C for 5 min, 30 cycles at 94 °C for 30 s denaturation temperatures, 62 °C for 45s annealing temperature, and at 72 °C for 45 s extension temperature. The final extension step was performed at 72 °C for 5 min.

Sequencing and Sequence Analysis:

The amplified PCR product was then sequenced using Sanger's Method. The percent sequence identity was determined using BLAST (www.ncbi.nlm.nih.gov/BLAST/) and phylogenetic tree construction done by using the ClustalW2 program (www.ebi.ac.uk/Tools/msa/clustalw2/).

3. Result & Discussion

The infected plant samples Citrus Medica (Lemon), Citrus Indica (Orange), Citrus Reticulata (Narangi)

were collected from the nurseries of Kozhikode (Kerala), Bangalore and Jaunpur (UP) respectively.



Fig 1: Citrus medica plant showing symptoms of Yellowing of Leaves (b) Citrus indica plant showing leaves in which diseased part is feeded by Trioza

In the present study, the processing was done using successive washing with ethanol, sodium hypochlorite and sterile distilled water.

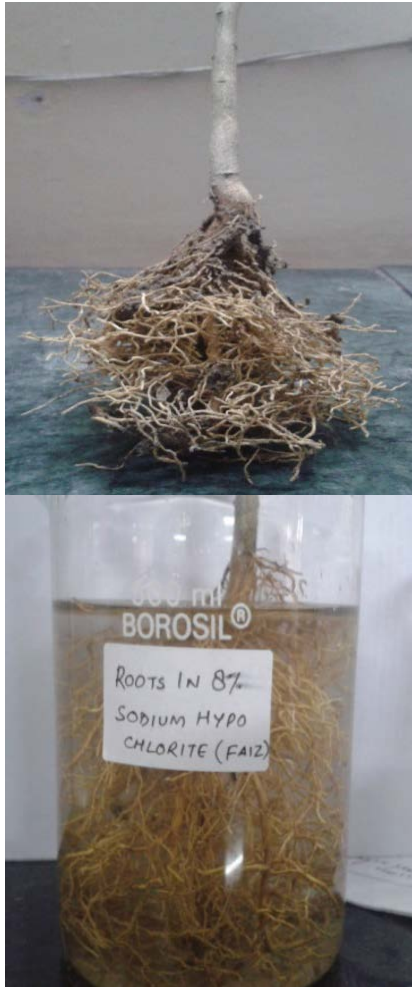


Fig 2: Roots of infected plant (a) after running tap water wash (b) immersed in 8% Sodium hypochlorite

The culture obtained on TSA media was used for biochemical tests. The isolated bacterial species shown positive result for Mac Conkey Test, hence all the bacterial species which are gram negative grew on the media. In case of oxidase test, change of color from blue to purple occurred due to production of cytochrome oxidase. Red color ring form, reduction of nitrate to Nitrite gave a positive test for nitrate reductase test. Positive test of klinger iron test as red

slants were seen. Positive result for Motility agar test as diffused zone of Growth was observed. Gram staining showed pink stained bacteria i.e. Gram negative bacteria.

The bands of DNA were observed on 0.8% agarose gel. And band for amplified PCR product were observed on 1.2% gel in gel documentation system.

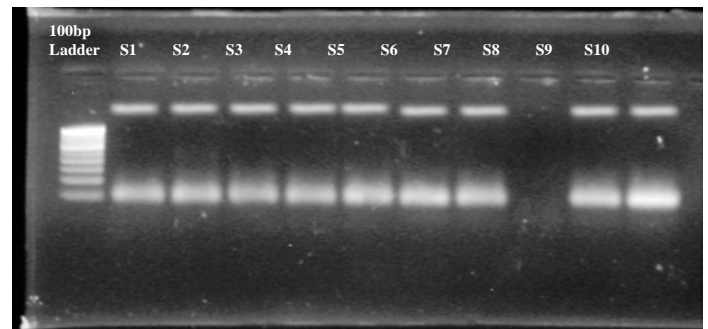


Fig 3: DNA isolated from bacterial culture run on a 0.8% gel stained with ethidium bromide and analyzed in Gel Doc System. S1-10: bacterial culture samples

The PCR product was sequenced and the sequence received was analyzed to construct the phylogenetic tree and calculate the maximum identity with the query sequence from database sequences.

```
GACGGGTGAGTAACACATATTGGCAGTCCTCGAGAGAC
TAAGTTTTTCTACGGGATAACGCATGGAAACGTGTGC
TAATACCGTATACGCCCCATTGGAGGAAAGATTTTATT
GGAGAGAGATGAGCCTGCGTTGGATTAGCTAGTTGGTA
GGGTAAGAGCCTACCAAGGCTACGATCTATAGCTGGTC
TGAGGGGACGATCAGCCACACTGGGACTGAGACACGG
CCCAGACTCTACGGGAGGCAGCAGTGGGGAATATTGG
ACAAATGGGGCAACCCTGATCCAGCCATGCCATATAT
AAAAGGGTCTCTCTTTGGGAAATTCTCTCTCCGGGT
GTAAAGCTCTTCGCCGGGAAGATAATGACGGTATTC
GGAGAAGAAGCCCCGGCTAACTTCGTGCCAGCAGCCGC
GGTAATACGAAGGGGGCGAGCGTTGTTCCGAATAACTG
```

GGCGTAAAGGGCGCGTAGGCGGGCGATTAAGTTAGAG
 GTGAAATCCCAGGGCTCAACCTAACGGATGGAAGTCC
 TTTAATACTGGTTGTCTAGAGTTTAGGAGAGGTGAGTG
 GAATTCGAGTGTAGAGGTGAAATTCGTAGATATTCGG
 AGGAACACCGGTGGCGAAGGCGGCTCACTGGCCTGATA
 CTGACGCTGAGAACTTCGGCTGCTGGTAATTCCTACA
 CCCTACAAATTCGGGGCAGCTCAGAAGTCCACGCCGT
 AAACGATGAGTGTAGCTGTTGGGTGGTTTACCATTCA
 GTGGCGCAGCTAACGCATTAAGCACTCCGCCTGGGGAG
 TACGGTCGCAAGATTAATAACTCAAAGGAATTGACGGGG
 GCCCGCACAAAGCGGTGGAGCATGTGGTTAATTCGATG
 CAACGCGCAGAACCTTACCAGCCCTGACATGTATAGG
 ACGATATCAGAGATGGTATTTCTTTTCGGAGACCTTTA
 CACAGGTGCTGCATGGCTGTCGTTTGGGTACTTTATAGG
 GACTGCCGGTGATAAGCCGGAGGAAGGTGGGGATGAC
 GTCAAGTCCTCATGGCCCTTATGGGCTGGGCTACACAC
 GTGCTACAATGGTGGTTACA

A BLAST search for homologies revealed that the given sample sequence exhibited 92% identity with *Ca. Liberibacter africanus* ([GU991650.1](#)). To further characterize the “*Ca. Liberibacter*” the nucleotide sequences obtained were aligned with the *maximum identity hit* sequences of “*Ca. Liberibacter africanus*” isolates. A phylogenetic tree was constructed using the maximum-parsimony method. Interestingly, the group was divided into three subgroups corresponding to the two “*Ca. Liberibacter*” species.

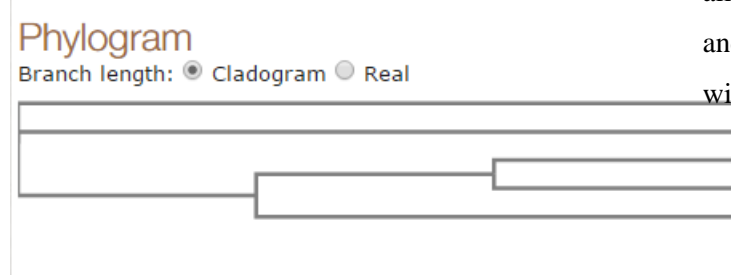


Fig 4: A phylogenetic tree constructed using CLUSTALW2 showing relationship among *Ca. Liberibacter* species

4. Conclusion:

The objective of this study was the detection of the bacterium *Candidatus Liberibacter asiaticus* in the Citrus plants viz *Citrus Medica* (Lemon), *Citrus Indica* (Orange), *Citrus Reticulata* (Narangi). From the earlier studies, it was observed that this bacterium is responsible for the yellowing, notching and mottling of leaves, seed abortion, fruit colour alteration in citrus plants. For the present study, we took the extracts from roots of the three infected citrus species i.e. *Medica*, *Indica* and *Reticulata*. The infected plant amples *Citrus Medica* (Lemon), *Citrus Indica* (Orange), *Citrus Reticulata* (Narangi) were collected from the nurseries of (Kozhikode) Kerala, Bangalore and Jaunpur (U.P) respectively. The sample processing was done and spread onto TYA media. The plates were grown overnight at 28°C for 72 hrs. The samples gave positive results for all the tests performed. A gram negative bacteria was observed. The culture was then used for bacterial DNA isolation and bands were observed on 0.8% gel. The amplified product was then sequenced, analysis was done using BLAST and multiple sequence alignment using CLUSTALW2 tool, the alignment and tree construction showed a maximum identity with *Ca. Liberibacter asiaticus*.

gi|677286281|gb|KJ944267.1| -0.00045
 gi|677286279|gb|KJ944265.1| 0.00045
 gi|677286284|gb|KJ944270.1| -0.00046
 gi|677286283|gb|KJ944269.1| 0.00046
 gi|301602453|gb|GU991650.1| 0.00393

Acknowledgment

Thanks are due to Division of Biotechnology, CytoGene Research & Development (Lucknow) for providing us with all necessary requirements during the project and I am grateful to the Almighty.

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[7] **N. Urasaki, S. Kawano, H. Mukai, T. Uemori, O. Takeda, T. Sano.** Rapid and sensitive detection of “*Candidatus Liberibacter asiaticus*” by cycleave isothermal and chimeric primer-initiated amplification of nucleic acids

B – Spline Based Finite Element Method for Two-Dimensional Problems

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Abstract: In this work, an attempt is made to use the B-spline basis functions as the shape functions in the finite element method in contrast with the conventional Finite Element method. An open uniform knot vector is used to obtain the second degree B-Spline basis function. For the spatial discretization, the Potential Energy approach approximation method is employed. Two test cases are considered to study the effectiveness of the present method. These test cases included two dimensional elasticity problems. The results obtained by the present method are compared and found to be in good agreement with the analytical solution and the finite element method.

Keywords: B-Spline, Isogeometric Method, Potential Energy approach

INTRODUCTION

In the recent years, a new class of approximating methods which are variants of the finite element methods are proposed to solve various initial and boundary value problems. The methods that can be included in this category are Meshfree methods [1], B-Spline based Finite element method and Isogeometric methods [2]. In these methods, the approximating function provides higher order of continuity and is capable of providing accurate solutions with continuous gradients throughout the domain.

In the present work, an attempt is made to use an approximating function for the field variable based on the B-Spline basis function to solve the various boundary value problems. An open uniform knot vector is used to obtain the second degree B-Spline basis function. For the spatial discretization, the Potential Energy approach approximation method is employed. Numerical studies are performed with

problems of linear elasticity in two dimensions. The two problems considered are the one end fixed a prismatic bar with axial traction on the unclamped end and two end fixed prismatic bar with body load problem.

B-SPLINE FINITE ELEMENT METHOD

The B-splines are a standard tool for describing and modelling curves and surfaces in computer aided design and computer graphics [3]. The aim of this section is to present a short description of B-splines and its associated terminology.

B-Spline Basis Function

The *cox-de Boor* recursion formula for the B-Spline basis functions are defined recursively starting with the zeroth degree ($p = 0$). These basis functions are given as

$$N_{i,0}(\xi) = \begin{cases} 1 & \text{if } \xi_i \leq \xi < \xi_{i+1} \\ 0 & \text{otherwise} \end{cases} \dots\dots\dots(1)$$

And for any polynomial degree ($p \geq 1$),

$$N_{i,p}(\xi) = \frac{\xi - \xi_i}{\xi_{i+p} - \xi_i} N_{i,p-1}(\xi) + \frac{\xi_{i+p+1} - \xi}{\xi_{i+p+1} - \xi_{i+1}} N_{i+1,p-1}(\xi) \dots\dots\dots(2)$$

When evaluating these functions, ratios of the form 0/0 are defined as zero

In the above equations, the basis functions are defined over a parametric domain ξ . The span of the parametric domain is known as the knot vector $\{\xi_1 \ \xi_2 \ \dots \ \xi_{n+p+1}\}$, where ξ_i is the 'i' th knot, n is the number of basis functions and p is the polynomial degree.

A knot vector is a sequence in ascending order of parameter values. A knot vector is said to be open

if its first and last knots have multiplicity equal to the polynomial order plus one. An important property of open knot vectors is that the resulting basis functions are interpolatory at the ends of the parametric space. If the knots are evenly spaced then knot vector is called uniform otherwise it is non-uniform.

As examples, for polynomial degree $p = 0$ and 1 using uniform knot vector $\{0 \ 1 \ 2 \ 3 \ 4 \ 5 \dots\}$, the basis functions are shown in figure 1 and figure 2.

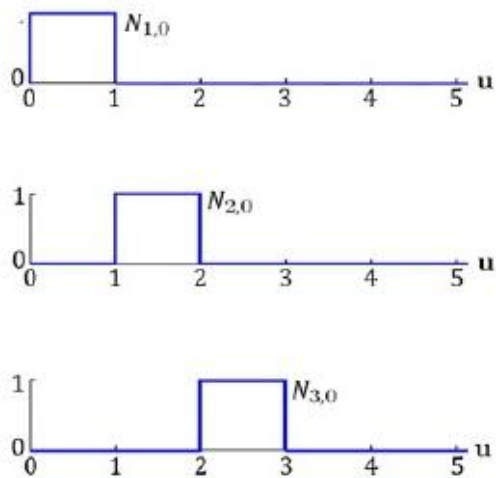


Figure 1

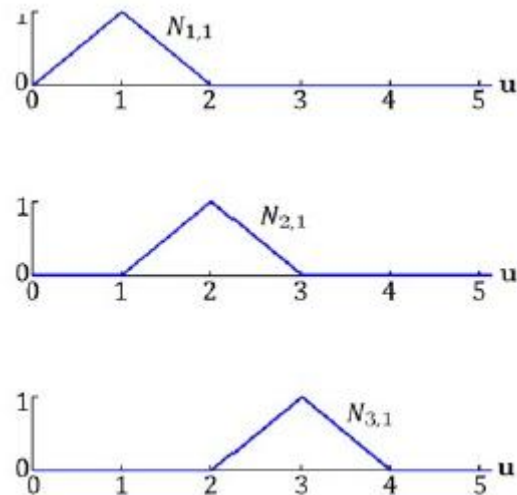


Figure 2

THE TEST PROBLEMS

Two test elasticity problems are considered to study the effectiveness of the present method. They are a prismatic bar subjected to axial traction on the

unclamped end in the x direction and a two end fixed prismatic bar subjected to body load.

Prismatic bar subjected to axial traction on the unclamped end

The first problem studied is a prismatic bar subjected to axial traction on the unclamped end in the x direction. The geometry and loading conditions for this problem are shown in figure 3 [6].

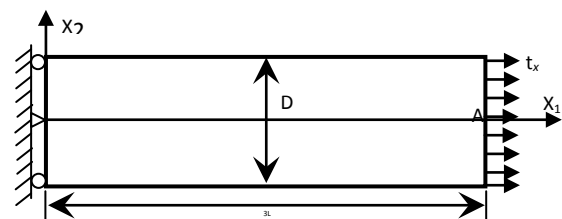


Fig 3: Prismatic bar with one end fixed problem: geometry and loading

$$\text{Exact solution } u \text{ is } u = \frac{(t_x)X(x)}{E} \dots\dots(3)$$

Young's modulus (E) = 200 GPa and Poisson's Ratio (ν) = 0.3. Other dimensions of the problem are length of the beam, $L = 2 \text{ mm}$ and height of the beam, $D=1 \text{ mm}$. The penalty parameter in enforcing essential boundary conditions is taken as 1000 times the Young's modulus. The traction on the unclamped end is 5 N/mm^2 .

The axial displacement $u(x)$ that is produced by the force is the solution. In the B-spline based Finite element method (BSFEM), the displacement field is approximated by,

$$Q(u, w) = \sum_{i=1}^{ne} \sum_{j=1}^{me} B_{i,j} N_{i,k}(u) M_{j,l}(w) \dots\dots(4)$$

In equation (4), 'ne,me' represents the number of nodes in an elements respectively X & Y directions, $N_{i,k}$, $M_{j,l}$ is the basis functions obtained from the B-Spline basis functions for any point in the domain. In the present study, only the second degree ($p = 1$) approximation is considered. Generally, the B-spline basis functions are not

interpolatory except when the knot vector is open uniform. When an open uniform knot vector is used, the essential boundary conditions can be directly implemented. Therefore, an open uniform knot vector is taken as parametric space coinciding with the coordinates of the domain.

The domain is discretised with 63 nodes and 48 elements with four nodes per each element shown below fig.20. Knot vectors are [0 0 0.25 0.5 0.75 1.0 1.25 1.5 1.75 2.0 2.0] in X & [0 0 0.16 0.33 0.50 0.66 0.83 1.0 1.0] in Y directions for this problem

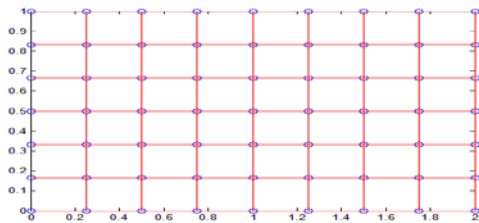


Fig 4: Nodes & Element distribution of prismatic bar (63 nodes & 48 elements)

The obtained results are compared with the exact solution are tabled in table 4 and plot in the fig 21. For 48 elements & 63 nodes error percentage in the result is less than 2%. If the number of nodes is increased to 221 the error percentage is less than 1%

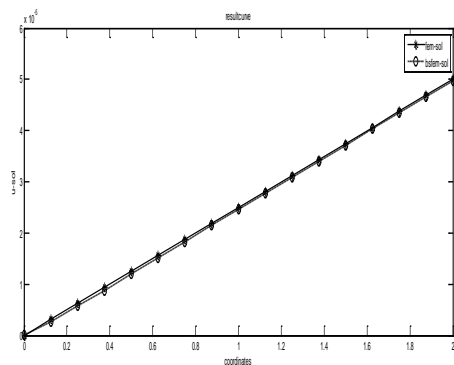


Fig 5: Compression of field variable (u) with exact solutions

where, The figure 5 shows the displacement field along the length of the bar. It can be observed from the figure that the results obtained by the present method are in very good agreement with the analytical solutions.

Two end fixed prismatic bar subjected to body load.

The second problem studied is two end fixed prismatic bar subjected to body load. The geometry and loading conditions for this problem[6] are shown in figure 6

Young's modulus (E) = 200 GPa and Poisson's Ratio (ν) = 0.3. Other dimensions of the problem are length of the beam, $L = 3L$ mm and height of the beam, $D=1$ mm. The penalty parameter in enforcing essential boundary conditions is taken as 1000 times the Young's modulus. The body force is 2 N/mm^3

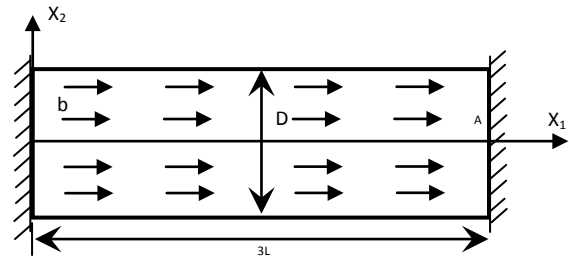


Fig 6: Two end fixed prismatic bar subjected to body load: geometry and loading

Exact solution given as

$$u = bx \frac{3L_x - x}{2E} \dots\dots(5)$$

The domain is discretised with 130 nodes and 108 elements with four nodes per each element shown below fig.23. Knot vectors are [0 0 0.25 0.5 0.75 1.0 1.25 1.5 1.75 2.0 2.25 2.5 2.75 3.0 3.0] in X-direction [0 0 0.11 0.22 0.33 0.44 0.55 0.66 0.77 0.88 1.0 1.0] in Y-direction for this problem

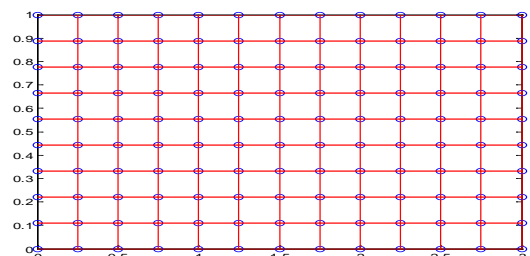


Fig 7: Nodes & Element distribution of simple supported beam (130 nodes and 108 elements)

The obtained results are compared with the exact solution are an plot in the fig 8. For 108 elements & 130 nodes error percentage in the result is less than 2%. If the number of nodes is increased to 336 the error percentage is less than 1%

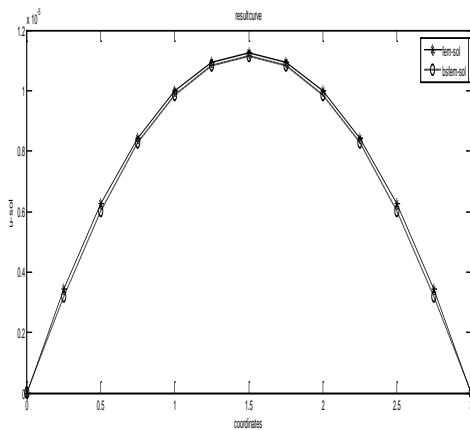


Fig 8: Compression of field variable (u) with exact solutions

CONCLUSION

In this work, an attempt is made to use the B-spline basis functions as the shape functions in the finite element method. An open uniform knot vector is used to obtain the first degree and second degree B-Spline basis function. For the spatial discretization, the potential energy approach is employed for two dimensional problems. Two test cases have been performed to study the effectiveness of the current method. The results obtained by the present method are compared and found to be in good agreement with the analytical solution (exact solution) as well as the finite element method. The maximum error found that 2%

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Intelligent Energy Management System for Residential Buildings Based On Zigbee Technology

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Abstract

Energy consumption in residential buildings account for 20 to 40 per cent of total energy consumed in a country and therefore represents a significant and potential source of energy savings. An Intelligent Energy Management System can contribute to major reductions of energy use in hundreds of millions of buildings. This paper gives an overview of sensor technology and wireless networks in the development of an intelligent energy management system for residential buildings (IEMSRB). This technology has ample potential to change the way we live and work. In this paper ZigBee is used as a communication medium in building intelligent energy management system. From the prototype setup, it is shown that ZigBee is a suitable technology to be adopted as the communication infrastructure in energy management system for residential buildings. The performance analysis discussed in this paper verifies the effectiveness of using ZigBee in energy management system. The novelty of the present scheme is its ability to save the energy and improve the performance as it learns and gains more

experience in real-time operations. Results also demonstrate that the proposed scheme can achieve the minimum electricity cost for residential customers. The proposed system can be installed and maintained in residential environments with ease.

Keywords: *Energy Management System, ZigBee, Sensor and Actuator Networks.*

Introduction

Energy was once a commodity which most enterprises did not have that much control of in the past. In this day and age, energy control is now a top priority. It is important for all of us to have the responsibility and make sure that we have a good energy system. The energy system includes energy of water, electricity, gas, air, and steam. The energy system cannot only affect our corporation or industry, but also affect the environment around our corporation or industry. An intelligent energy management system can contribute to major reductions of energy use in hundreds of millions of buildings. Energy savings and user happiness are two major design considerations for intelligent home system.

Intelligent homes in a building must fulfill four basic requirements. First, they must facilitate safe, convenient, and healthy lifestyle. Secondly, they must be environmentally sustainable. Thirdly, they must promote comfort. And finally, an intelligent home must provide an efficient workspace to its occupants. The most effective way to reduce energy is to turn devices off. The second most effective way is to turn them down. An automated control system can do both for consumer based on factors such as occupancy, available daylight and time of day. Removing the wires from the controls provides additional benefits, including greater flexibility in where controls can be placed, and significant savings in installation by avoiding the expense and disruption of wiring. This paper describes the development of an intelligent energy management system for residential buildings using the concept of a sensor technology and wireless network. In this paper ZigBee is used as a communication medium in energy management systems. By using this energy management system, it is possible to see and control the energy system of various devices. Wireless sensor technology is fast replacing wired technology in almost all the fields, because it is less costly and also because it is more efficient as compared to wired networks. Sensors measure multiple physical properties and include electronic sensors, biosensors, and chemical sensors. These sensors can thus be regarded as “the interface between the physical world and the world of electrical devices, such as computers”.

In this paper ZigBee is used as a communication medium in energy management systems which can be implemented in building, household, research laboratory and so on.

II. Wireless Sensor & Actuator Network

The whole point of a wireless network is to send reliable data between nodes in the network. Wireless sensor and actuator networks (WSANs) are networks of nodes that sense and potentially also control their environment. They communicate the information through wireless links “enabling interaction between people or computers and the surrounding environment”. The data gathered by the different nodes is sent to a sink which either uses the data locally, through for example actuators, or which “is connected to other networks (e.g. The Internet) through a gateway. Sensor nodes are the simplest devices in the network. A sensor node typically consists of five main parts: one or more sensors gather data from the environment. The central unit in the form of a microprocessor manages the tasks. A transceiver communicates with the environment and a memory is used to store temporary data or data generated during processing. Fig1 shows architecture of a sensor node. To assure a sufficiently long network lifetime, energy efficiency in all parts of the network is crucial. Due to this need, data processing tasks are often spread over the network, *i.e.* nodes cooperate in transmitting data to the sinks. Fig2 shows the most important fields of application. If compared the performance with wired Local Area

Network (LAN), it is generally accepted that wired LAN network offers higher speed than wireless LAN network.

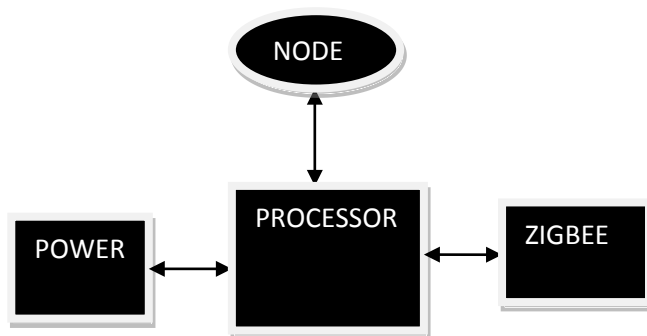


Fig 1: Architecture of Sensor Node

III. Zigbee Networks

Energy conservation, control, and safety are some of the prospects of ZigBee. Word ZigBee was originated from word Zigzag indicating cross-shaped network cables and Bee to indicate economical communication method. The name refers to the waggle dance of honeybees after their return to the beehive. The ZigBee network automatically figures out how to route the data from one node to another with the maximum chance of success. ZigBee networks have the following requirements and features: low power consumption, low cost, low packet throughput, lots of network nodes, low request on quality of service, security control, and high reliability. ZigBee can be used in various applications such as HVAC controls, Lighting Controls, and Utility Networks. ZigBee consumes low electricity supply and can be configured to large scale sensor networks by integrating

with sensor (Activity, light, temperature and humidity, etc) and transmitter/receiver devices. This type of structure is defined as foundation technology for sensing, monitoring and controlling. ZigBee has recognized as next generation short-distance wireless communication standard based on strong advantages including lowest costs, lowest energy consumption which can be last 2 years with 2AA type batteries, scalability of up to 65,000 nodes, simple network configuration and reliability from immediate recovery function from data transmission errors. Especially, ZigBee supports multi-hop function to ensure highest transmission success rates.

IV. Proposed Intelligent Energy Management System for Residential Building

Fig shows the architecture of the proposed Intelligent Energy Management System for Residential Buildings (IEMSRB). Each home of the building has one living room, one bed room, one kitchen, one rest room and each section is equipped with necessary load as shown in Fig 2, one power outlet, and one ZigBee hub. The dimming light and the power outlet include a power measurement function to measure the power consumption. They report the information periodically to the ZigBee hub through ZigBee communication. Because home appliances are connected to the power outlet, their power usage can be acquired by the power measurement function of the power outlet. The ZigBee hub in the room gathers the power information

reports of the light and the power outlet, and then it transfers the information to the home server. The home server analyzes the power information of all home appliances in each room. It displays the real-time active power consumption of each home appliance and the accumulated power consumption of each home appliance. A user can figure out which home appliance is unnecessarily turned on through the real-time active power consumption and how much power each home appliance consumes in this month through the accumulated power consumption. A user can also analyze the power usage of each room through the ZigBee hub. A user can access the home server and turn off unnecessarily turned on home appliances. The power outlet periodically monitors the power consumption of the connected home appliance. As soon as the monitored power consumption of the home appliance is below the threshold for the determined period, the power outlet automatically cuts off the AC power to reduce the standby power of home appliance.

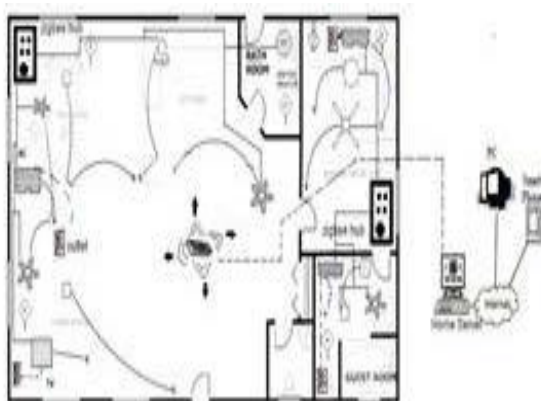


Fig 2: Architecture of proposed intelligent energy management

V. Implementation Details & Performance Analysis

To show the achievability of the proposed architecture an experimental based case study has been done on the system which is developed to demonstrate that smart, simple sensor devices can be used to manage, control and save energy in smart home in a smart building. We have developed as smart node that has sensing, processing and networking abilities. It is equipped with a microcontroller (8952) as shown in Fig 6 and a narrow-band radio frequency (RF) device that can support physical-layer functionalities of IEEE802.15.4. Various optional sensor and actuator modules can be equipped with this smart node with the help of a connector and directly controlled by the microcontroller in our smart node. Temperature sensor is included in the smart node. An experimental based case study has been done on the system which is developed to demonstrate that smart, simple sensor devices can be used to monitor activities of daily living and lifestyle of person living in smart home in a smart building. The system has been tested by connecting the soldering iron to the temperature sensor as shown in Fig

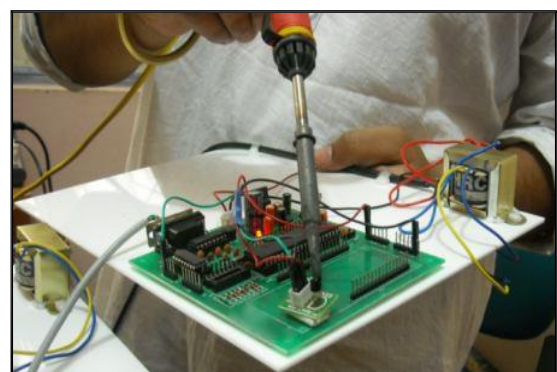


Fig 3: System Testing with Soldering Iron

VI. Conclusion

The system has been tested by connecting the ZigBee based temperature sensor to the following appliances-soldering iron, air conditioner and tube lights.

The data collected during various seasons and Electricity bill on monthly basis for the said duration. The monthly kWh consumption of energy with and without ZigBee based sensors. This captured data can help us to identify load pattern and energy saving in smart homes of an intelligent building. The proposed system can be installed and maintained in residential environments with ease. A ZigBee based Intelligent Energy Management System for residential building system can provide significant cost savings in a building environment, great level of flexibility and control for the building administrators and great comfort for the occupants.

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Surgical Management of Unusual size of Cystic Calculi in a Bitch: A Case Report

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Abstract

A case of unusual size of cystic calculi has been reported in five year old Pomeranian female dog and its successful management through surgical intervention.

Keywords: cystic calculi, cystotomy, bitch

Urolithiasis is the formation of calculi from less soluble crystalloids of urine as a result of acquired physiological and pathological changes (Jattennavar and Kalmath, 2012). The urinary obstruction is more common in 5-7 years of age group. But bitches are also prone for occurrence of few types of Uroliths (Linda et al., 2011). The present report describes the surgical management of cystic calculi in a middle aged bitch.

History and clinical observations

A 5 year old, Pomeranian female dog was presented to the College Hospital with the complaint

of haematuria and dribbling of urine since one month. On physical examination, the bitch was dehydrated, tense abdomen attributed to pain and distended urinary bladder. Clinical examination revealed slightly elevated rectal temperature (103.8 °F), heart rate and respiration rate. Radiography of lateral pelvis revealed distended urinary bladder containing radiodense single big calculus (Fig.1). It was decided to perform cystotomy.

Treatment and Discussion

As the condition of animal was poor, the animal was administered 150ml of Ringers Lactate & 150ml of 5% Dextrose intravenous route prior to surgical intervention. The ventral abdomen was prepared for surgery and animal was premedicated with Atropin Sulphate @ 0.04mg/kg body wt. and followed by Xylazine Hydrochloride @ 1mg/kg body wt. Intra muscularly. Ketamine hydrochloride was given @ 5mg/kg body wt. Intravenously to induce

general anaesthesia. Animal was controlled in dorsal recumbency. The bladder was approached through caudal paramedian incision just 2 inches posterior to umbilicus. Urinary bladder was exteriorized, Sterile, saline- moistened gauze squares were packed around the bladder to prevent urine spillage into the abdominal cavity. A 20 gauge needle attached to a 20ml syringe was inserted through the bladder wall to facilitate drainage of the bladder prior to incising it. Two stay sutures were placed in cranial and caudal positions through the serosal and sub-mucosal muscular layers of ventral bladder wall and an incision was given on the ventral bladder wall. The exposed mucosa appeared slightly thickened and hyperemic. A large 5 cm hard single calculus was removed (Fig. 2). The cystotomy incision was closed by continuous 2 layers of lambert sutures using chromic catgut no.3/0 and abdominal incision was closed with No.1/0 catgut and Skin was sutured in routine manner. Post-operatively, the animal was given ceftriaxone @ 20mg/kg body weight intravenously daily for five days, meloxicam @ 0.2

mg/kg body weight intramuscularly for 3 days and oral Cystone tablets for one month. Antiseptic dressing of surgical wound was done by povidone iodine daily for 10 days till removal of skin sutures. The removed big calculi was irregular oval in shape and slight brown in color. By estimating the mineral content of the stone was predicted as cystine (Malik Abu Rafee et al., 2014). The prevalence of Cystine uroliths is common in dogs and disorder has some congenital link (Chakraborty, 2007). In the present case the reason is not known. Medical management is possible but in present case the surgical intervention was decided due to big size of calculi. Animal was maintained with low protein diet, ad libido drinking water and minimal salt intake resulted in uneventful recovery and no recurrence of urinary calculi was reported in the follow up period of 2 years.

Summary

A case of surgical management of unusual size of cystic calculi in a bitch has been reported and discussed.

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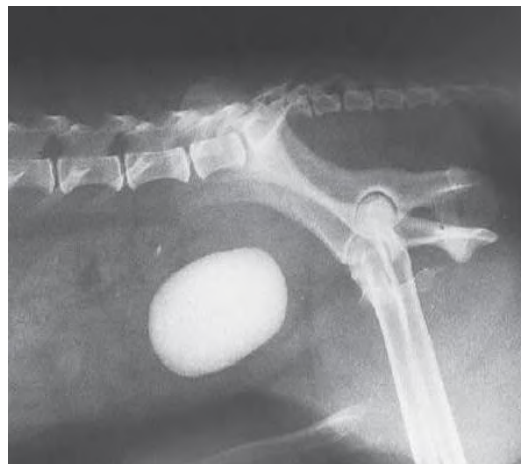


Fig. 1 Lateral abdominal radiodense cystolith



Fig.2 Removed cystoliths

Electric Power Management Using Zigbee Wireless Sensor Network

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Abstract

The world passing the biggest problem of power. Because the production of power is less than the demand power of consumer side. In many countries the increase in demand is growing at a faster rate than transmission capacity and also the cost of providing power is also increasing due to the higher coal prices and deficiency of fuel. Also the reason of not getting the full power to consumers side is that the growing population of countries. To overcome the problem of power distribution this paper provides an overview of wireless sensor network by managing the equal power distribution by using zigbee network sensor.

Keywords: ARM71C, ZIGBEE SENSOR NET.

I. Introduction

The world today's facing the most critical Problem of not getting the regular power. In many Countries peoples had not getting at least the primary needs of lights, fans, TV etc. In nearly every country, researchers expect existing energy production capabilities will fail to meet future demand without new sources of energy, including new power plant construction. However, these supply side solutions ignore another attractive alternative which is to slow down or

decrease energy consumption through the use of technology to dramatically increase energy efficiency.

To manage the available power more often the power is cut for particular area, and that area goes in dark i.e. not even a single bulb can work. Instead, we can use available power in such a way that only low power devices like Tubes, Fans, and Desktops TV. Which are primary needs should be allowed and high power devices like heater, pump-set, A.C. etc should not be allowed for that particular period. To achieve this, system can be created which will differentiate between high power and low power devices at every node and allow only low power devices to be ON.

To achieve this system we create a wireless sensor network having number of nodes which communicate with each other in full duplex mode. The communication will consist of data transfer, controlling node operation. We are using zigbee protocol for the wireless communication. The main advantage of using ZigBee protocol is that the nodes require very less amount of power so it can be operated from battery. And in this way we have managing the available power by using wireless sensor network working on zigbee protocol. Each node is measuring the power, which is being consumed by the appliance. The appliance is controlled by the end device i.e. node. An overall

operation of the system controlled by the control device. Main purpose of the project is that the wireless sensor network will differentiate and control the devices in the network on the basis of power consumed by appliances to make the efficient use of power.

The basic parts of the project include a Control Unit, End Device Unit having Zigbee Interface, LCD, ARM7 and Load.

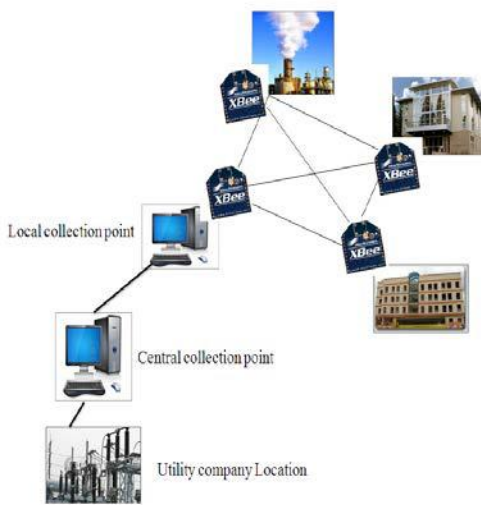


Fig.1: Concept Diagram

II. IMPLEMENTATION

The block diagram of the system is shown below. Here controller will wirelessly communicate with end devices to control them. The power threshold will be set by the controller. The end device will compare this threshold with the power being consumed by the device connected through it and will take the appropriate action.

2.1 End device:

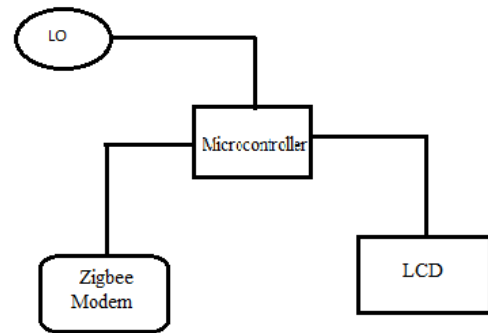


Fig.2: End Device block diagram

2.1.1. ARM7: It takes the power value from the Switch compares it with the threshold value set by the control unit and accordingly takes the controlling action like whether to keep device ON or switch it OFF. It also takes corrective action for power factor improvement.

2.1.2. Device driver: It is series pass element to Switch on/off the device. It is nothing but relay to have make and break contact. It is driven by ARM7.

2.1.3. ZigBee module: It uses the ZigBee protocol to communicate with the control unit. It consists of transceiver, ARM7 and ZigBee stack implemented in it. This is very small battery operated which provides full duplex communication with mesh networking.

2.1.4. LCD module: it is used 16x2 display module for displaying the power factor, available power, and load condition.

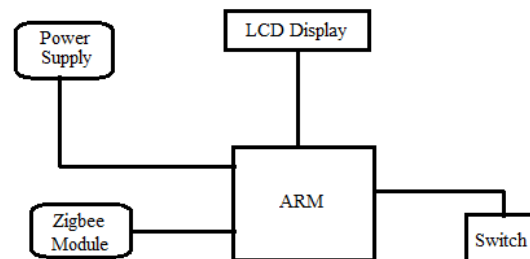


Fig.3: Control Unit Block Diagram

2.2. Control Unit:

It includes the ARM7 family microcontroller board, ZigBee, interface. ARM7 sets the threshold for the end devices through the wireless communication using ZigBee module interface or simply it distributes power within the home. This control unit can be remotely programmable through switch as MSEB DISTRIBUTION utility. Utility sets threshold for the control unit that is power for particular house. This threshold will be set to smaller value during peak period and vice versa.

2.3. Result:

Utility companies sending the message of power available to the control device unit. Control device unit receive the message and display the available power on LCD. The control unit will divided the available power to the end devices connected to the control device. If the load will be more than the available power then automatically cut off the high end devices and only to ON the low devices. In this way the system will be managing by availability of power.

III. Why Zigbee?

ZigBee was developed by the ZigBee Alliance, a world-wide industry working group that developed standardized application software on top of the IEEE802.15.4 wireless standard. So it is an open standard. The power measurement application encompasses many services and appliances within the home and workplace, all of which need to be able to communicate with one another. Therefore, open standards architecture is essential. Open standards provide true interoperability between systems. Open standards also help to future-proof investment made by both utilities and consumers. Using an open protocol typically reduces costs in implementing

there are no interoperability problems to solve, and manufacture costs tend to be lower. ZigBee also provides strong security capabilities to prevent mischief, and is extremely tolerant of interference from other radio devices, including Wi-Fi and Bluetooth. ZigBee-enabled meters form a complete mesh networks they can communicate with each other and route data reliably. And the ZigBee network can be easily expanded as new homes are built or new services need to be added.

3.1 Zigbee Vs Bluetooth

Bluetooth

- Targets medium data rate continuous duty
- 1 Mbps over the air, ~ 70 kbps best case data transfer
- Battery life in days only
- File transfer, streaming telecom audio
- Point to multipoint networking
- Network latency (typical) news lave enumeration-20s sleeping slave changing to active-3s
- Uses frequency hopping technique
- 8 device per network
- Complexity is higher

Zigbee

- Targets low data rate
- 250 kbps over the air, 60-115 kbps typical data transfer
- Long battery life (in years)
- More sophisticated networking best for mesh networking
- Network latency (typical) news lave enumeration sleeping slave changing to active
- Mesh networking allows very reliable data transfer
- Uses direct spread spectrum technique
- 2 to 65535 devices per network
- Simple protocol

IV. SCOPE

Even though smart meter solutions seems to be more expensive to implement up-front than traditional meters, the long-term benefits greatly outweigh any short-term pain. Utilities are able to track peak usage times (and days), which provides them with the ability to offer consumers greater range of rates and programs, such as time-based pricing. Demand response can enable utilities to keep prices low by reducing demand when wholesale prices are high. In recent trials, this has been shown to provide significant saving to all consumers. Not just those who adjust their usage habits. Utilities can post meter readings daily for consumers to view, which enables consumers to track and modify their energy usage. This provides more timely and immediate feedback than traditional monthly or quarterly statement. Utilities can not only notify consumers of peak demand times. But also monitor the extent to which those notifications cause consumers to change their habits and reduce their load during these periods. Utilities and consumers both benefit from more accurate billing that is available, thanks to the increased granularity of usage information, for example, for individual floors, apartments, or offices within a building. This gives consumers better control of their power and water usage, and passes on the biggest savings to those who use these services most efficiently. It also helps to reduce the number of billing enquiries, and helps to make those enquiries easier to resolve.

4.1 Future Work

On-demand meter reading and remote trouble shooting allow utilities to provide better and timelier consumer support. Utilities have more at hand about outages and restorations, and are able to provide consumers with good information

about when power will be restored. During emergencies, utilities can create “partial outages” in non-exempt buildings to ensure the power remains available where it is most needed. Partial outages are more economically efficient than full rotating outages, because the effects are limited to the reduction of a single discretionary service such as air conditioning rather than the elimination of all services. Also power factor improvement can result in a lot of power saving for industrial sector. Power demand and usage, allowing utilities and consumers alike to do their part to ensure continued and affordable supply of essential services into the future.

V. CONCLUSION

The most challenges and “green” legislation that utilities are facing today, combined with increased demand from consumers for more flexible offerings and cost savings, make a solution like smart meters both timely and inevitable. Zigbee’s wireless open standard technology is being selected around the world as the energy management and efficiency technology of choice. Implementing smart meters with an open standard such as ZigBee helps to keep costs down, ensure interoperability, and future-proof investments made by both utilities and consumers. Consumers and businesses will see changes they never dreamed possible. The information collected through smart energy meters provides unprecedented insight into energy demand and usage, allowing utilities and consumers alike to do their part to ensure continued and affordable supply of essential services into the future. The “tipping point” is indeed here and much bigger than ever imagined.

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IMPROVED AIR COMPRESSION SYSTEM

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ABSTRACT

Intercooling of air compressors is necessary for an efficient process. A heat exchanger of shell and tube type particularly suitable as an intercooler between compression stages of a compressor. A characteristic of heat exchanger design is the procedure of specifying a design, heat transfer area and pressure drops and checking whether the assumed design satisfies all requirements or not. The purpose of my research paper is to provide an easy and efficient way to design of an air compressor intercooler. This paper describes modelling of heat exchanger which is based on the minimization of heat transfer area and a flow chart is provided showing the designing procedure involved. Computer codes for design are organized to vary systematically the exchanger parameters such as, shell diameter, baffle spacing, number of tube-side pass to identify configurations that satisfy the specified heat transfer and pressure drops. A case study is provided for which the program is run and the results obtained are compared with the available from industry data.

1. INTRODUCTION

Industrial plants use compressed air throughout their production operations, which is produced by compressed air units ranging from 5 hp to over 50,000 hp. It is worth noting that the running cost of a compressed air system is far higher than the cost of a compressor itself. The US Department of Energy (2003) reports that 70% to 90% of compressed air is lost in the form of unusable heat, friction, misuse and noise. For this reason, compressors and compressed air systems are important areas to improve energy efficiency at industrial plants.

For improving efficiency compression is done in more than one stage and between each stage intercooler is provided. Intercooler improves the quality of air and reduces inlet air temperature. On doing this large quantities of condensate (water) are formed. Disentrainment of liquids can be a problem in intercooler systems of compressor plants, so proper separator arrangement should be made without considerable pressure drop. In industry, reciprocating compressors are the most widely used type for air compression.



Fig no-1 multistage air compressor

REASONS FOR ENERGY REDUCTION

leakage

For a particular installation get a feel for the percentage of air lost to leaks. Tests need to be conducted at night or other time when manufacturing is closed. Allow the compressor to fill the system to normal working pressure, then record the timing of the load/off-load cycle of the compressor as it does nothing more than sustain the leaks. Compare this with the normal daily compressor cycle to estimate the losses. The actual losses are likely to be more. Devices and components used in machinery may well have dynamic leakage occurring during their normal cycle of use but no leak when not running. Identify leaks by listening for a characteristic hiss. Examine suspect areas and if necessary spray on a leak detection liquid and watch for bubbles. Static leak rates to individual machines and local sections can be measured using a plug in flow meter. Please note: audio leak detection equipment is available for plant-wide audits of large leaks even while production is operating. The basis for calculating the costs of flow losses is the waste formula:

Total cost = 0.19 x operating hours per year x flow scfm x energy cost per kWh. (0.19 is a factor relating kW to scfm for typical compressors).
 The cost of a single continuous leak from a 0.08 in (2mm) diameter orifice with 8 scfm

is:

$$0.19 \times 8400 \times 8 \times 0.068 = \$ 868 / \text{year}$$

The average leak will take around half a man-hour to fix and offer quick payback.

Misuse of jets

A major waste of compressed air is lack of consideration for the detailed specification and application of equipment. Frequently within a machine cycle, jets of air from nozzles are used to carry out processes such as dusting, cooling, separating and other tasks. Sometimes due to the normal high throughput of a machine these jets are left permanently running. With most machines there will be times when the production

Leakage rate for different hole diameters

How to improve energy efficiency Safety issues of hand held blowguns are of extreme importance. Selecting pressure regulation and blowgun types of the air saver and safety design, good practice can be adopted to reduce the risk of injury as well as saving costs $(D_2 - d_2) \times L \times (CR_1 - CR_2) \times N / 1728 = \text{saving in scfm}$,

Where:

D = cylinder diameter (in)

d = piston rod diameter (in)

L = stroke length (in)

CR_x = compression ratio = $(P_x + 14.7) / 14.7$

P_1 = applied pressure (psig) - outstroke

P_2 = applied pressure (psig) - return stroke

N = cycles per minute



Fig-1 safety blow gun

Overpressurization

Many systems run at full line pressure with the only control being the compressor cut off switch. Pneumatic systems and individual components have an optimum operating pressure and flow for their particular application. Both under and over pressurization will slow down production rates and over pressurization additionally increases the amount of air consumed and

wear in components. The absence of pressure regulators in a system may indicate that equipment is being used at excessive pressures. Savings can be realized in many areas, including air tools, control valves and on the return stroke of large double acting cylinders. Check for correct Lubrication, high friction will demand higher set pressures. For a device or system that is over pressurized, the cost can be calculated by using a simple calculation. For example, a system is designed to run at 45 psig and consume air at 17 cfm. If it is supplied at 100 psig, the waste of air in scfm can be found using the following approach:

Compression Ratio

$$CR_1 = (14.7 + P_1) / 14.7 = (14.7 + 45) / 14.7 = 4.06$$

$$CR_2 = (14.7 + P_2) / 14.7 = (14.7 + 100) / 14.7 = 7.8$$

To convert cfm into scfm:

$$\text{Air usage at normal pressure} = CR_1 \times \text{air consumption} = 4.06 \times 17 = 69 \text{ scfm}$$

$$\text{Air usage at high pressure} = CR_2 \times \text{air consumption} = 7.8 \times 17 = 132.6 \text{ scfm}$$

This represents a wastage of compressed air of 63.6 scfm. Using the formula from the previous page and the same operation time this wastage represents \$ 6900 / year.

COMPRESSED AIR SYSTEM CONTROLS

Filtration

Filtration in various parts of a system is essential for the removal of water and solid particles. This ensures long life and trouble free operation of components in compressed air systems. The micrometer size of the filter elements determines the air quality. The standard size for the vast majority of applications is 40 μm. Finer sizes of 5 μm and 0.01 μm are available for special applications but size for size will be more restrictive. Fine grade filters should be installed based on their specific applications. Do not filter the whole of a sub-system to a fine grade if the majority of connections to it need only standard grade.

Dryer. Dryer appropriateness is assessed based on the facility's end-use applications. Dryer size, pressure drop, and efficiency are measured and evaluated. Modifications and replacements are recommended if needed.

Automatic Drains. Location, application, and effectiveness of both supply-side and demand-side drains are evaluated and alternatives recommended if necessary.

Air Receiver/Storage. The effectiveness of

the receiver tank is evaluated in terms of location and size, and the receiver drain trap is examined to see if it is operating properly. Storage solutions to control demand events should also be investigated.

process is intermittent or even at a halt. Jets that continue to run in these circumstances are incurring unnecessary costs. With a suitable valve and sensor, these can be controlled automatically so they are only on when required. When applying jets ensure that the distance between the exit nozzle and the product is as short as possible, this will allow the supply pressure to be reduced. Air saver nozzles are designed to entrain and accelerate air, these produce the desired outputs with reduced supply pressures (typically 30 psig). Savings of up to twenty times can result.

Maintenance

Evaluate maintenance procedures, records and training. Ensure that procedures are in place for operating and maintaining the compressed air system, and that employees are trained in these procedures.

Compressor management

Large compressor installations are likely to be fitted with sophisticated power and load management systems as part of the package. Simpler compressor installations with intermittent use could also benefit from automatic compressor management systems. These use figures of expected consumption rate, storage volume and pressure to tell the compressor how long to run in an off load condition before shutting down during times of low or no demand.

A safety conscious system helps to save energy

Much of the legislation, standards and codes of practice necessary to ensure safe systems deal with correct selection, installation and maintenance of equipment and systems. This includes safety details such as the use of air fuses and replacement of old polycarbonate bowls with new ones or with metal bowls. Compliance with safety requirements and advice inherently addresses many of the issues appropriate to energy efficient systems. Add specific energy saving awareness and a few fast pay back techniques and pneumatic systems of all sizes can realize significantly reduced operational costs and increased reliability for years to come.

EXPERIMENTAL RESULTS

The efficiency of the compressed air system increased with the reduction of the losses like air leakage, heat increased, over pressure, misuse of jet, different hole diameter etc. in this paper we see that use of some accessories like filters, dryer, intercooler, pressure switch, safety relief valve can increase the efficiency up to 10% .

CONCLUSION

In this paper we have studied about multistage air compressor & main components used in air compression system mainly intercooler. In this paper, we have used very simple and time efficient algorithms for designing of air compressor intercooler. Placement of the fluid in shell or tube side is done mainly on basis of corrosion and fouling basis which affects more on the cost of intercooler. In this paper effect of tube length, number of tubes, fluid velocity, number of baffles and baffle spacing on heat transfer coefficient of both side fluid is illustrated with the help of proper graph. To increase tube density, so that heat transfer will increase, triangular pitch pattern is used. Pressure drop for both sides is trying to reduce with proper spacing of baffle and baffle cut and also with tube diameter and tube length.

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PIR SENSOR A GOON IN SENSING

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ABSTRACT

We know that now a day's maximum projects are based on the sensing technology. So PIR is one of the sensing technologies. Due to its compact size and various types of PIR sensor it is flexible for a user to use it as per requirement according to the project. so the ease of its use increases and the sensing process becomes flexible.

INTRODUCTION

A PIR detector is a motion detector which senses the heat that living body emits. it is also fitted to security lights so that they will switch on automatically. They are very useful in home security systems. The sensor is called passive as in place of emitting a beam of light or microwave energy that must be interrupted by a passing person in order to "sense" that person, the PIR is very sensitive to the infrared energy emitted by every living thing. When something walks into the detector's field of vision, the detector "sees" a sharp increase in infrared energy. when a person approaches a PIR sensor light turns on, but will not react to a person standing still. The in this manner the

lights are designed. A moving person tends a sudden change in infrared energy, and motionless body emits a slower change. Slower changes may also caused by gradual fluctuations in the temperature of the environment. the light if sensitive to these slower changes then it would react to the sidewalk cooling off at night, in place of the motion of a burglar.

TYPES OF PIR

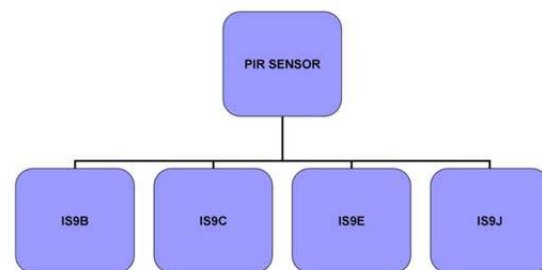


FIG:1: Tree of PIR

1 IS9B



FIG:1: Image of IS9B

- Rated Voltage : 230V AC 50Hz
- Load Wattage : Max.1500W incandescent bulb or Max.300W fluorescent lamp
- Detection Area : Max. 5 meters radius
- Detection Angle : 360° around
- Time delay: From 10±5 seconds to 4±1 minutes adjustable
- LUX Control Level : From daytime to darkness adjustable
- Protection Class : IP44

2 IS9C



FIG:3:Image of IS9C

- Rated Voltage : 230V AC 50Hz
- Load Wattage: Max. 300W incandescent bulb or Max. 150W fluorescent lamp
- Detection Area : Max. 8 meters
- Detection Angle : Max. 90°
- Time delay: From 10±5 seconds to 4±1 minutes adjustable
- LUX Control Level: From daytime to darkness adjustable
- Protection Class : IP44

3 IS9E



FIG:4:Image IS9E

- Rated Voltage : 230V AC 50Hz
- Load Wattage: Max. 1000W incandescent bulb or Max. 300W fluorescent lamp
- Detection Area : Max. 14 meters
- Detection Angle : Max. 120°
- Time-delay: From 10±5 seconds to 4±1 minutes adjustable
- LUX Control Level : From daytime to darkness adjustable
- Protection Class : IP44

4 IS9J



FIG:5:Image of IS9J

- Rated Voltage : 230V AC 50Hz

- Load Wattage : Max. 100W incandescent bulb or Max. 300W fluorescent lamp
- Detection Area : Max. 10 meters.
- Detection Angle : Max. 100°
- Time delay : From 60±5 seconds adjustable.
- LUX Control Level : At night or darkness
- Protection Class : IP44

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CONCLUSION

From the above studies it is seen that the use of such effective tool like PIR Sensors will make the things simple and hence the result could be obtained with more ease. The detection will be simple. It is seen that the better system can be developed with PIR Sensor.

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Evaluating the performance of ICT offices in Tabriz villages using balanced scorecard (BSC) model

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Abstract

Nowadays Information and Communication Technology (ICT) offices play an important role in development of electronic government, acceleration of service delivery to villagers, and a reduction in travels. Constructing and developing these offices were taken in close consideration in early 2000's in Iran, and 48 ICT offices have been constructed in villages of Tabriz since 2007. However, the performance of these offices have not yet been investigated from qualitative and quantitative perspectives in order to specify their weaknesses and strengths in providing the villagers with services. The present study was aimed at evaluating the performance of ICT offices in Tabriz villages using balanced scorecard (BSC) model. In regard with its objectives, it was an applied descriptive survey. The statistical population of the study consisted of the authorities of the ICT offices with a minimum work experience of 3 years (30 offices) and the villagers covered by them, so 30 ICT authorities and 185 villagers covered by them were selected by a probability proportionate method as the study sample. The study instruments included two types of questionnaire whose questions were designed according to the four perspectives of evaluating model of BSC. The authorities also responded to financial, growth and learning, and internal questions, and the villagers responded to the questions related to the customer satisfaction in the form of a 5-point Likert scale. The results of the study indicated that on average the offices had an appropriate performance reached 70% of the defined operational goals. Moreover, regarding the customer satisfaction, the performance of the ICT offices placed first, regarding the internal perspective it

placed second, regarding the growth and learning perspective it placed third, and in regard with the financial perspective it placed last.

Keywords: *information and communication technology (ICT); performance evaluation; balanced scorecard (BSC); rural ICT offices*

1. Introduction

Since the second half of the 20th Century and after the industrial and agricultural revolution, man has stepped into information era in which the world's economy and industry is based on exchange of information, electronic communication and greater independence and man has encountered issues such as large volumes of data that need to be produced, processed, and analyzed. This has led man toward developing a new technology called information technology (IT) and created a new realm in information era (Rezayian, 2001). In information era, instead of focusing on capital and money, it is the volume of the data that has gained significance. Sovereignty belongs to computers, IT, experts, and highly skilled individuals, and instead of physical endeavor, there is an emphasis on utilization of the power of thought (Jerald & Anderson, 1981). In other words, in this era, activities rotate on a knowledge-based approach which can be actualized through a comprehensive development in a factor called "information". With entrance of communication and information devices, villagers are provided with various and valuable services in the villages of the third millennium (Jalali et al, 2006). Since less than one third of Iran's population lives in villages, equipping the villages with ICT services can play an important role in developing and accelerating the

provision of social-economic services. The history of ICT offices in Iran dates back to 2000, and at the present there are 9,700 ICT offices; therefore, it is necessary to evaluate their performance in order to strengthen their strengths and resolve their weaknesses.

Performance evaluation is one of the best methods to obtain information to be used in decision making in organizations; therefore, the managers need to evaluate the performance of their organizations in every period of time (Kaplan & Norton, 2001). In the present era, evaluating invisible assets and long-term competitive capabilities of the organizations is uniquely significant because presence of such assets is more vital for the success of the organization than visible and physical assets (Sattarifard, 2004). Therefore, organizations need a system that not only evaluates all aspects of the organization but it also measures the rate of the organization's success in terms of achieving its objectives and prospects. This system should also help the managers of the organizations with strategic planning and decision making (Sajedinezhad, 2006). In the present study, balanced scorecard (BSC) was proposed as a performance evaluation system that can help meet the organizations' objective. BSC helps the managers to improve the performance of their organization by presenting the performance level of the organizations. BSC approach provides this opportunity in specifying the organization's position in order to utilize this tool to find the faults. In so doing, one should attempt to define appropriate criteria to evaluate performance (Karimi, 2008).

Since 2007, 48 ICT offices have been constructed in villages of Tabriz. However, their performance has never been evaluated in order to identify their strengths and weaknesses or success so that necessary measures could be adopted according to the results of performance evaluation. Therefore, the main question of the study is, "What performance have the ICT offices had so far and what are their strengths and weaknesses?"

2. The study questions

How is the performance situation of the ICT offices in Tabriz from the perspective of the internal processes?

How is the performance situation of the ICT offices in Tabriz from the perspective of growth and learning?

How is the performance situation of the ICT offices in Tabriz from the perspective of customer satisfaction?

How is the performance situation of the ICT offices in Tabriz from the financial perspective?

Therefore, the main objective of the present study is to evaluate the performance of ICT offices in Tabriz villages using BSC model.

ICT was created after the beginning of the industrial era and has willingly or unwillingly penetrated into the organizations. Nowadays, this is IT that proposes a new method of development with the emergence of technological model (Castles, 2001). With the dependence of the global economy on a system whose shape is always changing, one can observe emergence of new shapes and formats of relations between actors in different areas such as economy, government, electronic business, society, geographical environment, etc. There is no doubt that the effect scope of IT is not just limited to urban environments, but it reaches and covers even the furthest rural regions (Fazelnia & Kiani, 2003). Regardless of villages and deprived regions, development of ICT can have negative effects like an increase in the distance between villages and cities, an increase in immigration from villages to cities, the loss of local industries, loss of local markets, etc. However, global experiences indicate that proper planning and development of ICT can facilitate villagers' access to various health, educational, and governmental services, creation of occupational opportunities, an increase in awareness level in regard with activities related to manufacture, agriculture, and the market of agricultural products in a way that this technology is considered as one of the tools and opportunities for comprehensive development (Rezvani, 2004). It is noteworthy that the first village that was equipped with Internet

connection and its people used it was “Joan” in Spain in 1999 (Hamshahri Newspaper, 2002). The history of ICT in our country dates back to 2000 in the village of “Shah Kouh” in Golestan Province. In 2003, the village of “Gharn ABdad” in the same province was equipped with an ICT center, and the village was awarded the Asian-Pacific Award by UNESCO in 2007 and placed first in regard with innovation and creativity. However, the first plan with an extensive coverage that was carried out by Iranian government was the plan of equipping 10,000 rural ICT offices that was formally declared in the fourth plan of development (Seddigh, 2004).

What that indicates the necessity of studying the issue of ICT more than anything else is the situation that Iran possesses as a developing country. It is claimed that due to the rapid trend of development in the world, one cannot expect that the industrialization path will be paved in short run in order to step into the postindustrial era. However, it can be stated that this technology can be a master key that can change the current economic equations. On the other hand, one can claim that the significance of new ICT technologies is nowadays quite clear for all the countries all over the world. Awareness about the capacities of this technology as one of the tools and opportunities for comprehensive development and in order to take advantage of potential capacities of this technology in different fields, by signing Information Society Declaration of Principles (ISDP), Iran has practically committed itself to affecting the structure of the global information society. In one of the issues stated in the “action plan” of the principles announced to the countries, it is recommended that all villages should have access to the Internet and enter the global information society through education by 2015 (ICT Ministry, 2004). According to the formal statistics published by the International Telecommunication Union (ITU) in 2007, Iran has placed 87th among 170 countries in the world. The studies conducted by the World Bank in 1999 indicated that the critical situation in poor villages of developing countries has caused these countries to seek to design and implement more supportive and efficient plans. That is why developing policies and strategies of developing ICT has become an

important issue for most countries especially the Third World Countries (Riyahi & Hedayati, 2006). Rural ICT development and equipment of the rural community with ICT depend on understanding the internal and external perspectives of these offices more precisely and deeply. Regardless of the environment they perform, organizations always need to improve their performance and should make an utmost attempt in order to obtain the highest level of performance, which indicates that performance evaluation has always been a challenging issue within the realm of organizational management, and specification and exploration of appropriate indices to evaluate the performance of organization are highly significant in order to achieve the goals and prospects of the organization (Kaplan & Norton, 2001). BSC model was proposed by Kaplan and Norton in 1992. This model employs four vital perspectives of the customers, internal processes, growth and learning, and finance in order to control the short-term operations of an organization with its long-term prospects and strategies. Therefore, it highlights the key proportions of performance within the scope its central goals. The main perspectives of this model are financial perspective, internal processes, customer perspective, and learning and growth perspective. Balanced evaluation puts emphasis on the three temporal perspectives of the past, the present, and the future because it is likely that a past performance has caused a result in the present or the future, or a performance in the present leads to an outcome today or tomorrow. Moreover, in this model, the indices are classified into performance-provoking indices and consequences. This model tries to relate and create a relationship between organizational strategies and organizational operations by determining critical factors of success and strategic indices (Karimi, 2005). This model has three generations; in the first generation it mostly emphasizes the creation of balance among different perspectives, in the second generation, BSC is proposed not only as an evaluating system but also as a management system, and it puts emphasis on the role of the prospect, mission, and strategy of the organization. Kaplan and Norton (1996) (the third generation) proposed a more developed version of BSC as a strategic management system. They stated

that traditional management systems are incapable of creating a relationship between long-term strategies of the organization and its short-term performance. Managers who utilize BSC; however, are not forced to put emphasis on short-term financial indices as the mere factors for the performance of their organization. BSC enables them to begin four new managerial processes which separately and collectively help with the establishment of a relationship between long-term strategic goals and short-term performance (Ibn al-Rasoul, 2004).

Balanced evaluation provides the managers with a comprehensive view over what is happening inside and outside an organization. Many large companies use this method to evaluate the effects of strategic decisions on employees, customers, and profitability. These decisions can cause a change in the process of good production. Kaplan and Norton explained the logic behind balanced evaluation like this: the financial criterion that refers to past events was enough to evaluate the performance of the companies in the industrial era in which long-term capacities and relationship with the customers are not considered as factors in achieving success. These criteria; however, are not sufficient to guide and evaluate the performance of the companies in the present era in which creation of value and wealth production are possible by investing in the customers, material and good suppliers, processes, technology, and innovation. In addition to considering financial criteria, balanced evaluation provides new criteria to adapt evaluation methods with the conditions of the present era. In Iran, many studies have been conducted on rural ICT and the analysis of the effects of these offices in different cultural, social, and economic fields (Sidayi & Hedayatimoghadam, 2012; Shah Kouhi et al, 2012; Enabestan & Vaziri, 2011). However, there is no study that was directly aimed at the performance of ICT offices using BSC model.

In their study of presenting indices to evaluate the performance of Iran Automobile Assistance Company (IAAC) using BSC, Parhizgar et al (2010) concluded that the final percentage of evaluating indices of the company was 50% for financial

perspective, 88% for customer perspective, 77% for internal perspective, and 73% for growth and learning perspective. According to BSC model; therefore, IAAC can properly evaluate its important indices and monitor its main processes accordingly.

In their study of evaluating and analyzing the effect of ICT on the quality of the villagers' lives in the village of Gharn Abad, Shah Kouhi et al (2012) concluded that there is a significant relationship between utilizing ICT and enhancement of social and economic indices and access to services and rural infrastructures. In their study of evaluating the role of rural ICT offices in providing services to rural regions, Seydayi and Hedayatimoghadam (2012) concluded that despite of the fact that these offices are highly capable of providing services (educational, health, agricultural, postal, bank, etc.), their performance is only limited to bank and postal services (economic perspective) at the moment, and they have a poor performance in regard with social and cultural perspectives.

Behjuji (2014) evaluated the performance of plant pathology clinics in Tabriz using BSC method and concluded that in actualization of the defined operational objectives, clinics placed first in regard with internal processes, second regarding customer view, third in terms of financial perspective, and last regarding growth and learning. And in regard with effective factors in performance of the clinics, two factors of motivation and education played a bigger role than other factors in predicting the performance level of the clinics.

Anand et al (2005) sent BSC questionnaire to more than 75 global Indian companies. Their most important finding was that BSC was utilized by 45.28 and 43.9% of Indian and American companies, respectively. They also found that financial perspective is the most important perspective followed by customer perspective and growth and learning. Furthermore, they concluded that budgeting costs, incomes, average profit and interest, and valuating mechanism are among administrative management tools that are used by Indian companies. Most companies declared that utilization of BSC can lead to identification and utilization of chances,

reduction of costs, and improvement in the performance of organizations in the end of the year.

Chen et al (2006) studied and compared the hospitals of Japan and China. In their study, a hospital from China and one from Japan were selected. The key criteria were also determined in BSC framework. Analyzing the financial indices and internal processes indicated that Hospital C (China) was better than Hospital N (Japan) in terms of these two perspectives. The results of their study; however, indicated the superiority of the Japanese hospital in terms of the customer and growth and learning perspectives, which may be contributed to the fact that Chinese managers sought short-term profits than long-term ones. In a study entitled, “Improving the performance after applying BSC method”, Changa et al (2008) investigated MMH hospital in Taiwan. The results of their study indicated that the criteria of the internal processes, growth and learning, financial perspective, and customer satisfaction had the highest scores, respectively.

3. Materials and methods

In regard with its nature, the present study was a descriptive survey, and in regard with its objective, it was an applied research. The researchers aimed to describe and evaluate the performance of the ICT offices in the form of BSC model from the perspective of the members of the offices and the villagers in order to utilize the results of the study to develop and activate ICT offices and boost their strengths and resolve their weaknesses.

The statistical population of the study consisted of two groups: the members of the ICT offices active in Tabriz villages with at least three years of experience and the villagers that are provided with ICT services (48,000 families). Due to the high rural population of the study villages and in order to save time and study cost, it was decided to collect related data through sampling, and Cochran formula (Eq. 3.1) was employed to determine the sample size. The sample size of the customers was 10 individuals (out of 42,000 families), and in order to enhance the preciseness of the results, the sample size was increased to 185 individuals. 2. (Eq. 3.1)

$$n = \frac{N(t.s)^2}{Nd^2 + (t.s)^2}$$

Where, n is the sample size, N is the population size, t is the acceptable confidence coefficient of standard error, S² is the variance of the study variable, and d is the confidence degree or appropriate probability precision. The statistical population of the authorities of the offices with at least 3 years of experience consisted of 30 offices. The data collection instrument was questionnaire. Regarding the properties of BSC model, two types of questionnaire were utilized to evaluate the performance of the offices from four perspectives: A questionnaire was designed for the authorities of the ICT offices. This questionnaire was composed of 4 sections: demographic section (6 open-ended questions and 4 closed-ended ones), financial perspective section (19 open-ended questions), internal processes section (7 closed-ended questions), and growth and learning perspective (8 closed-ended questions). The second questionnaire was related to the customer satisfaction perspective based on BSC model which was designed in two sections: the first section was related to demographic information (6 open-ended questions and 4 closed-ended ones) and the second section was related to questions of customer satisfaction (20 closed-ended questions in the form of 5-point Likert scale) which was completed by the villagers who received ICT services. Validity of the questionnaire was confirmed by some rural development and ITC experts. The reliability of the questionnaire was calculated through Cronbach’s Alpha which was 0.88, which indicates an acceptable level of reliability.

To evaluate the performance of the ICT offices using BSC model, first the strategic objectives of the offices were defined from four perspectives (financial, customer, internal processes, and growth and learning) afterwards indices that could measure the objectives were determined. In so doing, the performance of the ICT offices was evaluated from financial, internal processes, and growth and learning perspectives by the authorities of the offices residing in rural regions. And the customer perspective was

evaluated by the customers (villagers receiving ICT services) based on the defined operational goals (customer satisfaction). For the financial perspective, financial indices were utilized. However, the other three perspectives of BSC (internal processes, growth and learning, and customer) were measured in the form of poll and Liker scale.

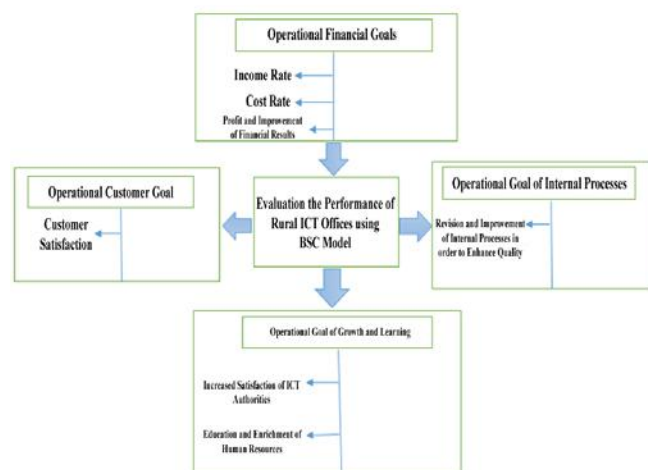


Fig. 2. The frame work of evaluating the performance of the rural ICT offices using BSC model

4. Results

4.1. Descriptive findings

The results of the study indicated that the highest frequency of age (i.e. 30%) was between 26-30 years and the mean age of the authorities was about 34 years. The minimum experience of activity in the ICT offices was 4 years and the maximum was 7 years. Moreover, the mean experience was 6 years. In regard with the participants' education, the highest frequency was related to diploma with 14 cases (46.7%). In regard with their place of residence, 86.7% of the authorities, (26 individuals) resided the villages of their service. Moreover, the results of the study indicated that the highest rate of reference to the offices is related to the group age of 26-30 years (26.2%) and the lowest rate of reference is related to the group age of 65 and more (1.1%). The mean age of the customers was 30 years and the mean reference to the offices was 7 times per month with a minimum and maximum of once and 15 times a

month, respectively. Among the clients of the offices, 19.1% (35 people) were self-employed (not farmer) and 16.9% were farmers.

Table 1. Performance of the ICT offices in Tabriz from the four perspectives of BSC model

<i>BSC Perspectives</i>	<i>Percentage of actualization of operational goals from the four perspectives</i>
Customer Perspective	71%
Internal Processes Perspective	80%
Growth and Learning Perspective	81.53%
Financial Perspective	46.55%
Total	69.77%

According to the results of the study, the ICT offices to a large extent succeeded in achieving the defined goals and have met 69.77% of the goals. Moreover, from the four perspectives, the ICT offices were placed first in regard with the customer perspective with a score of 81.53%, second regarding the internal processes with a score of 80%, third in regard with the growth and learning perspective with a score of 71%, and last regarding the financial perspective with a score of 46.55%.

4.2 The performance status of the ICT offices in Tabriz from the growth and learning perspective

To evaluate the performance status of the ICT offices in Tabriz from the growth and learning perspective of BSC, two criteria (in total four variables for each criterion) were employed in the form of two operational goals, and the mean statistic was used to score each variable from this perspective. Table 2 indicates the criteria and variables from the perspective of growth and learning of BSC model for the ICT offices. According to the mean of each variable, one can conclude that in the operational goal of enhancing the authorities' satisfaction, the variable of "the office authority's support of the company during related educational period" with a score of 3.94 gained the highest score and the variable of "the rate of satisfaction with the educational period of ICT services" with a score of 2.73 obtained the lowest score. In the operational goal of education and enrichment of human resources, the highest and the lowest scores of 4.13

and 3.60 were related to the variables of “the office authority’s attention to the employees’ creativity and skills” and “using motivational

from growth and learning perspective based on BSC model methods to provide better services”, respectively. According to the results presented in Table 2; therefore, the actualization percentage of the defined variables can be observed from the perspective of growth and learning based on the goal

rate that is the score 5 for each variable. Moreover, the actualization percentage for defined operational goals from the perspective of growth and learning was 63.55 and 78.45% respectively for “an increased in the satisfaction of the ICT offices authorities” and “education and empowerment of the human resources”. In total, the studied offices have met 71% of their defined operational goals from this perspective.

Table 2. Evaluating the performance of the ICT offices in Tabriz from growth and learning perspective based on BSC model

Operational Goal	Criterion	Variable	Mean	SD	Goal Value	Percentage of Variable Actualization	Percentage of goal Actualization
Increased Satisfaction of ICT Office Authorities	The rate of the related educational periods	The rate of the office authority’s support of the employees in the periods of education and workshops	3.94	0.81	5	78.8%	
		The rate of satisfaction with postal educational periods	2.73	1.33	5	54.6%	
		The rate of satisfaction with telecommunication educational periods	2.75	1.28	5	55%	63.55%
		The rate of satisfaction with ICT educational periods	3.29	1.2	5	65.8%	
Education and Empowerment of Human Resources	The rate of research and development opportunity	The rate of the office authority’s attention to the employees’ creativity and skill	4.13	0.67	5	82.6%	
		The rate of using motivational methods and awards in presenting better services	3.60	1.5	5	72%	78.45%
		The rate of the employees’ mastery over computer and software	4	0.89	5	80%	
		The office authority’s support of the employees’ innovative activities	3.96	0.77	5	79.2%	

4.3 The performance status of the ICT offices in Tabriz from the perspective of the internal processes

To evaluate the performance of the ICT offices in Tabriz from the perspective of internal processes based on BSC model, three criteria (a total of 7 variables) were utilized in the form of an operational goal, and mean statistics was employed to score each variable from this perspective. Table 3 indicates criteria and variables from the perspective of internal

based on BSC model for the ICT offices in Tabriz. According to the mean score of each variable, it can be suggested that in the criterion of paying attention to customer orientation, the variable of storage of the villagers’ information with a score of 4.54 had the highest score had the maximum rate, and in the criterion of the rate of paying attention to the diversity of services, the variable of the rate of proportionality between the working hours of the offices and the volume of the services with a score of 3.69 had the minimum rate. According to the results presented in Table 3; therefore, the actualization percentage of the defined variables can be observed from the perspective of the internal processes

according to the rate of the goal which is a score of 5 for each variable. Moreover, the rate of actualization of the defined goal of “improving the internal

processes in order to enhance the quality of the services” which was 80% from this perspective.

Table 3. Evaluating the performance of the ICT offices in Tabriz from internal processes perspective based on BSC model

Operational Goal	Criterion	Variable	Mean	SD	Goal Value	Percentage of Variable Actualization	Percentage of goal Actualization	
Improving the internal processes in order to enhance the quality of services	The rate of tendency toward the employees	The rate of paying attention to the employees' education	3.73	1	5	74.6%	80%	
		Storing the rural customers' information	4.54	0.68	5	90.8%		
	The rate of paying attention to customer orientation	The rate of paying attention to customer orientation by the employees	4.31	0.62	5	86.2%		
		The rate of cooperation of the related organizations with the office to provide the customers with more services	3.77	1.25	5	75.4%		
		Diversity of the activities and services provided to the customers	4.04	0.92	5	80.8%		
	The rate of paying attention to the diversity of services	The effect of the environment and the rate of development of villages in providing ICT services		3.92	0.84	5		78.4%
			The rate of proportionality between the working hours of the office and the volume of the service	3.69	0.90	5		73.8%

4.4 The performance status of the ICT offices in Tabriz from the customer perspective

In order to examine the performance of the ICT offices in Tabriz villages from the customer perspective, one criterion (a total of 20 variables) was employed in the form of an operational goal, and the mean statics was used to score each variable from the customer perspective. Table 4 indicates the criterion and variables from the customer perspective based on BSC model for the ICT offices in Tabriz villages. According to the mean of each variable, it can be stated that the ICT offices were more successful in terms of customer perspective in a way that in the last variable of this criterion, the customers of the offices were asked to determine the rate of their satisfaction with the performance of the rural ICT offices, and this variable obtained the maximum score, i.e. 4.51, and the variable of ICT services cost gained the minimum score, i.e. 3.51. Moreover, this table

indicates the percentage of the actualization of the variables for the customer perspective based on a 5-score scale. In this regard, the percent of actualization of the defined operational goal of “an increase in customer satisfaction” for this perspective was 81.53%.

Table 4. Evaluating the performance of the ICT offices in Tabriz from customer perspective based on BSC model

Operational Goal	Criterion	Variable	Mean	SD	Goal Value	Percentage of Variable Actualization	Percentage of goal Actualization
Customer satisfaction	An increase in customer satisfaction	Effect on reduction of commuting in the city	4.10	1.10	5	82%	81.53%
		Effect on reduction in receiving bank and administrative services	4.03	1.03	5	80.6%	
		Use of Internet, fax, and telephone services	3.75	1.25	5	75%	
		Bank services of the ICT office	4.14	1.01	5	82.8%	
		Postal services of the ICT office	3.87	1.13	5	77.4%	
		The cost of telecommunication services	3.51	1.15	5	70.2%	
		The cost of postal services	3.58	1.22	5	71.6%	
		The location of the ICT office in the village	3.98	1.06	5	79.6%	
		The performance of the ICT office compared to other rural offices	4.05	1.01	5	81%	
		Behavior and performance of the office's employees	4.15	1.07	5	83%	
		Responsiveness to the customers' needs and demands	4.18	1	5	83.6%	
		The level of guidance provided by the employees	4.28	0.86	5	85.6%	
		The rate of the employees' awareness and skill in responding to the customers	4.18	0.99	5	83.6%	
		The rate of satisfaction with the bank services of the ICT office	4.23	0.98	5	84.6%	
		The rate of satisfaction with the telecommunication services of the ICT office	3.96	1.07	5	79.2%	
		The rate of satisfaction with the postal services of the ICT office	4.23	0.89	5	84.6%	
		To what extent are you willing to refer to the rural ICT office to do various administrative tasks?	4.12	0.97	5	82.4%	
		To what extent do you recommend the villagers and acquaintances to use the services provided by the ICT office?	4.19	0.99	5	83.8%	
To what extent is the presence of the ICT office necessary in your village?	4.49	0.85	5	89.8%			
To what extent are you satisfied with the services provided by the ICT office?	4.51	0.70	5	90.2%			

4.5 The performance status of the ICT offices in Tabriz from the financial perspective

Evaluation of the performance of the ICT offices from financial perspective of BSC was carried out this way that after the financial data were extracted

from the related documents and other calculations conducted by other organizations, the rate of the total income, total cost, and the profits of the ICT offices were calculated in 2014 for each office separately, which is indicated in Table 5, below.

Table 5. Estimating the financial data of the ICT offices in Tabriz villages in 2015

Number of the Offices	Total Income (Million Rials)*	Total Cost (Million Rials)	Total Profit (Million Rials)
30	4.332	1.548	2.784
Mean	144.40	51.61	92.79

* One million Rial ~ 31.25 dollars

According to Table 5, it can be understood that the average income of the ICT offices of Tabriz was 4.332 million Rials, their average cost was 1.548 million Rials, and their average profit was 2.784 million Rials. However, since this information cannot tell us whether the ICT offices were successful in achieving their operational goals, the variables of “income-cost ratio” to examine the operational goal of “income increase”, “cost-income ratio” to examine the operational goal of “cost reduction”, “profit-income ratio” and “investment efficiency ratio” that are obtained through the ratio of profit to fixed investment to examine the operational goal of “increased profit and improved financial outcomes” were employed (See Table 6). According to the results presented in Table 6, the more the “income-

cost ratio”, the ICT offices have moved toward an increase in their income and the less the “cost-income ratio”, the ICT offices have moved toward a decrease in their income. And finally, the more the “profit-income ratio” compared to the “profit-fixed investment ratio”, the ICT offices have moved toward an increase in their profit and improvement in their financial outcomes.

Table 6. The rate of obtaining the defined operational goals from financial perspective of BSC model

Operational Goal	Variables (Ratio)	Mean	SD	Goal Value	Percentage of Actualization of the Ratios	Percentage of Actualization of Operational Goal
Increase in Income	Income-Cost Ratio	2.88	2.55	5	57.6%	46.55%
Decrease in Costs	Cost-Income Ratio	0.38	0.27	5	7.6%	
Profit and Improvement in Outcomes	Profit-Income Ratio	0.60	0.27	5	12%	
Financial	Investment Efficiency	5.45	8.97	5	109%	

According to the results presented in Table 6, from the financial perspective the ICT offices have reached to 46.55% of their defined operational goals, which places in a lower rank compared to other three

perspectives. Therefore, it is necessary that the defined financial goals be taken into closer consideration and more effective steps be taken forward to resolve the weaknesses.

5. Conclusion

It is understood that nowadays programs of economic and social development of countries and also their rural development plans will not have necessary and expected efficiency without considering the total role and proper share of ITC. The most important characteristic and advantage of the modern

technologies is overcoming the time and place and removing spatial distances and decentralizing. On the other hand, the main problem of the villages in Iran is that they are dispersed and away from administrative, economic, cultural, political, and social centers. Therefore, ICT can be considered and employed as the most appropriate means to resolve the main problems of the villages and villagers. All

governmental and private organizations need a type of effective performance evaluation system in order to reach development, growth, and sustainability, which measure the efficiency and effectiveness of the organizations' programs, processes, and human resources. Performance evaluation is a process that is determined to evaluate the progress toward achieving the assigned goals, and it includes data on the efficiency of delivery of goods and services and the rate of the customers' satisfaction, achievements, and effectiveness of the activities in order to reach their certain goals. By indicating the rate of the organizations' performance, BSC help the managers improve their organizations. In determining the position of the organization, BSC approach provides the opportunity to utilize this tool to find the faults in the organizations. In this regard, one should just utilize appropriate criteria in order to evaluate the defined performance. In the present study, analyzing the total percentage of the performance of the ICT offices from the four perspectives (69.77%) indicates that the offices to a large extent succeeded in achieving their operational goals. Therefore, it can be concluded that the rural ICT offices in Tabriz

operated successfully and achieved their operational goals. According to the results of the present study, the following suggestions are proposed to enhance the success of the ICT offices and remove their weaknesses.

Since the ICT offices obtained the minimum score on the financial perspective and the variable of "profit-income ratio" had a lower percentage compared to

other variables, it is suggested that ICT offices be enabled to provide more financial services such as issuing credit cards, devoting ATMs, giving self-employment loans with low interest rate and without any typical bureaucracies of other banks, etc. whereby the offices' income will increase.

Due to the high motivation of the authorities of the ICT offices to participate in high quality educational courses that was evaluated from the growth and learning perspective, it is suggested that governmental organization see to holding educational courses. If the ICT system is considered to be composed of three sections hardware, software, and human agent, after hardware, software, and necessary infrastructures were prepared, the main effective factor in success of the ICT offices will be their human resources, and availability of expertise and high education can lead to the creation of a kind of credit and value among the villagers and their attitude toward the human resources will change.

According to the evaluations that have been conducted over last years by the affiliated organizations (to the Telecommunication Company), it is suggested that evaluations be carried out constantly in order to provide the organizations with the feedback of the performance of the offices, whereby the weakness of the offices can be resolved and their strengths can be boosted in order to provide better services.

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Microbial population response exposed to Different pesticides

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Abstract

Growth curve experiment of various microorganisms was studied with different Pesticides (Alpha Cyhalothrin, Miticide and Fungicide). Alpha Cyhalothrin and Miticide showed drastic inhibitory effect on the growth of all the bacteria which include *E.coli*, *Bacillus subtilis*, *Serratia marscens*, *Enterobacter sp* and *Kurthia sp*. But the application of Fungicide to the bacterial cultures proliferates the growth of all the bacterial cultures.

INTRODUCTION

Pesticides are defined as “any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest (insects, rodents, nematodes, fungus, weeds and other forms of terrestrial or aquatic plant or animal like bacteria or other microorganisms)” [1]. The extensive use of pesticides in agriculture to eliminate pest, such as grasshoppers, has resulted in the accumulation of pesticide residues in soil and has altered the soil microbial communities by favouring the growth of those pesticide degrading organisms. Due to the xenobiotic features of pesticides, pesticides in soil can be persistent in the environment and eventually enter the food chains, which cause reproductive failure in birds and even cancer in humans [2].

There is also concern about the increased use of pesticides, which may cause (i) environmental hazards such as watertable and water body contamination, (ii) biological imbalance in ricefield populations, and (iii) reduced efficiency because of shifts toward soil microorganisms more efficient in pesticide degradation.

The pesticides that are used frequently eventually reach the soil from the crop plants and are accumulated usually in top 0-15 cm layer of soil, where the activities of microbes are found to be maximum. Pesticides in the soil affect the non target and beneficial microorganisms [3] and their activities which are essential for maintaining soil fertility [4].

Microorganisms form a vital part of the soil food web, therefore microbial biomass is considered to be a measure of potential microbiological and ecosystem functioning. However for proper understanding of ecosystem functioning and

determining soil disturbances because of various agricultural management practices, microbial activities must also be determined [5, 6] along with microbial biomass.

Insecticidal residues are generally degraded and degradation products as simulated by soil microorganisms resulting in increased population sizes and activities of microorganisms which in turn influences the transformations of plant nutrient elements in soil [7]. On the other hand, there are some insecticides which are not utilizable by soil microorganisms and these types of insecticides are degraded in soil by microorganisms through cometabolism. Other insecticides exert deleterious effects on microorganisms. Therefore, no definite conclusion can be made on the effect of insecticides on microorganisms and their associated transformations of nutrients in soil, since different groups of insecticides exhibit manifold variations in toxicity.

A study was conducted to investigate the effects of different pesticides including Lambda Cyhalothrin, Myticide and Fungicide on the growth and distribution of soil microorganisms.

MATERIALS AND METHODS

In laboratory experiment, soil samples were taken with the help of sterilized spatula at a depth of 15-20 cm from different agricultural fields. Soil organic matter and moisture was determined then other plant debris was removed manually and soil was sieved with 4mm mesh. 1 gram of soil was mixed with 9 ml of sterilized water and shook it thoroughly. 1 ml from the solution was then mixed in 9 ml sterilized water to make 10^{-2} dilution of this solution and in the same pattern dilutions up to 10^{-7} were prepared to determine the appropriate

dilutions to count bacterial population conveniently. A stock solution of each pesticide was made for further dilutions and different volumes i.e. 50, 100, and 200 µl was used.

The bacterial cultures were enumerated with and without adding Pesticides. 0.2ml aliquot of 24h culture grown in nutrient broth was inoculated into 10ml nutrient broth flask containing different concentrations of each pesticide and incubated in incubator shaker. Control flasks of equal volume of nutrient broth medium containing culture but no pesticide were run in parallel. Growth of each microorganism was determined Spectrophotometrically immediately after inoculation up to the stationary phase of microorganism at different time intervals (30 min, one hr, Two hr upto 24hr for bacteria). With the exhaustion of nutrients and build-up of waste and secondary metabolic products, the growth rate has slowed to the point where the growth rate equals the death rate. Effectively, there is no net growth in the population after the stationary phase.

RESULTS AND DISCUSSION

The results of present study revealed that different concentration of all pesticides brought reduction on the growth of all the bacterial populations which were significantly different from control including *E.coli*, *Bacillus subtilis*, *Enterobacter sp*, *Serratia marcescens* and *Kurthia* and this effect was offset during exponential phase of treatment but at slow rate.

Alpha Cyhalothrin brought reduction on the growth of all the bacterial populations which were significantly different from control including *E.coli*, *Bacillus*, *Serratia*, *Enetrobacter* and *Kurthia* and this effect was offset during exponential phase of treatment but at slow rate (Figure 1-5 a) which is in conformity with Azaz *et al* (2005) [8]who reported that above cited effect of cypermethrin and monocrotophos on bacteria while fenvalerate had very low effect on soil microbes approx 25% (Figure 1A-1E).

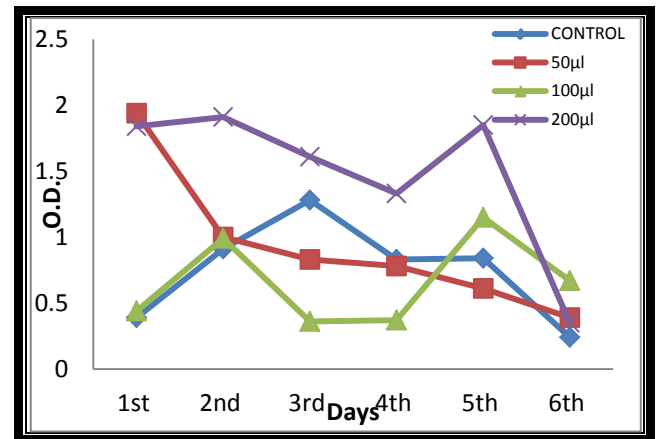


Fig 1 (a)- Effect of Different concentrations of Lambda Cyhalothrin on *E.coli*

Fig 1 (B)- Effect of Different concentrations of Lambda Cyhalothrin on *B.subtilis*

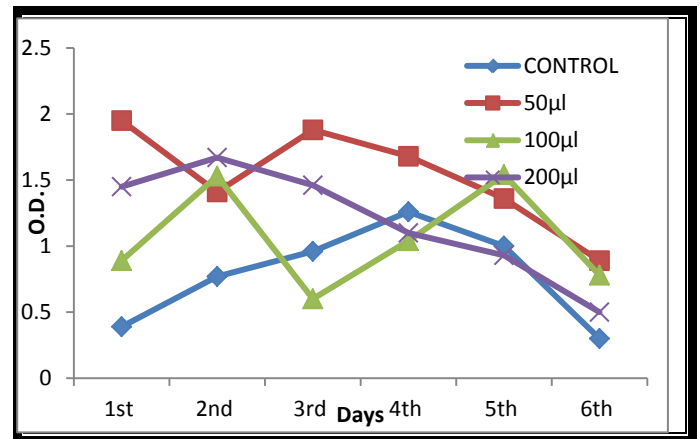


Fig 1 (C)- Effect of Different concentrations of Lambda Cyhalothrin on *Enterobacter sp*

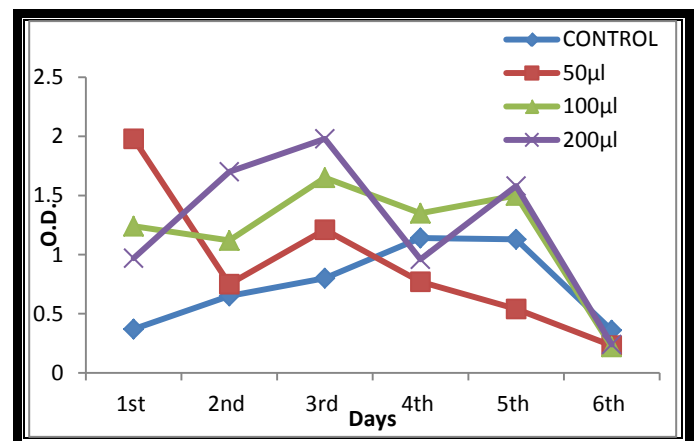


Fig 1 (D)- Effect of Different concentrations of Lambda Cyhalothrin on *Serratia sp*

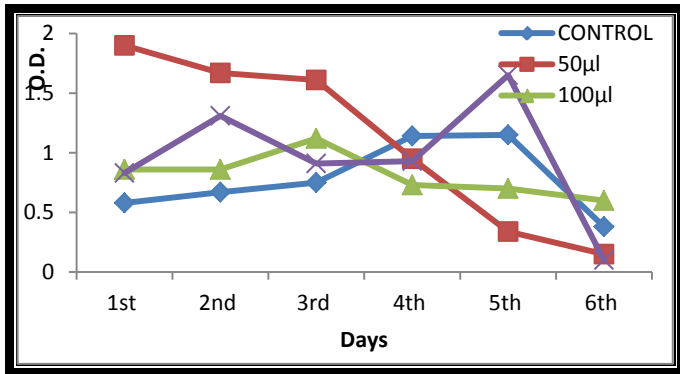


Fig 1 (E)- Effect of Different concentrations of Lambda Cyhalothrin on *Kurthia*

These findings support earlier workers [9] who reported that numbers of soil microorganisms were stimulated through the utilization of chlorinated hydrocarbon, organophosphate and synthetic pyrethroid insecticides. Deltamethrin and Alpha cyhalothrin had demonstrated little change on the growth of all the bacterial populations when compared at different concentrations and control which indicated greater utilization of insecticidal residues as well as their degraded products [10] by

the soil microorganisms.

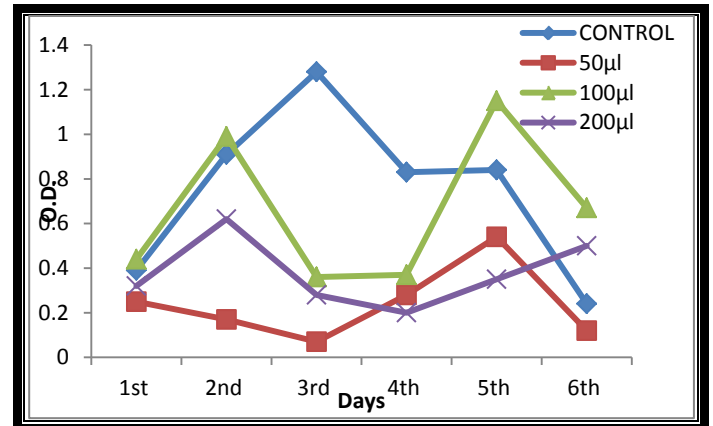
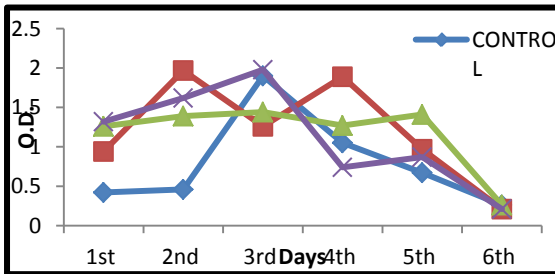


Fig 2 (A)-Effect of Different concentrations of Miticide on *E.coli*

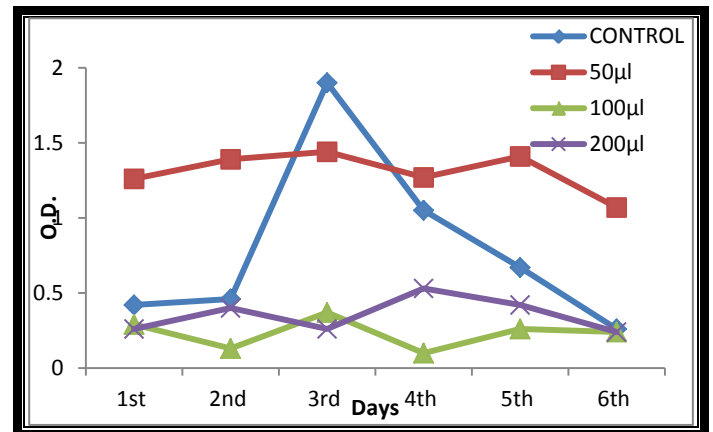


Fig 2 (B)-Effect of Different concentrations of Miticide on *Bacillus subtilis*

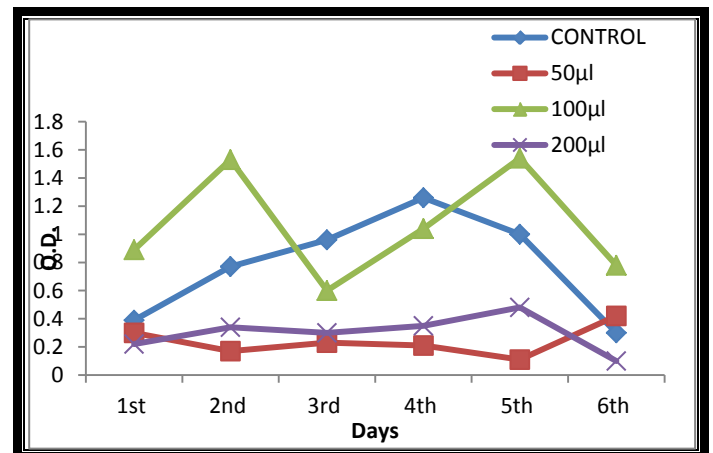


Fig 2 (C)-Effect of Different concentrations of Miticide on *Enterobacter*

Further Miticide brought reduction on the growth of all the bacterial populations with increase in the concentrations which were significantly different from control including *E.coli*, *Bacillus*, *Serratia*, *Enterobacter* and *Kurthia* and this effect was offset during exponential phase of treatment but at slow rate (Figure 2A-2E)

F

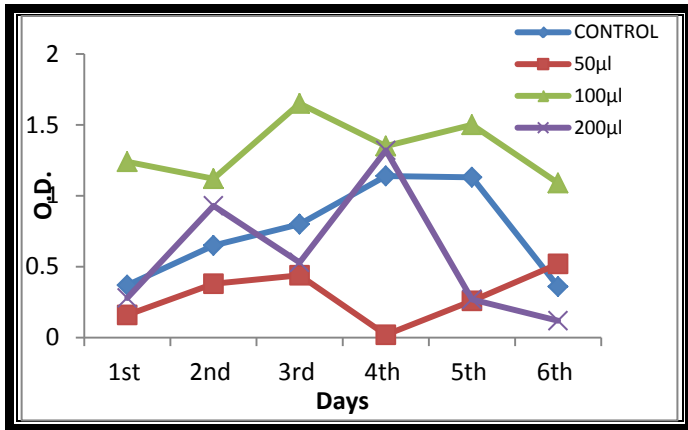


Fig 2 (D)-Effect of Different concentrations of Miticide on *Serratia*

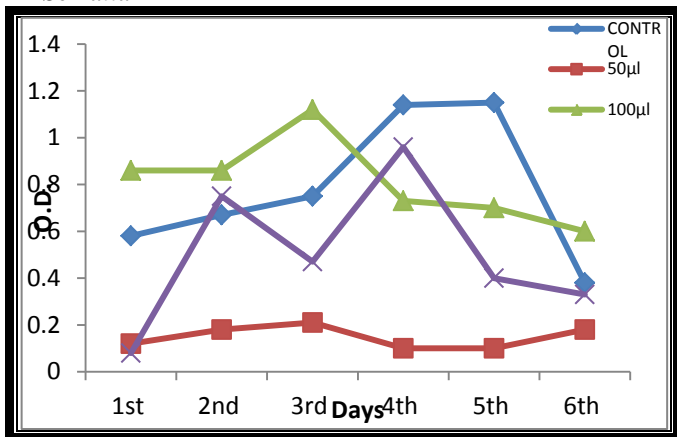


Fig 2 (E)-Effect of Different concentrations of Miticide on *Kurthia*

Whatever the mechanism of this effect was, with the concentration of insecticide applied, it could not have a significant impact on the total biomass synthesis. These facts, suggest that among the species of microorganisms some of them can be selected to be used for the controlled degradation of this insecticide. Probably for the intensification of this process a concomitant carbon source is necessary to serve as a co-substrate [11]. It is assumed that for the full degradation of insecticides makes sense not pure (mono) cultures, but a mixture of populations sequentially metabolizing the intermediates to be used [12]. Such method of combining co-metabolism with comensalism, i. e. the coordinated interaction of cellular and population levels open great opportunities for intensification of the treatment processes in biosphere as well as under controlled conditions.

Further the effect of different concentrations of fungicide on soil microorganism was studied and found that on application of fungicide enhances the

growth of microorganisms as compared to the control. All the bacterial cultures *E.coli*, *Bacillus subtilis*, *Serratia marscens*, *Enterobacter sp* and *Kurthia sp* showed positive effect on the application of fungicide (Fig 3A-3E)

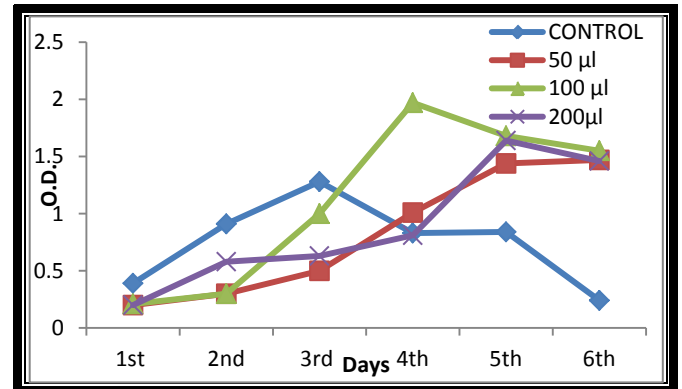


Fig 3 (A)-Effect of Different concentrations of Fungicide on *E.coli*

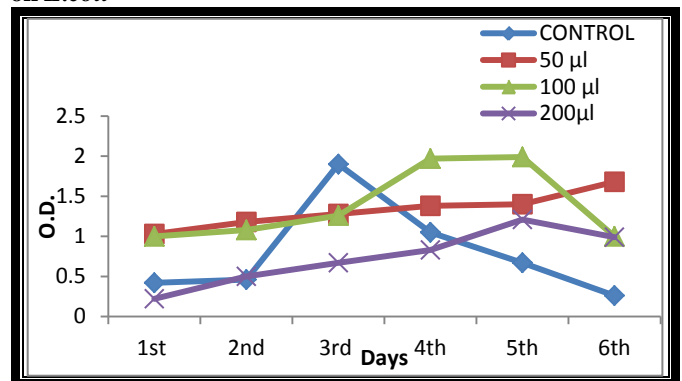


Fig 3 (B)-Effect of Different concentrations of Fungicide on *Bacillus subtilis*

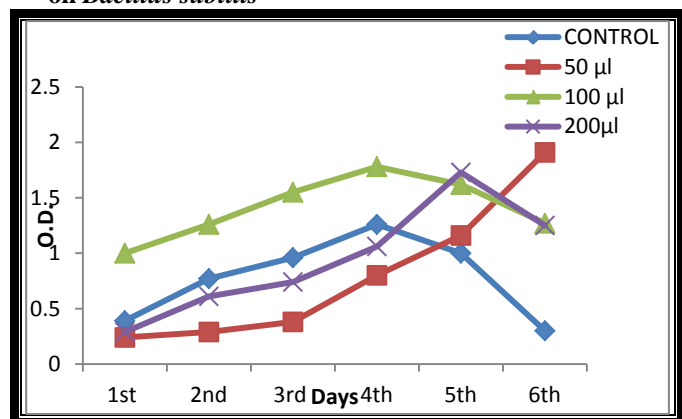


Fig 3 (C)-Effect of Different concentrations of Fungicide on *Enterobacter sp*

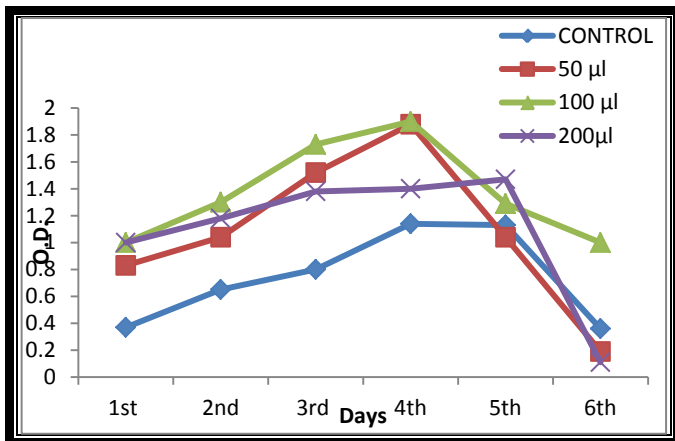


Fig 3 (D)-Effect of Different concentrations of Fungicide on *Serratia sp*

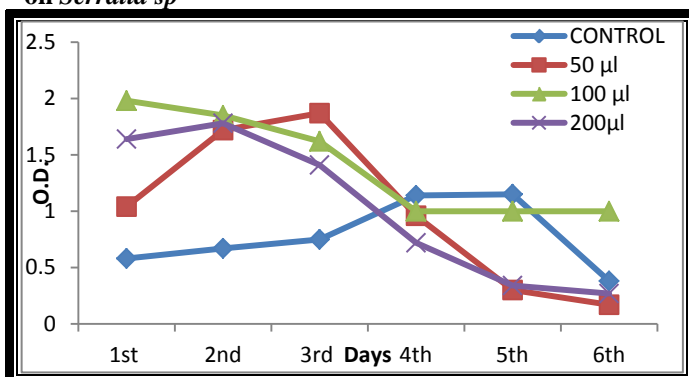


Fig 3 (E)-Effect of Different concentrations of Fungicide on *Kurthia*

The proliferation of the bacteria at low concentrations was augmented due to the application of insecticides in the medium and the augmentation was highly significant when the medium was treated with pesticides. This clearly indicates that organisms preferentially utilize insecticides to derive energy and other nutrients resulting in increase in their populations in medium [13, 10].

Microorganisms are a vast heterogeneous group that occurs in substantial numbers in soil where they are active agents of mineralization of organic matter. These organisms possess a variety of diverse catabolic pathways that enables them to metabolize an equally diverse number of low molecular weight compounds, including insecticides. The growth responses revealed the degree of bacterial sensitivity or resistance and the amount of growth stimulation when exposed to different type and concentration of insecticides.

Some studies report increased populations of actinomycetes and fungi after treatment with glyphosate [14] increased soil microbial biomass [15] or no long-term change in microbial populations [16]. There was significant reduction in percentage organic matter after the pesticides were applied to soils, although organic matter increased after continuous application from the second to the sixth week of treatment.

Ayansina and Oso (2006) [17] reported that soil treatment with atrazine resulted in significant changes in percentage organic matter measurements. Ali (1990) [18] had shown that the fate of pesticides in soils is greatly affected by the presence of organic matter in the soil by aiding their disappearance.

CONCLUSION

Pesticides are indispensable in agriculture and public health programs. Among pesticides, insecticides are the principle pollutants of our environment. It has been recognized that microbes possess remarkable spectrum of activities and are resilient to most natural and anthropogenic perturbations. However, indiscriminate use of insecticides might affect microbial populations and their micro-organisms also play a vital role in the movement, transport and biomagnifications of insecticides residues in various component of our environment. It is, therefore a fundamental necessity to have a deeper understanding of 1)the quality and quantity of insecticides 2)their interaction with micro-organism in order to maintain a stable ecosystem.

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BREAST FEEDING PROBLEM AS IT AFFECTS MOTHER AND INFANT'S HEALTH. (A STUDY OF KANO METROPOLIS, KANO STATE, NIGERIA)

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Abstract

This study examined breast feeding problem as it affects mother and infant's health. (A study of kano metropolis in kano state, Nigeria).The study was guided by four research questions, Samples of 45 nursing mothers' with breast feeding problems were randomly selected for the study, Data was collected through questionnaire and analyzed using percentiles and mean scores. The findings revealed that infant's health is affected by unsatisfied feeding and crying then later emaciating and slow growth, while mother's health is affected by frequent fever, severe breast engorgement, and even mastitis, possible solutions to problems are by frequent and slow nursing, taking advice from expert or breast feeding units in hospitals and so on .To reduce these problems, imperative programs by government, non governmental and individuals should be organized

Introduction

Baby is the seed that propagate human generation that need irrigation with free, Sterilized and balanced breast milk for proper yield, prevention of diseases and infections. The gift of breast milk feeding provides emotional bond between mother and baby continuously unless for medical reasons, unfortunately, sometimes, some identified and concealed correlated problems may arise from mother or baby which may consequently impede successful breastfeeding or even stop it, the effects are vice-versa, apart from emotional disturb the problems affects their physical well being and most importantly result to nutritional problems among infants. National Health Service

u k, (2013) stated that sometimes it can be difficult and even downright painful need to learn how to breastfeed but tackling breastfeeding problems quickly will give more time to enjoy babies early days. In many cases, the solution is as simple as changing baby's position or more often breastfeeding positioning and attachment, but stopping breastfeeding makes the symptoms worse, so asking for help and support as early causes are fear, anxiety, hurried and illness. Llewellyn-jones (1999) described that breast feeding techniques should be comfortable to nuzzle the nipple and areola inside and squeeze the milk from sinus or reservoir provided there is a quality diet for mother, fractious baby is by wrongly sucked way. National Health Service u. k (2013) described signs of well breast feeding as when baby has mouthful of breast, chin is touching the breast, baby's cheeks stay rounded during sucking or takes rhythmic long sucks and swallows and is normal for them to pause sometimes and finally comes off the breast on their own. According to healthychildren.org (2015) breast feeding problems start when a baby is always finding something to suck usually their fingers after feeding or take very short or extremely long nursing sessions baby still seems hungry after feeding, by two weeks of age the baby is under birth weight or hasn't started gaining weight, fewer wet diapers stools per day, others include dark yellow urine or specked with red, or stools still dark rather than yellow and loose, milk hasn't come in or breasts don't feel as though they're filling with milk, severe breast engorgement, the fullness and hardness of breasts don't decrease by the end of a feeding or severe pain interferes with breastfeeding

According to National Health Service U.K (2013) Sore breasts, blocked ducts, and mastitis cracked nipples, slow let down and forceful letdown, engorgement, nipple confusion cracked or sore nipples, inverted nipples etc. are causes of breast feeding problems from mothers side while

Bear, Mayer, Ryan and Uphoff (2015) mentioned lack of support, visitation, travelling, tight schedules make mother to delay nursing time, stuff nose, tongue tie, lip tie, or improper positioning resulted to in ability to suck effectively. Finello (2015) listed thrush, tongue-tie, unsettle baby and reflux and Bonyata (2011) stated thrush, stuffy nose, teething, reflux and tongue-tie can affect feeding by making it hard for baby to attach effectively. Bear, Mayer, Ryan and Uphoff (2015) mentioned poor positioning; insufficient milk resulted to damaged nipple, or disorganized the breast, fussiness at the breast accompanied by fever, lethargy, cough, stunted growth and dehydration. According to Pettinillo (2015) frequent nursing, hands-on pumping during the day helps to increase milk supply. healthychildren.org (2015) suggested drinking plenty of water, ensure baby latches well and that both breasts are emptied at each feeding, use a breast pump between feedings to stimulate production, nurse at night when prolactin hormone that stimulates milk production are the highest and ask lactation consultant about certain foods, such as oatmeal in specific quantities that may improve milk production. Bear et al (2015) observed solutions to breastfeeding problems should include frequent nursing within 24 hours and responding to the needs of the baby.

Research methodology

Research Design: the study employed the survey type of the descriptive research, it is made to study breast feeding problems presently in kano metropolis.

Objectives of the study

The main purpose of this study is to survey on breast feeding problems among lactating mothers in kano metropolis

The specific objectives are to:-

- 1 Spot the causes of breast feeding problems during nursing in kano metropolis.
- 2 Identify the effects of breast feeding problems on infant's health.
- 3 Identify the effects of breast feeding problems on mother's health.
- 4 highlight the possible solutions to the common breast feeding problems

Research Questions The following research questions were formulated to guide the study

- 1 What causes breast feeding problems in kano metropolis?
- 2 To what extent breast feeding problems affects mother's health in kano metropolis ?
- 3 To what extent does breast feeding problems affects the health of an infant in kano metropolis?
- 4 What are the possible solutions to common breast feeding problems in kano metropolis?

Area of the study: - five areas were randomly selected from kano metropolis for the study they include: - kabara sheka, kawo, dala, and fagge quarters.

The population and sample: - the population of the study consisted all nursing mothers presently encountering breast feeding problems from June 15 to July 15 2015, fifty seven (57) cases of breast feeding problems were either reported or observed, forty five (45) respondents were selected out of the total population using random sample of nine (9) respondents in each of the selected area.

Instrument for Data Collection: - The instrument used to generate data for the study was a researcher developed questionnaire titled “Investigation into breast feeding problems (IBFP), the instrument was structured in five sections, section A for bi-data and the remaining for each research questions on 4-point Likert scale for each of the statements.

Method of Data Collection The researcher distributed the questionnaire with the assistance of four research assistants trained by explaining the location of the sample and formats for responding to the items, bio-data and the first three sets of questions were administered first then short lecture was delivered on the possible solutions, then the last part was administered separately a week after.

Method of Data Analysis simple percentage was used to analyzed bio-data and mean score was used to analyze the data research questions, the options were weighted on the 4-point Likert rating scale thus: The midpoint for the scale is 2.00. Therefore, only means scores above 2.00 were accepted while mean scores below 2.00 were regarded as unacceptable

Results

Findings showed that 40% of the respondents were within the age range of 26-35years and another 40% were 36-45years (table1) and 40% of the respondents received only primary education (table 2), table 3 showed respondents with 5-6 numbers of children fall in highest percentage of 35.554% and 73% of the respondent’s encountered breast feeding problems once (table 4). Table 5 showed the acceptance of many items that causes breast feeding problems like keeping baby away from mother for several hours, breast pain and insufficient breast milk with highest mean score above 2 points and others as confusion and multiple feeding as the causes of

breast feeding problem. Table 6 indicated the acceptance of baby slow growth, crying, dissatisfaction and emaciating as observed effects of breast feeding problems on babies and table 7 indicated frequent fever, breast sore and engorgement, and mastitis as effects on mother's health. Table 8 indicated that all the items were accepted solutions to breast feeding problems as frequent and slow feeding, advice by experienced experts and breast feeding support in hospitals.

Section a Bio data

Table 1: Age range of the respondents

Age range	frequency	percentage
15-25 years	3	6.6667
26-35years	18	40
36-45 years	18	40
Above 45 years	6	13.3332
N= 45		100%

Source: field work

Table 2: educational qualification of the respondents

educ. level	frequency	percentage
Non formal education	12	26.64
Primary education	18	40
Secondary education	7	15.54
Tertiary education	5	11.111111
Graduated	3	6.6667
n=45		45 100%

Source: field work

Table 3: respondent's number of children

Number of children	frequency	percentage
1 and 2	10	22.222
3 and 4	9	19
5 and 6	16	35.554
7 and 8	10	22.222
Above 9	0	0
n=45		45% 100%

Source: field work

Table 4: Number of encountered breast feeding problems

Time	frequency	percentage
1 time	33	73.33326
2 times	8	17.77776
3 times	3	6.66667
4 times and more	1	2.2222
n=45		100%

Source: field work

Section B

Research question 1 what are the causes of breast feeding problems

Table 5: respondent's observation on the causes of the problems

S/N	What contributed to the feeding problems	Response category				Mean	Remark
		SA	A	D	SD		

1	baby is away from the mother for several hours during the day.	18	3	15	9	2.6667	Accepted
2	Breast pain, engorgement, sore nipples etc. disturb the mother	33	3	3	6	3.4	Accepted
3	Baby always sleep and don't care about feeding	3	3	27	12	1.9333	Rejected
4	Breast milk is not sufficient	37	3	2	3	3.6444	Accepted
5	Baby is unable to suck well	24	6	9	6	3.0667	Accepted
6	Baby have cold, stuffy nose and other related cases	35	6	1	3	3.6222	Accepted
7	Mother is pregnant	3	3	27	12	1.8	Rejected
8	Baby mouth is not normal	1	3	21	20	1.6667	Rejected
9	Mother is confused and unable to detect the problem	18	12	9	6	2.9333	Accepted
10	Breast Feeding multiple babies	6	-	33	6	2.1333	Accepted

Source: field work

Research question 2: effects of breast feeding problems on infants.

Table 6: respondent's observations on effects of breast feeding problems on infants.

Response category

S/N	Effects of breast feeding problems on children	SA	A	D	SD	Mean	Remarks
11	Baby slow growth	18	15	6	6	2.9778	Accepted
12	Baby crying and unsatisfied	33	12	-	-	3.7333	Accepted
13	Diarrhea, abnormal stooling and less excreta by the baby	3	3	24	15	1.86667	Rejected
14	Baby is emaciating	30	3	6	6	3.2667	Accepted

Source: field work

Research question 3, effects of breast feeding problems on mothers

Table 7, mother's explanation on the effects of breast feeding problems on their health

S/N	Effects of breast feeding problems on mothers	Responses category				Mean	Remarks
		SA	A	D	SD		
15	Frequent fever	15	12	9	9	2.7333	Accepted
16	Breast sores, engorgement, and others.	15	9	15	6	2.7333	Accepted
17	Damaged nipples and disorganized breast	0	0	30	15	1.6667	Rejected
18	Fussiness of the breast	3	2	24	16	1.7556	Rejected
19	Mastitis	9	6	15	15	2.2	Accepted

Source: Field work

Research question 4, mother's observations on solution to common breast feeding problems

Table 8, the best solution to breast feeding problems

Response category

S/N	Solutions to common breast feeding problems	SA	A	D	SD	Mean	Remarks
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20	Frequent feeding	24	12	3	6	3.2	Accepted
21	Slow nursing till baby is satisfied	27	12	3	3	3.4	Accepted
22	Traditional treatment	6	5	30	4	2.2889	Accepted
23	Mixed feeding	5	3	31	6	2.1556	Accepted
24	Breastfeeding help and support in hospital	3	12	27	3	2.3333	Accepted
25	Advice by experienced people	32	6	4	3	3.4889	Accepted

Source: Field work

Discussion

The finding of the study revealed that breastfeeding problems affect women of different age groups since respondents' within the age range of 26-35years and 36-45years are women of reproductive years and have highest percentages, that means, there is no specific age range that mostly affected by breast feeding problems.(table1). The study also revealed that highest percentage of respondents have not received formal education, the correlation between education and breast feeding problems is associated to the believed of insufficient milk (table5) and un nutritive breast milk (nono ba maiko) as a cultural believes among Hausa people of the study area since Llewellyn-jones (1999) stated that provided there is good diet breast milk is qualitative and sufficient. Table 3 indicated that breast feeding problems can affects women of any age .table 4 showed that breast feeding problem do not affect every nursing time expect few women with the possibility of further illness that encountered the problems more than once. The study also revealed that so many problems from both mother and the baby caused breast feeding problems (table 5) as breast engorgement, Sore breasts, blocked ducts, cracked nipples, slow let down and forceful letdown as stated by National Health Service U.K 2013, baby's un able to suck well etc. some causes are unidentified that is why the respondents were confused have high mean score. Table 6 indicated the effects of breast feeding problems on babies as crying and unsatisfied babies which further leads to emaciating and slow growth which has been stated by

National Health Service U.K (2013). Mothers were affected with breast feeding problems because table 7 revealed the mean score of above average on frequent fever, breast engorgement and mastitis as encountered problems by mothers and this indicated the problems is on baby side as is unable to suck well thus resulted to mothers problems. Finally, as stated by Pettinillo (2015) the solution to breast feeding problems should be by frequent and slow feeding. advise given by hospitals and experienced people because the last part of questionnaire were administered a week after the administration of the first part, by considering the educational level of majority of the respondents, traditional treatment and mixed feeding were accepted since their mean scores were above average and thus accepted.

Conclusion

Breastfeeding problems usually start from minor problems, improper handling leads to more complicated issues, infant's position as future educators, executives and nation builders, their health is of paramount importance therefore, their feeding system should be considered as some breast feeding problems affect child future.

Recommendations

Based on the findings of the study on breast feeding problems and the effects on mothers and infant's health, the following recommendations were made:-

- Government should minimize this problem by organizing seminars extension services and workshops to enlighten women on breast feeding problems and solutions.



- Non governmental organization should join hand to address this issue at its early stage.
- Mass media should intensify their efforts by including more programs on breast feeding problems and solutions.
- Hospitals antenatal and post natal care units and immunization sections should educate women on the signs of breast feeding problems especially at early detection.
- Nursing mothers should keep eye on their babies and report any small changes on themselves or their babies.
- Experienced women and health workers should be observing nursing mothers and their babies at every gathering and ready to offer advice in order to address the issues effectively.

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Study on Mechanical, Thermal and Morphological Properties of RHA Filled PVC Composite

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Abstract

Rice husk ash (RHA) and polyvinyl chloride (PVC) composite has been prepared by solution technique. Cyclohexane has been used as a solvent for PVC. The influence of RHA on different properties of PVC/RHA composite has been studied. The dispersion of RHA in PVC matrix has been evaluated by the SEM studies. The thermal properties showed an increasing trend as the filler concentration is increased in the PVC matrix system. The melting and crystallization behavior has characterized by DSC analysis. Thereafter, the mechanical properties like tensile strength showed an increasing nature when composite comprise the 90:10 of RHA and PVC in the composite. Modulus has shown best results at the 70:30 due to hard and strong nature of composite. Elongation at break found maximum of virgin PVC. The hardness of the prepared composite has been increased when loading has been increased of RHA in PVC. Furthermore, this research work has shown that the solution technique is easy and cheap method to produce PVC/RHA composite for different applications.

Keywords: Mechanical properties, Rice Husk Ash (RHA), Polyvinyl Chloride (PVC), Thermal & Morphology, Fourier Transform InfraRed Spectroscopy (FTIR), Composite

Introduction

Rice hull is an organic waste which is used as fuel to generate steam. Rice hulls contain about 75 % organic volatile matter and the remaining 25 % of the weight is converted into ash. RHA comprises high amount of silica 92-95 % of total weight. Additionally, high porosity and light weight with very high surface area is essential requirement for filler in composites. Environmental safety from RHA is a great challenge for researchers and scientists.[1] In a study S.P. Deshmukh and A.C. Rao prepared a composite of PVC and mica. The results shows a better in dielectric properties with improvement in young's modulus shore D hardness and stiffness, the elongation at break is decreased. Due to the lower in particle size

RHA decreases the volume of large pores and therefore makes the continuous pores into discontinuous ones. This will lead to make the structure more homogeneous and denser of the matrix system.[2, 3] The large number of rice husk ash has been used as a pozzolana in various countries due to lower in cost and high reactivity with plastics and cements. [4] When burning at 600 to 700°C temperature for 2 hours RHA contains 90-95% SiO₂ content, amorphous nature and develops cellular form, with 50-1000m²/g surface area. [5]

Azman Hassan et al [6] concluded that the addition of RHA in PVC-U increased the fusion time. It is also revealed that the RHA and PVC-U composite with shorter fusion time and fusion torque was increased to the higher point. It is well evidenced in this paper that upon the addition of 20 phr RHA, the end torque is decreased compared to unfilled sample. Polyvinyl chloride (PVC) is a product based on chlorine and ethylene that can be combined to form the monomer vinyl chloride. PVC is a thermoplastic material that can undergo softening and cooling many times without any significant chemical change. PVC has a good combination of stiffness and impact strength with the aid of non-flammability. Including these properties and applications in the construction, electrical, automobile and medical industries it is chosen as the base matrix material as a binder for the RHA filler.

Rice husk is a low valuable agricultural by-product produced by the rice mills because of exceeding in utilization and production of rice in the developing countries. Due to the high silica content it is used as filler in the polymers, rubbers industries and cement products for reducing the cost and increasing the strength. [10]

There are so many papers can be found on rice husk with the other polymeric materials [1,7,13]. Maleic anhydride modified rice husk filled PVC composite, Carbon /silica composite, blended with cement for increasing the strength and due to the low thermal conductivity, high melting point, low bulk density and high porosity makes it fine filler for the industries. [6-17]

In this research, we are trying to develop a new kind of composite based on polymer and RHA for its various applications in the field of desiccant polymers, electrically insulating and other places.

2. Materials and Experimental Methods

2.1 Raw Materials

The following materials listed in table 1 were used in the preparation of the composites. Polyvinyl chloride (PVC) was obtained from Research & Development, CIPET Lucknow. Rice Husk was obtained from the local rice miller situated in Lucknow, Uttar Pradesh. Cyclohexane was supplied from Lova Chemicals Private limited, Mumbai.

Table 1 Materials and suppliers with specification.

Materials	Specifications	Suppliers
Poly Vinyl Chloride (Resin)	Density:1350-1700kg/m ³	Research & Development Lab., CIPET, Lucknow
Rice Husk	Bulk Density:70-80g/cm ³ Length: 3-6 mm	Local rice miller in Lucknow, Uttar Pradesh.
Cyclohexanone	Density: 0.9478 g/mL (liquid)	Lova Chemie Private limited, Mumbai.

2.2. Experimental Methods

2.2.1. Preparation of Rice Husk Ash (RHA)

The collected rice husk from a local rice mill contains many impurities like dust, small rice particles, and fine sand particles. These impurities could be influenced the properties and composition of the rice husk ash, so it need to be cleaned to get pure rice husk. This purpose could be attained by washing the rice husk thoroughly with the double distilled water. Some extra care was taken so as the rice husk was not washed out in this process. This kind of wash removes major impurities like sand particles or dust particles & small rice particles remained in rice husk. The finally obtained rice husk kept all day in the sun to dry it up. The husk was thoroughly dried so as no amount of moisture remains in this process and desiccator was used to do not introduced moisture till the preparation of composite. Finally, the rice husk ash was produced by burning rice husk at 650^oC in a furnace for 30 minutes burning time. After the whole process the obtained rice husk was sieved to get the uniform particle size and lesser particles (in micrometer) of rice husk ash as filler.

2.2.2. Composite Preparation

Poly vinyl chloride, Rice Husk Ash (RHA) and Cyclohexanone were used in the preparation of PVC/RHA composites. Furthermore, Rice Husk Ash was sieved in a sieve analyzer with

the different mesh size upto 240 μ m were used after the preparation steps of rice husk ash. The solution blending technique was used to prepare the composite of PVC/RHA with the different loadings of rice husk ash (10, 20, and 30) in weight %. Pre-dried rice husk ash was kept in a desiccator to remove vacant moisture. The mixture of PVC and RHA were taken simultaneously in a beaker capacity of 1 liter and cyclohexanone was used as a solvent to dissolve them with the help of a glass rod and stirred thoroughly for half an hour to get dissolve PVC and allow to introduce RHA particle in the PVC matrix. The preparation of composites has been completed with the help of compression molding machine. Before the mixtures were poured inside the mould, the mould was initially polished with silicon as a release agent to prevent the composites from sticking to the mould upon removal. After the mixture had been poured into the mould, it was consolidated by compression moulding at room temperature for 24 hours for fully cured and hardened at the load of 2.4 MPa.

2.2.3. Testing & Characterization methods

Mechanical properties of the samples, such as tensile strength, tensile modulus, elongation at break, and flexural strength were measured according to the ASTM D-668 standards with the aid of universal testing machine (UTM, Instron) at room temperature (23^oC) and crosshead speed of 5 mm/min., all the samples were cut down as the ASTM standards. Furthermore, thermal studies were carried out by Differential Scanning Calorimetry (DSC; Perkin Elmer) and Thermogravimetric analysis (TGA) in the temperature range from room temperature to 300^oC at a constant heating rate of 10^oC/min and 50 to 700^oC, respectively. Fourier transform infrared (FTIR), ATR spectroscopic studies were carried out on the composite samples with a Perkin Elmer FTIR instrument. The graph was plotted by PerkinElmer Spectrum (version 10.03.06). Thereafter, Scanning Electron Microscopy (SEM) was used to study the surface morphology of the developed composite. Micrographs were taken out at 2.00 KX resolutions at the voltage of 15kV. Before taking the micrographs all samples were coated with gold in an auto fine coater (JOEL, JFC-1600) to avoid the charging effect and increase the efficiency of secondary electrons.

3. Results and Discussion

3.1. Mechanical properties

3.1.1. Tensile Strength& Tensile Modulus

In table 2 and figure 1 & 2 tensile strength and tensile modulus results of the developed PVC/RHA composite have been shown. It can be observed from the test results that the addition of rice husk ash filler decreased the tensile strength of the neat PVC. However, there is a different trend of decrement in the tensile strength as, when the 10% of RHA is loaded into the PVC matrix the tensile strength reduced from 45.2 to 28.1 MPa and thereafter a gradual decrement from 25.8 to 20.7 when loadings of RHA are 20 and 30 wt%, respectively. From these results the effect of RHA at different loading into PVC matrix has been clearly shown. The sharp decrement in the tensile strength of PVC/RHA composite can be attributed to that the morphology of the blends reveals the poor and weak adhesion between the polymer matrix and rice husk ash filler and large cavities or cracks also influenced the tensile strength of the developed composite of RHA/PVC.

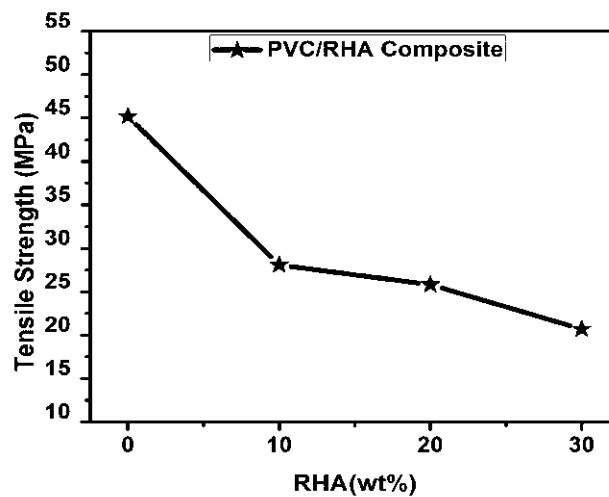


Figure 1 shows tensile strength of PVC/RHA composite.

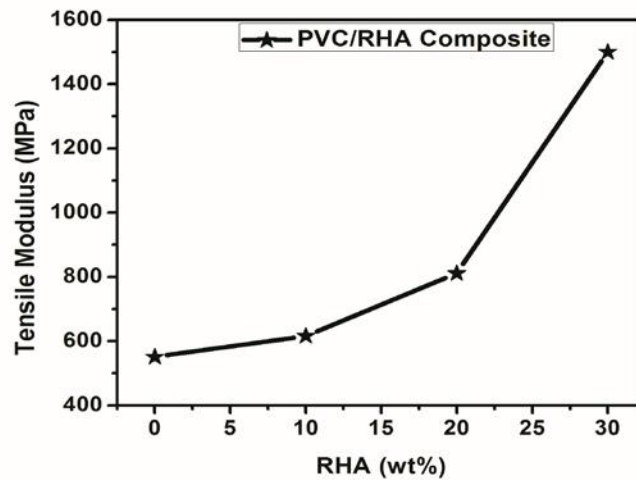


Figure 2 shows tensile modulus of PVC/RHA composite.

Generally the rigidity of the organic materials has lower side when compared to the inorganic fillers. Therefore, the addition of these rigid particles into the PVC matrix results the significant improvement in the tensile modulus and decrease in the tensile strength. The rigid and stiff nature of the composite correspondingly decreases the tensile strength and increases the tensile modulus.

Table 2 shows the mechanical properties of PVC influenced by the RHA

Sample	Composite designation	Tensile strength (MPa)	Tensile Modulus (MPa)	Elongation at break (%)	Flexural strength (MPa)
1.	P ₁₀₀	45.2	551	80	95
2.	P ₉₀ R ₁₀	28.1	616	69	60.9
3.	P ₈₀ R ₂₀	25.8	811	30.7	48
4.	P ₇₀ R ₃₀	20.7	1500	28	40.6

3.1.2. Elongation at break

It has been seen in the table 2 and figure 4 that there is a decrement in the elongation at break of the test samples, increasing the loading of RHA filler in the PVC matrix. Due to the addition of rice husk ash the movement and displacement of the polymer chains are

restricted. SEM micrographs revealed that the bonding or adhesion between the RHA filler and PVC polymer matrix is weak and those cracks and multiple surface structures reduced the elongation at break of the PVC/RHA composite. [2]

The neat PVC retained 80% elongation at break, while 10 wt% of RHA reduced it to 69% in comparison to neat PVC. Furthermore, a sharp change (from 69-28%) in the elongation at break has been observed when the filler content is increased upto 30 wt% of RHA in the polymer matrix. The rigid nature of the RHA filler is due to the higher silica content in the ash and the rigidity of the RHA filler also improved the stiffness and rigidity of the composite system.

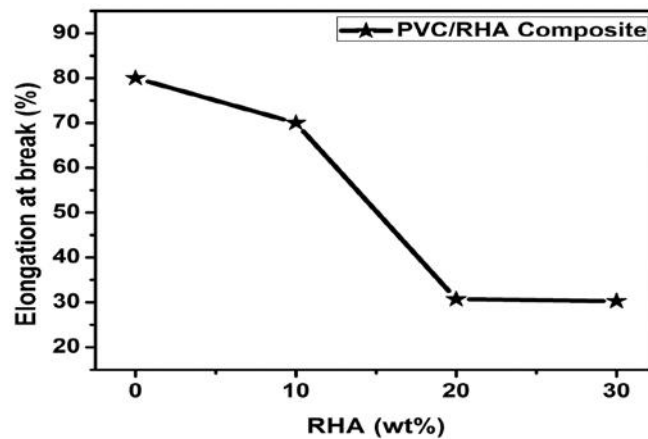


Figure 3 shows elongation at break of PVC/RHA composite.

3.1.3 Flexural Strength

The flexural strength of the PVC/RHA composites is presented in the table 2. Flexural strength is the ability of the material to withstand bending forces applied perpendicular to its longitudinal axis. Therefore, it is depends on the bonding and adhesion between the filler and the matrix of the composite system. The dispersion of the filler also plays a key role to give the strength to the composite. In figure 4 it is clearly shown that the addition of the 10 wt% of filler sharply decreased the flexural strength of the PVC/RHA composite. Furthermore, it is revealed that the filler content upto 30 wt% not significantly decreases the flexural strength. However, in our study the flexural strength of the PVC/RHA composite decreased while increasing the content of the RHA. This may be attributed due to the agglomeration of the RHA particles in the developed composite.

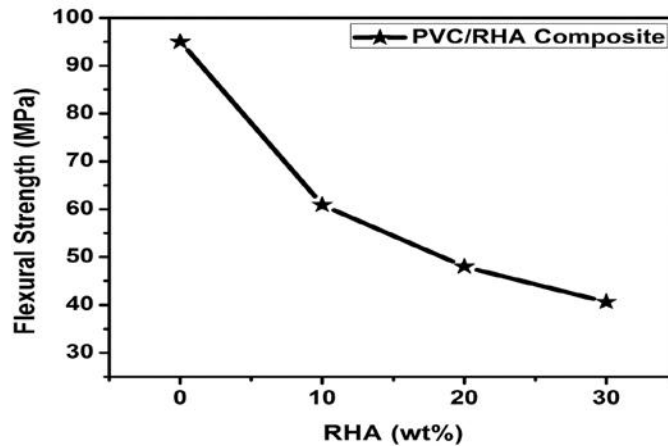
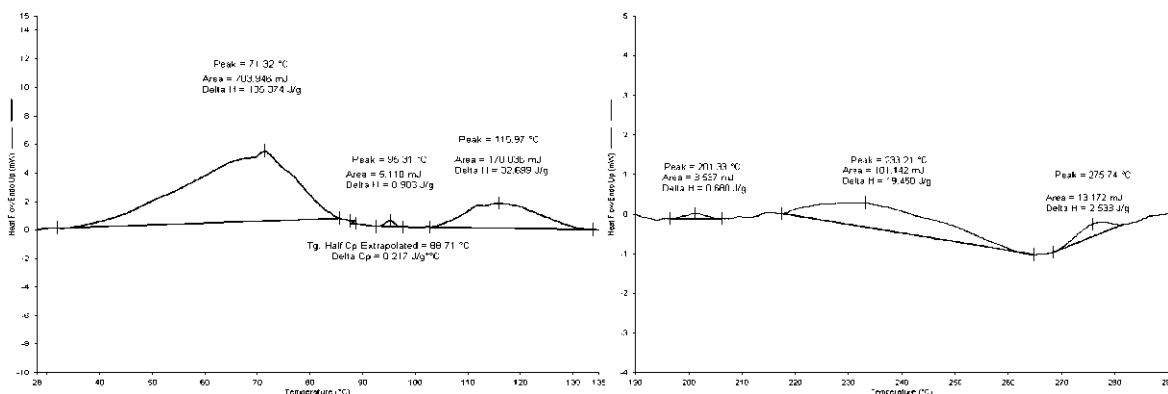


Figure 4 shows flexural strength of PVC/RHA composite.

3.2. Thermal properties

3.2.1. Differential Scanning Calorimetry (DSC)

The DSC thermograms illustrated in table 3 and figure 5a-d. The exceptional thermal properties of prepared PVC and RHA based composite has been harness as fillers to improve thermal stability and dimensional stability. The melting point (T_m) of virgin PVC material is shown in figure 5a. The results revealed that virgin PVC shows three peaks at 71, 95, 115 $^{\circ}$ C. The T_m of PVC/ RHA composite was higher than that of virgin PVC. The melting point peaks for PVC and 10 wt% RHA composite found to 201, 233, 275 $^{\circ}$ C due to the small incorporation of RHA in the PVC matrix. Furthermore, as be amount of filler was in increased to 20wt% the melting point of PVC/RHA composite was increased 295 and 320 $^{\circ}$ C.



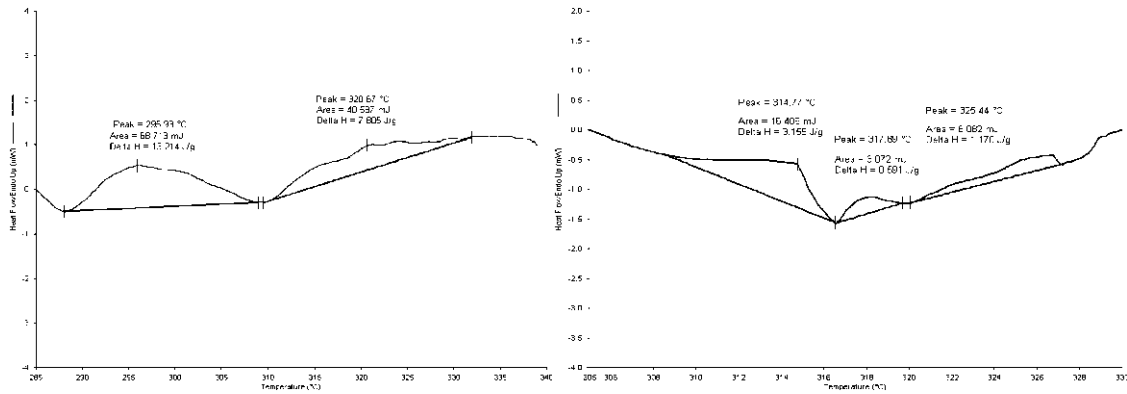


Figure 5 (a-d) shows the DSC thermo grams for different PVC/RHA composite system.

But when the amount of filler was increased upto 30 wt% in the PVC matrix, the melting point for first second and third peaks were higher than the other composite compositions and found 314, 317 and 325^oC. Therefore the use of RHA particles as filler affects the melting behavior of the develop composites. Bahareh Azinfar et al concluded that, the probable hindrance of polymer chains movement due to the RHA filler particles can restricted the change from crystallization. The higher melting temperature of PVC/RHA composite compared to virgin PVC can be summarized by the slow heat transfer in the composite through RHA particles.

Table 3 refers the thermal data of different formulations.

Sample No.	Melting point (°C)			ΔH (J/g)		
	Peak 1	Peak 2	Peak 3	Peak 1	Peak 2	Peak 3
1.	71	95	115	135.3	0.98	32.6
2.	201	233	275	0.68	19.45	2.53
3.	295	320	-	13.21	7.80	-
4.	314	317	325	3.15	0.59	1.17

3.2.2. Thermogravimetric analysis (TGA)

The influence of rice husk ash (RHA) on the thermal degradation or stability of PVC was assessed by TGA in table 4 and figure 6. The TGA curve suggested that the addition of rice husk ash as a filler in the PVC matrix greatly increased the thermal stability and weight loss

was also increased due to the higher temperature of rice husk ash. The final degradation temperature (at 40 wt% loss) of the different composite systems recorded as given in table. We resulted that the at the 10 wt% of loading of RHA the higher thermal stability is achieved (684°C) due to the even and fine dispersion of filler with the polymer matrix. The initial degradation temperature (IDT) at 10 wt% loss was decreased upto 63 °C and the degradation at 40 wt% loss was achieved 355°C. S. Kumar et al showed this kind of trend in carbon/polyetherimide composite which reduces the thermal stability of the composite system. [19] The addition of RHA upto 30 wt% also increased the final degradation temperature (FDT) of the developed composite which revealed the degradation at 30 wt% was maximum (686 °C) for the composite. By the SEM micrographs it is concluded that the addition of 30 wt% RHA in the PVC matrix has fine dispersion of filler and the improved adhesion between these components. Lower amount of cavities and distorted surface also improved the thermal stability of composite system. Navin Chand et al reported that the three types were achieved during the thermal degradation process. As compare to this, the same trend was shown in the present study and degradation of PVC was influenced by the RHA as shown in above results. The degradation at the range between 500-700 °C was recorded due to the other compounds present in the RHA.

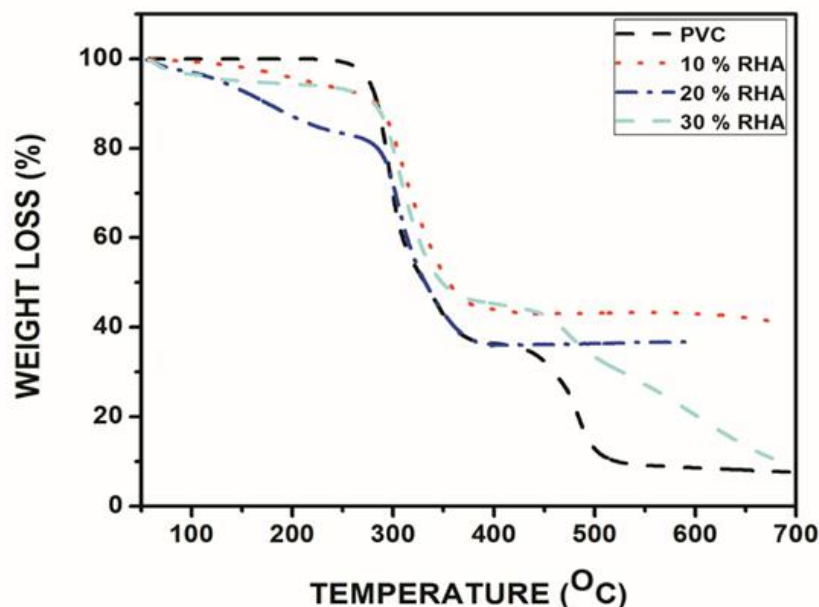


Figure 6 shows thermal stability of the PVC/RHA composite at different filler level.

Table 4 shows the degradation temperature of developed composites.

Sample designation	Initial Degradation Temperature (IDT)	Half Degradation Temperature (HDT)	Final Degradation Temperature (FDT)
P₁₀₀	253 ^o C	331 ^o C	358 & 521 ^o C
P₉₀R₁₀	116 ^o C	35 ^o C	684 ^o C
P₈₀R₂₀	64 ^o C	331 ^o C	398 ^o C
P₇₀R₃₀	63 ^o C	348 ^o C	686 ^o C

3.3. FTIR spectroscopy

Table 5 and Figure 6 shows the spectra of the developed PVC/RHA composites. In the FTIR results eight major peaks are observed as given in the table 3, respectively. In the FTIR transmittance plot of PVC/RHA composite a broad peak is observed at 3419cm⁻¹, which corresponds to O-H hydroxyl bond and can be attributed to water observed by the composite system with transmittance of 36.6%. Another two sharp but narrow peaks are observed at higher wavenumber 3021 cm⁻¹ and 2963 cm⁻¹ with transmittance 15.2 and 29.3 respectively and corresponds to asymmetric and symmetric stretch bonds of C-H. The peak around 1386 cm⁻¹ is assigned to C-H aliphatic bonding bond. The bonding bond of C-H near Cl generates the peak at 1215 cm⁻¹ with transmittance level of 40.5%. The C-C stretch bond to PVC/RHA composite backbone chain occurs at 1074 cm⁻¹ with transmittance of 42.7%. Due to the presence of rich silica filler Si-O vibration is recorded at 762 cm⁻¹ with 29.5% transmittance. Finally, the peak at 670 cm⁻¹ relates to C-Cl gauche bond with the 47.4 transmittance.

Report

Filename PEService 1346_1
 Analyst PEService
 Description Sample 1346 By PEService Date Tuesday, June 24 2014

Spectrum Graph

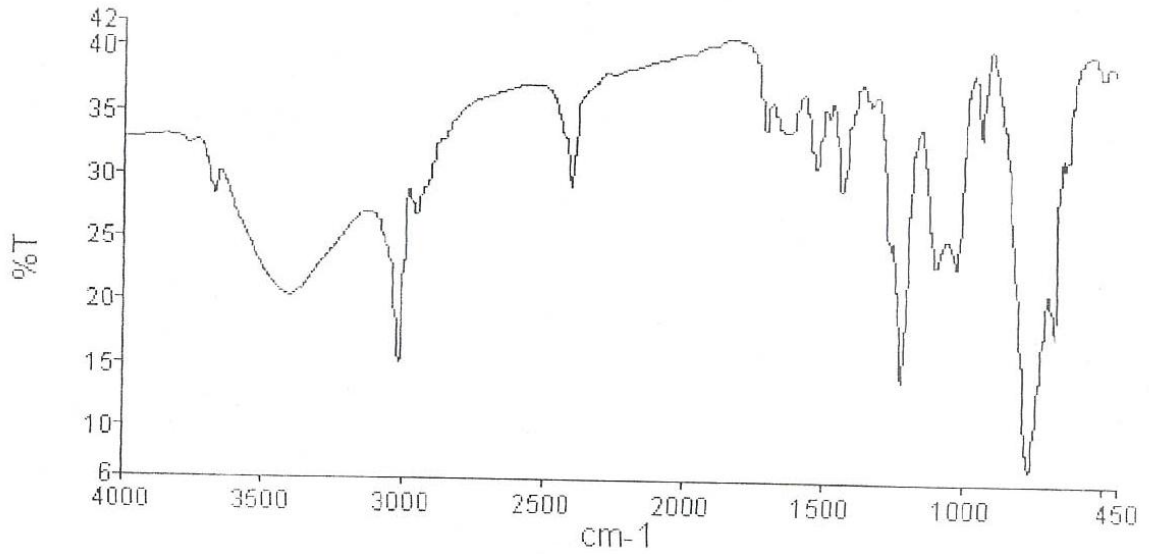


Figure 6 showing the graph plotted between wavelength (cm^{-1}) and transmittance (%) of the PVC/RHA composite.

Table 5 displays the peak values observed by the FTIR results.

S.No.	Wavenumber on X-axis (cm^{-1})	Transmittance Y-axis (%)
1.	670	47.4
2.	762	29.5
3.	1074	42.7
4.	1215	40.5
5.	1386	43.3
6.	1636	41.6
7.	3021	26.8

3.4. Morphological properties

Figure 7 presents the SEM images of the PVC/RHA composites with the different loadings of RHA. Rice Husk Ash (RHA) particles were embedded in the PVC matrix to yield composite with the loadings of 10 wt%, 20 wt%, and 30 wt% as presented in figure 7 (a-c). In the composites dispersion of filler can affect the properties. The figure 7 (a) indicates that the surface of the sample is relatively smooth and fine but large cavities, cracks and island like structures are present. The size of the cavities are large and sharp, showed a strong incompatibility and poor interfacial adhesion between PVC and RHA. The dispersion of filler and surface texture of RHA particles between the three composites have been seen. Figure 7 (b) and 7 (c) shows that the cavities are smaller when compared to the 10 wt% RHA filled PVC composite. The surface morphology of 20 and 30 wt% RHA filled composite present's uneven surfaces and pieces of filler which indicates poor adhesion and weak interaction between the filler and matrix. The significant decrement in the tensile strength and elongation at break occurs due to weak interaction of RHA to PVC and high level of particles pullout when samples were prepared and mechanical tests processed. [2]

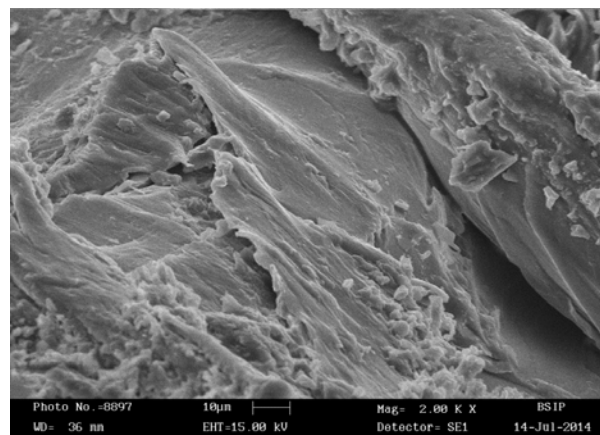


Figure 7 (a) shows the SEM micrographs of developed composite of PVC/RHA

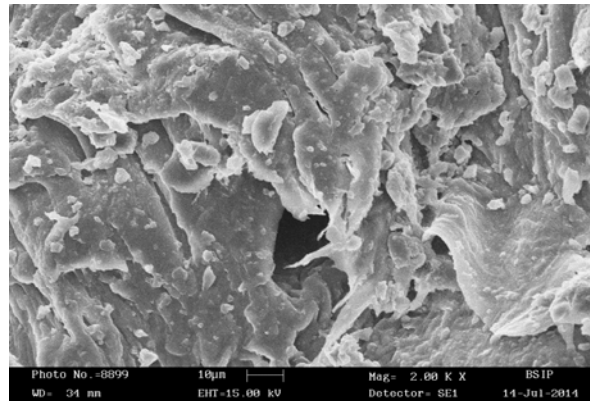


Figure 7 (b) shows the SEM micrographs of developed composite of PVC/RHA

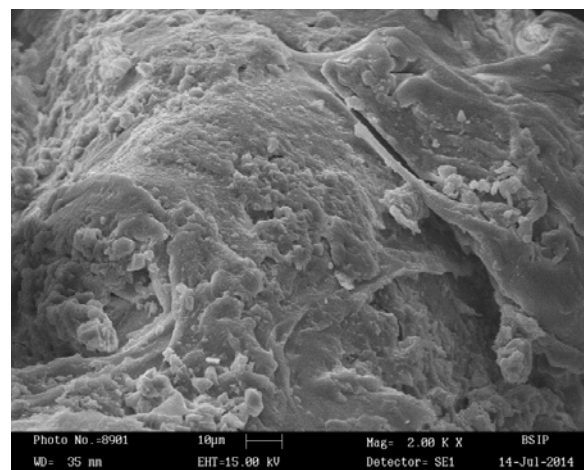


Figure 7 (c) shows the SEM micrographs of developed composite of PVC/RHA

4. Conclusion

Rice husk ash is used as reinforcing filler in the PVC matrix. The composite has been fabricated via solution blending method and concentrations of rice husk ash to fabricate the composites used as 10, 20, 30 wt % of the matrix. On the basis of above results it is concluded as follows:-

1. Tensile strength, elongation at break and flexural strength has been decreased due to the poor filler dispersion and interaction with the matrix. While the tensile modulus is increased due to the rigidity and toughness of the RHA filler provided to the matrix PVC.

2. Thermal property has been increased when the concentration of the filler is increased due to the higher temperature of rice husk ash RHA, the presence of the silica (SiO_2) and other elements and their higher amount of melting and ignition temperature increased the thermal properties.
3. FTIR and SEM studies have been accompanied to analysis of the functional groups present in the composite system and surface analysis. It is evaluated that the poor and weak filler and polymer matrix interaction and bonding leads to decrease the properties of the developed system.
4. The composite can be used where high temperature resistance and chemical resistance is required due to the PVC and RHA. Lower in cost and easy in the processing makes this way better for fabrication and developing and improves the properties of the composite by adding the coupling agents and grafted polymer.

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HASSLE MANAGEMENT AMID THE PHD STUDENTS

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Abstract

Stress is an unavoidable phenomenon in a PhD student life. Due to the contribution of many structural issues within the program, PhD students are susceptible to stress and anxiety during their academic experience. Students face lots of challenges during the period of research and when they fail to cope up with the challenges, they become stressed. Factors such as personal, academic, family and societal are the main sources of stress among the students. Stress may result in physiological, behavioural or even psychological effects. The study is aimed to focus on the stress perception, causes of stress and coping strategies among PhD students. The data was collected using questionnaire. Out of 300 questionnaires issued 260 filled in questionnaire were received. The data was analysed using tabulation and various suggestions on managing stress were provided.

Keywords— Stress, PhD students, causes, challenges, management

I. INTRODUCTION

Stress is the response to a demand that is placed upon the person. In a normal reaction, when the brain recognizes a threat it results in stress. When the brain perceives the threat, body releases hormones that activate “fight or flight” response. This response is not limited to perceiving a threat, but in less severe cases, is triggered when we encounter unexpected events. Stress can be positive or negative. Stress can be positive when the situation offers an opportunity for a person to gain something. It acts as a motivator for peak performance. Stress can be negative when a person faces social, physical, organisational and emotional problems.

Doctoral students are unclear about their responsibilities and are unsure about what help they can ask from their supervisors. This is compounded by the lengthy isolation from peers that often occurs in the later stages of research. These factors can contribute to “imposter syndrome,” the sense that one is about to be “found out” for not really being smart enough. Some PhD students experience a sense of infantilization along with the conflicting expectation that they develop a professional identity.

The shortage of funding can lead to student debt and other financial difficulties as well as more intense competition for grants and pressure to complete sooner. This kind of competition can be depressing and stressful. And of course, alongside the professional pressures they also experience personal issues and events that affect everyone. This can throw one’s career off-track.

A. Causes of Stress

Stressors are anything that cause or increase stress.

1. Academics –the biggest stressor for students
2. Environment –discussing heated topics, slow moving traffic, finding a parking spot, etc.
3. Extracurricular – extracurricular activities a part of the daily routine
4. Peers – peer pressure is a major stressor
5. Time Management – not knowing how to plan and execute daily activities
6. Money – some students think more about money than they do anything else
7. Parents –Pressure from parents to succeed

B. Effects Of Stress

Physiological –prolonged stress increases the tension that is put on the arteries. In turn the immune system is affected resulting in cold and flu illness usually during seminars

Behavioural –some students may drink or smoke heavily, neglect exercise or proper nutrition, or overuse either the television or the computer.

Psychological –decrease the ability to work or interact with others, and be less able to make good decisions.

C. Signs Which Should Not Be Ignored

- Constant feeling of unable to work hard
- Feeling overwhelmed by the workload
- Inability to focus
- Feeling that even easy things have become difficult
- Fear of failure
- Feeling like they don't belong to a PhD program
- Physical or mental exhaustion

D. Stress Management

Many times even if we are under the influence of a stressful condition we fail to realize that we are reacting under stress. The body constantly tries to tell us through symptoms such as rapid palpitation, dizzy spells, tight muscles or various body aches that something is wrong. It is important to remain attentive to such symptoms and to learn to cope with the situations. Students should not load themselves greater than their capacity. They should think rationally while solving issues and they should feel free to express their feelings. Alcohol/cigarettes are short term remedies, students should avoid going behind them. Students should eat healthy food and exercise frequently to burn off stress. For the optimum functioning of the brain, a minimum of 7 hours sleep is essential. PhD students should have good set of friends with whom they can share their problems. The students should manage time effectively by appropriate planning. Financial problems should not become a hurdle for the research, they should plan their expenses.

II. LITERATURE REVIEW

Increased stress has been identified as a predictor of unhealthy behaviours, such as smoking, drinking, eating poorly, infrequent exercising, and obtaining inadequate amounts of sleep (Von Ah, Ebert, & Ngamvitroj, 2004). Hudd et al. (2000) found that students who are more stressed will more likely exercise infrequently and eat junk food, while less stressed students will have healthy habits, such as eating nutritious foods.

More stressed students were found to have lower self-esteem and less awareness of their health (Hudd, Dumlao, & Erdmann-Sager, 2000). There was also a correlation between stress and time management, with increased management skills leading to decreased stress levels (Misra & McKean, 2000).

Stress can affect a student's grades, health, and personal adjustment. Students perception with the immediate environment, their personal lives, and tasks confronting them serves to define, in a unique manner, people and events as potentially dangerous or relatively innocuous (Roberts & White, 1989). If stress is not dealt with effectively, feelings of loneliness and nervousness, as well as sleeplessness and excessive worrying may result (Wright, 1967).

If students experience stress as a challenge, it can be a positive aspect of learning (Roberts & White, 1989). Many experiences distress rather than challenge, which can lead students to feel threatened and helpless. Some students may be older and are starting PhD after working for several years. They find it more difficult to return to student status, especially when the teachers are the same age or younger than they are (Arnstein et al., 1999).

When students have financial troubles, their outlook on life may be dramatically affected. Many studies (Hodgson & Simoni, 1995; Arnstein et al., 1999 and Saunders & Balinsky, 1993) have found that financial problems during PhD study were strongly related to psychological distress. Financial constraints are a reality for almost all PhD students.

Having good social support from family and friends can help to alleviate some of the stress that students may be experiencing. Strong social support is associated with low to moderate effects on stressors (Nelson et. al, 2001). Sapp (1996) found in his study that for worry and anxiety, relaxation therapy was the most effective treatment for graduate student stress. Research has shown that "relaxation procedures are useful in reducing test anxiety in students" (Sapp, 1996, p. 83)

III. RESEARCH METHODOLOGY

Descriptive research is used in this study. A well- structured questionnaire is framed. Data is collected from the PhD students across various universities in India. Out of 300 questionnaires issued 260 filled in questionnaire were received. The data was analysed using tabulation and various suggestions on managing stress were provided.

IV. RESULTS AND DISCUSSION

TABLE I
STRESS SURVEY

S.No	Item	Often	Few Times A Week	Rarely
1	Anxious and Nervous	101	123	36
2	People around cause tension	118	121	21
3	Eat/drink/s moke	72	131	57
4	Cannot turn off thoughts in night	142	80	38
5	Difficult to concentrate	139	112	9
6	Less time to relax	113	141	6
7	Hard to relax	96	121	43
8	Many deadlines	18	142	100

The results of the stress survey reveal that most of the PhD scholars feel difficult to concentrate and do their work and they are not able to turn off their thoughts even during nights due to stress. They are tensed and nervous due to stress. They feel that they have less time to relax and even if they have time the work related thoughts prevent them from relaxing. And this is because they are under stress

TABLE 2
CAUSES OF STRESS-ACADEMIC

S.No	Item	No Stress	Minimum Stress	Average Stress	Maximum Stress
1	Course work	31	43	89	97
2	Presentation	22	88	74	76
3	Guide conflict	96	49	50	65
4	Library visit	114	96	26	14
5	Selecting thesis topic	22	16	82	140
6	Literature collection	4	6	89	161
7	Asking guide's	17	15	96	132

	help				
8	Part time	45	25	53	137
9	Complete research paper	0	0	77	183
10	Difficult to motivate	3	18	92	147

The results indicate that the PhD scholars are more stressed during the period when they are writing research papers. PhD scholars are stressed in choosing the topic for their research. The scholars are stressed when they are collecting literature relating to their topic. Part time scholars are facing more stress as they have to manage both work and research.

TABLE 3
PERSONAL CAUSES

S.No	Items	No Stress	Minimum Stress	Average Stress	Maximum Stress
1	Budgeting money	7	9	83	161
2	Lack decision making	17	14	96	133
3	Being alone	24	86	92	58
4	Shyness	5	32	96	127
5	Tension	14	40	64	142
6	Depressed	15	19	101	123
7	Fear of failure	20	21	106	113
8	Change in personal habits	8	12	96	144
9	Concern over physical health	12	30	97	121
10	Lack self confidence	9	18	101	132

The results show that the PhD students are mainly stressed due to the lack of financial aid. The work tension and change in personal habits are causing stress. Fear, shyness and lack of self-confidence are some of the causes that results in stress among PhD students.

TABLE 4 SOCIAL CAUSES

S.no	Title	No stress	Minimum stress	Average stress	Maximum stress
1	Friend death	10	47	123	90
2	Problems with friend	13	31	75	141
3	Meeting new people	83	72	90	15
4	Room mates	17	90	71	82
5	Maintaining Friendship	67	97	86	10
6	Lack of social activities	43	72	96	49
7	Alone	2	80	72	106
8	Discrimination	115	82	23	40
9	Hostel	16	29	73	142
10	Rules	5	153	70	32

The results reveal that PhD students staying in hostel are more stressed. Students who are alone and who are having problems with friends face stress.

TABLE 5

FAMILY CAUSES

S.no	Item	No stresses	Minimum stress	Average stress	Maximum stress
1	Health problem of a family member	10	47	123	90
2	Lack of phone calls/visits by family members	13	31	75	141
3	Family pressure for marriage	83	72	90	15
4	Feeling homesick	17	90	71	82
5	Parental separation /divorce	67	97	86	10
6	Death of a parent	3	12	96	149
7	Conflict with parents	2	80	72	106
8	Illness in my own children	115	82	23	40
9	Child care arrangements	16	29	73	142
10	Fear to meet family expectation	5	153	70	32

The results show that the students who have conflicts with their parents face more stress. The death of a parent acts as a cause for the student's stress. PhD scholars who are married face more stress due to the arrangements they have to make for childcare.

TABLE 6
STRESS MANAGEMENT

S.no	Items				
	Fun	Lots	Few	Occasional	Serious
1		42	132	58	28
	Exercise	Everyday	Alternate day	Once in a week	No
2		32	39	73	116
	Handle stress	Take action	Escape	Take a break	Don't believe in action
3		21	47	94	98
	Pressure	Buzz to perform	Relax and recharge	No let up	When bored

4		32	46	103	79
	Guide feedback	all times	Once in six months	Only when I do wrong	No feedback
5		26	89	123	22
	Atmosphere	Dynamic	Good	OK	Politics
6		35	76	56	93
	Help/suppose	Not afraid to ask help	Will not ask often	Ask under extreme situation	Helpless
7		45	78	93	44
	University environment	Fairly relaxed	Not always relaxed	Not particularly safe	Unsafe
8		81	112	60	27
	University role in stress management	Various initiative	Some formal mechanism	Poor mechanism	No mechanism
9		42	61	92	65
	Pride	Proud & guide recognises	Proud but no recognition	Don't feel proud	Guide undervalues skills
10		82	72	86	20

The results of stress management survey among PhD students show that many students don't take any effort in managing their stress. Most of them do not perform any exercise to reduce stress. They feel that there is no way to avoid pressure in their work. Many students think that the guide gives feedback only when they are doing something wrong. Many PhD students feel that there are lots of politics and backstabbing which acts as a barrier to discuss issues with other research scholars.

V. SUGGESTIONS

PhD students should learn to identify the symptoms of stress (getting irritable, tensed, neck pain etc) and control them as soon as they encounter stressful situation. There may be many blocks hindering the performance things may turn out different than we expect. But if we fix a goal and work towards achieving it there won't be any barriers.

Although stress can be reduced by talking with friends, exercising, and seeing a counselor, yoga can help to reduce stress as it promotes relaxation, which is the natural antonym of stress. People who do a little bit of yoga each day often find they're better able to handle things when life gets a little crazy. Laughter and laughter therapy allows students to look at a situation with a different perspective and this changed perspective can influence the amount of stress. Humour and laughter therapy lighten the burden and help students to connect with others

PhD students should start writing down every week-end what they have accomplished during the preceding week. This is very important as it motivates students. Sometimes in the middle of the week if they realize that they hadn't accomplished anything to be recorded at the end of the week and they would make sure that something is done. They give a satisfaction of seeing their

accomplished. During a Ph.D. you often try something and it doesn't work in the end. That can be frustrating but tracking what you have done helps to overcome this frustration. The path to success has unexpected twists and turns in a PhD and while a failed attempt looks like no progress it really is.

A best work is done when scholars work on a topic that they really care about. It is better to come up with own thesis topic rather than having supervisor finding a thesis topic. It will be easier to care deeply about a thesis topic that they came up with themselves. **Healthy** eating habits, exercise, taking breaks are really important. PhD researchers are highly driven people they find it difficult to switch off from academic work. Breaks are periods that help students to work more effectively in the long run. PhD students often complain about feeling isolated, which is not surprising given the number of hours spent facing a computer screen or conducting lab or field tasks which require steady concentration. So they should actively seek supportive people to surround themselves. PhD not only develops the research skills, but also the personal skills. The research process can test patience and determination, so the students should make effective strategies to manage themselves and their research. If the task is big then they should break them into manageable portions which in turn save time. If there are large volumes of books/journals to read then they should try reading review articles which gives an overview of the subject area. Devoting some time and effort to developing skills makes life much easier in the long run.

VI. CONSLUSION

Stress can be both positive and negative, which have an impact on the student's performance. If taken positively, the results are positive, and if taken in a negative way, may yield disastrous results. For most of the people, low to moderate amount of stress enable them to perform better. However, a high level of stress or for that matter even a low level stress spread over a long period, eventually takes its toll, and the performance declines. Though stress cannot be prevented, the PhD students should be smart enough to identify the symptoms of stress and practice the stress management techniques to cope up with stress and succeed in their research.

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Review On: Security Based On Speech Recognition Using MFCC Method

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Abstract

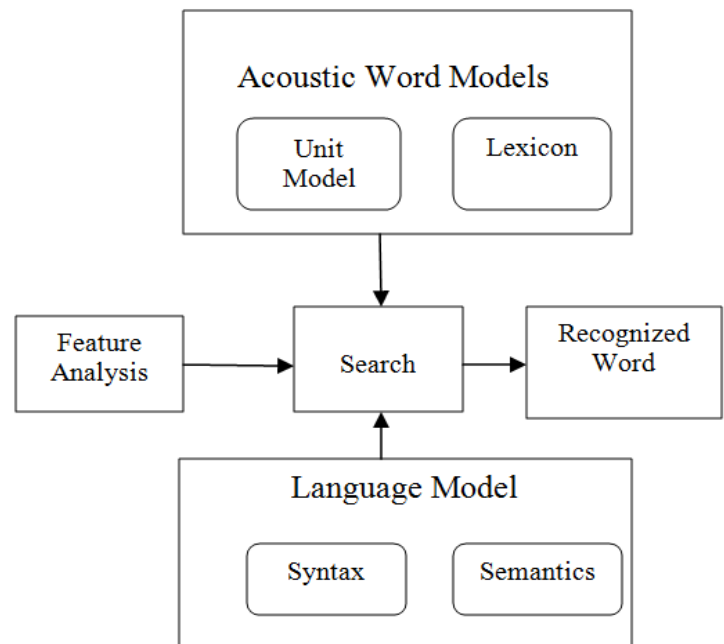
Speech is most, effective and natural medium to exchange the information among people. People are comfortable with speech, so that any person would also like to interact with computer via speech. Speech recognition basically means talking to a computer, having it recognize what we are saying and lastly, doing this in real time. The main goal of speech recognition technologies is to allow machine to, “hear”, “understand”, and “act upon” human spoken word. Speech recognition technology is used for security purpose. Security system means method by which something is secured through a system of interworking component and devices, that is protection from harm. There are many security system in IT realm like computer security, internet security, network security, information security. To prevent the information, the speech goes under the process of some software tools, provide useful and valuable service. In this paper we present review on security based on speech recognition using MFCC(Mel Frequency Cepstral coefficients) method.
Keywords: Acoustic Word Model, Feature Extraction, LPC, MFCC, Speech Recognition.

1. Introduction

Speech processing is one of the exciting areas of signal processing. The goal of speech recognition area is to developed technique and system to enable computer to act upon human voice. Speaker recognition methods can be divided into text-independent and text-dependent methods. In a text-independent system, speaker models capture characteristics of somebody’s speech which show up irrespective of what one is saying. In a text-dependent system, on the other hand, the recognition of the speaker’s identity is based on his or her speaking one or more specific phrases, like passwords, card numbers, PIN codes, etc.

1.1 Basic Speech Recognition System:

Figure (1) shows basic block diagram of speech recognition system. In speech recognition system the feature analysis module provides the acoustic feature vectors used to characterize the spectral properties of the time varying speech signal. The input to speech recognizer is in the form of a stream of amplitudes, sampled at about 16,000 times per second. But audio in this form is not useful for the recognizer. Hence, Fast-Fourier transformations are used to produce graphs of frequency components describing the sound heard for 1/100th of a second. Any sound is then identified by matching it to it closest entry in the database of such graphs, producing a number, called the “feature number” that describes the sound.



Figure(1): Basic Block Diagram Of Speech Recognition

In acoustic word model, the word level acoustic match module evaluates the similarity between the input feature vector sequence (corresponding to a portion of the input speech) and a set of acoustic word models for all words in the recognition task vocabulary to determine which words were most likely spoken. In unit model, Unit matching system provides likelihoods of a match of all sequences of speech recognition units to the input speech. These units may be phones, syllables or derivative units such as fenones and acoustic units. They may also be whole word units or units corresponding to group of 2 or more words. Each such unit is characterized by some HMM whose parameters are estimated through a training set of speech data. In lexicon, lexical decoding constraints the unit matching system to follow only those search paths sequences whose speech units are present in a word dictionary. In language model, language model to determine the most likely sequence of words. Language model contain syntax model and semantics model. Syntactic and semantic rules can be specified, either manually, based on task constraints, or with statistical models such as word and class N-gram probabilities. In syntax model, Apply a "grammar" so the speech recognizer knows what phonemes to expect. This further places constraints on the search sequence of unit matching system. A grammar could be anything from a context-free grammar to full-blown English. In semantics model, this is a task model, as different words sound differently as spoken by different persons. Also, background noises from microphone make the recognizer hear a different vector. Thus a probability analysis is done during recognition. A hypothesis is formed based on this analysis. A speech recognizer works by hypothesizing a number of different "states" at once. Each state contains a phoneme with a history of previous phonemes. The hypothesized state with the highest score is used as the final recognition result. In search, Search and recognition decisions are made by considering all likely word sequences and choosing the one with the best matching score as the recognized sentence.

1.2 Use of MFCC Method In Speech Recognition:

MFCC stands for Mel Frequency Cepstral Coefficient. The speech signal consists of tones with different frequencies. For each tone with an actual

Frequency, f , measured in Hz, a subjective pitch is measured on the 'Mel' scale. To capture the phonetically important characteristics of speech, signal is expressed in the Mel frequency scale. The Mel scale relates perceived frequency, or pitch, of a pure tone to its actual measured frequency. Humans are much better at discerning small changes in pitch at low frequencies than they are at high frequencies. Incorporating this scale makes our features match more closely what humans hear. The mel -frequency scale is a linear frequency spacing below 1000Hz and a logarithmic spacing above 1000Hz. As a reference point, the pitch of a 1kHz tone, 40dB above the perceptual hearing threshold, is defined as 1000 mels. In sound processing, the mel-frequency cepstrum (MFC) is a representation of the short-term power spectrum of a sound, based on a linear cosine transform of a log power spectrum on a nonlinear mel scale of frequency.

Mel-frequency cepstral coefficients (MFCCs) are coefficients that collectively make up an MFC. They are derived from a type of cepstral representation of the speech. The difference between the cepstrum and the mel-frequency cepstrum is that in the MFC, the frequency bands are equally spaced on the mel scale, which approximates the human auditory system's response more closely than the linearly-spaced frequency bands used in the normal cepstrum. This frequency warping can allow for better representation of sound.

2. Feature Extraction:

Feature extraction is the process that extracts a small amount of data from the voice signal that can later be used to represent each utterance Feature extraction involves analysis of speech signal. Broadly the feature extraction techniques are classified as temporal analysis and spectral analysis technique. In temporal analysis the speech waveform itself is used for analysis. In spectral analysis spectral representation of speech signal is used for analysis. There are different method used for feature extraction, such as Linear Prediction Coding(LPC), Mel-Frequency Cepstrum Coefficients(MFCC), and others.

2.1 Linear Prediction Coding(LPC):

One of the most powerful signal analysis techniques is the method of linear prediction. LPC of speech has

become the predominant technique for estimating the basic parameters of speech. It provides both an accurate estimate of the speech parameters and it is also an efficient computational model of speech. The basic idea behind LPC is that a speech sample can be approximated as a linear combination of past speech samples. Through minimizing the sum of squared differences (over a finite interval) between the actual speech samples and predicted values, a unique set of parameters or predictor coefficients can be determined. These coefficients form the basis for LPC of speech. The analysis provides the capability for computing the linear prediction model of speech over time. The predictor coefficients are therefore transformed to a more robust set of parameters known as cepstral coefficients. As human voice is nonlinear in nature, Linear Predictive Codes are not a good choice for speech estimation.

2.2 Mel Frequency Cepstral coefficients(MFCC):

MFCC method is best and more popular used for feature extraction in speech recognition. In MFCC method, the drawbacks present in LPC Method is reduced. MFCCs being considered as frequency domain features are much more accurate than time domain features. Mel-Frequency Cepstral Coefficients (MFCC) is a representation of the real cepstral of a windowed short-time signal derived from the Fast Fourier Transform (FFT) of that signal. Figure(2) shows Steps involved in MFCC feature extraction. MFCC consists of seven computational steps:

Step 1: The Speech Input:

The speech input is recorded at a sampling rate higher than 10kHz. This Sampling Frequency is chosen to minimize the effects of aliasing in the analog-to-digital conversion process.

Step 2: Framing:

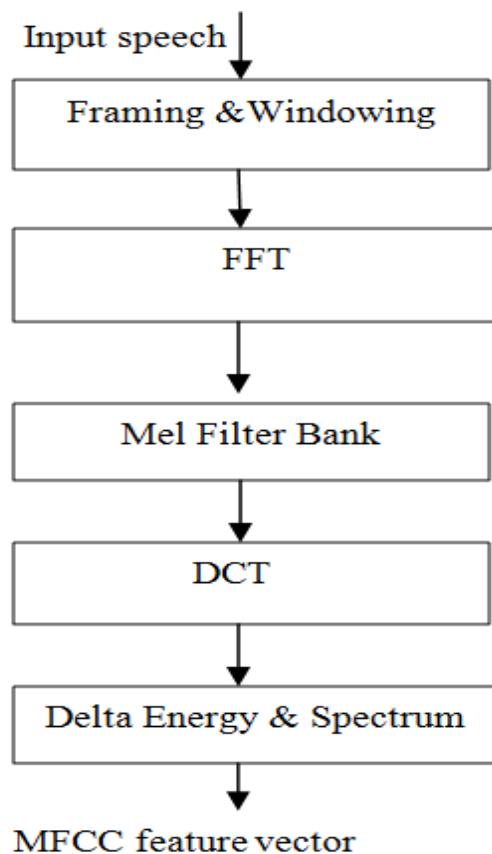
Speech samples obtained from analog to digital conversion (ADC) are segmented into a small frame with the length within the range of 20 to 40 msec.

Step 3: Hamming windowing:

The windowing process is the act of multiplying N sample of the signal by a window defined as,

$$h_n = h_{nw}(n) \dots \dots \dots (1)$$

$$n \in \{0, 1, \dots, N-1\}$$



Figure(2): Steps Involved in MFCC Method

The Hamming window is by far the most popular window used in speech processing. Equation (2) presents the N-point Hamming window,

$$w(n) = 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right) \dots \dots \dots (2)$$

N-Sample period of a frame

Hamming window is used as window shape by considering the next block in feature extraction processing chain and integrates all the closest frequency lines. Hamming window is applied to minimize the discontinuities of a signal.

Step 4: Fast Fourier Transform:

The next step in the processing of the speech data to be able to compute its spectral features is to take a Discrete Fourier Transform of the windowed data. This is done using the FFT algorithm. Each frame of

N samples was converted from time domain into frequency domain. The Fourier Transform is used to convert the convolution of the glottal pulse and the vocal tract impulse response in the time domain into frequency domain.

Step 5: Mel Filter Bank Processing

The human auditory perception is based on a scale which is somewhat linear up to the frequency of 1000 Hz and then becomes close to logarithmic for the higher frequencies. This was the motivation for the definition of Pitch in the Mel-scale. Mel filter-bank to model the auditory system. The frequencies range in FFT spectrum is very wide and voice signal does not follow the linear scale. The bank of filters according to Mel scale is then performed. One approach to simulating the subjective spectrum is to use a filter bank, one filter for each desired mel frequency component. The filter bank has a triangular bandpass frequency response, and the spacing as well as the bandwidth is determined by a constant mel-frequency interval.

Step 6: Discrete Cosine Transform

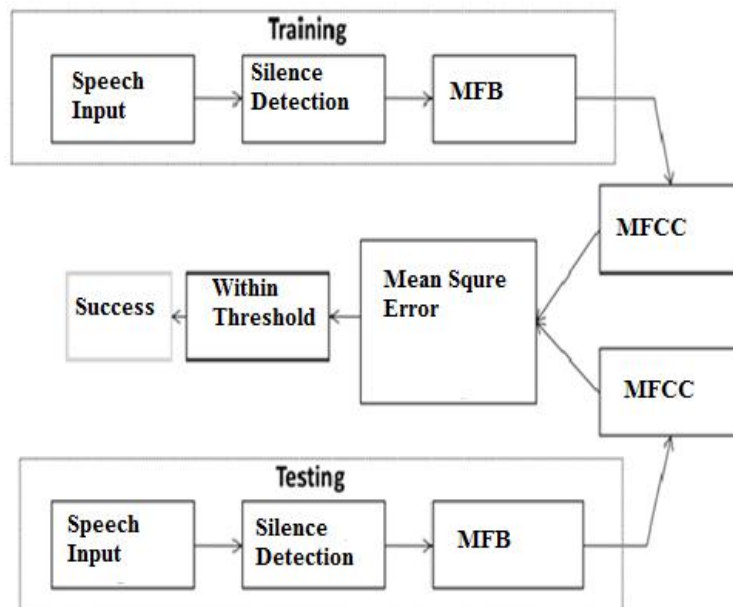
Converting the log Mel spectrum into time domain using Discrete Cosine Transform(DCT).The result of the conversion is called Mel Frequency Cepstrum Coefficient.

Step 7: Delta Energy and Delta Spectrum

The voice signal and the frames changes over time, such as the slope of a formant at its transitions. Therefore, there is a need to add features related to the change in cepstral. By applying the procedure, for each speech frame of about 30 ms with overlap, a set of mel-frequency cepstrum coefficients is computed. This set of coefficients is called an acoustic vector. These acoustic vectors can be used to represent and recognize the voice characteristic of the speaker. Therefore each input utterance is transformed into a sequence of acoustic vectors.

3. Proposed System

The analysis of various feature extraction techniques signifies the MFCC in regards of the efficient speech recognition system. The implementation is speech recognition system with single utterance. In the experimentation, the results are analyzed for the single utterance in MATLAB environment. Figure (3) show block diagram for speech recognition system with single utterance.



Figure(3) Speech Recognition System With Single Utterance

Following steps involved in block diagram:

Step 1 : Recording of input speech during training phase:

The speech input is typically recorded with a microphone at a sampling rate above 10000 Hz. This sampling frequency was chosen to minimize the effects of aliasing in the analog to digital conversion.

Step 2: Silence Detection:

Silence detection will remove the non-speech segments from the utterance for the faithful processing of the speech recognition system.

Step 3: Mel Filter Bank:

Mel filter banks the Mel frequency cepstral coefficients vector with certain dimension will be obtained during the training and testing sessions.

Step 4:Mean Square Error:

If the mean square error is well below the threshold then the success will be asserted.

Step 5 : Testing Phase:

During the testing phase the same word is uttered with approximate same energy. The uttered signal is compared with the one which was uttered during the training phase. The mean square error is determined between the two signals. If the mean square error is within the threshold determined by the user the word is said to be detected and the ‘Access granted’ signal is displayed in the command window and ‘thank you’ audio file will be played in the background. A user can save important data in a folder, the name of folder is “LOCKER”. When access granted then a folder is open .So that, only user can open the folder. when third person try to open the folder then the mean square is not below the threshold the ‘Access Denied’ signal is displayed in the command window and the ‘Try again’ wave file is played in the background. the window will be closed.

4. Performance Parameter Evolution

The comparison between different speech recognition systems are based on: Mean Square Error (MSE), Recognition accuracy and Power Spectral density resolution.

4.1 Mean Square Error (MSE) :

It is defined as the square of error between training input speech & testing input speech signal. The distortion in the speech signal can be measured using MSE. The error is the amount by which the value implied by the estimator differs from the quantity to be estimated. It is calculated as follows:

$$MSC = \frac{1}{2} \sum_{n=0}^{\infty} [y(n) - x(n)]^2$$

where, x(n) : training input speech signal value and

y (n) : testing input speech signal value

4.2 Recognition Accuracy :

It is a measure used in science and engineering that compares the level of a desired signal to the level of false signal. It is defined as the ratio of number of correctly recognized words to the total number of words uttered

$$\text{Recognition Accuracy} = a(n) \div b(n)$$

where, a(n) : Correctly Recognized utterances

b(n) : total number of utterances

4.3 Time and Frequency Resolution of PSD :

The degree to which the finer details of the power spectrum can be achieved is usually measured in terms of the frequency and time resolution. The resolution always boosts importance of analysis in the speech recognition technique. It allows us to highlighting the energy content of the utterances according to time and frequency scale.

4.4 Testing

MATLAB is a numerical computing environment and fourth generation programming language created by Math Works. One of the reasons for selecting MATLAB is to fit perfectly in the necessities of an speech processing research due to its inherent characteristics and helpful to solve problems with matrix and vector formulations.

5. Conclusion

It is concluded that the proposed research uses the technique of MFCC to extract unique and reliable human voice feature pitch in the form of Mel frequency. Because we have discussed LPC and MFCC extraction method. LPC parameter is not so acceptable because of its linear computation nature. As human voice is nonlinear in nature, LPC are not a good choice for speech estimation. MFCC is derived on the concept of logarithmically spaced filter bank, clubbed with the concept of human auditory system and hence had the better response. So we get more & more security based on speech recognition using MFCC method.

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An Approach for Representing Knowledge in Natural Language Processing

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Abstract

Natural Language Processing is the process of providing interaction between computer and human in linguistic concerns. Knowledge Representation is designing computer systems to perform tasks that would normally require human intelligence. Both of these belong to the fields of Computer Science, Artificial Intelligence which can bring forth the knowledge and make it explicit. This can lead to develop Expert Systems with human like intelligence like Question-Answering, Automated Reasoning, Machine Translation systems that can work on natural language. Expert systems are used for decision making ability based on stored facts. Expert systems are a kind of knowledge based systems that are dependent on inference rules. Inference rules are modelled with either First Order Logic or Propositional Logic, which can perform forward and backward chaining for deriving reason of any given query based on stored or existential facts. These existential facts are real facts or knowledge for the system and this is an approach for acquiring and representing knowledge from real-time feed.

Keywords—Artificial Intelligence, Natural Language Processing, Information Extraction, Knowledge Representation.

1. Introduction

With Watson [1], the world has seen how a computer system is able to compete at human in real-time. The advancement of a computer system to such an extent is made possible with the IBM research project DeepQA [2]. It is a software architecture that performs deep content and evidence based analysis for a question posed in natural language. To perform such a task, it needs most advanced natural language processing, semantic analysis, information retrieval, automated reasoning through machine learning. For such kind of content analysis it uses a software framework called Unstructured Information Management Architecture also called as Apache UIMA [3]. It is the only industrial software framework used to perform content analysis over large volumes of structured and unstructured data to find required knowledge. This works on different

levels of components and its interfaces through an analytical pipeline, finding the relevant design patterns, organizing them in memory and convert them into structured data, so that the answer can be generated by building hypothesis based on resources.

Text Mining and Information Extraction are the major tasks performed by this architecture. Text Mining is a process of performing search, index, labelling, etc. Information Extraction is a task of extracting structural, semi-structural, unstructured, machine readable data from the documents. Most of the cases, these documents are presented in natural languages that are human readable context. Extracting information from the documents that are in natural language is challenging. Such task can be accomplished using Natural Language Processing.

The greatest challenge in the history of computer machinery and intelligence is Turing Test. It is proposed by Alan Turing in which a machine is said to be intelligent when it is able to answer the questions posed in natural language with limited available resources without aid. This test has many controversies and the research is always performed to produce, intelligent machine with specific kinds of purpose and limitations. The intelligence that is aimed to accomplish for machines or computers is called as Artificial Intelligence. Artificial Intelligence is defined as the designing of intelligent agents that take rational decision just like humans. It includes learning, planning, knowledge, reasoning, communication as human perspective, but according to machine approaches it deals with problem solving methods, machine learning, knowledge representation, decision making, etc.

UIMA is one good industrial standard that exists for logistic analysis system software. There are other frameworks like General Architecture for Text Engineering (GATE) and Natural Language Processing Toolkit (NLTK) at present. GATE is developed to perform wide range of natural language tasks, information extraction with the help of the Java programming language which is widely used by the scientific community as well as in academics for

better approached in their tasks. NLTK is a suite of libraries and programs that contain statistically based approaches using Python programming language. With the help of NLTK the process of text mining, information retrieval, etc., can be achieved.

Computers are essential tools for humans to deal with existing information but limited in its capabilities. Most of the information is stored in the form of documents either offline or online. Those are real facts which are in the natural language format, which are to be interpreted to extract knowledge. For that we need to perform a lot of operations at extremely high speed, which may need approaching a lot of space like terabytes. Most of the information exists on internet which continues to increase for each day. The internet is a service provided for the exchange of services throughout the world. Internet as an infrastructure provides website hosting, file transfer, electronic mail, etc. Website hosting deals with website that belong to government, academic, industrial, social networking, blogging, shopping, etc, that provides information regarding that organization. Electronic mail is for the purpose of communication in the form of digital medium through some domain services. File transfer refers to transmitting files over a network. Fundamentally, all these kind of services work or function using some communication protocols for sending, receiving, navigating, retaining, exchanging information over a digital medium. These websites are developed using programming languages that make the plain text to appear on the user's display terminal or web browsers. There is some kind of formatted instructions or syntax that is interpreted by a computer so that any user can be able to get the required content.

From Fig.1, interpretation of data, information,

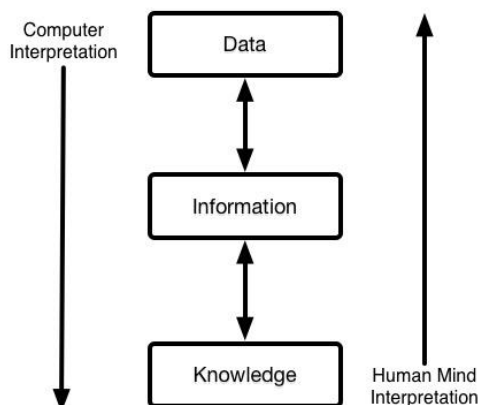


Fig.1: Interpretation of Data-Information-Knowledge

knowledge by a computer and human mind is understandable. These are closely related by slightest changes in their roles or their occurrences. Data is a set of values that can be either quantitative or qualitative type of individuals that collectively claims as information. For example, "0" and "1" are used to represent data for a computer at a low level to store and manipulate. While program execution, it is interpreted as instructions. Then information, which can be derived either from data or using knowledge which depends on the circumstances. Information resolves uncertainty of an event in any moment of time, sometimes it stands as a cause of communication. In modern era information, transforming into knowledge is a critical thing, for this purpose information is captured, generated, processed, transmitted, presented, stored. For any question posed in natural language information is the solution that exists. Information resolves uncertainty, sometimes information is stored as records for evidence, as semiotics in terms of signs. Knowledge can be referred as an implicit understanding of the theory or explicit way of dealing with facts, skills, which can be more or less formal or systematic.

2. Related Work

Computers are considered as a convergence point of data, information and knowledge. Information system are those composed of people and the computers that process or interprets information which are helpful in almost all domains. Data acts as bridge between hardware and people. For specific reasons programs are allowed to-do machine-readable instructions on hardware of system to produce useful information from data, which is called as Software. For the development of such information system need to have a strong fundamentals to be laid to deal with all kinds of data, that is why information systems are modelled depending on kind of data that system. There are three kinds of data, they are:

- **Structured Data**—which deals with organising and relating data elements between one another. It is also called as Data Model, which explicitly determines the structure of data. These kind of data are managed through programming languages designed specifically for performing all kind of operations on it.
- **Semi-Structured Data**—a self-describing structure with tag as separator between elements and represent ordered records and within data.

- **Unstructured Data**—source that does not have pre-defined data model, typically text-heavy and contain ambiguities which cant be dealt with traditional programs.

Dealing with large amounts of structured and unstructured data is an important task of Information System. The structural integration and manipulation aspects of the data stored are described by data structure. From [4], most of the existing systems are build using only structure data and others with either semi-structured data or unstructured data. Fundamentally a structured data is built by using data model, these implicitly use metadata. Metadata is defined as ‘data about data’, these are of two type: structural and descriptive. The data that deals with the containers of data is called Structural Metadata where the data content or individual instances of content is called Descriptive Metadata. With the help of such metadata organize electronic resources, discovery of relevant information. Metadata registry or repository is a database, where storing, manipulation of metadata is performed.

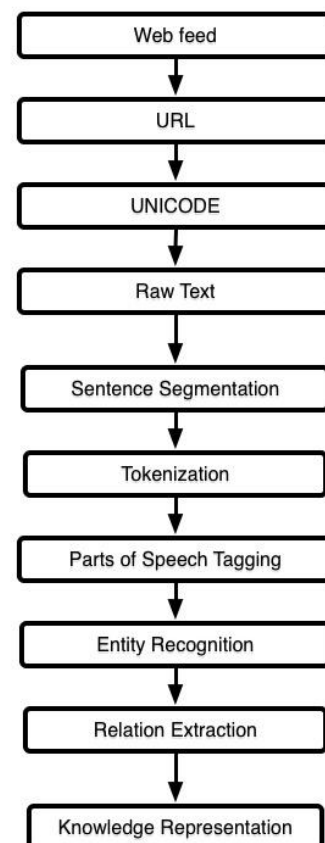
From [5], metadata is in the form of tag. A Tag is a non-hierarchical keyword assigned to a piece of information. It helps to describe an item and allows itself to find while browsing or searching. These are popular in websites and are generally chosen informally and personally by viewer depending on system. Tag play an important role in exploring records with the use of keywords in computer based search. Tagging gained popularity with the increase of social networking, bookmarking, photo sharing , etc. Using tags in system, an item can be classified in many ways with no wrong choice, instead one item belong to one category can have other tags too. Combined structural hierarchal or flat tagging can help in retrieval of information. There are some special kind of tags, they are: Triple Tags, Hashtags, knowledge tags. Triple Tags or Machine tag are special type which uses semantic information about the tag, which makes it easier or meaningful for interpretation by a computer program. Microformat is one kind of metadata that allows to add data on-page in a way users cannot see but computers can readily access. Metadata of webpages are added to search engines. Hashtags is a kind of metadata tag prefix #, sometimes known as “hash” symbol, largely used in microblogging, social networking services. Knowledge tag is of type that defines information source. These capture knowledge in the form of descriptions,

Fig.2: Approach for Representing Knowledge

categories, classification, semantics, annotations, references that are collected in tag profile.

3. Proposed Work

Computing with natural language is not that easy, to do such kind, the approach has been a tough because computers can't think or act like humans. Natural languages are great source of knowledge as of humans because it contain meaning, context, background knowledge and that is why it plays a major role in communication. From [6], anticipating natural language is possible with their semantics. The semantics of natural language are its words, phrases(noun, verb) and their grammatical syntax. Most of the natural languages are based on the grammar, which organize words into sentences. The basic structure of sentence is determined by the position of the word, which is again dependent on the parts of speech. For example, in english language basic part of sentence is Subject, Object and Verb. Subject is usually noun phrase i.e. either a noun combined with a determinant or predicate. Object receives the action of verb, Verb tells what subject does. The primitives of english language are words,



collectively makes a sentence and set of sentences make a paragraph, information is to be extracted from those paragraphs using Natural Language Processing. Prior to language semantics, dealing with wide range of documents or accessing text is important.

From [7-9], knowledge representation in natural language processing can be defined as extracting useful information from natural language by using mathematical techniques and represent the knowledge. As illustrated in Fig.2 the process of representing knowledge from web feed to knowledge representation is followed by a pipeline and is explained below in detail:

- **Web feed:** The option for which kind of knowledge to be acquired by selected feed among the RSS feed of real-time. The feed of choice contains URL, title, timestamp or published time of article which are to be extracted and saved for further use.

- **URL:** It is an acronym for Uniform Resource Locator which contain protocol type and resource name. Most of time those protocol is HTTP and resource name is a web page i.e. HTML page. Through the type of protocol the web page is acquired and further processed.

- **UNICODE:** From [12], it is clear about how to manipulate strings that are acquired from web. With the help of UNICODE each and every character sequences are processed in which web page containing markup tags, empty space are removed.

- **Raw Text:** To derive only content that is important for natural language processing, removing of unnecessary code by slicing the above and below of content and cleaning that content from unwanted tags if in case leads to raw text. In this raw text, word level operations of spelling corrections, space handling between symbols are performed with respect to Word-Net [10].

- **Sentence Segmentation:** In this phase huge amount of string type is segmented by using “.”(full stop) as delimiter. Before that strings are normalized by lowering and splitting the content by delimiter.

- **Tokenization:** Words are considered as tokens and from each segmented sentence, words are segmented by using space as delimiter.

- **Parts of Speech Tagging:** The process of tagging tokens depending on their parts of speech or their position of occurrence in a sentence. Most

of the words can be observed in [10,11], with that parts of speech tagging is performed without errors.

- **Entity Recognition:** This is a sub-process of information extraction where identification, classification and exemption of elements i.e. based on parts of speech. Chunking and Chinking are techniques in which each selected or defined grammar of segmented sentences with multi token sequences are parsed is a chunk and those which are exempted are chink. This is done depending on specific type of requirement or application

- **Relation Extraction:** With the identification of entities in place extracting relations that exist between them is easy. For english language basic structure of sentence is subject, verb and object are dominant sequences that relation is to be extracted for each sentence or extracting the relative noun phrase with its verb phrase is possible.

- **Knowledge Representation:** The relations that are extracted are represented with its individual parts of relationships either in the form of noun-verb phrase or in subject-verb-object form. By seeing in such an abstract manner it can be easy to understand depending on relationships for computers and can be utilized further.

With the extraction of semantic relationship of natural language and representing it with their respective relations for any given document which can be either from web or any other format like electronic books, ms word, pdf. In the above pipeline it is very important to handle with unicode [12] in digital medium. With [13,14] care taken on unicode it is easy to deal with any kind of character occurrences while processing raw text from internet to information extraction.

4. Conclusion

Finally the extraction of knowledge from unstructured data is one good way to deliver the semantic relationships exist in any given input. This method can be integrated to information extraction systems like search engines to search over the internet. Most search engines, searches data based on metadata and indexing, which always show the matched text results from ranking based algorithm. These search engines does not work on information exploring, which should be like domain independent and they don't even understand the contextual meaning that lie in the query. Exploratory search is a method followed in problem solving techniques of artificial intelligence, in which the resources are

consequently explored on a wide range (but not domain independent) of specific tasks. By integrating this type of search, there will be increase in accuracy of user search based on the contextual understanding terms that closely leads to exploratory search. In this we perform knowledge extraction from information but unable to deal with word sense disambiguation and building a graphical representation for entities based upon their relationships can be supplied as knowledge base containing facts of entities for expert systems can be the future work.

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A STUDY ON YASHODA HOSPITAL WITH REFERENCE TO EMPLOYEES SATISFACTION

KU.Rameshkumar

INTRODUCTION

The demand for healthcare services in India has grown from \$ 4.8 billion in 1991 to \$ 22.8 billion in 2001-02, indicating a compounded annual growth rate of 16 per cent. The health care industry accounted for 5.2 per cent of India's GDP in 2002, and this figure could reach \$ 47 billion or 6.2 - 7.5 per cent of GDP by 2012. The Indian middle class, with its increasing purchasing power, is more willing than ever before to pay more for quality healthcare. The supply of healthcare services has grown steadily, as the private sector becomes more involved in owning and running hospitals.

Healthcare industry in developing world is all set to grow exponentially and India with its inherent qualities can become the global hub for healthcare services. It is being touted as the next big boom and the sector is expected to grow rapidly over the next decade, to reach a level of Rs.3200 billion by 2012, largely spurred by an increased corporate presence in the sector.

The need of the hour is to equip us in terms of "Manpower supply" and "Retention of existing Manpower" and this demands the Hospital management to make their employees comfort and to keep them satisfied. This study is an attempt to measure the employees satisfaction level of Yashoda Hospital, Secunderabad.

Research scholar in bharathiar university, coimbatore

PROFILE

Yashoda Super Specialty Hospital, situated in Secunderabad, Malakpet and SomajiGuda, are one of the pioneer corporate health care hospitals in the state of Andhra Pradesh. Since its inception, Yashoda hospital has been in the forefront in offering International standard corporate health care facilities. As leaders in super specialty healthcare in the state of Andhra Pradesh, Yashoda group is the only corporate hospital to have over 1000 beds capacity. The hospital being located is in short distances away from Airport and Railway stations making accessibility very easy and convenient.

The hospital has expert and renowned doctors, state of the art medical infrastructure which includes the advanced Linear Accelerator, IMRT, Cath Lab, MRI, CT Scan, Color Doppler, Ultrasound and other diagnostic services with fully equipped labs. All these combine to provide round the clock prompt and accurate treatment.

As a leading healthcare provider, the hospital provides patients with the latest technological innovations for diagnosis and treatment of the most acute clinical conditions. The hospital admits and provides healthcare services to over 5 lakhs patients each year. This is made possible by the compassionate care and expertise of doctors providing the "Healing Touch" to the patient.

The Hospital has 3000 trained staff including nurses; full time doctors and support staff to provide round the clock personalized attention and care leading to faster recovery of patient. The hospital has been recognized as one of the premier healthcare institution in India and abroad.

SPECIALITIES & SERVICES

Neonatology

Pediatric surgery

Pulmonology

Dermatology

Cosmetic & plastic surgery

Radiology & imaging sciences
Anesthesiology
Operation theatres
Cardiology and cardio-thoracic surgery
Cath lab
Pediatric cardiology
Cardiothoracic surgery
Neurology & Neurosurgery
Nephrology and urology
Center for organ transplant
Dialysis unit
General medicine
General surgery
Orthopaedics
Ear, nose and throat
Gastroenterology
Pediatrics

AIM

The study aims to identify the level of 'Satisfaction of employees of Yashoda Hospital, Secunderabad'. It also attempts to know whether the satisfaction level of Clinical and Non-clinical group is same or not.

OBJECTIVES

- 1) To identify the level of 'Employees Satisfaction of Yashoda Hospital, Secunderabad',
- 2) To develop a comprehensive scale measuring various level of Employees satisfaction in each criteria as well as overall satisfaction
- 3) To find out the influence of the nature of job i.e Clinical and Non-clinical on satisfaction level of employees

HYPOTHESIS

- a) There is no difference in the level of employees satisfaction between Clinical and Non-clinical staffs.
- b) The Employees satisfaction level is high (The score is more than 200)

SAMPLING

The number of laboratory Employees working in different department of Yashoda Hospital is around 700. The population or universe of the study is Seven hundred. Sample consists of Fifty samples from both Clinical and Non-clinical staffs respectively were randomly selected.

The Clinical Staff includes Doctors, Duty Medical Officers, Casualty Medical Officers, Consultants, Specialists, Nurses, Laboratory technicians, Operation Theatre staffs and Radiology department staffs. The Non-clinical staff includes Senior Management staffs, General Managers, Managers, Supervisors, Incharges, Patient Relation Executives, Billing staffs, Front office Executives, Typist and Office Assistants

RESEARCH DESIGN

The researcher has selected the "Ex post - facto" research design which is considered suitable *for* the present study. The main characteristics of the "Ex post-facto" method is that the researcher has no control over the variable and can only report what has happened or what is happening? The "Ex post - facto" method is used *for* descriptive studies by means of which the researcher seeks to measure the variables.

TOOL USED

The researcher has developed a Questionnaire, which consists of fifteen parts. Each part is constructed aiming to find the level of satisfaction of employee based on different criteria, which contribute to employees satisfaction. The items in the tool were selected after a brief discussion with the laboratory technicians. This has greatly helped the investigator to identify various factors leading to laboratory hazards. The scale consists of 15 dimensions.

Commitment
Communication
Customer service
Decision-making



Employee development
Job content & Design
Leadership
Pay
Performance
Performance Appraisal
Safety at Workplace
Team work
Training
Benefits
Other open questions

The scale having the "Response" category as follows

SA- Strongly Agree-5

A - Agree-4

UD - Undecided -3

DA - Disagree- 2

SDA- Strongly Disagree – 1

SCORING METHOD

The score of each criteria / dimension is the summation of the score for all items in that particular criteria / dimension. A total score in the scale indicates the level of Employees satisfaction perceived by the employees of Yashoda Hospital, Secunderabad. The scale is given with direction, which helps respondents to give their responses accordingly. The respondents have given direction to tick the appropriate column. This tool consists of fifteen parts with closed type questions. The researcher has administered the questionnaire to the employees including both Clinical and Non-clinical staff and clarification is given to the respondents whenever required. The collected data from the 100 samples were subjected to statistical analysis - Percentage Analysis, Mean, Standard Deviation, Correlation co-efficient, Factor Analysis.

CONCLUSIONS

As the healthcare industry is expanding at tremendous pace, it is the need of the hour is to equip us to cater to the enhancing demand of healthcare workers in near future. It is easy to retain and strengthen the existing Manpower rather to create or search for new people. In order to retain the existing Manpower it is essential to keep their Morale high and keep them satisfied. Hyderabad is in the process of becoming the second big city of India next to New Delhi and many new hospitals are cropping in and around of hospital leading to high demand of Manpower of healthcare workers. Being a leader of Hyderabad private hospital market, Yashoda Hospital will face acute shortage of manpower. The researcher has to measure the level of satisfaction of their employees and to retain them to keep encouraging.

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Surgical management of traumatic crop fistula in a hen

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Abstract: A case of traumatic crop fistula in a one year old hen and its successful surgical management has been reported.

Keywords: crop fistula, traumatic, hen

A crop (ingluvies) is a large thin-walled diverticulum, which can store food for a short period of time and in chicken, it is displaced towards the right side of the median plane in front of the furcula on the pectoralis muscle (Greenacre and Morishita, 2014). Crop fistulation mostly results from scalding by food given at high temperatures (Coles, 2008). The present case describes the management of traumatic crop fistulation in a hen.

History and clinical observations

A one year old hen was presented to the college hospital with traumatic injury by an iron rod leading to draining of food grains through open wound on lower cervical oesophageal region. On physical examination, deep cut wound at right cervical region was observed with two openings through and through (Fig. 1) and with pectoralis muscle tear. It was diagnosed as a case of crop fistula and decided for surgical repair.

Treatment and discussion

The hen was anaesthetized with inj. Ketamine hydrochloride (40mg/kg) and inj. Diazepam (1mg/kg). After achieving stable anaesthesia, feathers were plucked manually around the site of wound. The area was thoroughly cleaned with povidone iodine, irrigated with normal saline and prepared for aseptic surgery. Wounded crop was

prepared for reconstruction. Skin between both the openings was incised. Crop was located and demarcated by passing a tube through the mouth. The crop wound was sutured using catgut 2-0 in cushions pattern (Fig. 2). Muscle and skin were closed routinely. Postoperatively, cephalixin @50mg/kg, carprofen @ 4mg/kg, multivitamin (Capsitas) were administered for 5 days and the surgical wound was dressed and bandaged on alternate days till the removal of sutures.

The necrotic debris on wound edges should be cleared of to differentiate crop wall and skin. Further placement of crop tube in place during suturing facilitates visual differentiation of crop mucosa from skin (Coles, 2008). Basha *et al.* (2010) described the surgical management of traumatic wounds on crop in pigeons and also reported that foreign body penetration of the crop wall to be one of the primary non-infectious lesions of the crop, which was observed in the present case. The owner was advised to maintain the hen on soft diet resulted in uneventful recovery and no recurrence was

reported in the follow up period of 3 months.

Summary

A case of surgical management of traumatic crop fistulation has been reported and discussed.

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Fig. 1 Through and through opening of crop wound

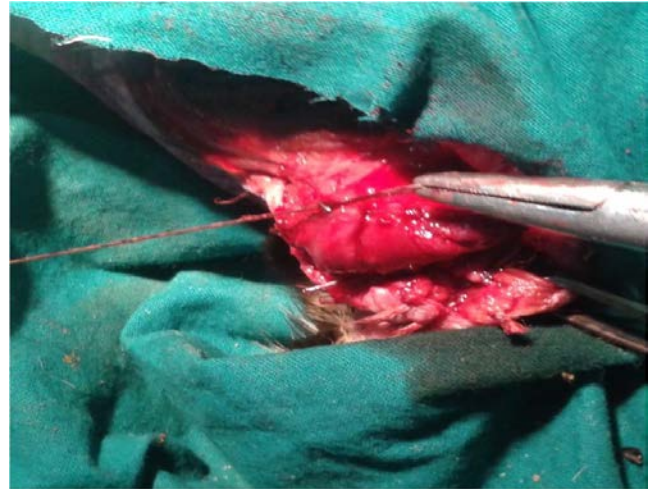


Fig. 2 Photograph showing closing of crop fistula in cushings suture pattern



On the Multiplication of Identical Numbers to Summation of its Lagged Multiplicands

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Abstract

Multiplication of Identical Numbers (MIN) was considered to determine the model that performs better to ease the complicated concept of multiplication. Properties of multiplication were examined with core interest on identity, commutative and distributive laws of identical numbers with any length of numbers. The distributive law was not as beneficial to the development of the general model as summation of corresponding lagged multiplicand along with multiplicative identity whereas it was invaluable when combined with identity and commutative laws in formulating specific models for digits two (2) to nine (9). Bearing in mind the laborious task involved in multiplication process of any long length of numbers with identical numbers, an algorithm was developed with JAVA programming language for MIN model to enhance better performance than calculator or Excel package. Results of MIN model were displayed completely without approximation involving exponent compared to results of calculator or Excel package. Therefore MIN model is found to be preferred.

Keywords: *Multiplication; Summation; Lag; Identical numbers, MIN Model.*



1. Introduction

Multiplication is one of the mathematical operations in elementary arithmetic (others being addition, subtraction and division) often denoted by cross symbol "x" of scaling one number or variable by another (Fine, 1907; Merzbach, 1991). This cross symbol "x" introduced by William Oughtred in seventeenth century also known as St. Andrew's cross or dimension sign or into sign (Cajori, 1919; Stallings, 2000) while the middle dot (.) is commonly connotated with more advanced or scientific use for multiplication internationally (Browell, 1939; Julius, 2013).

The multiplication of any number or variable and the identity value give the same number or variable as the result. The number "one" (1) is the identity property of multiplication called multiplicative identity (Peano axioms) (White head and Russel, 1913). Other properties of multiplication include commutative, associative and distributive.

The ability to multiply any number or variable with one (1) and still retains its identity prompted this study in relation to identical numbers in multiplication processes and the formulation of a model for the procedures.

2. Multiplication of Identical Numbers

One (1) as a multiplicative identity is an element of natural numbers (N) otherwise called counting numbers. However, one (1) may be replicated to form other elements of the natural numbers such as 11, 111, 1111, ... that are identical in nature (property wise) and other elements of the natural numbers can be replicated to form identical numbers include digits two (2) to nine (9).

Cutler and Trachtenberg (1960), Benjamin and Shermer (2006), Sawyer (2006) extended multiplicative identity of one (1) on eleven (11) to multiply by any length of numbers (multiplicand) starting with the first and last digits (they remain the same except

where carrying of number is applicable to be added to the next first digit) inserting the sums of adjacent pairs of digits sequentially in between (Appendices 1 and 2).

Further study of distributive property of multiplication [$a(b+c) = ab + ac$] into the study of Cutler and Trachtenberg (1960) decomposed eleven (11) as ten (10) plus one (1) (that is, $11 = 10 + 1$) reflecting the multiplication of any length of numbers by ten (10) and one (1) as transferring of zero (0) to the number multiplied by ten (10) while multiplicative identity for one (1) still holds and the resulting summation remains unchanged when compared with multiplication of eleven (11) (Jason, 2010) (Appendix 3).

The combination of identity, commutative and distributive properties of multiplication in determining the results for multiplication of identical numbers as to relating digits one (1) to nine (9) will be useful in achieving an understandable model for this study.

Multiplication of any length of numbers by identical numbers of digit one (1) reflected distributive and identity properties of multiplication (Appendix 4) (Jason, 2010) while multiplicative identity extended for eleven (11) only (Cutler and Trachtenberg, 1960; Benjamin and Shermer, 2006; Sawyer, 2006). However, multiplication of identical numbers of digits two (2) to nine (9) involves identity, commutative and distributive laws of multiplication (Appendix5). This enhances effective results for multiplication of identical numbers between digits one (1) to nine (9) which can be extended to any length of numbers as replicated independent digits of one (1) to nine (9) are stochastically identical (Table 1).

3. General Presentation of the MIN Model

The MIN model is to ease the processes of multiplication involving identical numbers from digits one (1) to nine (9). It is therefore necessary to have first a pertinent and stable specification of the relationships, which are very often largely summation of lagged multiplicands. See Appendix 6

Typically, the general MIN model $\sum_{j=0}^n X_{i-j}$ (where random variable X is the multiplicand, X_i is the digits of the multiplicand and $X_{i-j}; j = 0,1,2,\dots, n$ are the lagged



multiplicands) is build around the premises of multiplicative identity. However, further study into the general MIN model involving commutative and distributive properties of multiplication lead to some specific models for multiplication of identical numbers of digits two (2) to nine (9) (Appendix 7).

In furtherance of the MIN model, an algorithm was developed using JAVA programming language (version JDK 1.7, in a NETBEANS Integrated Development Environment, IDE) as to enabling competition with calculator and Excel package (Appendices 8 and 9) in achieving quick, faster and accurate results in terms of time management and calculations without approximation or exponent.

4. Discussion and Conclusion

The present study demonstrates that Multiplication of Identical Numbers (MIN) is enhanced with summation along identity, commutative, associative and distributive properties of multiplication (Sawyer, 2006 and Jason, 2010). It also identifies any length of numbers (multiplicand) multiply by identical numbers as a variable and the digits (values) of the multiplicand as its respective variates.

In this study, a better and faster method is formulated as MIN model for multiplication of identical numbers of any length of digits. On the basis of this investigation, the MIN model should constitute a reliable method for calculating the multiplication of identical numbers as it will assist students with weak background in multiplication concepts and results are explicitly stated without any approximation when large numbers are involved unlike calculator and Excel package.



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Table 1

Identical Numbers formed from digits one (1) to nine (9)

Digit	Identical Numbers						
1	11	111	1111	11111	111111	1111111	...
2	22	222	2222	22222	222222	2222222	...
3	33	333	3333	33333	333333	3333333	...
4	44	444	4444	44444	444444	4444444	...
5	55	555	5555	55555	555555	5555555	...
6	66	666	6666	66666	666666	6666666	...
7	77	777	7777	77777	777777	7777777	...
8	88	888	8888	88888	888888	8888888	...
9	99	999	9999	99999	999999	9999999	...



Appendix 1

Multiplication of any length of numbers by eleven (11) for carrying of digits not applicable

Examples

1. Multiply 23 by 11

$$\underline{2(2+3)3}$$

$$\underline{2 \quad 5 \quad 3}$$

$$23 \times 11 = 253$$

2. Multiply 234 by 11

$$\underline{2(2+3)(3+4)4}$$

$$\underline{2 \quad 5 \quad 7 \quad 4}$$

$$234 \times 11 = 2574$$

3. Multiply 7142 by 11

$$\underline{7(7+1)(1+4)(4+2)2}$$

$$\underline{7 \quad 8 \quad 5 \quad 6 \quad 2}$$

$$7142 \times 11 = 78562$$

4. Multiply 27145 by 11

$$\underline{2(2+7)(7+1)(1+4)(4+5)5}$$

$$\underline{2 \quad 9 \quad 8 \quad 5 \quad 9 \quad 5}$$

$$27145 \times 11 = 298595$$

5. Multiply 222222 by 11

$$\underline{2(2+2)(2+2)(2+2)(2+2)(2+2)2}$$

$$\underline{2 \quad 4 \quad 4 \quad 4 \quad 4 \quad 4 \quad 2}$$

$$222222 \times 11 = 2444442$$



Appendix 2

Multiplication of any length of numbers by eleven (11) for carrying of digits applicable

Examples

1. Multiply 79 by 11

$$\begin{array}{r} 7 \ (7 + 9) \ 9 \\ 7 \ (16) \ 9 \\ (7 + 1) \ 6 \ 9 \\ \hline \end{array}$$

$$\begin{array}{r} 8 \quad 6 \quad 9 \\ \hline 79 \times 11 = 869 \end{array}$$

2. Multiply 877 by 11

$$\begin{array}{r} 8 \ (8 + 7) \ (7 + 7) \ 7 \\ 8 \ (15) \quad (14) \ 7 \\ 8 \ (15 + 1) \ 4 \ 7 \\ 8 \quad (16) \ 4 \ 7 \\ (8+1) \ 6 \ 4 \ 7 \\ \hline 9 \quad 6 \ 4 \ 7 \end{array}$$

$$877 \times 11 = 9647$$

3. Multiply 9787 by 11

$$\begin{array}{r} 9 \ (9+7) \ (7+8) \ (8+7) \ 7 \\ 9 \ (16) \ (15) \quad (15) \ 7 \\ 9 \ (16) \ (15+1) \ 5 \ 7 \\ 9 \ (16+1) \ 6 \ 5 \ 7 \\ 9 \quad (17) \ 6 \ 5 \ 7 \\ (9+1) \ 7 \ 6 \ 5 \ 7 \\ (10) \ 7 \ 6 \ 5 \ 7 \\ \hline 1 \ 0 \ 7 \ 6 \ 5 \ 7 \end{array}$$

$$9787 \times 11 = 107657$$



Appendix 3

Multiplication of any length of numbers by eleven (11) using distributive and identity properties.

Examples

1. Multiply 79 by 11

$$\begin{array}{r} 79 \times 11 \\ 79 \times (10 + 1) \\ (79 \times 10) + (79 \times 1) \\ 790 + 79 \\ \begin{array}{r} 7 \quad 9 \quad 0 \\ + \quad \quad 7 \quad 9 \\ \hline 8 \quad 6 \quad 9 \end{array} \\ 79 \times 11 = 869 \end{array}$$

2. Multiply 888 by 11

$$\begin{array}{r} 888 \times 11 \\ 888 \times (10 + 1) \\ (888 \times 10) + (888 \times 1) \\ 8880 + 888 \\ \begin{array}{r} 8 \quad 8 \quad 8 \quad 0 \\ + \quad \quad 8 \quad 8 \quad 8 \\ \hline 9 \quad 7 \quad 6 \quad 8 \end{array} \\ 888 \times 11 = 9768 \end{array}$$

3. Multiply 9787 by 11

$$\begin{array}{r} 9787 \times 11 \\ 9787 \times (10 + 1) \\ (9787 \times 10) + (9787 \times 1) \\ 97870 + 9787 \\ \begin{array}{r} 9 \quad 7 \quad 8 \quad 7 \quad 0 \\ + \quad 9 \quad 7 \quad 8 \quad 7 \\ \hline 1 \quad 0 \quad 7 \quad 6 \quad 5 \quad 7 \end{array} \\ 9787 \times 11 = 107657 \end{array}$$



Appendix 4

Multiplication of any length of numbers by identical numbers of digits one (1)* using distributive and identity properties.

Examples

1. Multiply 35 by 111

$$\begin{array}{r} 35 \times 111 \\ 35 \times (100 + 10 + 1) \\ (35 \times 100) + (35 \times 10) + (35 \times 1) \\ 3500 + 350 + 35 \\ \begin{array}{r} 3 \quad 5 \quad 0 \quad 0 \\ + \quad \quad 3 \quad 5 \quad 0 \\ \hline \quad \quad \quad 3 \quad 5 \\ \hline 3 \quad 8 \quad 8 \quad 5 \\ \hline 35 \times 111 = 3885 \end{array} \end{array}$$

2. Multiply 38725 by 1111

$$\begin{array}{r} 38725 \times 1111 \\ 38725 \times (1000 + 100 + 10 + 1) \\ (38725 \times 1000) + (38725 \times 100) + (38725 \times 10) + (38725 \times 1) \\ 38725000 \\ 3872500 \\ + 387250 \\ \hline 38725 \\ \hline 43023475 \\ 38725 \times 1111 = 43023475 \end{array}$$

3. Multiply 875 x 111111

$$\begin{array}{r} 875 \times 111111 \\ 875 \times (100000 + 10000 + 1000 + 100 + 10 + 1) \\ 87500000 + 8750000 + 875000 + 87500 + 8750 + 875 = \\ 97222125 \\ 875 \times 111111 = 97222125 \end{array}$$

*Multiplication of any length of numbers by eleven (11) is in appendix 3 which is also an identity number of digit one (1).



Appendix 5

Multiplication of any length of numbers by identical numbers of digits two (2) to nine (9) using commutative, distributive and identity properties.

Example

Multiply 653 by 999

$$653 \times 999$$

$$653 \times 9 \times 111$$

$$(653 \times 111) \times 9$$

$$(653 \times 111) \times (4 + 4 + 1)$$

$$(653 \times 111) \times [(2+2) + 4 + 1]$$

$$72483 \times [(2+2) + 4 + 1]$$

$$[72483 \times (2+2)] + (72483 \times 4) + (72483 \times 1)$$

$$[(72483 \times 2) + (72483 \times 2)] + (72483 \times 4) + (72483 \times 1)$$

$$2(72483 \times 2) + (72483 \times 4) + (72483 \times 1)$$

$$\begin{array}{r}
 \\
 \\
 + \\
 \hline
 1
 \end{array}$$

$$72483 \times 2 = 144966$$

$$2(144966) + (72483 \times 4) + (72483 \times 1)$$

$$(144966 \times 2) + (72483 \times 4) + (72483 \times 1)$$

$$\begin{array}{r}
 1 \\
 + \\
 \hline
 2
 \end{array}$$

$$144966 \times 2 = 289932 = 72483 \times 4$$

$$(289932 + 289932) + (72483 \times 1)$$

$$2(289932) + (72483 \times 1)$$

$$(289932 \times 2) + (72483 \times 1)$$

$$\begin{array}{r}
 2 \\
 + \\
 \hline
 5
 \end{array}$$

$$289932 \times 2 = 579864$$

$$579864 + 72483$$

$$\begin{array}{r}
 5 \\
 + \\
 \hline
 6
 \end{array}$$

$$653 \times 999 = 652347$$

Appendix 6

Generalization of the MIN model

Examples

1. Multiply 6537 by 11
 6537 is the multiplicand (X_i)

$$11isX_{i-j}; j = 0,1$$

$$\sum_{j=0}^1 X_{i-j} = X_i + X_{i-1}$$

X_i	6	5	3	7	
X_{i-1}		6	5	3	7
$\sum_{j=0}^1 X_{i-j}$	7	1	9	0	7

$$6537 \times 11 = 71907$$

2. Multiply 79856576 by 111111
 79856576 is the multiplicand (X_i)

$$111111 \text{ is } X_{i-j}; j = 0, 1, 2, 3, 4, 5$$

543210

$$\sum_{j=0}^5 X_{i-j} = X_i + X_{i-1} + X_{i-2} + X_{i-3} + X_{i-4} + X_{i-5}$$

X_i	7	9	8	5	6	5	7	6					
X_{i-1}		7	9	8	5	6	5	7	6				
X_{i-2}			7	9	8	5	6	5	7	6			
X_{i-3}				7	9	8	5	6	5	7	6		
X_{i-4}					7	9	8	5	6	5	7	6	
X_{i-5}						7	9	8	5	6	5	7	6
$\sum_{j=0}^5 X_{i-j}$	8	8	7	2	9	4	4	0	1	5	9	3	6

$$79856576 \times 111111 = 8.872944016 \times 10^{12} \text{ (Calculator)}$$

$$79856576 * 111111 = 8.8729 \text{ E12 (Excel Package)}$$

The general MIN model is $\sum_{j=0}^n X_{i-j}$

Appendix 7

Formulation of Specific MIN Model

Digit	Model	Example
1.	$\sum_{j=0}^n X_{i-j}$	$6537 \times 11 = 71907$
2.	$\sum_{j=0}^n X_{i-j} + \sum_{j=0}^n X_{i-j} = 2 \sum_{j=0}^n X_{i-j}$	$6537 \times 22 = 2(6537 \times 11) = (6537 \times 11) + (6537 \times 11) = 143814$
3.	$2 \sum_{j=0}^n X_{i-j} + \sum_{j=0}^n X_{i-j} = 3 \sum_{j=0}^n X_{i-j}$	$6537 \times 33 = 3(6537 \times 11) = 2(6537 \times 11) + (6537 \times 11) = 2157521$
4.	$2 \sum_{j=0}^n X_{i-j} + 2 \sum_{j=0}^n X_{i-j} = 4 \sum_{j=0}^n X_{i-j}$	$6537 \times 44 = 4(6537 \times 11) = 2(6537 \times 11) + 2(6537 \times 11) = 287628$
5.	$4 \sum_{j=0}^n X_{i-j} + \sum_{j=0}^n X_{i-j} = 5 \sum_{j=0}^n X_{i-j}$	$6537 \times 55 = 5(6537 \times 11) = 4(6537 \times 11) + (6537 \times 11) = 359535$
6.	$4 \sum_{j=0}^n X_{i-j} + 2 \sum_{j=0}^n X_{i-j} = 6 \sum_{j=0}^n X_{i-j}$	$6537 \times 66 = 6(6537 \times 11) = 4(6537 \times 11) + (6537 \times 11) = 431442$
7.	$4 \sum_{j=0}^n X_{i-j} + 3 \sum_{j=0}^n X_{i-j} = 7 \sum_{j=0}^n X_{i-j}$	$6537 \times 77 = 7(6537 \times 11) = 4(6537 \times 11) + 3(6537 \times 11) = 503349$
8.	$4 \sum_{j=0}^n X_{i-j} + 4 \sum_{j=0}^n X_{i-j} = 8 \sum_{j=0}^n X_{i-j}$	$6537 \times 88 = 8(6537 \times 11) = 4(6537 \times 11) + 4(6537 \times 11) = 575256$
9.	$4 \sum_{j=0}^n X_{i-j} + 5 \sum_{j=0}^n X_{i-j} = 9 \sum_{j=0}^n X_{i-j}$	$6537 \times 99 = 9(6537 \times 11) = 4(6537 \times 11) + 5(6537 \times 11) = 647163$

Application of Graph Theory in Scheduling Tournament

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Abstract:

The field of mathematics plays an important role in various field, one of the important areas in mathematics is graph theory. The present paper states that various application of graph theory in scheduling a tournament, computer sciences, networking & an overview has been presented here.

1.Introduction:-

Sports tournament are main economic activities around the world. They draw attention of millions of people aere the globe. The broadcasters and organizer invest a lot of money in sports events. The schedule is the main aspect of the tournament. On one hand, there are multiple decision makers; the broadcasters, the team, the organizer and the government. For there quandary of scheduling. Sports tournament have gained considerable amount of attention in recent years among the operation research perpetually.

Keywords: Graph, vertices, edges, directed path, Hamiltonian path, and scheduling tournament

2.Some Basic definitions of Graph theory

a) Graph:- A group is an ordered pair $G=(V,E)$ comprising a set of vertices (or

nodes) together with a set E of edges (or line).

- b) Vertices:- If $G=(V,E)$ is a graph then the set V is said to vertex set of a graph G and the member V are said to be vertices of the graph.
- c) Edges:- The family E is said to be edge of the graph G and the member of E is said to be the edges of the graph G.
- d) Directed graph or digraph: A directed graph or digraph is an ordered pair $D=(V,E)$ where each edge has a direction.[2]
- e) Complete graph: A complete graph is a simple graph in which each pair of distinct vertices is joined by edges.

3.Some properties of Tournaments

If every team has its own home field it is desirable to schedule the tournament in such way that the home and away games for every team alternate as regularly as possible. A team has a break in the schedule when it plays two successive home or away games. The most balanced schedule is one with no breaks. Suppose that there are at least three teams. Then either at

least two of them starts their Schedule with a home game, or at least two of them start with an away game without loss of generality. We can suppose that two starts with a home game, but since both of them have no breaks, they always play home at the same time and they never play each other.

A Kirkman tournament has the property that its rounds can be recorded so that two teams have no breaks while all other teams have precisely one break each.

Ex. Use the convection that in a game $k-j$ the home team is j and schedule round 1 as $\infty-1, 7-2, 6-3, 5-4$. Round 2 is obtained from round 1 by adding 4 to each team number. In general, Round $(i+1)$ is obtained from round i by adding 4 to each team number and the games involving team ∞ alternate ∞ as the away and home team. Then team ∞ and 4 have no breaks teams 1, 2 and 3 have one home break each and team 5, 6 and 7 have one way break each. If we want to be fair and have one break for each team, we can schedule the games between ∞ and 4 in the round 7 as $4-\infty$ rather than $\infty-4$. Thus also works for $2n$ teams and round $i+1$ is then obtained from round I by adding n to each team number.

We want to schedule a tournament for an odd number of team $2n-1$, we can take any schedule for $2n$ teams and pick a team j to be the dummy team. Whatever team is schedule to play the dummy team in round i then is said to have a bye in that round this is the only schedule for odd number of teams with

this property as discovered by Mariusz Meszka and the author [7], who proved that for only even number of teams there exist a unique schedule in which every team has one bye and no break.

The main aspect of round robin tournament is the carry over effect [8]. When there are games $k-j$ in round i and $k-t$ in round $(i+1)$. We say that team t received carry over effect team j in round $(i+1)$ Kirkman Tournament as above properly, we can see that team 1 receives carry over effect from team 6 in 5 rounds, namely n rounds 2 though 6 and once from team ∞ in round 7 i.e., team 1 plays six times during the tournament against the team that played team 6 in the previous round. Thus may be an advantage or disadvantage depending on weather team 6 is the best or not best team in the tournament. Similarly all team except ∞ receives the carry over effect from the same team five times while ∞ receives it in each round from different team this is due to the rotational structure of Kirkman tournament and the special role of ∞ in it. There are tournament that have perfect carry over effect. i.e., every team receives the carry over effect from each other team at most once. However such a tournament are known to exist only when the number of teams is either a power of two [8], 22 or 22[1]. Unfortunately, the tournaments with perfect carry over effect typically have very bad break structures and balancing both properties are difficult. Some example of league where both properties are well balanced can be found in [5].

4.Example : Let $T=\{1,2,3,4,5,6\}$ be the set contestants in the initial tournament and $Tr=\{1,2,3,4\}$ be the set of contestants to be removed. Thus $n=6, n^r=4$.

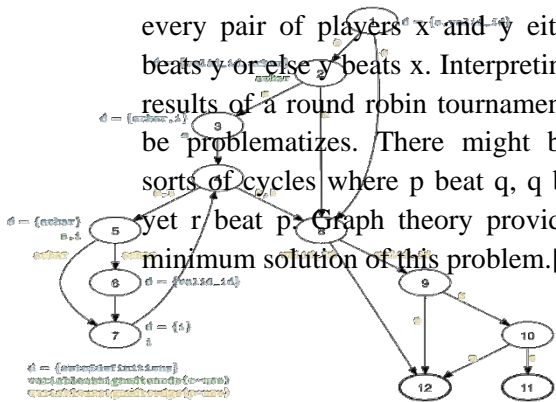
case1: Let $r=3$ so that $r>n-nr=2$. In what follows. We consider a schedule where maximum number of matches involving the removed contestants is kept after round $r=3$

The result of a round robin tournament can be represented with a tournament graph. This is a directed graph in which the vertices and edges represents players outcome respectively the games. In particular, an edge from x to y indicates that player x defeated y . In a round robin tournament, every pair of players has a match. Thus in a tournament graph there is either an edge from x to y or an edge from y to x every pair of vertices x to y . Here is an example of a tournament graph.[3]

Rounds	Match 1	Match 2	Match 3
Round 1	2 √ 4	3 √ 1	5 √ 6
Round 2	1 √ 5	6 √ 4	2 √ 3
Round 3	3 √ 6	1 √ 2	4 √ 5
Round 4	6 √ 2	5 √ 3	1 √ 4
Round 5	4 √ 3	2 √ 5	6 √ 1

5) Tournament Rankings:-

Suppose that n players complete in a round-robin tournament. Thus, for every pair of players x and y either x beats y or else y beats x . Interpreting the results of a round robin tournament can be problematized. There might be all sorts of cycles where p beat q , q beat r yet r beat p . Graph theory provides a minimum solution of this problem.[4]



The another notation of walks, Euler tours and Hamiltonian cycles all carry over naturally to directed graphs. A

directed walk is an alternating sequence of vertices and directed edges:
 $v_0, v_0 \rightarrow v_1, v_1, v_1 \rightarrow v_2, v_2, \dots, v_{n-1}, v_n, v_n$.

A directed Hamiltonian path is directed walk that visits every vertex exactly once. We are going to prove that in every round robin tournament, there exist a ranking of the player such that player lost to the player ranking one position higher. For example, in the tournament above, the rankings $A > B > D > E > C$ Satisfies this criterion, because B lost to A, D lost to B, E lost to B, E lost to D and C lost to E. in graph teams providing the existence of such a ranking amounts to proving that every tournament graph has a Hamiltonian path.[3]

Theorem: Every tournament graph contains a directed Hamiltonian path.

Proof: We use strong induction. Let $p(n)$ be the proposition that every tournament graph with n vertices contains a directed Hamiltonian path.

Base case: $p(1)$ is trivially true, every graph with a single vertex has a Hamiltonian path consisting of only of only that vertex.

Inductive step: For $n=1$, we assume that $p(1)$ -----
 $p(n)$ are also true and prove and $(n+1)$.

Consider a tournament with $(n+1)$ players.

Select one vertex v arbitrary. Every other vertex in the tournament either has an edges to vertex v or an edges from vertex v . thus, we can partition the remaining the vertices into two corresponding set, T and E each containing at most n vertices.

The vertices in T together with the edges that join them form a smaller tournament. Thus, by small induction, there is a Hamiltonian path within T . similarly; there is a Hamiltonian path within the tournament on the vertices in the F . joining the path T to the vertex followed by the path in F gives a Hamiltonian path through the whole tournament. (as a special case if T or F is empty, them so is the corresponding portion of path).

The ranking defined by a Hamiltonian path is not entirely satisfactorily. In the example tournament, notice that the lowest ranked player (C) actually denoted by the highest ranked player (A)!

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Design of Multislot Dual Band Patch Antenna for Satellite Communications

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Abstract

This paper gives configuration and analysis of dual band slotted patch antenna. For resonance purpose antenna is loaded with rectangular slots. Microstrip feed line is used to feed the antenna. Antenna characteristics were simulated using full-wave electromagnetic simulator (IE3D). According to simulations, the proposed antenna can provide two separated impedance bandwidths of 1.05 GHz (about 12.96% centered at 8.1 GHz) and 1.55 GHz (about 16.45% centered at 9.422 GHz), satisfying VSWR, and stable radiation patterns for satellite communications.

Keywords: *Microstrip Antenna, Return Loss, VSWR*

1. Introduction

Due to the rapid development in the field of satellite and wireless communication there has been a great demand for low cost minimal weight, compact low profile antennas that are capable of maintaining high performance over a large spectrum of frequencies. Through the years, microstrip antenna structures are the most common option used to realize millimeter wave monolithic integrated circuits for microwave, radar and communication purposes. Using the Dual Band Microstrip Antenna concept in this thesis dual band rectangular Microstrip antenna is designed simulated and tested. There are a few softwares available which allow the optimization of the antenna. IE3D is one of the most imperial electromagnetic software which allows to solving for radio and microwave application.

A Microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side. Micro strip antennas are planar resonant cavities that leak from their edges and radiate. Printed circuit techniques can be used to etch the

antennas on soft substrates to produce low-cost and repeatable antennas in a low profile.

2. Proposed Antenna Design & Optimizations

The Performance of the micro strip antenna depends on its dimension. Depending on the dimension the operating frequency, return loss and other related parameters are also influenced.

2.1 Design specifications:

Frequency of operation:

1. 7.84-8.81 GHz centered at 8.11GHz
2. 9.18-10.10GHz centered at 9.42 GHz

Height of dielectric substrate: 1.588mm

Dielectric constant: 4.4

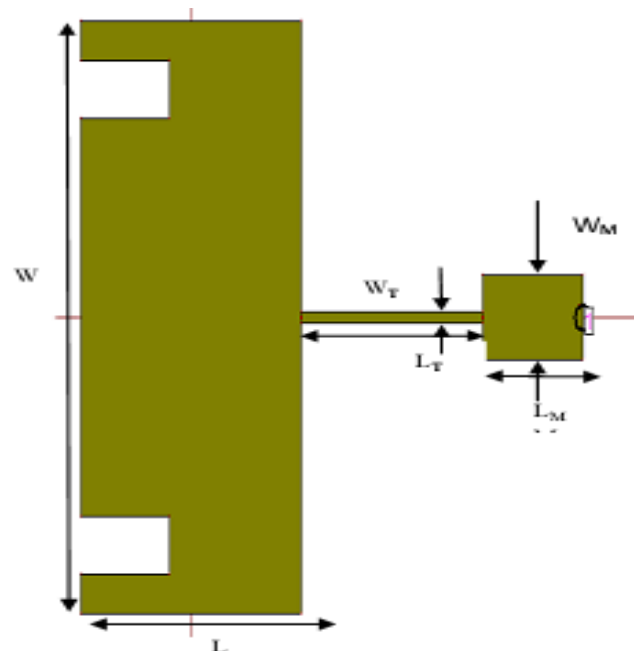


Fig. 1. Proposed antenna.

Parameter	Dimension (mm)	Optimized Dimension (mm)
L	6.58	6.5
W	11.25	11.2
L _T	5.6	5.6
W _T	0.3	0.3
L _M	3	3
W _M	1.623	1.6
L _S	2.632	2.6
W _S	0.98	0.9

3. Results

The software used to model and simulate the Micro strip patch antenna is Zealand Inc's IE3D. IE3D is a full-wave electromagnetic simulator based on the method of moments. It can be used to calculate and Return loss plot, VSWR, radiation patterns etc.

3.1 Return Loss:

The center frequencies are selected as the one at which the return loss is minimum. Return loss values obtained at 8.12GHz and 9.422GHz are -17dB and -44dB respectively.

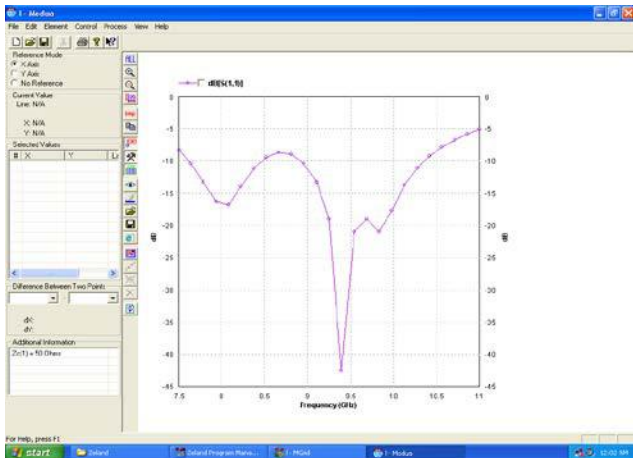


Fig. 2 Simulated results.

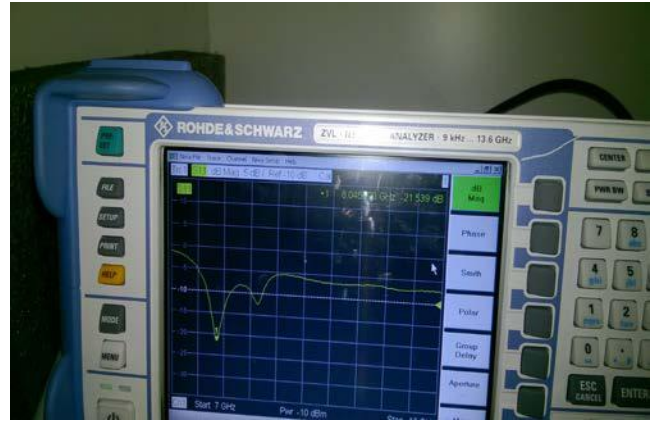


Fig. 2. Tested Hardware Results.

3.2 VSWR:

VSWR values are 1.26dB and 1.2 dB at 8.12GHz and 9.422GHz respectively.

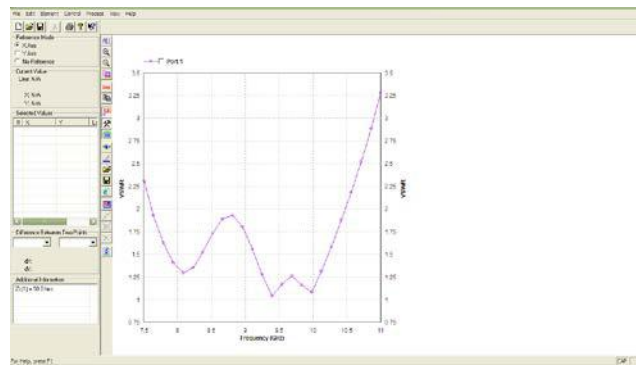


Fig. 3 Simulated results

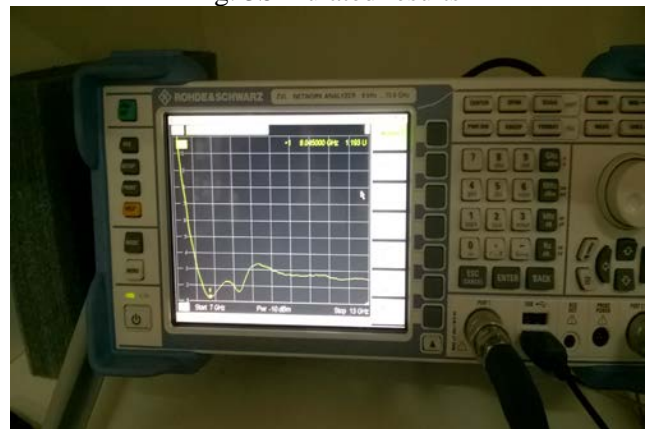


Fig. 4. Tested Hardware Results.

4. Conclusions

The antenna is designed and fabricated successfully with VSWR < 2 and two bandwidths 12.96% (centered at 8.1 GHz) and 1.55 GHz (about 16.45% centered at 9.422 GHz). $\lambda/4$ transformer was successfully designed for matching purpose.

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ENTREPRENEURSHIP EDUCATION AS A STRATEGIES FOR REDUCING POVERTY ALLEVIATION IN HOME ECONOMICS (NCE)

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Abstract

This paper focuses on poverty Alleviation as well as concept of entrepreneurship education and the ways of encouraging entrepreneurship education in NCE Home economics, It also looks towards factors that challenges the teaching of entrepreneurship education, it further reviews the strategies to employ in addressing the challenges and enhancing the teaching of entrepreneurship education within Home Economics at the NCE level. Some recommendation were made in order to reduce the suffering of people in the society.

Introduction

Poverty is experienced in every human community, and varying in degree. The worse hit are those in the developing countries like Nigeria, where poverty has continued to constitute a big hindrance to the development of her people. Poverty is a state where an individual or group cannot obtain the basic necessities of life. It can equally be seen as insufficient natural and human resources and lack of capacity and capability to harness available natural resources, and mismanagement of available resources Ajekamo (2008).

In additional Ajekamo (2008) confirms that of all scourge in the world, poverty is the most basic that denies human right and denies human right the benefit of their talents.

Poverty alleviation can be described as a process of reducing the sufferings of the populace there by making it possible for the people to live above, the absolute poverty standard of living.

Entrepreneurship education seeks to provide students with the knowledge, skills and motivation to encourage entrepreneurial

success in a variety of setting. Entrepreneurship education equips people with the ability to seek investment opportunities. Through entrepreneurship education, entrepreneurship education in NCE Home Economics programme can equip student with entrepreneurship skills that will enable them create and develop enterprises in the various areas of Home Economics. This will in turn help to enhance graduate employment and reduce unemployment. The Nigeria Certificate in Education (NCE) programmes are designed among other goals.

Produce highly motivated, conscientious and efficient classroom teachers for all levels of the Nigerian education system, provide graduates with the intellectual and professional background adequate for their assignment and make them adoptable to changing situations fed republic of Nigeria (2004).

The strategies for the attainment of the goal for the integration of entrepreneurship education in home economics include the planning of specific objectives, learning experience, organization and integration of the learning experiences, instructional methods and facilities and evaluation techniques for assessing

the attainment of specific objectives, Lemchi and Anyakona, (2006) says the specific objectives are of utmost importance to curriculum development and implementation as they are particularly helpful guides in selecting learning, selecting instructional materials and also evaluation techniques. Home economics hinged on the specific objectives. This content should include, among others, business ownership, entrepreneurial responsibilities, product development, record/book keeping and market segmentation Fayolle (2005).

Facilities and methods of teaching entrepreneurship education should be suited to the objectives. Hindle (2007) noted that there is no universal method of teaching entrepreneurship education.

- Factors that challenge the teaching of entrepreneurship education in home economics.

There are several factors that challenge the teaching of entrepreneurship education in NCE Home economics include:

- Teacher's competency: Weidmann (1977) defined competency as an attitude, behaviour, skill or understanding at a specified level of performance home

economics teachers who are not competent in entrepreneurship education may not be able to teach it.

- Absence of relevant textbooks-since entrepreneurship education is a new inclusion into home economics curriculum, there is also the problem of lack of textbooks in the area. This has neatly challenged education

Idibie (2004) also noted the teaching and learning without textbooks would mean a lot of memorization as well as make the words of the teacher final authority. This does not pave ways for competency in entrepreneurship.

- Lack of facilities: It is glaring that most colleges of education have not been able to provide adequate facilities and equipment to cope with the increasing enrolment of the students, Obunadike (2009) noted that lack of laboratory facilities compel home economics teachers to use inappropriate methods of teaching. This situation stifles entrepreneurial skill amongst students.
- Lack of fund: inadequate funding of colleges has often affected the teaching and learning of home economics. It is

the major cause of inadequate facilities and equipment in the institution.

Poor enterprise culture; Due to lack of adequate training centre and enterprises, students are faced with the problems of getting appropriate establishment for their work experience. They end up attaching themselves to road side tailors and other home economics related enterprises, where they often acquire wrong enterprising culture and skills.

This is contrary to the goals of students industrial work experience science (SIWES) which is expected to provide students with opportunities of exposure to practical experiences and relating their knowledge and skills learnt in the classroom to the real world of work ONU (2008).

- Strategies for addressing the challenges and enhancing the teaching of entrepreneurship education in order to reduce poverty alleviation in entrepreneurship knowledge, attitudes and skills that can be taught within the NCE Home Economics programme, the following strategies can be employed;

- Innovation: Innovation is change that create a new dimension of performance. It is create idea that is realized. Lucke and Katz (2003) note that Lucke innovation is the combination of synthesis of knowledge in original, relevant, value new products, processes or services.

Innovation typically involves creativity but is not identical to it Kaka and Agwa (2007). Home Economics teachers at the Colleges of Education need to provide an entrepreneurship education that will stir up the knowledge, skills and attitudes of the NCE students so that they can be more innovative. This will enable them introduce new ideas into the economy, formulate new goals, initiate new methods of production, new methods of distribution or carry out new organization of an industry Gula and Ewubare, (2007).

- In - service training NCE Home Economics teachers should be given opportunity for in-service training so that they can brace up in with the changes in the curriculum. Adiotomre (2005) noted that re-training of teachers gives room for professional growth which in turn enhances creativity and productivity.

- Research: - This is another strategy for addressing the challenges of the teaching of entrepreneurship education. Anyakoha (2001) noted that Home Economics is constantly evolving and adapting to a world where a speed of change is increasing. Its goal poses enormous challenges to the field and the practitioner hence research in Home Economics becomes imperative so that issues that pose challenges can be determined and address appropriately. For instance, the issues of entrepreneurship education emerged as a result of research. College management should endeavour to provide recent textbooks should update themselves through research, seminars, workshops and conference. This will also help to improve their competencies.
- Improvement of teaching facilities and techniques: Anyakoha (2001) stressed the need to be willing to learn improve on old methods and techniques of teaching. The NCE Home Economics educators should explore new techniques/methods of teaching the entrepreneurship courses so that the students can cope with dynamic society at graduation. For instance, they should carry out entrepreneurial

practice in various areas of Home Economics under the supervision of their lecturers.

- Improved School/Industry relationship: College and Industry should have an improved working relationship, which should enhance student's skill acquisition. When students are sent out on industrial attachment, college should give them the necessary orientation needed to have a good rapport with the industry.
- Improvisation: Olaitan and Agusiobo (1985) defined improvisation as the choice and use of alternative instructional materials which enable the teacher to obtain some carefully specified objectives Idible (2004) also define it as an act of making use of alternative materials or resources to facilitate instructional in the absence or shortage of some specified conventional instructional aids whenever it is necessary and possible, teachers and students should improvise some instructional materials needed for the teaching of this course, when the facilities and equipment are inadequate.

Conclusion

Entrepreneurship education is a carefully planned process that leads to the acquisition as well alleviate poverty and competencies. It seeks ton provides students with the knowledge, skills and motivation to encourage entrepreneurial success in a variety of setting. NCE Home Economics graduates are expected to be prepares for teaching and self - employment.

Thus entrepreneurship education needs to be promoted within the NCE Home Economics programmes and self reliance in order to alleviate the suffering of female in the society generally.

Recommendations

Considering the importance of entrepreneurship education in NCE Home Economics, the following recommendations are made:

> NCE Home Economics lecturers should be paragramatic, innovative and committed to the teaching of NCE Home Economics entrepreneurship education.

- Opportunities for in-service training entrepreneurship education programme should be given NCE Home Economics teachers by the government.

- Government should provide adequate facilities and equipment for Colleges of Education.

- Government should provide sufficient grants for research while the NCE Home Economics Education should explore ways of obtaining such research grants with vigour to assess them.
- NCE Home Economics lecturers should improvise when it is imperative to do so.
- Government and management of Colleges of Education should produce new and relevant information on entrepreneurship education.

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EFFECT OF HEAT AND MASS TRANSFER ON UNSTEADY MHD POISEUILLE FLOW BETWEEN TWO INFINITE PARALLEL POROUS PLATES IN AN INCLINED MAGNETIC FIELD.

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ABSTRACT

The effect of heat and mass transfer on unsteady MHD poiseuille flow between two infinite parallel porous plates in an inclined magnetic field has been investigated, where the lower plate is considered porous. The governing equations of the flow field are solved by perturbation technique and the expression for the velocity u , temperature θ and concentration c were obtained. The effect of parameters such as Hartmann number Ha , Grashof number (Gr and Gc), Radiation N , Prandtl number Pr , Schmidt number Sc and Chemical parameter Kc were studied. The results show that at high Hartmann number Ha , the velocity decreased. Velocity increased due to effect of thermal Grashof number Gr and solutal Grashof number Gc . An increase in Prandtl number Pr decreased temperature. Species concentration reduced with increase in chemical parameter Kc and Schmidt number Sc .

Keywords: unsteady, MHD, poiseuille flow, porous plate, Heat Transfer, Mass Transfer.

1. INTRODUCTION

Magnetohydrodynamic (MHD) is the study of the dynamics of electrically conducting fluids under the influence of a magnetic field. Fluid such as mercury, molten iron and ionized gases often called plasma by physicist of which the solar atmosphere is an example, are but a few electrically conducting fluids.

The applications of the effect of heat and mass transfer on unsteady MHD poiseuille flow between two infinite parallel porous plates in an inclined magnetic field are visible in several fields of engineering technology.

The motion of an electrically conducting fluid placed in a constant magnetic field induces current that creates a force on the fluid. The current generated has been used in the designed MHD generators for electricity generation, MHD devices, nuclear engineering and the possibility of thermonuclear power that has created an immense practical used for understanding the dynamics of electrically conducting fluid. The effect of magnetic field in viscous incompressible flow of electrically conducting fluid is of use in extrusion of plastics and food.

Hannes Alfven (1942), a Swedish electrical engineer first initiated the study of MHD. Shercliff (1956) considered the steady motion of an electrically conducting fluid in pipes under transverse magnetic fields. Sparrow and Cess (1961) observed that free convection heat transfer to liquid metals may be significantly affected by the presence of magnetic field. Drake (1965) considered flow in a channel due to periodic pressure gradient and solved the resulting equation by separation of variables methods. Singh and Ram (1978) studied Laminar flow of an electrically conducting fluid through a channel in the presence of a transverse magnetic field under the influence of a periodic pressure gradient and solved the resulting differential equation by the method of Laplace transform. More to this, Ram et al (1984) analyzed hall effects on heat and mass transfer flow through porous media. Soundelgekar and Abdulla Ali (1986) studied the flow of viscous incompressible electrically conducting isothermal plate. Singh (1993) considered the steady MHD fluid flow between two parallel plates. John Mooney and Nick Stokes (1997) considered the effects of thermal radiation and free convection flow past a moving vertical plate. Al-Hadhrami (2003) discussed flow through horizontal channels of porous material and obtained velocity expressions in terms of the Reynolds number. Ganesh (2007) studied unsteady MHD Stokes flow of a viscous fluid between two parallel porous plates. Stamenkovic et al (2010) investigated MHD flow of two immiscible and electrically conducting fluids between isothermal, insulated moving plates in the presence of applied electric and magnetic fields. They matched the solution at the interface and it was found that decrease in magnetic field

inclination angle flattens out the velocity and temperature profiles. Rajput and Sahu (2011) studied the effect of a uniform transverse magnetic field in the unsteady transient free convection flow of an incompressible viscous electrically conducting fluid between two infinite vertical parallel porous plates with constant temperature and variable mass diffusion. Mayonge et al (2012) studied steady MHD poiseuille flow between two infinite parallel porous plates in an inclined magnetic field and discovered that high magnetic field strength decreases the velocity. Heat transfer effects on rotating MHD coquette flow in a channel partially filled by a porous medium with hall current has been discussed by Singh and Rastogi (2012). Choudhary and DebH (2012) studied heat and mass transfer for viscoelastic MHD boundary layer flow past a vertical flat plate. Sandeep and Sugunamma (2013) analyzed the effect of an inclined magnetic field in unsteady free convection flow of a dusty viscous fluid between two infinite flat plates filled by a porous medium. Joseph et al (2014) studied the unsteady MHD coquette flow between two infinite parallel porous plates in an inclined magnetic field with heat transfer. They found out that when the magnetic field is high, it reduces the energy loss through the plate. Large Nusselt number corresponds to more active convection and high prandtl number decreases the temperature distribution. The unsteady MHD poiseuille flow between two infinite parallel plates in an inclined magnetic field with heat transfer has been studied by Idowu et al (2014).

In this paper, we considered one dimensional poiseuille flow of an electrically conducting fluid between two infinite parallel porous plates under the influence of magnetic field with heat and mass transfer.

2. PROBLEM FORMULATION

The concept of magneto hydrodynamics phenomenon can simply be described as follows: consider an electrically conducting fluid moving with velocity V . at right angles to this flow, we apply a magnetic field, the field strength of which is represented by the vector B . we assume that the fluid has attained unsteady state conditions. That is, flow variables are dependent of the time t . Because of the interaction of the two

fields, an electric field vector denoted E is induced at right angles to both V and B . This electric field is given by

$$E = V \times B \quad (1)$$

If we assume that the conducting fluid is isotropic/exhibits adiabatic flow in spite of the magnetic field, then we denote the electrical conductivity of the fluid by a scalar σ . By Ohm's law[14], the density of the current induced in the conducting fluid denoted J is given by

$$J = \sigma E \quad (2)$$

$$\text{Or } J = \sigma(V \times B) \quad (3)$$

Simultaneously occurring with the induced current is the Lorentz force F given by

$$F = J \times B \quad (4)$$

This force occurs because, as an electric generator, the conducting fluid cuts the lines of the magnetic field. The vector F is the vector cross product of both J and B and is a vector perpendicular to the plane of both J and B . This induced force is parallel to V but in opposite direction. Laminar flow through a channel under uniform transverse magnetic field is important because of the use of MHD generator, MHD pump and electromagnetic flow meter.

We now consider an electrically conducting viscous, unsteady, incompressible fluid moving between two infinite parallel plates both kept at a constant distance $2h$ between them. Both plates of the channel are fixed with no motion. This is plane poiseuille flow. The equations of motion are the continuity equation

$$\nabla \cdot V = 0 \quad (5)$$

and the Navier-Stokes equations

$$\rho \left[\left(\frac{\partial}{\partial t} + V \cdot \nabla \right) \right] V = f_B - \nabla P + \mu \nabla^2 V \quad (6)$$

Where ρ is the fluid density, f_B is the body force per unit mass of the fluids, μ is the fluid viscosity and P is the pressure acting on the fluid. If we assume a one dimensional flow so that we choose the axis of the channel formed by the two plates as the x-axis and assume that the flow is in this direction. Observe that \bar{u} , \bar{v} and \bar{w} are the velocity components in \bar{x} , \bar{y} and \bar{z} directions respectively. Then this implies $\bar{v} = \bar{w} = 0$ and $\bar{u} \neq 0$, then the continuity equation is satisfied.

From this we infer that \bar{u} is independent of \bar{x} . This makes the nonlinear term $[(V \cdot \nabla)V]$ in the Navier-Stokes equation vanish. We neglect body forces f_B which are mainly due to gravity in the Navier-Stokes equations and replace them with the Lorentz force and from the assumption that the flow is one dimensional, it means that the governing equation for this flow is

$$\frac{\partial \bar{u}}{\partial t} = -\frac{1}{\rho} \frac{\partial \bar{P}}{\partial \bar{x}} + \nu \frac{\partial^2 \bar{u}}{\partial \bar{y}^2} + \frac{F_x}{\rho} \quad (7)$$

Where $\nu = \frac{\mu}{\rho}$ is the kinematics viscosity and F_x is the component of the magnetic force in the direction of x-axis. Assuming unidirectional flow so that $\bar{v} = \bar{w} = 0$ and $B_x = B_z = 0$ since magnetic field is along y-direction so that $V = i\bar{u}$ and $B = B_0 j$. Where B_0 is the magnetic field strength.

Now,

$$F_x = \sigma[(i\bar{u} \times jB_0)] \times jB_0 \quad (8)$$

So that we have

$$\frac{F_x}{\rho} = -\frac{\sigma}{\rho} B_0^2 \bar{u} \quad (9)$$

Then (7) becomes

$$\frac{\partial \bar{u}}{\partial t} = -\frac{1}{\rho} \frac{\partial \bar{P}}{\partial \bar{x}} + \nu \frac{\partial^2 \bar{u}}{\partial \bar{y}^2} - \frac{\sigma}{\rho} B_0^2 \bar{u} \quad (10)$$

From (10), when angle of inclination is introduced, we have

$$\frac{\partial \bar{u}}{\partial t} = -\frac{1}{\rho} \frac{\partial \bar{P}}{\partial \bar{x}} + \nu \frac{\partial^2 \bar{u}}{\partial \bar{y}^2} - \frac{\sigma}{\rho} B_o^2 \bar{u} \sin^2(\alpha) \quad (11)$$

Where α is the angle between V and B . Equation (11) is general in the sense that both fields can be assessed at any angle α for $0 \leq \alpha \leq \pi$.

Because of the porosity of the lower plate, the characteristic velocity ν_o is taken as a constant so as to maintain the same pattern of flow against suction and injection of the fluid in which it is moving perpendicular to the fluid flow. The origin is taken at the Centre of the channel and \bar{x}, \bar{y} coordinate axis are parallel and perpendicular to the channel walls respectively. The governing equations, that is; the momentum equation, the energy equation and the concentration equation are as follows:

The momentum equation is given as

$$\rho \frac{\partial \bar{u}}{\partial \bar{t}} = -\nu_o \frac{\partial \bar{u}}{\partial \bar{y}} - \frac{\partial \bar{P}}{\partial \bar{x}} + \mu \frac{\partial^2 \bar{u}}{\partial \bar{y}^2} - \frac{\sigma}{\rho} B_o^2 \bar{u} \sin^2(\alpha) + g\beta(\bar{T} - \bar{T}_\infty) + g\beta^*(\bar{C} - \bar{C}_\infty) \quad (12)$$

since the flow is isentropic, the energy equation is given as

$$\frac{\partial \bar{T}}{\partial \bar{t}} = \frac{k}{\rho c_p} \frac{\partial^2 \bar{T}}{\partial \bar{y}'^2} + \frac{1}{\rho c_p} \frac{\partial q}{\partial \bar{y}} \quad (13)$$

Where k is the thermal conductivity of the fluid, ρ is the density, c_p is the specific heat constant pressure and \bar{T} is the temperature.

The concentration equation is given as

$$\frac{\partial \bar{C}}{\partial \bar{t}} = D \frac{\partial^2 \bar{C}}{\partial \bar{y}^2} - Kc'(\bar{C} - \bar{C}_\infty) \quad (14)$$

The q in (13) is called the heat flux. It is given by,

$$\frac{\partial q}{\partial \bar{y}} = 4\alpha^2(\bar{T}_\infty - \bar{T}) \quad (15)$$

The boundary conditions are

$$\bar{U}(\bar{y}, \bar{t}) = 0, \bar{T} = \bar{T}_\infty; \text{ at } \bar{t} = 0, \bar{U}(-L, \bar{t}) = 0,$$

$$\bar{U}(L, \bar{t}) = \frac{v}{L}, \bar{T} = \bar{T}_w; \text{ at } \bar{t} > 0, \bar{C} = \bar{C}_\infty \text{ at } \bar{t} = 0, \bar{C} = \bar{C}_w; \text{ at } \bar{t} > 0 \quad (16)$$

In order to solve equations (12), (13) and (14) subject to the boundary conditions (16), we introduce the following dimensionless parameters:

$$\begin{aligned} \bar{u} &= \frac{uv}{L}, \bar{t} = \frac{tL^2}{\nu}, \bar{y} = yL, \bar{P} = p\rho \frac{v^2}{L^2}, \bar{x} = xL, \theta = \frac{\bar{T} - \bar{T}_\infty}{\bar{T}_w - \bar{T}_\infty} \Rightarrow \bar{T} - \bar{T}_\infty = \theta(\bar{T}_w - \bar{T}_\infty) \\ \Rightarrow \bar{T} &= \theta(\bar{T}_w - \bar{T}_\infty) + \bar{T}_\infty, Gr = \frac{\rho L^2 g \beta (\bar{T}_w - \bar{T}_\infty)}{\mu \nu}, C = \frac{\bar{C} - \bar{C}_\infty}{\bar{C}_w - \bar{C}_\infty} \Rightarrow \bar{C} - \bar{C}_\infty = C(\bar{C}_w - \bar{C}_\infty) \\ \Rightarrow \bar{C} &= C(\bar{C}_w - \bar{C}_\infty) + \bar{C}_\infty, Gc = \frac{\rho L^2 g \beta^* (\bar{C}_w - \bar{C}_\infty)}{\mu \nu}, Pr = \frac{\mu c_p}{k} \Rightarrow Cp = \frac{Prk}{\mu}, N^2 = \frac{4\alpha^2 L^2}{k} \Rightarrow \alpha^2 = \frac{N^2 k}{4L^2}, \bar{x} = xL, \bar{y} = yL, \frac{\partial q}{\partial y} = 4\alpha^2 (\bar{T}_\infty - \bar{T}) \\ , Sc &= \frac{V}{D} \Rightarrow D = \frac{V}{Sc} \end{aligned}$$

Equations (12), (13) and (14) now become

$$\frac{\partial u}{\partial t} = A \frac{\partial u}{\partial y} - \frac{\partial p}{\partial x} + \frac{\partial^2 u}{\partial y^2} - M^2 u + Gr\theta + GcC \quad (17)$$

Where $M = m^* \sin \alpha$ and $m^* = LB_o \sqrt{\frac{\sigma}{\mu}} = Ha, A = \frac{-Re}{\rho}$. Since it is poiseuille flow, $\frac{\partial p}{\partial x} \neq 0$.

$$Pr \frac{\partial \theta}{\partial t} = \frac{\partial^2 \theta}{\partial y^2} + N^2 \theta \quad (18)$$

$$\frac{\partial C}{\partial t} = \frac{1}{Sc} \frac{\partial^2 C}{\partial y^2} - \bar{K}_c C \quad (19)$$

The boundary conditions in dimensionless form are

$$U(-1, t) = 0, \theta(-1, t) = 0, C(-1, t) = 0 \text{ at } t = 0$$

$$U(1, t) = 1, \theta(1, t) = 1, C(1, t) = 1 \text{ ----- (20)}$$

3. METHOD OF SOLUTION/SOLUTION OF THE PROBLEM

The momentum equation, energy equation and concentration equation can be reduced to the set of ordinary differential equations, which are solved analytically. This can be done by representing the velocity, temperature and species concentration of the fluid in the perturbation series as follows

$$U(y, t) = U_o(y) + \varepsilon U_1(y)e^{i\omega t} + 0(\varepsilon^2) \quad (21)$$

$$\theta(y, t) = \theta_o(y) + \varepsilon \theta_1(y)e^{i\omega t} + 0(\varepsilon^2) \quad (22)$$

$$C(y, t) = C_o(y) + \varepsilon C_1(y)e^{i\omega t} + 0(\varepsilon^2) \quad (23)$$

Substituting equations (21), (22) and (23) into equations (17), (18) and (19). Equating the coefficients of harmonic and non-harmonic term and neglecting the coefficients of higher order of ε^2 , we get:

$$U_o''(y) + AU_o'(y) - M^2U_o(y) = -Q - Gr\theta_o(y) - GcC_o(y) \quad (24)$$

$$U_1''(y) + AU_1'(y) - bU_1(y) = -Gr\theta_1(y) - GcC_1(y) \quad (25)$$

Where $b = M^2 + i\omega$, $Q = \frac{-\partial p}{\partial x}$ (constant)

$$\theta_o''(y) + N^2\theta_o(y) = 0 \quad (26)$$

$$\theta_1''(y) - a_1\theta_1(y) = 0 \quad (27)$$

Where $a_1 = i\omega Pr - N^2$

$$C_o''(y) - ScKcC_o(y) = 0 \quad (28)$$

$$C_1''(y) - ScLC_1(y) = 0 \quad (29)$$

The corresponding boundary conditions become

$$U_o(-1, t) = 0, \theta_o(-1, t) = 0, C_o(-1, t) = 0$$

$$U_o(1, t) = 1, \theta_o(1, t) = 1, C_o(1, t) = 1$$

$$U_1(-1, t) = 0, \theta_1(-1, t) = 0, C_1(-1, t) = 0$$

$$U_1(1, t) = 1, \theta_1(1, t) = 1, C_1(1, t) = 1 \quad (30)$$

We now solve equations (24) – (29) under the relevant boundary conditions for the mean flow and unsteady flow separately.

The mean flows are governed by the equations (24), (26) and (28) where U_o, θ_o and C_o are called the mean velocity, mean temperature and mean concentration respectively. The unsteady flows are governed by equations (25), (27) and (29) where U_1, θ_1 and C_1 are the unsteady components.

These equations are solved analytically under the relevant boundary conditions (30) as follows;

Solving equations (24), (26) and (28) subject to the corresponding relevant boundary conditions in (30), we obtain the mean velocity, mean temperature and mean concentration as

$$U_o(y) = C_5 e^{m_5 y} + C_6 e^{m_6 y} + K_1 + K_2 \cos Ny + K_3 \sin Ny + K_4 e^{m_3 y} + K_5 e^{m_4 y} \quad (31)$$

$$\theta_o(y) = c_1 \cos Ny + c_2 \sin Ny \quad (32)$$

$$C_o(y) = c_3 e^{m_3 y} + c_4 e^{m_4 y} \quad (33)$$

Similarly, solving equations (25), (27) and (29) under the relevant boundary conditions in (30), the unsteady velocity, unsteady temperature and unsteady concentration becomes

$$U_1(y) = C_{11} e^{m_{11} y} + C_{12} e^{m_{12} y} + K_6 e^{m_7 y} + K_7 e^{m_8 y} + K_8 e^{m_9 y} + K_9 e^{m_{10} y} \quad (34)$$

$$\theta_1(y) = C_7 e^{m_7 y} + C_8 e^{m_8 y} \quad (35)$$

$$C_1(y) = C_9 e^{m_9 y} + C_{10} e^{m_{10} y} \quad (36)$$

Therefore, the solutions for the velocity, temperature and species concentration profiles are

$$U(y, t) = C_5 e^{m_5 y} + C_6 e^{m_6 y} + K_1 + K_2 \cos Ny + K_3 \sin Ny + K_4 e^{m_3 y} + K_5 e^{m_4 y} + \varepsilon [C_{11} e^{m_{11} y} + C_{12} e^{m_{12} y} + K_6 e^{m_7 y} + K_7 e^{m_8 y} + K_8 e^{m_9 y} + K_9 e^{m_{10} y}] e^{i\omega t} \quad (37)$$

$$\theta(y, t) = c_1 \cos Ny + c_2 \sin Ny + \varepsilon [C_7 e^{m_7 y} + C_8 e^{m_8 y}] e^{i\omega t} \quad (38)$$

$$C(y, t) = c_3 e^{m_3 y} + c_4 e^{m_4 y} + \varepsilon [C_9 e^{m_9 y} + C_{10} e^{m_{10} y}] e^{i\omega t} \quad (39)$$

4. DISCUSSION OF RESULTS

To discuss the effect of heat and mass transfer on unsteady MHD poiseuille flow between two infinite parallel porous plates in an inclined magnetic field. The velocity profile u , the temperature distribution θ and the species concentration C are shown graphically against y using matlab for different values of the following parameters such as Hartmann number Ha , thermal Grashof number Gr , modified Grashof number Gc , Radiation parameter N , Prandtl number Pr , Schmidt number Sc and chemical parameter Kc .

Figures 1,2 and 3 present the effect of Hartmann number Ha on velocity u . It is inferred from these figures that an increase in the Hartmann number decreases the fluid velocity.

Figures 4, 5 and 6 show the effect of thermal Grashof number Gr on velocity u . It is observed that an increase in thermal Grashof number Gr and the angle of inclination on velocity profile u increases the velocity.

Figures 7, 8 and 9 depict the effect of modified Grashof number Gc on velocity u . It is shown that the velocity increases as the modified Grashof number Gc increases.

Figure 10 describes the effect of Prandtl number Pr on temperature distribution θ . It is simulated from the figure that an increase in Prandtl number Pr leads to the decrease in temperature.

Figures 11 and 12 illustrate the effect of chemical parameter Kc and Schmidt number Sc on the species concentration. It is seen that an increase in the chemical parameter Kc and Schmidt number Sc decreases the species concentration.

Table 1 depicts variation of skin frictions τ_1 and τ_2 , Nusselt numbers Nu_1 and Nu_2 and Sherwood numbers Sh_1 and Sh_2 with time t . It is observed that, the time is constant and does not affect the values.

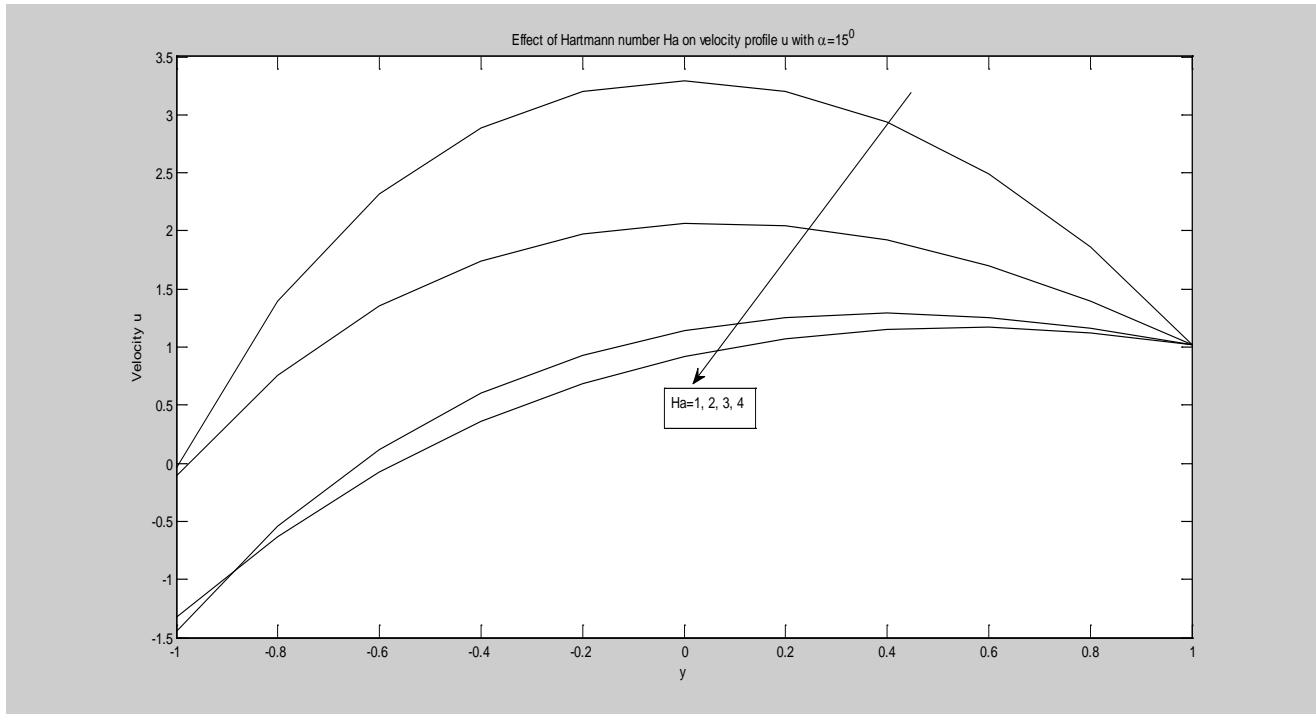


Figure 1: Effect of Hartmann number Ha on velocity profile u with $\alpha = 15^\circ, B = 1, t = 0.5, \varepsilon = 0.02, Gr = 1, Gc = 1, N = 1$ and $\omega = 1$.

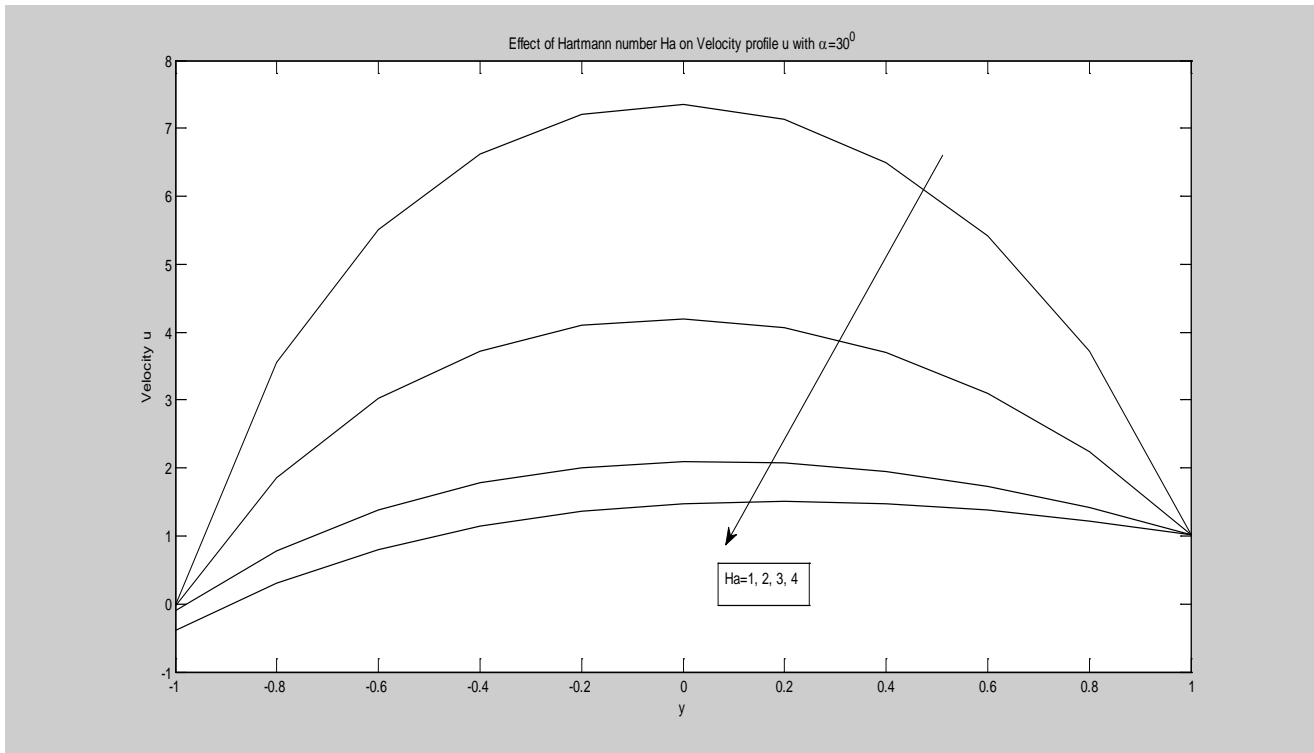


Figure 2: Effect of Hartmann number Ha on velocity profile u with $\alpha = 30^\circ$, $B = 1$, $t = 0.5$, $\varepsilon = 0.02$, $Gr = 1$, $Gc = 1$, $N = 1$ and $\omega = 1$.

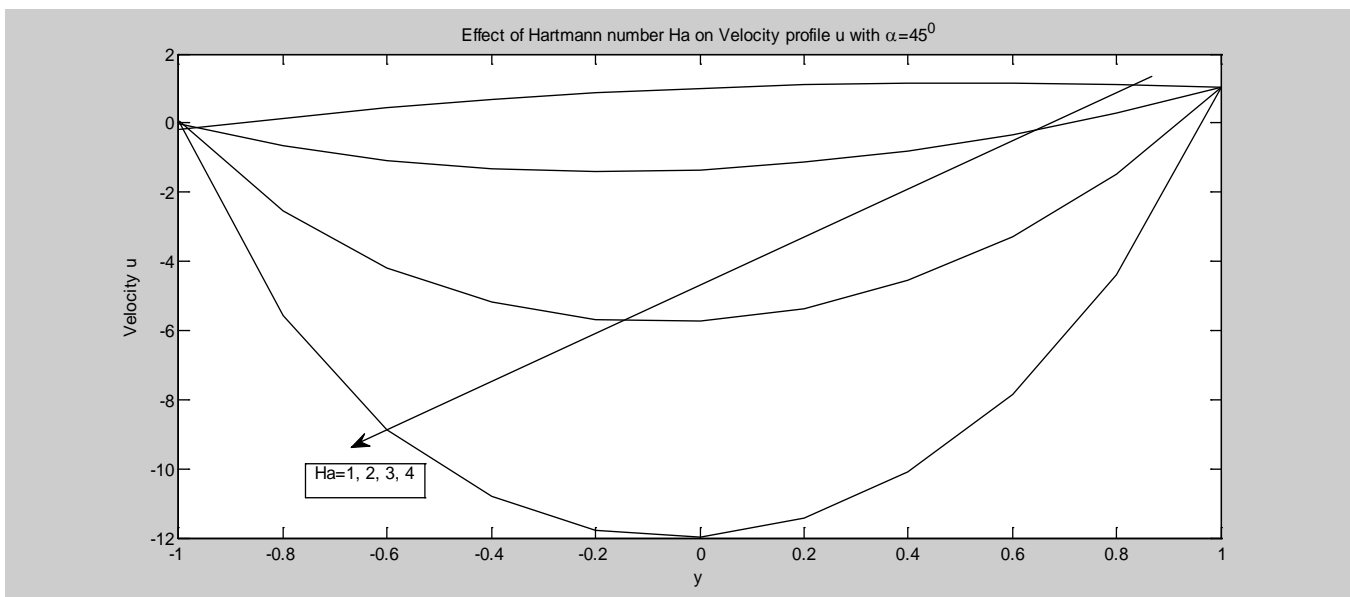


Figure 3: Effect of Hartmann number Ha on velocity profile u with $\alpha = 45^\circ, B = 1, t = 0.5, \varepsilon = 0.02, Gr = 1, Gc = 1, N = 1$ and $\omega = 1$.

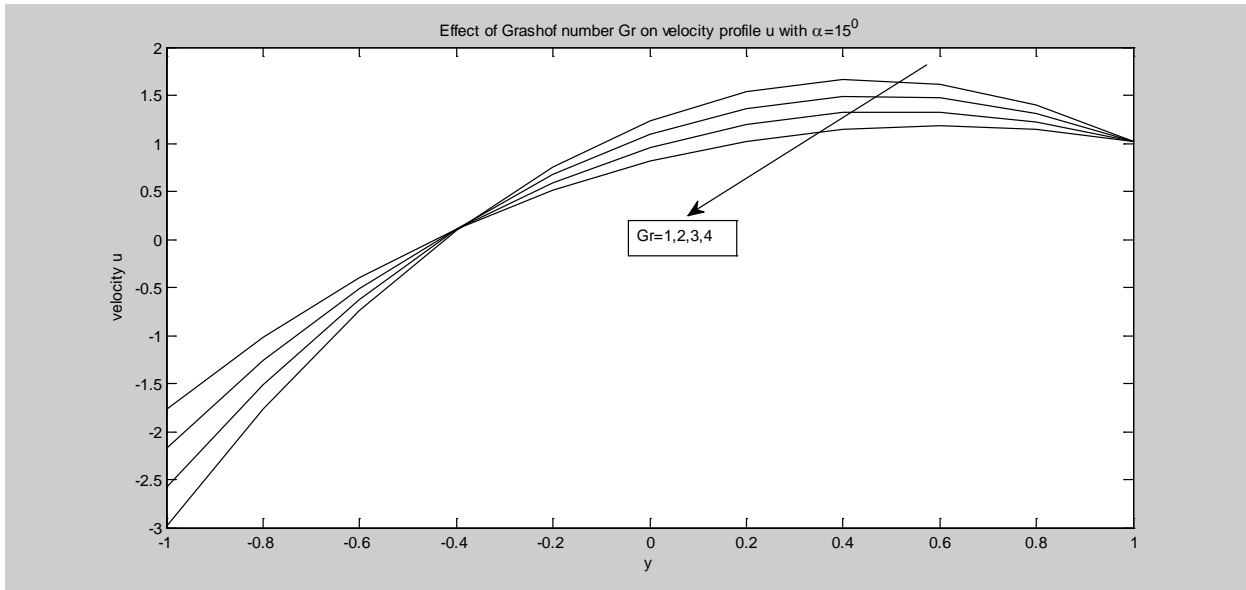


Figure 4: Effect of Grashof number Gr on velocity profile u with $\alpha = 15^\circ, B = 1, t = 0.5, \varepsilon = 0.02, Gc = 1, Ha = 1, N = 1$ and $\omega = 1$.

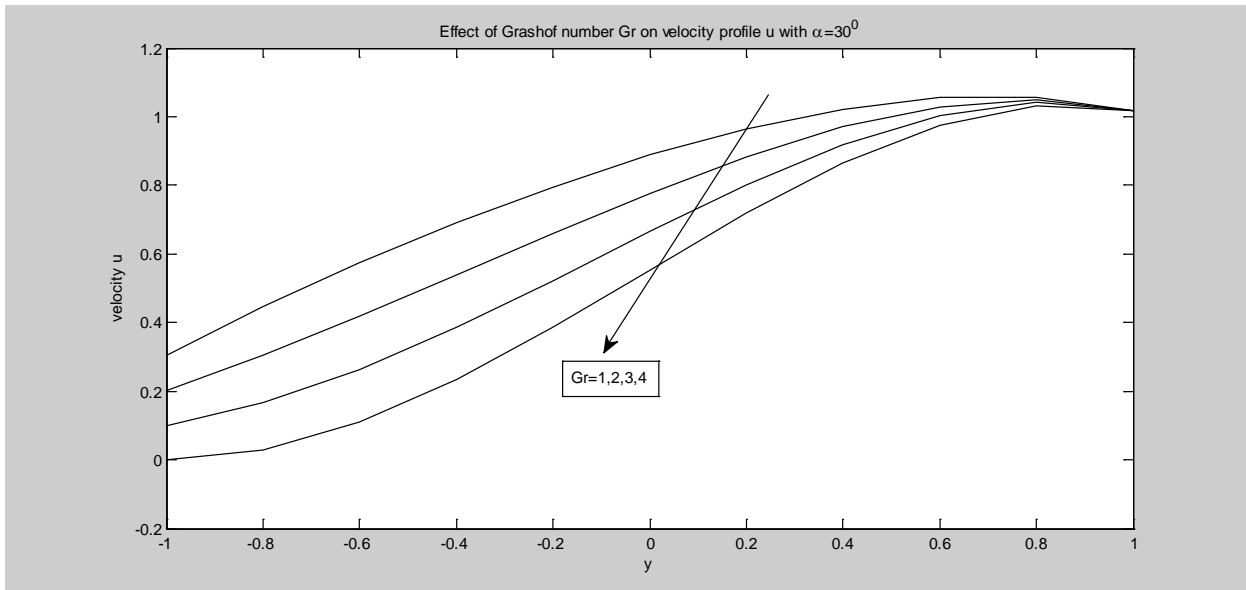


Figure 5: Effect of Grashof number Gr on velocity profile u with $\alpha = 30^\circ, B = 1, t = 0.5, \varepsilon = 0.02, Gc = 1, Ha = 1, N = 1$ and $\omega = 1$.

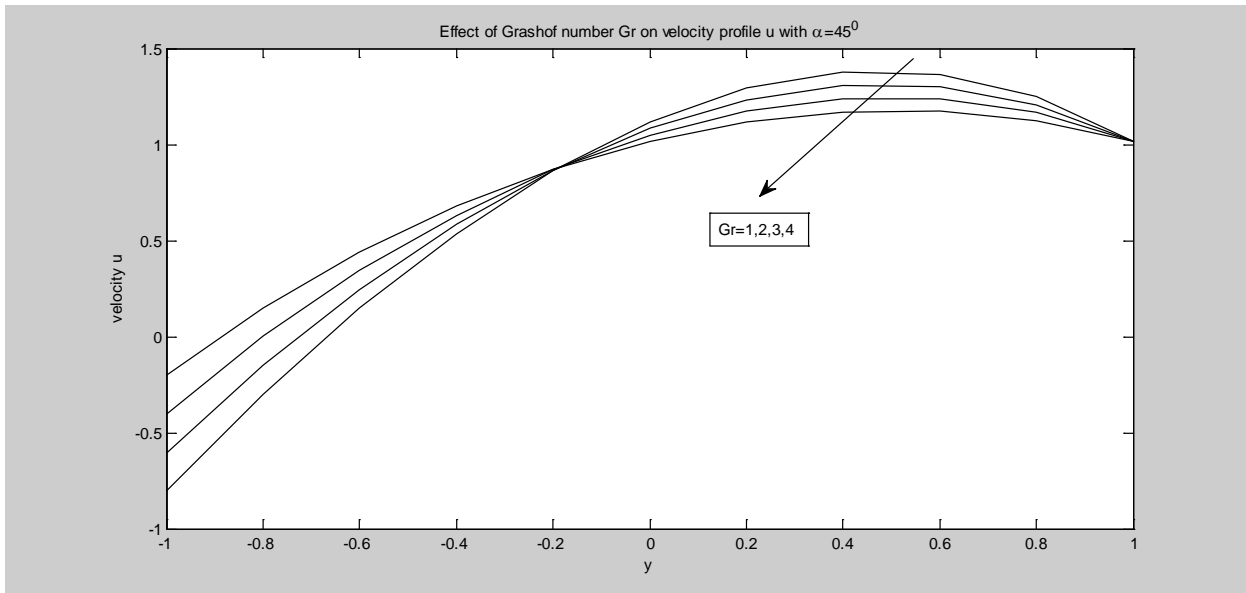


Figure 6: Effect of Grashof number Gr on velocity profile u with $\alpha = 45^\circ$, $B = 1$, $t = 0.5$, $\varepsilon = 0.02$, $Gc = 1$, $Ha = 1$, $N = 1$ and $\omega = 1$.

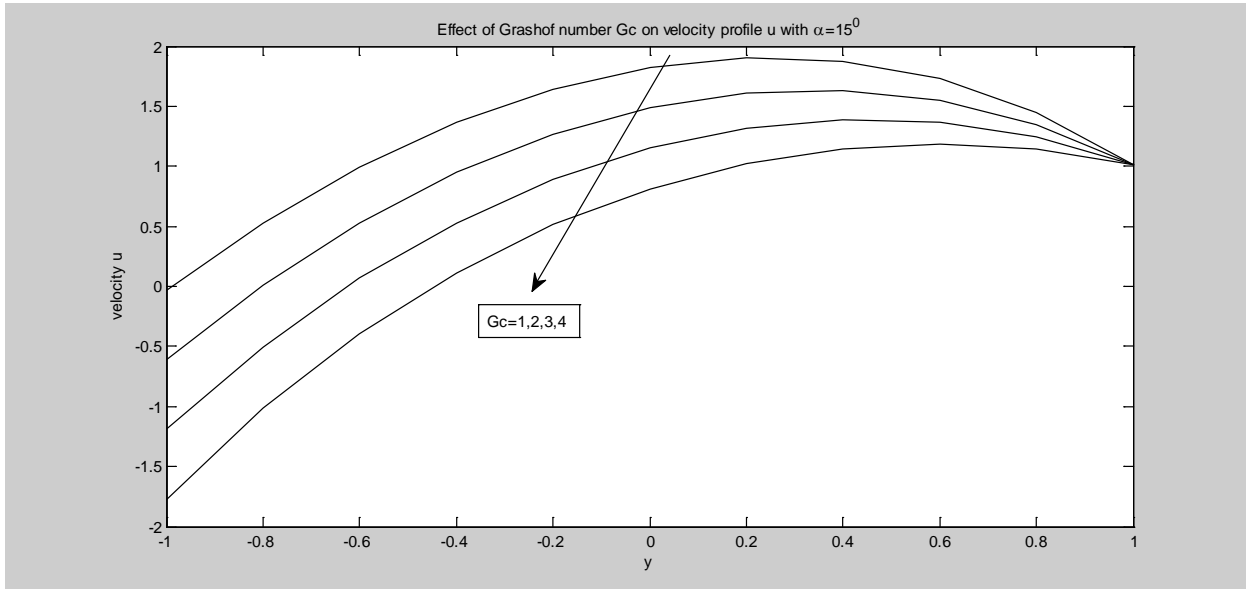


Figure 7: Effect of Grashof number Gc on velocity profile u with $\alpha = 15^\circ$, $B = 1$, $t = 0.5$, $\varepsilon = 0.02$, $Gr = 1$, $Ha = 1$, $N = 1$ and $\omega = 1$.

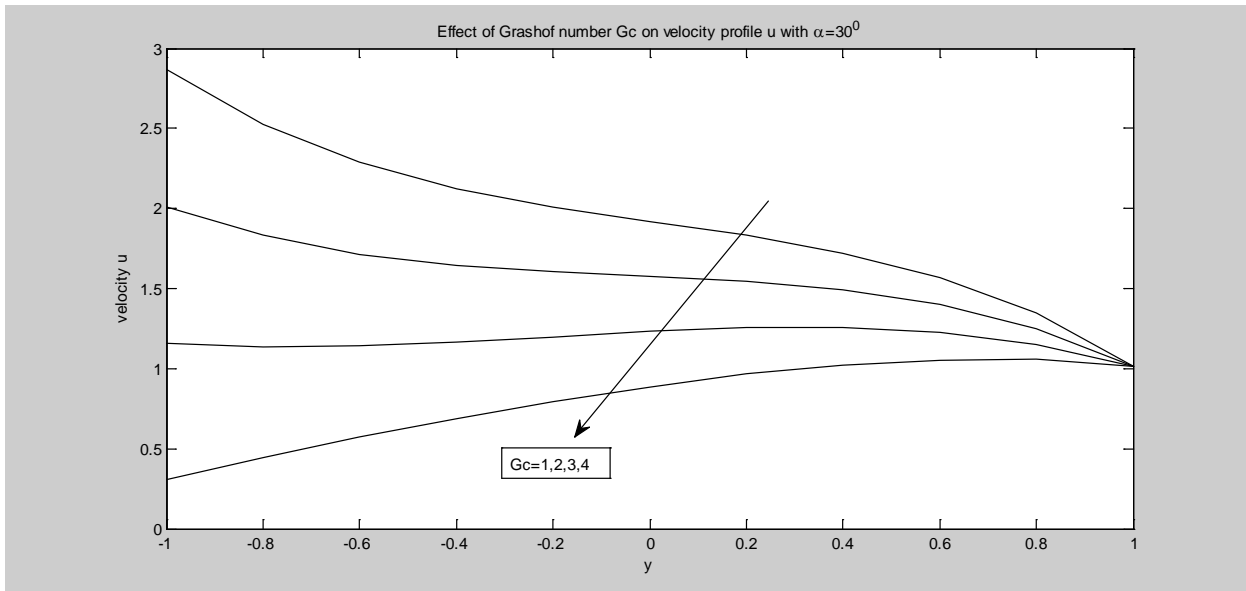


Figure 8: Effect of Grashof number G_c on velocity profile u with $\alpha = 30^\circ$, $B = 1$, $t = 0.5$, $\varepsilon = 0.02$, $Gr = 1$, $Ha = 1$, $N = 1$ and $\omega = 1$.

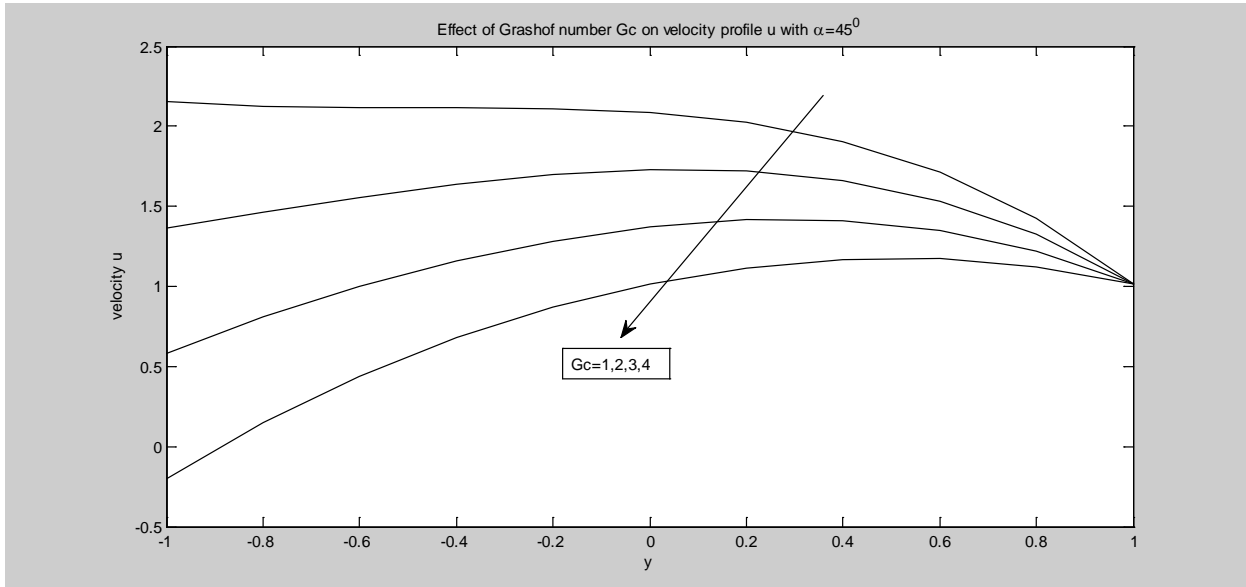


Figure 9: Effect of Grashof number G_c on velocity profile u with $\alpha = 45^\circ$, $B = 1$, $t = 0.5$, $\varepsilon = 0.02$, $Gr = 1$, $Ha = 1$, $N = 1$ and $\omega = 1$.

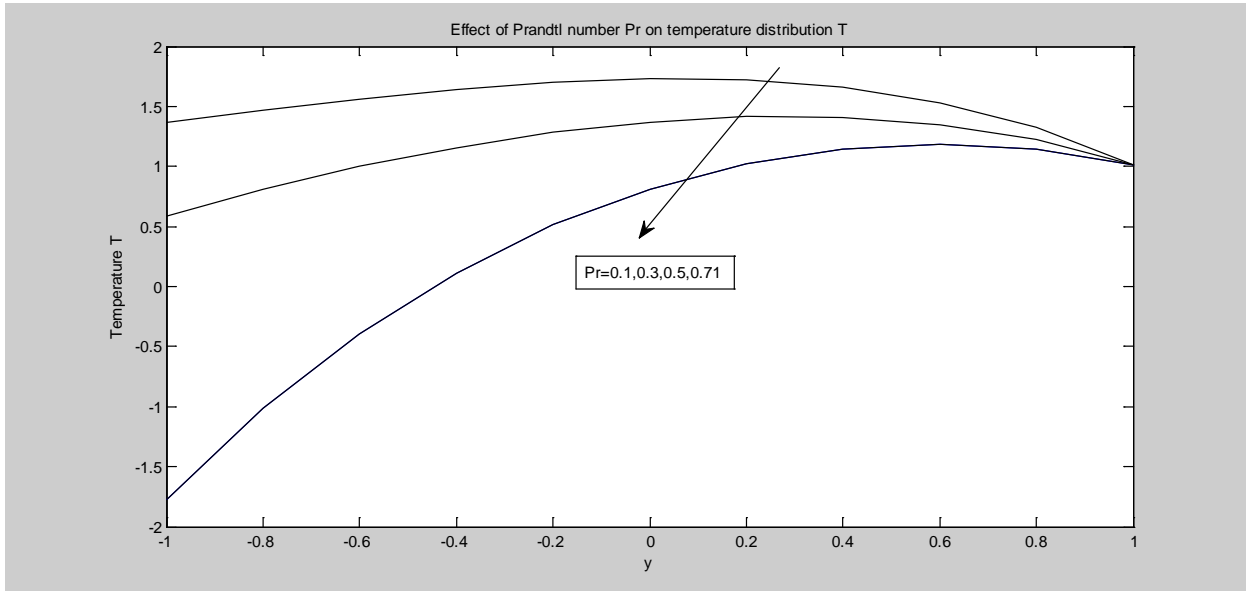


Figure 10: Effect of Prandtl number Pr on temperature distribution θ with $B = 1, t = 0.5, \varepsilon = 0.02, Gr = 1, Ha = 1, N = 1$ and $\omega = 1$.

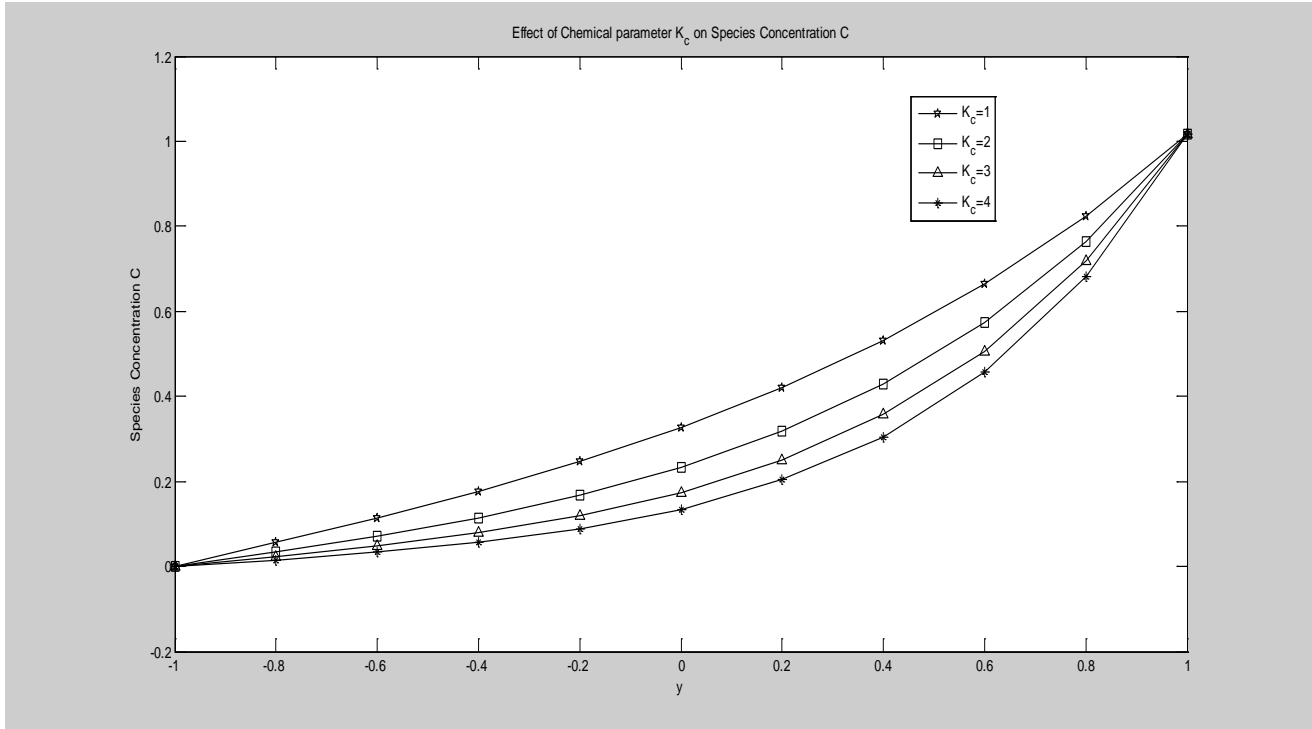


Figure 11: Effect of Chemical parameter K_c on Species Concentration C with $B = 1, t = 0.5, \varepsilon = 0.02, Gr = 1, Sc = 1, N = 1$ and $\omega = 1$.

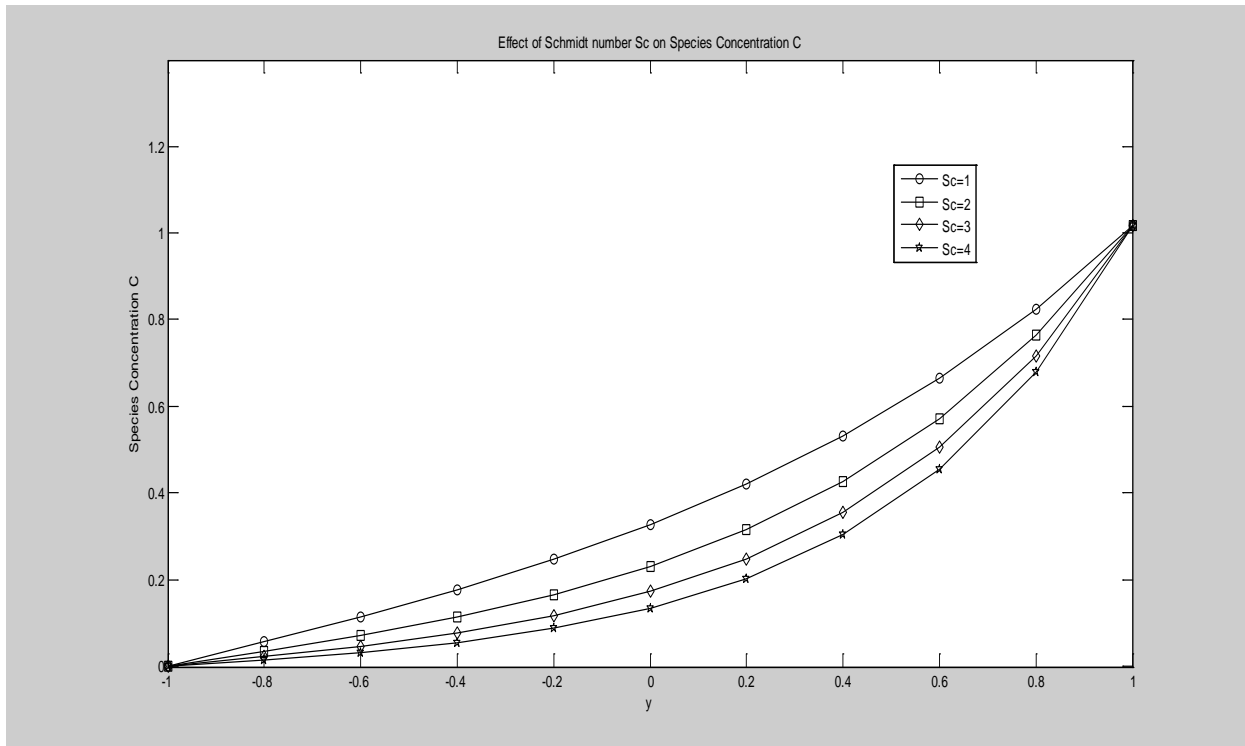


Figure 12: Effect of Schmidt number Sc on Species Concentration C with $Gr=1, Gc=1, B = 1, t = 0.5, \varepsilon = 0.02, Gr = 1, Kc = 1, N = 1$ and $\omega = 1$.

Table 1: Variation of skin frictions τ_1 and τ_2 , Nusselt numbers Nu_1 and Nu_2 and Sherwood numbers Sh_1 and Sh_2 with time t .

t	τ_1	τ_2	Nu_1	Nu_2	Sh_1	Sh_2
0.0	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
0.1	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
0.2	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
0.3	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373

0.4	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
0.5	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
0.6	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
0.7	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
0.8	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
0.9	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373
1.0	5.9958	-1.0028	1.0998	-0.4577	0.2757	1.0373

5. SUMMARY AND CONCLUSION

In this section, we studied the effect of heat and mass transfer on unsteady MHD poiseuille flow between two infinite parallel porous plates in an inclined magnetic field.

The governing equations, that is, the momentum, energy and species concentration equations have been written in dimensionless form using the dimensionless parameters.

Perturbation method was employed to evaluate and solve the velocity profile u , temperature distribution θ , the species concentration C , Skin frictions τ_1 and τ_2 , Nusselt numbers Nu_1 and Nu_2 and Sherwood numbers Sh_1 and Sh_2 .

The investigation of this research work leads to the following conclusions:

- ✓ At high Hartmann number Ha , the velocity decreased.
- ✓ Velocity increased due to effect of thermal Grashof number Gr and solutal Grashof number Gc .
- ✓ An increase in Prandtl number Pr decreased temperature.
- ✓ Species concentration reduced with increase in chemical parameter Kc and Schmidt number Sc .

This work can be applied in electric power generator, extrusion of plastics in the manufacture of rayon and nylon, extrusion of food in the manufacture of macaroni etc.

Appendix

CONSTANTS

$$m_1 = iN, m_2 = -iN, m_3 = \sqrt{ScKc}, m_4 = -\sqrt{ScKc}, m_5 = \frac{-A + \sqrt{A^2 + 4M^2}}{2}, m_6 = \frac{-A - \sqrt{A^2 + 4M^2}}{2}, m_7 = \sqrt{a_1}, m_8 = -\sqrt{a_1}; a_1 = i\omega Pr - N^2,$$

$$m_9 = \sqrt{ScL}, m_{10} = -\sqrt{ScL}; L = Kc - i\omega,$$

$$m_{11} = \frac{-A + \sqrt{A^2 + 4b}}{2}, m_{12} = \frac{-A - \sqrt{A^2 + 4b}}{2},$$

$$T_1 = K_1 + K_2 \cos N - K_3 \sin N + K_4 e^{-m_3} + k_5 e^{-m_4},$$

$$T_2 = K_1 + K_2 \cos N + K_3 \sin N + K_4 e^{m_3} + k_5 e^{m_4},$$

$$T_3 = K_6 e^{-m_7} + k_7 e^{-m_8} + K_8 e^{-m_9} + k_9 e^{-m_{10}},$$

$$T_4 = K_6 e^{m_7} + k_7 e^{m_8} + K_8 e^{m_9} + k_9 e^{m_{10}},$$

$$K_1 = \frac{Q}{M^2}, K_2 = \frac{-Gr(C_2 AN - C_1(M^2 + N^2))}{((M^2 + N^2)^2 - A^2 N^2)}, K_3 = \frac{Gr(C_2(M^2 + N^2) - C_1 AN)}{(A^2 N^2 + (M^2 + N^2))}, K_4 = \frac{-GcC_3}{(m_3^2 + Am_3 - M^2)}$$

$$K_5 = \frac{-GcC_4}{(m_4^2 + Am_4 - M^2)}, K_6 = \frac{-GrC_7}{m_7^2 + Am_7 - b}, K_7 = \frac{-GrC_8}{m_8^2 + Am_8 - b}, K_8 = \frac{-GcC_9}{m_9^2 + Am_9 - b},$$

$$K_9 = \frac{-GcC_{10}}{m_{10}^2 + Am_{10} - b},$$

$$C_1 = \frac{1}{2 \cos N}, C_2 = \frac{1}{2 \sin N}, C_3 = \frac{1 - C_4 e^{m_4}}{e^{m_3}}, C_4 = \frac{-e^{-m_3}}{(e^{m_3 - m_4} - e^{m_4 - m_3})},$$

$$C_5 = \frac{1 - T_2 - C_6 e^{m_6}}{e^{m_5}}, C_6 = \frac{-T_1 e^{m_5} - e^{-m_5} - T_2 e^{-m_5}}{(e^{m_5 - m_6} - e^{m_6 - m_5})}, C_7 = \frac{1 - C_8 e^{m_8}}{e^{m_7}},$$

$$C_8 = \frac{-e^{-m_7}}{(e^{m_7 - m_8} - e^{m_8 - m_7})}, C_9 = \frac{1 - C_{10} e^{m_{10}}}{e^{m_9}}, C_{10} = \frac{-e^{-m_9}}{(e^{m_9 - m_{10}} - e^{m_{10} - m_9})},$$

$$C_{11} = \frac{1-T_4-C_{12}e^{m_{12}}}{e^{m_{11}}}, C_{12} = \frac{-T_3e^{m_{11}}-e^{-m_{11}}-T_4e^{-m_{11}}}{e^{m_{11}-m_{12}}-e^{m_{12}-m_{11}}},$$

$$\tau_1 = m_5C_5e^{-m_5} + m_6C_6e^{-m_6} + NK_2\sin Ny + NK_3\cos Ny + m_3K_4e^{-m_3} + m_4K_5e^{-m_4} + \varepsilon(m_{11}C_{11}e^{-m_{11}} + m_{12}C_{12}e^{-m_{12}} + m_7K_6e^{-m_7} + m_8K_7e^{-m_8} + m_9K_8e^{-m_9} + m_{10}K_9e^{-m_{10}})e^{i\omega t},$$

$$\tau_2 = m_5C_5e^{m_5} + m_6C_6e^{m_6} - NK_2\sin Ny + NK_3\cos Ny + m_3K_4e^{m_3} + m_4K_5e^{m_4} + \varepsilon(m_{11}C_{11}e^{m_{11}} + m_{12}C_{12}e^{m_{12}} + m_7K_6e^{m_7} + m_8K_7e^{m_8} + m_9K_8e^{m_9} + m_{10}K_9e^{m_{10}})e^{i\omega t},$$

$$Nu_1 = NC_1\sin N + NC_2\cos N + \varepsilon(m_7C_7e^{-m_7} + m_8C_8e^{-m_8})e^{i\omega t},$$

$$Nu_2 = -NC_1\sin N + NC_2\cos N + \varepsilon(m_7C_7e^{m_7} + m_8C_8e^{m_8})e^{i\omega t},$$

$$Sh_1 = m_3C_3e^{-m_3} + m_4C_4e^{-m_4} + \varepsilon(m_9C_9e^{-m_9} + m_{10}C_{10}e^{-m_{10}})e^{i\omega t},$$

$$Sh_2 = m_3C_3e^{m_3} + m_4C_4e^{m_4} + \varepsilon(m_9C_9e^{m_9} + m_{10}C_{10}e^{m_{10}})e^{i\omega t}$$

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CHEMICALLY REACTING FLUID ON UNSTEADY MHD OSCILLATORY SLIP FLOW IN A PLANER CHANNEL WITH VARYING TEMPERATURE AND CONCENTRATION IN THE PRESENCE OF SUCTION/INJECTION.

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ABSTRACT

This paper examined the problem of unsteady MHD mixed convective oscillatory flow of an electrically conducting optically thin fluid through a planer channel filled with saturated porous medium. The effect of buoyancy, heat source, thermal radiation and chemical reaction of the fluid were taken into considerations with slip boundary condition, varying temperature and concentration. The closed-form analytical solutions are obtained for the momentum, energy and concentration equations. It was discovered that the velocity increases with increase in ω , and Gr . While the velocity decreases with increase in M , Gm , K and γ . The temperature increases with increase in R , α and $d2$. The concentration increases with increase in Sc , while it decreases with increase in $d1$ and K_r . The effect of skin friction, the rate of heat and mass transfer coefficients at the walls are shown in the tables.

Key words: chemical reaction, MHD, oscillatory flow, planer channel.

1. INTRODUCTION

Oscillatory flows has known to result in higher rates of heat and mass transfer, many studies have been done to understand its characteristics in different systems such as reciprocating engines, pulse combustors and chemical reactors. Cramer, K. R. and Pai, S. I. [1] taken transverse applied magnetic field and

magnetic Reynolds number are assumed to be very small, so that the induced magnetic field is negligible. Muthucumaraswamy et al. [2] have studied the effect of homogenous chemical reaction of first order and free convection on the oscillating infinite vertical plate with variable temperature and mass diffusion. Sharma [3] investigate the effect of periodic heat and mass transfer on the unsteady free convection flow past a vertical flat plate in slip flow regime when suction velocity oscillates in time. Chaudhary and Jha [4] studied the effects of chemical reactions on MHD micropolar fluid flow past a vertical plate in slip-flow regime. Anjalidevi et al. [5] have examined the effect of chemical reaction on the flow in the presence of heat transfer and magnetic field. Muthucumaraswamy et al. [6] have investigated the effect of thermal radiation effects on flow past an impulsively started infinite isothermal vertical plate in the presence of first order chemical reaction. Moreover, Al-Odat and Al-Azab [7] studied the influence of magnetic field on unsteady free convective heat and mass transfer flow along an impulsively started semi-infinite vertical plate taking into account a homogeneous chemical reaction of first order. The effect of radiation on the heat and fluid flow over an unsteady stretching surface has been analyzed by El-Aziz [8]. Singh et. al. [9] studied the heat transfer over stretching surface in porous media with transverse magnetic field. Singh et. al. [10] and [11] also investigated MHD oblique stagnation-point flow towards a stretching sheet with heat transfer for steady and unsteady cases. Elbashbeshy et. al. [12] investigated the effects of thermal radiation and magnetic field on unsteady boundary layer mixed convection flow and heat transfer problem from a vertical porous stretching surface. Ahmed Sahin studied influence of chemical reaction on transient MHD free Convective flow over a vertical plate.

Recently, the chemical reaction, heat and mass transfer on MHD flow over a vertical stretching surface with heat source and thermal stratification have been presented by Kandasamy et al. [13]. The opposing buoyancy effects on simultaneous heat and mass transfer by natural convection in a fluid saturated porous medium investigated by Angirasa et al.[14]. Ahmed [15] investigates the effects of unsteady free convective MHD flow through a porous medium bounded by an infinite vertical porous plate. Ahmed Sahin [16] studied the Magneto hydrodynamic and chemical reaction effects on unsteady flow, heat and mass transfer characteristics in a viscous, incompressible and electrically conduction fluid over a semi-infinite vertical porous plate in a slip-flow regime. V. SriHari Babu and G. V. Ramana Reddy [17] analyzed the Mass transfer effects on MHD mixed convective flow from a vertical surface with Ohmic heating and viscous dissipation. Satya Sagar Saxena and G. K. Dubey [18] studied the effects of MHD free convection heat and mass transfer flow of visco-elastic fluid embedded in a porous medium of variable permeability with radiation effect and heat source in slip flow regime. Unsteady MHD heat and

mass transfer free convection flow of polar fluids past a vertical moving porous plate in a porous medium with heat generation and thermal diffusion was analysed by Satya Sagar Saxena and G. K. Dubey [19]. Sudeerbabu et al [20] analyzed the radiation and chemical reaction effects on an unsteady MHD convection flow past a vertical moving porous plate embedded in a porous medium with viscous dissipation. Unsteady MHD free convection flow and mass transfer near a moving vertical plate in the presence of thermal radiation is studied by Seethamahalakshmi et al [21].

To the best of the author’s knowledge, studies pertaining to oscillatory flow investigations in a planer channel with variable temperature and concentration have not received much attention. Therefore, the main goal here is to study the chemical reaction effects on unsteady MHD oscillatory slip flow in an optically thin fluid through a planer channel in the presence of a temperature-dependent heat source. The closed form solutions for velocity, temperature, skin friction, concentration, Nusselt number, and Sherwood number are presented. The effects of pertinent parameters on fluid flow of heat and mass transfer characteristics are studied in detail and presented graphically and discussed qualitatively.

2. FORMATION OF THE PROBLEM

We consider the unsteady mixed convection, two dimensional slip flow of an electrically conducting, heat generating, optically thin and chemically reacting oscillatory fluid flow in a planer channel filled with porous medium in the presence of thermal radiation with temperature and concentration variation. Take a Cartesian coordinate system (x', y') where x' – axis is taken along the flow and y' – axis is taken normal to the flow direction. A uniform transverse magnetic field of magnitude B_0 is applied in the presence of thermal and Solutal buoyancy effects in the direction of y' – axis. Then, assuming a Boussinesq incompressible fluid model, the equations governing the motion are given as:

$$\frac{\partial v'}{\partial y'} = 0 \tag{1}$$

$$\frac{\partial u'}{\partial t'} = -\frac{1}{\rho} \frac{\partial P'}{\partial x'} + v \frac{\partial^2 u'}{\partial y'^2} + g\beta(T' - T'_1) + g\beta^*(C' - C'_1) \tag{2}$$

$$-\frac{v}{K'} u' - \frac{\sigma B_0^2}{\rho} u' - v' \frac{\partial u'}{\partial y'}$$

$$\frac{\partial T'}{\partial t'} = \frac{k}{\rho C_p} \frac{\partial^2 T'}{\partial y'^2} - \frac{1}{\rho} \frac{\partial q_r'}{\partial y'} + Q \frac{(T' - T_1')}{\rho C_p} - v' \frac{\partial T'}{\partial y'} \quad (3)$$

$$\frac{\partial C'}{\partial t'} = D \frac{\partial^2 C'}{\partial y'^2} - K_r'(C' - C_1') - v' \frac{\partial C'}{\partial y'} \quad (4)$$

Where $v' = -v_0(1 + \epsilon e^{i\omega t})$ is suction velocity.

The appropriate boundary conditions of the problem are

$$u' = L_1 \frac{\partial u'}{\partial y'}, T' = T_1' + \delta_T^* \frac{\partial T'}{\partial y'}, C' = C_1' + \delta_C^* \frac{\partial C'}{\partial y'} \quad \text{at } y' = 0 \quad (5)$$

$$u' = 0, T' = T_2' + \delta_T^* \frac{\partial T'}{\partial y'}, C' = C_2' + \delta_C^* \frac{\partial C'}{\partial y'} \quad \text{at } y' = d \quad (6)$$

where u', v' - the velocity components in the x', y' directions respectively, ν - the kinematics viscosity, k - the thermal conductivity, β - the coefficient of volume expansion due to temperature, β^* - the coefficient of volume expansion due to concentration, ρ - the density, σ - the electrical conductivity of the fluid, g - the acceleration due to gravity, T' - the temperature, T_1' - wall temperature of the fluid, q_r' - the radiation heat flux, C' -the concentration, C_1' - wall concentration of the fluid and K_r' - chemical reaction parameter, L_1 - mean free path, C_p - specific heat at a constant pressure and D - mass diffusivity.

The radiative heat flux (Cogley *et al.* [22]) is given by

$$\frac{\partial q_r'}{\partial y'} = 4(T_1' - T)I', \text{Where } I' = \int_0^\infty K_{\lambda w} \frac{\partial e_{b\lambda}}{\partial T} d\lambda \quad (7)$$

Where $K_{\lambda w}$ -radiation absorption coefficient at the wall, $e_{b\lambda}$ -Planck's function.

Introducing the following non-dimensional quantities

$$x = \frac{x'}{d}, y = \frac{y'}{d}, P = \frac{dP'}{\mu u_0}, u = \frac{u'}{u_0}, \theta = \frac{T' - T_1'}{T_2 - T_1}, \phi = \frac{C' - C_1'}{C_2 - C_1}, t = \frac{u_0 t'}{d}, Re = \frac{u_0 d}{\nu}, \gamma = \frac{K'}{d^2}, M = \frac{\sigma B_0^2 d^2}{\mu}, Gr = \frac{g\beta(T_2 - T_1)d^2}{\nu u_0}, Gc = \frac{g\beta^*(C_2 - C_1)d^2}{\nu u_0}, R = \frac{4I'd^2}{k}, Pe = \frac{\rho C_p u_0 d}{k}, Sc = \frac{D}{u_0 d}, Kr = \frac{K_r'}{u_0}, d_2 = \frac{\delta_T^*}{d}, d_1 = \frac{\delta_C^*}{d}, k' = kd^2$$

In view of the above dimensionless variables, the basic field equations (2) to (4) can be expressed in non-dimensional form as

$$Re \frac{\partial u}{\partial t} = -\frac{\partial P}{\partial x} + \frac{\partial^2 u}{\partial y^2} + \lambda_1 \frac{\partial u}{\partial y} + Gr\theta + Gc\phi - (M + \frac{1}{K})u \quad (9)$$

$$Pe \frac{\partial \theta}{\partial y} = \frac{\partial^2 \theta}{\partial y^2} + Pe \lambda_2 \frac{\partial \theta}{\partial y} + (C_p R + \alpha)\theta \quad (10)$$

$$\frac{\partial \phi}{\partial t} = Sc \frac{\partial^2 \phi}{\partial y^2} + \lambda_3 \frac{\partial \phi}{\partial y} - K_r \phi \quad (11)$$

The corresponding boundary conditions for $t > 0$ are transformed to:

$$u = \gamma \frac{\partial u}{\partial y}, \theta = d_2 \frac{\partial \theta}{\partial y}, \phi = d_1 \frac{\partial \phi}{\partial y} \text{ at } y = 0 \quad (12)$$

$$u = 0, \theta = 1 + d_2 \frac{\partial \theta}{\partial y}, \phi = 1 + d_1 \frac{\partial \phi}{\partial y} \text{ at } y = 1$$

where $P, Re, M, K, Pe, R, Sc, \lambda, d_1, d_2, Gr, Gc$ and γ are pressure, Reynolds number, magnetic parameter, permeability parameter, Peclet number, thermal radiation parameter, Schmidt number, real constant, volumetric concentration expansion, volumetric thermal expansion, thermal Grashof number, Solutal Grashof number and slip parameter respectively.

3. SOLUTION OF THE PROBLEM

In order to solve equations (9) - (11) with respect to the boundary conditions (12) for purely oscillatory flow, let us take

$$u(y, t) = u_o(y)e^{i\omega t} \quad (13)$$

$$\theta(y, t) = \theta_o(y)e^{i\omega t} \quad (14)$$

$$\phi(y, t) = \phi_o(y)e^{i\omega t} \quad (15)$$

$$-\frac{\partial P}{\partial x} = e^{i\omega t} \quad (16)$$

Substituting the Equations (13)-(16) in Equations (9)-(12), we obtain:

$$u_0''(y) + a_1 u_0'(y) - a_2 u_0 = -(\lambda + Gr\theta_0 + Gc\phi_0) \quad (17)$$

$$\theta_0''(y) + a_5 \theta_0' + a_6 \theta_0 = 0 \quad (18)$$

$$\phi_0''(y) + a_3 - a_4 \phi_0 = 0 \quad (19)$$

Where prime denotes ordinary differentiation with respect to y.

The corresponding boundary conditions can be written as

$$u_0 = \gamma u_0', \theta_0 = d_2 \theta_0', \phi_0 = d_1 \phi_0' \quad \text{At } y=0 \quad (20)$$

$$u_0 = 0, \theta_0 = 1 + d_2 \theta_0', \phi_0 = d_1 \phi_0' \quad \text{At } y=1$$

Solving equations (17) – (19) under the boundary conditions (20), we obtain the velocity, temperature and concentration distribution in the boundary layer as:

$$u_0(y, t) = A_1 e^{m_1 y} + A_2 e^{m_2 y} + K_1 + K_2 e^{m_5 y} + K_3 e^{m_6 y} + K_4 e^{m_3 y} + K_5 e^{m_4 y}$$

$$\theta_0(y, t) = A_5 e^{m_5 y} + A_6 e^{m_6 y}$$

$$\phi_0(y, t) = A_3 e^{m_3 y} + A_4 e^{m_4 y}$$

Where

$$K_1 = \frac{\lambda_1}{a_2}, K_2 = \frac{-GrA_5}{m_5^2 + a_1 m_5 - a_2}, K_3 = \frac{-GrA_6}{m_6^2 + a_1 m_6 - a_2}, K_4 = \frac{-GrA_3}{m_3^2 + a_1 m_3 - a_2}, K_5 = \frac{-GrA_4}{m_4^2 + a_1 m_4 - a_2}, A_1 = \frac{K_{14}}{K_{12}} -$$

$$\frac{K_{13}}{K_{12}} K_{18}, A_2 = K_{18}, A_3 = \frac{-k_{20} \sin n\pi}{k_{19}}$$

$$A_4 = \sin n\pi, A_5 = \frac{k_7}{k_7 k_8 - k_6 k_9}, A_6 = \frac{-k_6}{k_7 k_8 - k_6 k_9}, m_1 = \frac{-a_1 + \sqrt{a_1^2 - 4a_2}}{2}, m_2 = \frac{-a_1 - \sqrt{a_1^2 - 4a_2}}{2}, m_3 =$$

$$\frac{-a_3 + \sqrt{a_3^2 - 4a_4}}{2}, m_4 = \frac{-a_3 - \sqrt{a_3^2 - 4a_4}}{2}, m_5 = \frac{-a_5 + \sqrt{a_5^2 - 4a_6}}{2}, m_6 = \frac{-a_5 - \sqrt{a_5^2 - 4a_6}}{2}, a_1 = \lambda_1, a_2 = M +$$

$$\frac{1}{k} + iwRe, a_3 = \frac{\lambda_3}{Sc}, a_4 = \frac{(K_r + iw)}{Sc}, a_5 = Pe \lambda_2 iw, a_6 = R + \alpha - Peiw, k_6 = 1 - d_2 m_5, k_7 = 1 - d_2 m_6, k_8 = (e^{m_5} - m_5 e^{m_5}), k_9 = (e^{m_6} - m_6 e^{m_6}), K_{10} = K_1 + K_2 + K_3 + K_4 + K_5, K_{11} = \gamma(K_2 m_5 + K_3 m_6 + K_4 m_3 + K_5 m_4), K_{12} = (1 - \gamma m_1), K_{13} = (1 - \gamma m_2), K_{14} = K_{11} - K_{10}, K_{15} = K_1 + K_2 e^{m_5} + K_3 e^{m_6} + K_4 e^{m_3} + K_5 e^{m_4}, K_{16} = e^{m_1}, k_{17} = e^{m_2}, K_{18} = \frac{K_{14} K_{16} + K_{12} K_{15}}{K_{13} K_{16} - K_{12} K_{17}};$$

The shear stress, the coefficient of the rate of heat transfer and the rate of mass transfer at any point in the fluid can be characterized by

$$\tau^* = -\mu \frac{\partial u}{\partial y}, Nu^* = -k \frac{\partial T}{\partial y}, Sh^* = -D \frac{\partial C}{\partial y},$$

In dimensional form

$$\tau = \frac{\tau^* d}{\mu u_0} = -\frac{\partial u}{\partial y}, Nu = -\frac{Nu^* d}{x(T_1 - T_0)} = -\frac{\partial \theta}{\partial y}, Sh = -\frac{Sh^* d}{c_1 - c_0} = -\frac{\partial \phi}{\partial y}$$

The skin-friction (τ), the Nusselt (Nu) and the Sherwood number (Sh) at the walls $y = 0$ and $y = 1$ are given by

$$\tau_0 = -\frac{\partial u}{\partial y} \Big|_{y=0}, \quad \tau_1 = -\frac{\partial u}{\partial y} \Big|_{y=1},$$

$$Nu_0 = -\frac{\partial \theta}{\partial y} \Big|_{y=0}, \quad Nu_1 = -\frac{\partial \theta}{\partial y} \Big|_{y=1},$$

$$Sh_0 = -\frac{\partial \phi}{\partial y} \Big|_{y=0}, \quad Sh_1 = -\frac{\partial \phi}{\partial y} \Big|_{y=1}.$$

DISCUSSION OF RESULTS

To study the effect of heat and mass transfer in an MHD oscillatory flow in a planer channel with varying temperature and concentration in the presence of suction and injection, the velocity u , temperature θ and the species concentration ϕ profiles are depicted graphically against y for different values of different parameters; magnetic parameter m , frequency of oscillation ω , thermal Grashof number Gr , modified Grashof number Gc , permeability parameter K , Slip parameter γ , Thermal radiation parameter R , Heat

source parameter α , Volumetric concentration expansion $d1$, Volumetric temperature expansion $d2$, Schmid number Sc , Chemical radiation parameter Kr . The graphs are plotted using MATLAB where only the real parts of the equation were considered. Throughout the computations the values used were, $t = 1, M = 2, Re = 1, Gr = 2, Gc = 1, R = 2, \alpha = 3, Pe = 4, Kr = 2, Sc = 1, g = 0.1, d1 = 0.002, d2 = 0.002, \omega = 0.5$ except where a parameter is varied.

In Fig 1, increase in the magnetic field intensity initially increases the velocity field at first, thereafter the velocity begins to decrease as it increases. The effect of magnetic field is found to have a zero effect on the velocity field as we far away from the plate. In fig 2, it is noticed that, increased in the frequency of excitation lead to an increase in the velocity profile. In Fig 3, while all other parameters are held constant, increase in the thermal grashof number raise in the velocity field. In Fig 4, increases in the modified grashof number contribute to decrease in the velocity field. In Fig 5, increase in the permeability coefficient of the porous medium against the porosity of the porous medium decreases the fluid velocity. In Fig 6, increase in the slip parameter has the tendency to reduce the friction forces which reduces the fluid velocity. In Fig 7, increase in the radiation parameter increases the temperature distribution because large values of radiation parameter oppose the conduction over radiation, thereby increases the buoyancy force and increases the thickness of the thermal boundary layer. In Fig 8, increase in the heat source parameter significantly increases the thermal buoyancy effects which raise fluid temperature. In Fig 9, increase in temperature variation parameter initially increases the temperature and thereafter decreases it as we move away from the plate. In Fig 10, increase in the Schmidt number increases the species concentration (mass transfer). In fig 11, increase in the concentration variation parameter decreases the fluid concentration. In Fig 12, increase in the chemical radiation parameter decreases the concentration profile.

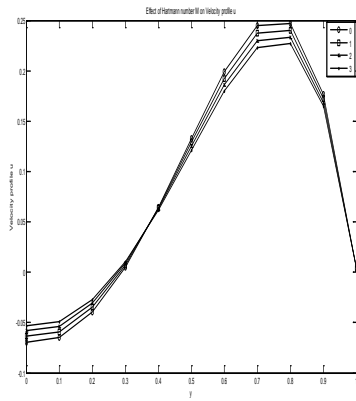


Fig.1. Velocity profile for different values of M

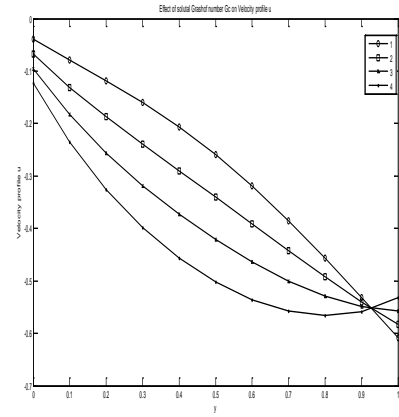


Fig.4. Velocity profiles for different values of Gc.

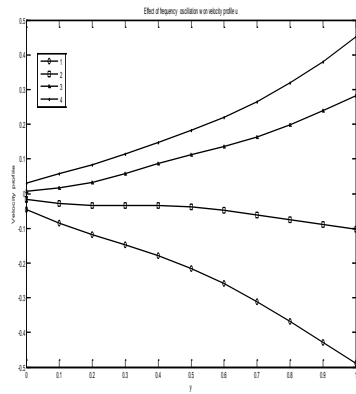


Fig.2. Velocity profiles for different values of ω .

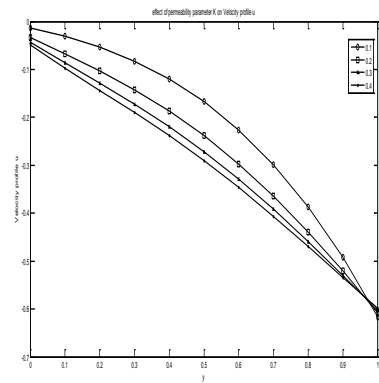


Fig.5. Velocity profiles for different values of K

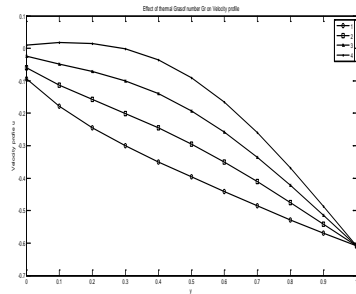


Fig.3. Velocity profiles for different value Gr

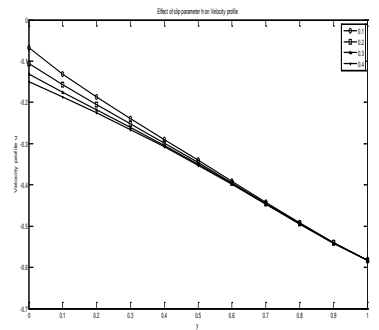


Fig.6. Velocity profiles for different values of γ

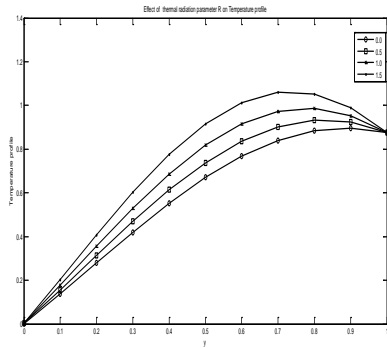


Fig.7. Temperature profiles for different values of R

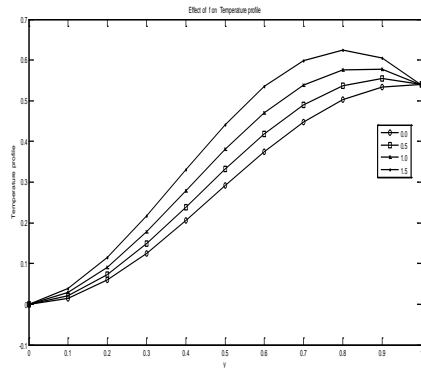


Fig.8. Temperature profiles for different values of α .

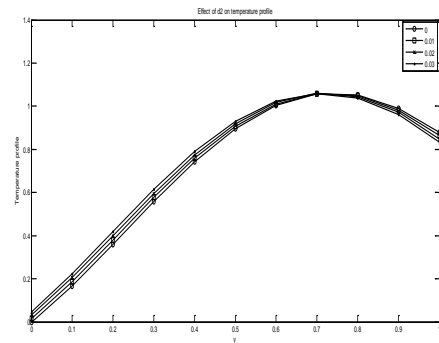


Fig.9. temperature profiles for different values of $d2$.

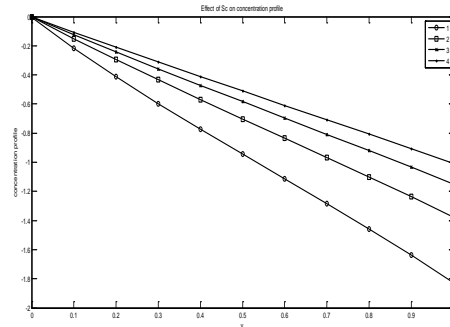


Fig.10. Concentration profiles for different values of Sc

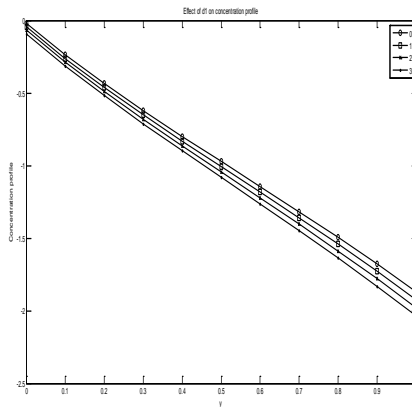


Fig.11. Concentration profiles for different values of $d1$.

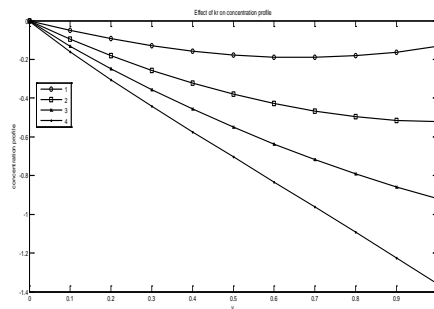


Fig.12. Concentration profiles for different values of Kr .



CONCLUSION AND RECOMMENDATION

The problem of unsteady MHD mixed convective oscillatory flow of an electrically conducting optically thin fluid through a planar channel filled with saturated porous medium has been examined. The effect of buoyancy, heat source, thermal radiation and chemical reaction of the fluid were taken into considerations with slip boundary condition, varying temperature and concentration. It was discovered that the velocity increases with increase in ω , and Gr . While the velocity decreases with increase in M , Gm , K and γ . The temperature increases with increase in R , α and d_2 . The concentration increases with increase in Sc , while it decreases with increase in d_1 and K_r .

It is concluded that the results obtained in a chemically reacting fluid on MHD oscillatory slip flow in a planar channel with varying temperature and concentration in the presence of suction/injection have a great applications in different systems such as reciprocating engines, pulse combustors and chemical reactors.



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Facial Emotion Recognition with Facial Analysis

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Abstract

Computer vision techniques are used in many fields such as traffic control, event monitoring, marketing, healthcare field, quality control, military technology, etc. One of the sub-areas of computer vision is facial expression recognition. Facial expressions which can be classified fear, happiness, joy, sadness, aggressiveness are recognizable with computer vision technics. In this study, we developed a system which can perceive four facial expressions are confused, happy, sad and normal. At the first step of the system, human faces are detected and located in an image. In the second step, eyes and mouth are detected in facial areas. Then, Bezier Curves are generated using the mouth and eyes with computer graphics technics. Each curve is compared with previously defined curves in the database and finally system decides emotion of face. Experimental results show that, the system performance is well enough for face emotions recognition and it can be use real-time

Keywords: *Computer Vision, Face Detection, Facial Emotion Recognition, Human-Computer Interaction, OpenCV.*

1. Introduction

With the enhancement of computer hardware and software, Computer vision became very popular research area. And it has been used many areas like traffic control, event monitoring, marketing [1], lie detection (especially in the area of emotion recognition) [2], criminality analysis [3], video games, human-computer interaction [4], security, safety [5], healthcare field, quality control, war technology, etc.

Facial emotion recognition is one of the specific issues of computer vision. Emotions which can be classified like fear, happiness, joy, sadness, aggressiveness are recognizable facial expressions using computer vision. Emotional expressions at face are related to the movements or positions of the muscles under the skin and are a form of nonverbal agreement [6]. According to a study; words are

important 7 percent, voice tone 38 percent and the effect of body language is 55 percent in a communication [7]. Analysis of emotions for humans can be used in many areas such as suspect tracking, patient monitoring, human-machine interaction and marketing [6].

The facial emotion detection is a difficult process for machines even facial expressions sometimes can't be understood by people [8]. One of the reasons of this complexity is two different facial expressions can be seen at a face at the same time and another reason is facial expressions differ from person to person [8], [9].

Face detection, face direction recognition, emotion recognition, face recognition, etc. are important for computer vision based system. For instance, security officers monitor videos from security cameras. Security officers are loose attention 45 percent after 12 minutes and after 22 minutes, this rate would be 95 percent [5]. In this respect, development of the abovementioned fields is very important for automatic computer monitoring. Also, computers can help effectively to the users [10] and robots can behave like humans[11].

According to [12] the eyes, nose, hair and ears give a lot of information about behavior. Using this information, we developed a system which can recognize four facial emotions with analysis of eyes and we added lip features in order to ease recognition. The eyes and lips on a face are converted lines with Bezier Curves and in this way a facial silhouette is generated. After this phase, the silhouette is compared with silhouettes which are stored in a database. At the end of the comparison, decision facial emotion is determined by the system.

After this introduction, the rest of paper is organized as can be seen below. The next section includes some works about facial emotion recognition. Section 3

describes our works and methodology. The final section has results and some suggestions.

2. Related Works

Computer vision applications have been studied for years. Facial emotion recognition is one of the sub-branch of computer vision. In this area, there are several applications and approaches. In view of these approaches, a Support Vector Machine (SVM) becomes prominent for classification.

Generally, the studies have a flow. According to the flow, first step is face segmentation and then the frames have a preprocessing process. The next step is feature extraction and then moves on to the classification process. The general flow is given Fig. 1.

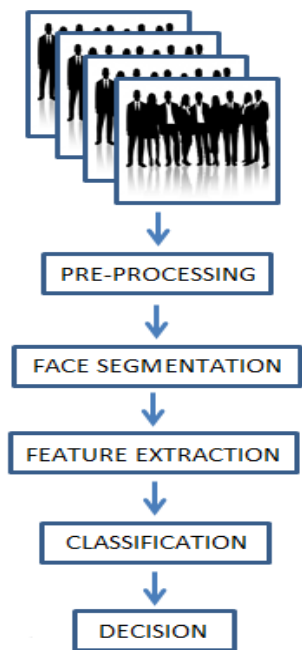


Fig. 1. General recognition flow

Kurt et al., use Artificial Neural Network (ANN) and skin analysis for face detection. Local Binary Pattern (LBP) was used for feature extraction and nearest neighbor approach was used for classification in their study [8]. Smiling, natural and sadness are recognized by their system and their accuracy is %77. In this study, multiple emotions may be rated at the same time, at the same face. Because, a face can reflect smiling and at the same time the owner of the

face can be sad at the same time. In [9], OpenCV face detector was used in order to detect face location in each frame. Histograms of oriented was used in order to extraction feature vectors and SVM with Radial Basis Function kernels were used for classification process. Their accuracy is 70 percentages. Anger, fear, joy, relief and sadness are recognized by the system. Dhall et al. used Pyramid of Histogram of Gradients and Local Phase Quantization (LPQ) for feature extraction. Constraint Local Model was used for face detection and for classification, they used SVM and Largest Margin Nearest Neighbours. In the study [2], Anger, fear, joy, relief and sadness could be recognized by their system with high performance. Tariq et al. presented a paper about emotion recognition [11]. Pittpat Face Detection and Tracking Library were used in order to capture and track the face location. Hierarchical Gaussianization, Scale Invariant Feature Transform (SIFT) and Optic Flow methods were used in feature selection and the classification method was SVM. Result of the study is approximately %80. Conneau and Essid presented a different approach in their paper [13] about feature extraction. For this purpose, electroencephalographic signal was used. SVM is its method for decision part as the same of the others. Their accuracy rate is 78 percentages. Yang and Bhanu's paper [14] includes a study about recognition of facial expression using a model with emotion avatar image. After the face detection, SIFT flow algorithm was used in order to register each frame with an avatar face model. For feature extraction, LBP and LPQ methods were used and in classification step, SVM was suggested. Cruz et al. used Boosted Cascade of Haar-like Features in order to detected face location in their study [4]. LPQ was used for feature extraction. SVM and Hidden Markov Model were used for decision step. De et al. recognized 5 emotions which are surprise, sorrow, fear, anger, happiness in their study [6]. Face detection process was actualized with HSV color space and for feature extraction, Principal Component Analysis are used. Euclidean Distance was used to decision. The study's performance is approximately %85.

There are different examples in literature for emotion recognition. For instance, some studies include voice recognition with computer vision to detect the emotions. These studies' name is audio-visual

emotion recognition. [10], [15], [16] are some examples of the works.

3. System Approach

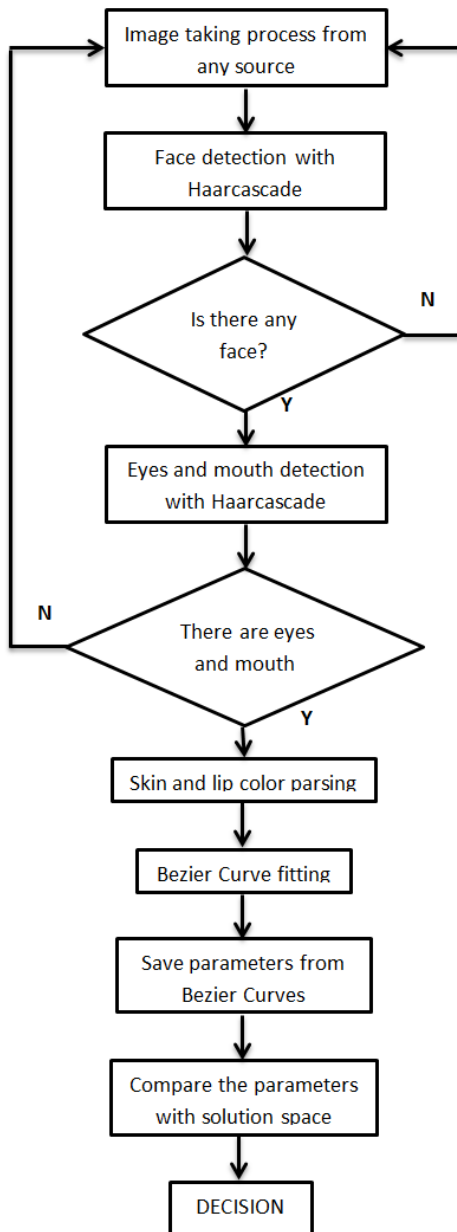


Fig. 2. The flow of the system

Our system consists of several stages. Firstly, an image is taken from a computer or a camera. The next stage is face detection with Haar Cascade Classification. If a face is found in the image, eyes

and mouth detection step is started. With eyes and mouth detection, lip location is marked and Bezier Curves is generated according to the marked location by the system. Some parameters are collected from the curves and store a database in order to compare with solution space. After the comparing, system gives decision about the face emotion which can be confused, happy, sad and normal. Flow of the system is shown Fig 2.

C# was used for coding and EmguCV library was used some computer vision process. EmguCV is a wrapper in order to access Open CV's ability on .NET Framework. In this project, face, eyes and mouth detection was performed with the OpenCV via EmguCV. Haar Cascade Classification is in OpenCV.

In face detection step, the image is converted grey scale and face detection is performed by haarcascad_frontalface_default.xml. We used this classifier because of its speed. Face location is cropped and transformed 200*200 pixels. After the detection of eyes and mouth, skin color locations are changed with white color and eyes with mouth locations are changed with black color. After this stage, Bezier Curves is generated from marked area (black color location). An overview for the Bezier Curve of a mouth is represented Fig. 3.



Fig. 3. An example of Bezier Curves of confused state

There are some examples of Bezier Curves for confused, happy, sad and normal situation in solution space. After the generated Bezier Curves process, this new shape is compared with our solution space and system give a decision. A general overview is presented Fig. 4.

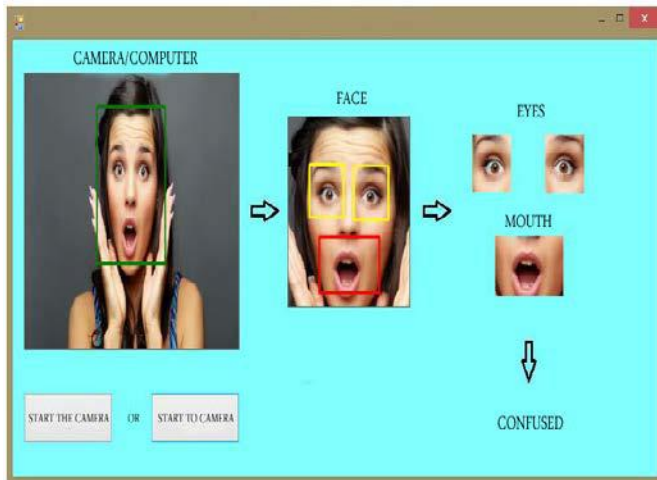


Fig. 4. A general overview of our application

4. Conclusion and Future Works

We present a human facial expression analysis system with a new approach. Our system uses an image which is taken from a camera or previously stored image by a user. The image is processed with Haar Cascade Classification by the system. Then face is detecting. After the face detection process, eyes and mouth are found out and marked. The biggest marked area must be lip location and this location is main point for Bezier Curves transform. Finally, these curves compared with our solution space for decision which can be confused, happy, sad or normal.

First step of our system is a Bezier Curves fitting study. We have achieved successful results in first stage. The system may generate incorrect results with some images which are under different lighting values in this state and another similar negative situation is partially or fully closed face with a hat or a glasses. In such circumstances, different methods may be demonstrated. For example, lighting problem can be solve with image preprocessing techniques.

For increasing the success of the system, an image preprocessing stage can apply for the image in order to overcome the lighting constraints. Increasing features vectors will increase the classification success rate of the system.

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Learning Media Introduction of Plant Species Based on Multimedia

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ABSTRACT

Learning about the introduction of plant species remains elusive and the learning process that is still conventional lead learning atmosphere seemed stiff and children are busy playing that needs to be made of instructional media can help the teacher's role in the process of delivery of material. The methodology used to collect data that is relevant topics through library research, interview and observation. Analysis was performed to determine the specifications for the learning needs of instructional media introduction of the types of plants to fit the needs. Results of the research is the formation learning media introduction of plant species based on multimedia to increase interest in learning and understanding of children against this type of plant. Test results showed a hundred percent media of learning about plant species able to increase interest in learning and understanding the kindergarten children Tunas Melati Yogyakarta.

Keywords — Learning, Multimedia, Plant, Tunas Melati.

1 INTRODUCTION

The rapid advances in computer technology have an impact on the growing number of computer hardware market with a price of dollars are getting cheaper. The number of computer ownership either by the institution or by educators themselves increased. Along with the increasing number of proprietary computing devices by various parties, the need for the availability of computer-assisted teaching

programs is increasing and needs serious attention [4].

Multimedia development is often applied in the cross of life. One area that developed it is education that is with teaching and interactive learning. Interactive multimedia is not a medium for conveying knowledge of anything is a communication tool which provides convenience in the teaching process that is useful to guide and expand the thinking of the child.

In the field of education, namely learning for children are sometimes the delivery is done by teachers in classical without reference to visual media or simulation results in learning to be less attractive and boring, so it needs to be done another way so that learning becomes interesting and the children become more receptive to the material being taught. Currently, the implementation of teaching in kindergarten Tunas Melati often confiscated quite a long time due to the limited number of teachers, so often there is a reduction portion to teach every child, and of course this will hinder the development of children's ability to understand what has been presented by the teacher. In other words, the learning process cannot be done optimally.

During this lesson taught by the teacher for the introduction of plant species using books and bring some plants as an example. Therefore required a medium of learning as a bridge between teachers and students to learn about the introduction of plant species are active and do not make kids saturated. Besides Suwartini, S.Pd. PAUD as one of the teachers who teach kindergarten class Tunas Melati also said that considerable difficulty in delivering the materials to children because children are more

focused on graphics in the book rather than the explanation described by teachers. Children play at the time the teacher explains the subject matter.

From interviews to several parents expressed by the learning media interest in children for higher learning and children are more enthusiastic in learning. In terms of numeracy learning media that has been owned by kindergarten Tunas Melati, parents are very supportive when learning about the introduction of plant species was made in to a medium of learning. Instructional media enough to help parents to children during the learning process at home and take advantage of existing computer at home as a tool for learning and parents can also evaluate the extent to which the learning that has been obtained in kindergarten Tunas Melati.

2 LITERATURE REVIEW

Previous studies of Fenia Arian Widjoyo in his research shows the design of instructional media using Macromedia Director MX is used for children aged 8-9 years [6].

Previous studies both of Margaretta Jawai, M. Thamarin and Hilda with Research that is a Class Action (RCA), which consists of three cycles. Each cycle includes the design, implementation, and evaluation of observation and reflection [2].

The proposed method is more robust than the one based on contour features since those significant curvature points are hard to find. Finally, the efficiency and effectiveness of the proposed method in recognizing different plants is demonstrated by experiments [7].

2.1 Plant

Plants in general is part of one of the classification of living things. Plants have chlorophyll or green substance that serves as a medium for the creation of food. Chlorophyll serves as the process of photosynthesis. A process of converting the energy of sunlight is

used as chemical energy which is the stored in the form of glucose [1].

Very easily recognizable traits in plants is the dominant green colour due to the content of chlorophyll pigments which played a vital role in the process of catching energy through photosynthesis that plants in general are autotrophs. Autotrophs nature, making the plants always occupies the first position in the chain of energy flow through living organisms [1].

2.2 Plant Species

There are several types of plant species around our environment, among others:

- a. Medicinal plant is a plant that is recognized as herbs for medicines. Example: ginger, hazelnut, lemon and others.
- b. Fruit plants are part of the plant that seems to function as an ovary of a plant. In general, fruits contain vitamin C, vitamin A, salt, iron, fat, and calories that are needed by the human body. Example: avocado, jackfruit, oranges, guava, rambutan and others.
- c. Vegetable plants are plants that can be eaten with either taken from the roots, stems, leaves, fruit, and other parts are used for side dishes. Example: spinach, carrots, kale, cabbage, beans, and others.
- d. Ornamental Plants (Flowers) is a plant species deliberately maintained and bred for beauty purpose. Example: roses, jasmine, orchids, and others.
- e. Food plants are plants that exploited and processed to meet the need for food for humans. Example: sago, rice, soybeans, potatoes, cassava, and others.

2.3 The Concept of Learning And Teaching

Learning is a whole series of activities or activities performed by a person consciously result in a change in him in the form of additions or proficiency based on the sense of his experience [5].

Teaching is an activity that regularly of an environment consisting of educators and learners to interact with each other in doing an activity so that the process of learning and teaching objectives achieved.

2.4 The Learning Process and Its Components

Learning objectives describe the child's ability or mastery level expected to be reached by children after they followed a process of learning. In organizing learning materials, learning development should pay attention to the ability of the child so as to lead children on learning experiences that encourage curiosity and desire for understanding.

2.5 Media Delivery of Content

Media presentation function is to help facilitate children's learning and help ease the teaching in presenting an abstract concept or theme that is embodied in concrete form. Research conducted on the use of media and methods consistent results, namely the use of media and methods will primarily provide effective results.

2.6 Computer Base Learning

The entry of computer technology was introduced as the third revolution in the world of education. Computer technology is one of the educational technology that helps the process of teaching and learning both the learning object or act as a tool [3].

2.7 Multimedia

Multimedia is a combination of text, art sound, images, animation and video delivered to a computer or manipulated digitally and can be delivered to interactively controlled [8].

2.8 Multimedia Elements

In multimedia there are several multimedia elements, namely:

- a. Text: It is a symbol in the form of visual media that is used to describe oral language.
- b. Graph: It is a visual-based media. All images are two-dimensional graph.
- c. Audio/ voice: Form of conversation, music or sound effects.
- d. Video: This is a technology to capture, record, process, transmit and rearranging moving images.
- e. Animation: This is a simulation of the movement generated by displaying a series of frames into layers.

2.9 Human Computer Interaction

Using a computer to control humans should give special commands in this case using machine language understood by the computer. As a means to enter commands into a computer humans using tools like keyboard, mouse and others.

Friendly terms with users (user friendly) WYSIWYG (What You See Is What You Get) is used to refer to the capabilities of the software or application program that is easy to operate, and has a number of other capabilities so that users feel at ease in operating the program. Graphical User Interface (GUI) is an interface that utilizes a variety of image to be able to communicate or dialogue with the computer.

3 METHODOLOGY

This study has a specific research design. Function research is to find explanations and answers to the problems as well as provide an alternative to the possibilities that can be used for troubleshooting.

3.1 Subject of Study

The subject of this study is the medium of learning about the introduction of plant species introduction material plant species for kindergarten Tunas Melati which aims to increase interest in learning and understanding of children in the form of learning applications based on multimedia.

3.2 Research Tools

This study used the hardware and software with certain specifications to complete an application to be built. Hardware are all part of the physical computer and are distinguished by the data there in as well as differentiated by software that provides instructions for the hardware to accomplish tasks.

3.3 Method of Collecting Data

In supporting facts and data collection in order to solve the problems associated with the case, the necessary understanding of how the system will be run. The method used in the preparation of this research is as follows:

- a. Library Studies, is a method of data collection is done by searching, reading and collecting documents as a reference.
- b. Observation, is a method of direct observation of how to teach a class about the kinds of plants on kindergarten Tunas Melati.
- c. Interviews, a method performed by asking a question or question and answer directly to the kindergarten teacher Tunas Melati associated with the introduction of material plant species.

3.4 Data Analysis

The analyzed data is a tutorial, as well as the visualization of images. Data contained material about medicinal plants, ornamental plants, vegetable plants, herbs plants and benefits of each plant. The auxiliary materials using image visualization according to case examples of such materials.

3.5 System Design Phase

Before creating instructional media introduction of plant species is done, need to create a system design, system design as follows:

- a. The Design Concept
- b. Designing Menu
- c. Navigation Diagram Design
- d. Manufacture Storyboard

3.6 Design Implementation

This stage is the stage of making an application based on the existing draft is using Adobe Flash CS6 Professional as software to make application design, layout and graphics processing. Adobe Flash CS6 Professional as support for vector drawing. Adobe Photoshop CS6 as image processing software. Adobe Soundbooth CS6 as software that serves to make the recording process to be used in applications that generate interactive applications and programming language Action Script.

3.7 System Implementation

An operating system will be applied or used in kindergarten Tunas Melati as a medium of learning to improve their learning and understanding of the children in identifying the types of plants. This system will be used by educators or parents in delivering lessons to children.

4 RESULTS AND DISCUSSION

Analysis of the needs of users ranging from preparing the data relating to the types of plants for the kindergartners were obtained from teachers of kindergarten. The data is processed into data suitable for a learning system implemented in the corresponding application programs and needs in the introduction of new species of plants, so easy to learn by kindergarten children and make it easier for teachers to give lessons.

4.1 Design System

The system design includes several stages as follows:

- a. The design Concept
- b. Designing Menu
- c. Navigation Diagram Design
- d. Storyboard Design
- e. From Design
- f. Design of Multimedia Elements

4.2 System Implementation

The final implementation of learning applications for plant species based on

multimedia case studies on kindergarten Tunas Melati Yogyakarta, Indonesia.

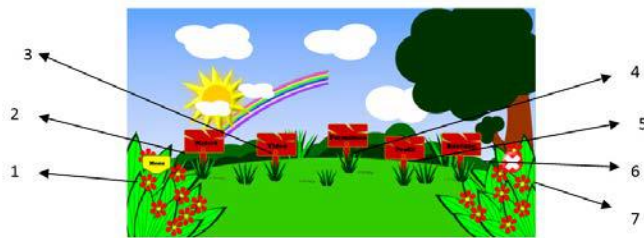


Fig. 4.1 Main Menu Display

Figure 4.1 shown Display main menu page. The above is an inner courtyard, where all the links that connect ine page to another. In the main menu theri is a 7 button menu are: (1) the main menu (2) the material menu (3) video menu (4) menu of the game (5) menu profiles (6) navigation (7) menu exit.

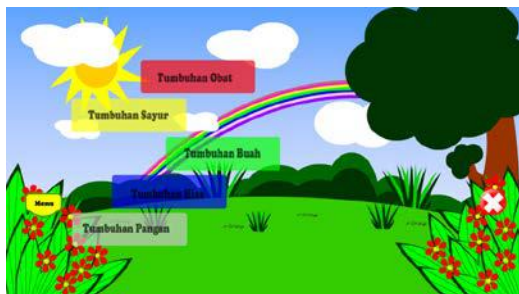


Fig. 4.2 Page View Material

Page views material depicted in figure 4.2. The above is an introduction page that contains material plant species and has 5 key to go any material which is key medicinal plants which would explain some of the types of medicinal plants and their benefits, vegetables plants that will explain some plant species vegetable, fruit plants which would explain some of the types of plants and their fruit specification form of the fruit, ornamental plants explains the different kinds of ornamental plants that exist around us and plant food that will explain the types of food plants in Indonesia.



Fig. 4.3 Page View Evaluation

Evaluation page views depicted in figure 4.3. Above, where in the evaluation page is a page that contains about evaluation of each material. At any material evaluations are used as a benchmark for understanding educates students in kindergarten Tunas Melati.



Fig. 4.4 Page Video Display

Display video illustrated in figure 4.4. The above is a page that contains the video that the introduction of medicinal plants, fruit plants video, video of food and flower plants video.



Fig. 4.5 Page View Game

Game page views depicted in figure 4.5. The above is a page that contains a puzzle game as an evaluation of the material introduction plant species. Students must construct words randomly

arranged into the correct wording is inserted into an existing long box above.

4.3 Discussion

Teachers feel that the introduction of instructional media on the types of this plant attractive to use because they have such material, video and game as required. With the introduction of instructional media on the types of plants teacher was not difficult to explain the material on plants species. The children were very enthusiastic to learn by using instructional media introduction of plant species they are interested and want to learn longer.

Parents feel that the medium of learning about the types of plants, because it can help children in learning activities while at home, and can measure the extent to which children's understanding of the kinds of plants.

5 CONCLUSIONS

Based on the results of research and discussion that has been described previously, it can be concluded as follows:

- a. The establishment of a media application learning the types of plants that can increase the interest in learning and understanding kindergarten children Tunas Melati about the types of plants.
- b. Based on testing using the black box test conducted by distributing questionnaires to the respondents. From these 100% of the media can increase children's interest in learning against the introduction of plant species that are around and simultaneously increase understanding of plant species.

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Virtual Makeup Application Using Image Processing Methods

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Abstract

Online shopping has become very popular recently. Despite the advantages of online shopping in terms of time and diversity, it is a disadvantage for users can't try products. This study aims to virtually try on products. Application developed for lipstick trial. User can see as if she tries on a lipstick on a monitor. We use face segmentation for detecting lips area, color segmentation for cutting lips and color space transformation for better result. In spite of some system delays, application works as realistic.

Keywords: *Virtual makeup, Image Processing, HSV color space, Online shopping, Color segmentation*

1. Introduction

With today's development, the image processing systems are used in many areas of our lives. One of them is the shopping area. Online shopping which is recently popularized has been reduced the loss of time and increased number of options.

The disadvantage of online shopping is customers can not get by trying the product. Recently there has been a lot of work to support in this regard to online shopping. For example we developed a system which people can try virtual garments on a monitor in previous study. We used Kinect Sensor for this application. When user moves his/her arms or legs, different poses of the garments are showed on the virtual mirror. Thus it increased sense of virtual reality [1]. Yang et al. presents a virtual try on system for design evaluation of footwear. The team used RGB-D (Red-Green-Blue-Depth) camera for providing augmented reality. They used iterative closest point (ICP) algorithm to follow that overlapped the captured depth data and predefined reference foot models [2]. Also Sabina et al. developed a virtual try on system taking into account the body shape of the users [3]. Meng et al. developed a garment design system. Then they placed this garment on the person body. Their system simulate the garment dynamically, taking into consideration human movement [4].

There are some papers about lip detection. Jang and Woo present an adaptive lip feature point detection algorithm for the proposed real-time smile training system using visual instructions [5]. Skodras and Fakotakis introduce a method using k-means color clustering with automatically adapted number of clusters, for the extraction of the lip area [6]. Kalbkhani and Amirani propose a new algorithm for lip detection [7].

In this paper, we propose a system which allows the user to interact the system for try on lipstick. User can select a color on a color scale and see as if she tries on this color of lipstick. For this system, our algorithm is organized as follows. Firstly, face area is detected, then face image is segmented and lip area is separated from the face image. The image of lips area is converted the HSV (Hue Saturation Validation) color space. After developing the color segmentation process, lips are detected by the system. Finally; lip's hue value is changed with the hue value of the color which is selected by the user. Finally it is converted to RGB color space and changed image is shown on the monitor.

The remainder of the paper is structured as follows. Section 2 describes virtual makeup application. Concluding remarks are in Section 3.

2. Virtual Makeup Application

The purpose of this study, it is provide to opportunity of trying of lipstick to the users. Image processing techniques are utilized for it. System runs real time and users can see original image and final image on monitor at the same time. No deterioration when the user turns his head. Block diagram of the study is shown in figure 1.

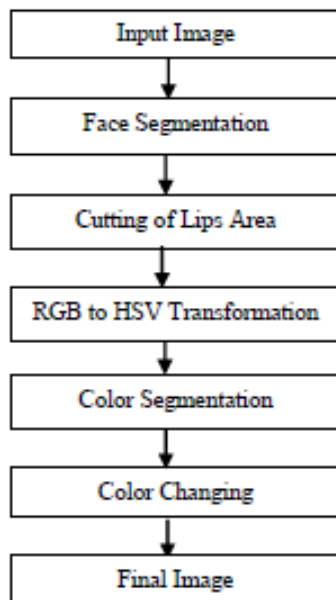


Fig. 1 Block Diagram of the System

2.1. Color Space Transformation from RGB to HSV

The transformation between HSV and RGB is nonlinear. The conversion from RGB to HSV is defined by the following equations (equation 1, equation 2, equation 3) [8].

$$V = m \tag{1}$$

$$S = \begin{cases} \frac{(m - n)}{m} , & \text{if } m \neq 0 \\ 0 , & \text{otherwise} \end{cases} \tag{2}$$

$$H = \begin{cases} \text{undefined} , & \text{if } S = 0 \\ \frac{60 \times (B - R)}{\delta} , & m = R \\ \frac{60 \times (B - R)}{\delta + 120} , & m = G \\ \frac{60 \times (R - G)}{\delta} + 240 , & m = B \end{cases} \tag{3}$$

In the equations; m defines the maximum of the (R, G, B) values and n is equal to the minimum of those values and δ defines subtraction n from m .

After this transformation, H value is converted to H value of color which is claimed by the user. Color corresponding of H value is showed in Table 1 [9].

Table 1: H value of colors

Angle Value	Color
0-60	Red
60-120	Yellow
120-180	Green
180-240	Cyan
240-300	Blue
300-360	Magenta

2.2 Face Segmentation and Lips Detection

The rectangular lips area is cropped from face image as shown in Figure 2 using Matlab Functions.



Fig. 2 Lips Area Detection

Then, this region is segmented looking for the color. To change the lips color, first the color space is converted to HSV from RGB, so we don't lose saturation and brightness of lips. The lips color is seek at the image and then it is marked as black at Figure 3. Thus; lips are detected by the system. Then we can change the color of this region.

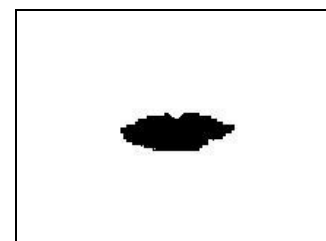


Fig. 3 Lips Detection

After changing the color at HSV color space the image is transformed to RGB color space.

Original image and final image are shown on the monitor in real time (Fig. 4).

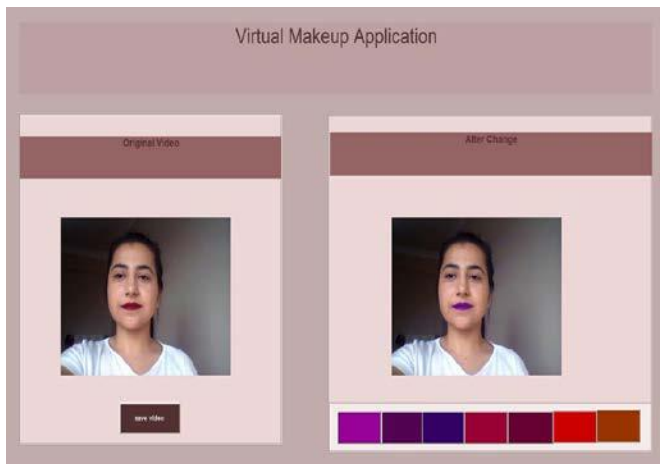


Fig. 4. Virtual Makeup Application

The change of lips color is shown in Fig. 5. The user can chose any color from list and can see how it is seem.

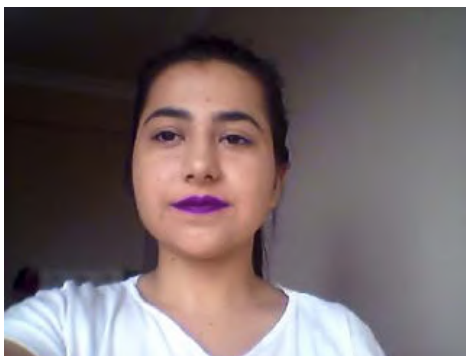


Fig. 5. The change of lips color

4. Conclusions

We have presented an approach to realize real-time virtual try-on of lipstick by user interaction. Our method is based on image processing methods. The system works realistic, but sometimes it can be temporal delays. One of the advantages of the system is cheapness. The user only needs to have a camera and a computer to use the system.

Sometimes synchronization disorders occur in the system. For example, if the user light-skinned, lip and skin colors are confused by the system. So, the color of wrong area changes.

In the future, it can be added to the system another makeup products. Also it can be provided system interaction with hand gestures.

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Synthesis, Magnetic and Spectral Investigations of Copper Metal Ion Complexes of 2-Substituted Benzaldehyde Semicarbazones and Thiosemicarbazones

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Abstract

The paper reports the synthesis of copper (II) complexes by refluxing the metal salts with the ligands 2-bromobenzaldehyde semicarbazone / thiosemicarbazone (basc, bbtsc) and 2-methoxybenzaldehyde semicarbazone/ thiosemicarbazone (mbasc, mbtsc) with general composition ML_2X_2 ($L \rightarrow$ basc, bbtsc, mbasc and mbtsc, $X \rightarrow$ Cl, Br, CH_3COO^- and SO_4^{2-}). All these complexes are characterized by elemental analysis, magnetic susceptibility measurements, infrared and electronic spectral studies. The infrared spectral

data of the complexes reveals bidentate complexing nature of the ligands coordinating through oxygen atom of carbonyl group/sulphur atom of thioketo form and azomethine nitrogen atom. High spin configuration has been suggested by magnetic moment of the complexes. The most probable geometry for all the metal complexes is proposed here.

Keywords: Semicarbazone, Thiosemicarbazone, Benzaldehyde, Ligands

1. Introduction

The chemistry of the transition metal complexes of semicarbazones and thiosemicarbazones have been receiving considerable attention largely because of their wide synthetic and analytical applications as well as biological activities [1]. In recent years thiosemicarbazones have been evaluated for the analytical determination of metals and received attention in view of their variable bonding modes, structural diversity and ion-sensing ability [2-4]. Occurrence of Copper (II) in human body as also in other living beings and plants in the form of cuproprotein is known since long [5]. The cytotoxic studies of copper (II) salicylaldehyde semicarbazone complexes on a number of human tumor cell lines were conducted [6]. Copper bis (thiosemicarbazone) complexes bearing methyl, phenyl and hydrogen on diketo backbone of the ligand have been synthesized, characterized and

study in vitro and vivo anticancer activity [7]. Several copper (II) complexes of bis (thiosemicarbazone) show promise as therapeutics for the treatment of neurological diseases, cancer and bacterial infections [8]. In the present study, we report the synthesis of complexes of divalent copper with the ligands 2-bromobenzaldehyde semicarbazone/ thiosemicarbazone (basc, bbtsc) and 2-methoxybenzaldehyde semicarbazone/ thiosemicarbazone (mbasc, mbtsc), magnetic and spectral studies of these complexes on the basis of various physico-chemical techniques and probable geometry for all the complexes.

2. Experimental

All the chemical and solvents used were of analytical reagent grade.

2.1 Preparation of Ligands

The ligands 2-methoxybenzaldehyde semicarbazone/ thiosemicarbazone (mbasc, mbtsc)

and 2-bromobenzaldehyde semicarbazone/thiosemicarbazone (bbsc, bbtsc) were prepared according to the literature[9] procedure by condensing 2-methoxybenzaldehyde and 2-bromobenzaldehyde with semicarbazide hydrochloride and thiosemicarbazide respectively and conformed by elemental analysis and IR spectral studies.

2.2 General method for synthesis of metal complexes

A hot ethanolic solution (20 ml) of metal salt (0.05 mol) was refluxed with a hot ethanolic solution (20 ml) of the respective ligands (0.10 mol) keeping the molar ratio 1:2 for 3-4 hours. The colored complexes were separated out on cooling the contents. The same was filtered, washed with 50% ethanol, dried in the electric oven, analyzed and the data is reported in table-1.

2.3 Physical and analytical measurements

The analysis of C, H and N were done by micro analytical techniques. Metal contents were determined [10] by the precipitation of copper extract with dilute Hydrochloric acid as cuprous thiocyanate. IR spectral data of the ligands and their complexes were recorded on perkin-Elmer 1600 FTIR automatic recording spectrophotometer in potassium bromide. Electronic spectra of the complexes were scanned in ethanol on Shimadzu U.V. and visible spectrophotometer 1601 C.P. The Magnetic susceptibility measurements of the complexes were determined by Guoy's method using Hg [Co(CNS)₄] as calibrant.

3. Results and Discussion

Synthesized metal complexes were insoluble in water and most of the organic solvents with the exception of polar solvents such as DMF and DMSO. The analytical data of all the complexes correspond to 1: 2 (M : L) stoichiometric ratio indicating coordination of anions and have the

general formula CuL_2X_2 ($L \rightarrow$ bbsc, mbsc, bbtsc and mbtsc, $X \rightarrow Cl^-$, Br^- , CH_3COO^- and $\frac{1}{2}SO_4^{2-}$). The complexes exhibit different stereo-chemistry varying from four coordinate tetrahedral, five coordinate square pyramidal & trigonal bipyramidal and six coordinate octahedral.

3.1 IR Spectral Studies

The main vibrational bands (cm^{-1}) of the ligands and complexes are reported. The ligands show main absorption bands in the region $\sim 3020-3045\ cm^{-1}$ due to $\nu(C-H)$, $\sim 1615\ cm^{-1}$ due to $\nu(C=C)$, $740-755\ cm^{-1}$ (Ortho substitution) diagnostic of aromatic character[11]. The strong bands at $\sim 1664\ cm^{-1}$ and $\sim 1535\ cm^{-1}$ are assignable to $\nu(C=O)$ and $\nu(C=N)$ stretching vibrations[12] respectively. The bands in the region $3380-3130\ cm^{-1}$ are assigned to $\nu(NH)$ and $\nu(NH_2)$ stretching vibrations[13] of free ligand and remain practically unchanged or shift slightly to higher side indicating no coordination. The medium intensity bands occur at $\sim 818\ cm^{-1}$ $\nu(C=S)$ and $\sim 998-1005\ cm^{-1}$ $\nu(N-N)$ vibrations[14] but the former shifts to lower side suggesting the sulphur atom is taken part in coordination with metal ion[15]. The absence of the bands above $3408\ cm^{-1}$ due to $\nu(O-H)$ or in the region $2512-2610\ cm^{-1}$ due to $\nu(S-H)$ vibrations suggests the presence of ligands in the keto/thione form[16] respectively.

The shifting of characteristic bands of free ligands in the complex formation indicates the bidentating behaviour of the ligands in all the complexes. The strong bands observed at $\sim 1664\ cm^{-1}$ shift to lower wave number side by about $25-50\ cm^{-1}$ in all the complexes indicating the oxygen atom is involved in complexation[12]. The position of $\nu(C=N)$ band appeared at $1535\ cm^{-1}$ is shifted toward lower wave number by about $35-60\ cm^{-1}$ in all the complexes indicating coordination via the azomethine nitrogen[17]. The appearance of a new band in the range $452-488\ cm^{-1}$ probably arising from $\nu(M-N)$ stretching vibration[18]. In the acetate complexes $\nu_a(COO^-)$ and $\nu_s(COO^-)$ are observed at $1670\ cm^{-1}$ and $1442\ cm^{-1}$ respectively indicating bridging nature of the acetate ion as the separation

between two frequencies is much larger in unidentate complexes than in the free ion[19]. The IR spectral data of sulphato complexes

exhibit bands at $1098-1129\text{ cm}^{-1}$, $\sim 957-963\text{ cm}^{-1}$ and $\sim 565\text{ cm}^{-1}$ corresponding monodentate behaviour of sulphate group[20].

Table-1
Elemental analysis data of Copper (II) Complexes

Complexes	Colour	% found (Calculated)			
		Cu	C	H	N
Cu (mbsc) ₂ Cl ₂	Light Blue	12.29 (12.21)	41.57(41.49)	4.32(4.23)	16.19(16.14)
Cu (mbsc) ₂ Br ₂	Bluish Green	10.49(10.43)	35.36(35.45)	3.73(3.61)	13.87(13.78)
Cu (mbsc) ₂ SO ₄	Bluish Green	11.58(11.65)	39.73(39.84)	4.09(4.03)	15.45(15.40)
Cu (mbtsc) ₂ Br ₂	Greenish Blue	9.98(9.91)	33.74(33.68)	3.34(3.43)	12.97(13.10)
Cu (mbtsc) ₂ SO ₄	Green	10.89(11.00)	37.61(37.40)	3.95(3.81)	14.41(14.54)
Cu(mbtsc) ₂ (CH ₃ COO) ₂	Brown	10.79(10.60)	36.15(36.03)	3.76(3.67)	14.09(14.01)
Cu (bbsc) ₂ Cl ₂	Light Green	10.14(10.28)	31.19(31.05)	2.70(2.59)	13.69(13.58)
Cu (bbsc) ₂ Br ₂	Greenish Black	9.11(8.99)	27.08(27.15)	2.29(2.26)	11.81(11.88)
Cu (bbsc) ₂ SO ₄	Light Green	9.76(9.88)	29.97(29.84)	2.57(2.49)	13.18(13.06)
Cu(bbsc) ₂ (CH ₃ COO) ₂	Brownish Green	9.69(9.55)	28.77(28.86)	2.58(2.40)	12.50(12.62)
Cu (bbtsc) ₂ Cl ₂	Light Orange	9.71(9.77)	29.63(29.52)	2.65(2.46)	12.99(12.92)
Cu (bbtsc) ₂ Br ₂	Red Black	8.79(8.60)	25.81(25.97)	2.22(2.16)	11.49(11.36)
Cu (bbtsc) ₂ SO ₄	Reddish Brown	9.34(9.41)	28.59(28.43)	2.28(2.37)	12.58(12.44)
Cu(bbtsc) ₂ (CH ₃ COO) ₂	Red	9.23(9.11)	27.67(27.53)	2.49(2.29)	12.19(12.05)

3.2 Study of Magnetic moment and Electronic spectral bands

The observed magnetic moments at room temperature for divalent copper complexes are in the range 1.73–2.05 B.M. (Table-2) corresponding

to one unpaired electron around the metal ion [21]. The only exception being acetate complexes of semicarbazones (bbcs, 1.57 B.M. and mbcs, 1.54 B.M.) indicate polymeric structure for complexes. Irrespective of the stereochemistry involved, bivalent copper complexes contain one unpaired spin [22] per copper atom. So, there should be some correlation between the magnitude of orbital contribution and coordination geometry. Lower magnetic moment or even diamagnetism results [23] to antiferromagnetic interactions which are absent in present case [24]. All the semicarbazone complexes except sulphato may be assigned to have tetragonal structure in planar configuration of the two semicarbazone molecules around metal ion with the anions occupying axial positions as the results resemble to that of semicarbazide chloro complex of copper (II) for which crystal structure is known[25].

The electronic spectra of complexes reported here except sulphato complexes exhibit only a broad absorption band ranging 13435–15400 cm^{-1} and a well defined shoulder in the range 15510–18350 cm^{-1} (Table–2). These spectral bands correspond to the transitions ${}^2B_{1g} \rightarrow {}^2A_{1g}$ ($d_x^2 - y^2 \rightarrow d_z^2$) and ${}^2B_{1g} \rightarrow {}^2E_g$ ($d_x^2 - y^2 \rightarrow d_{xz}$) transitions respectively. The low intensity bands due to ${}^2B_{1g} \rightarrow {}^2B_{2g}$ is usually not observed as a separate band in an octahedral field [26-27]. The splitting of the 2E_g state is a measure of the planar and axial fields. The change of position of the bands would be due to axial field only. Electronic spectra of these complexes were found to have tetragonal

configuration with planar arrangement of two ligand molecules around copper (II) ion and the anions occupying axial position[28]. Therefore the complexes may be considered to possess a tetragonal geometry [29]. The electronic spectra of 2–bromobenzaldehyde/2–methoxybenzaldehyde sulphato complexes of semicarbazone ligands show only one intense absorption band at 11400 cm^{-1} and 10970 cm^{-1} respectively which may be assigned to ${}^2A_1 \rightarrow {}^2E^II$ transition. These absorption bands are similar to earlier reported trigonal bipyramidal copper (II) complexes [30]. Electronic spectra of 2–bromobenzaldehyde/ 2–methoxybenzaldehyde thiosemicarbazone sulphato complexes exhibit two absorption bands at 13698, 14560 cm^{-1} and 16385, 18350 cm^{-1} respectively. These absorption bands are characteristic for square pyramidal geometry [31] of Copper (II) complexes.

4. Conclusion

Based on Elemental analysis, Magnetic moment, Infrared and Electronic spectral studies tetragonal planar configuration with two ligands around metal ion and anion occupying axial position have been proposed for complexes reported here except sulphato complexes. Five coordinated trigonal bipyramidal geometry has been suggested for semicarbazone sulphato complexes whereas square pyramidal geometry is proposed for thiosemicarbazone sulphato complexes under study.

Table–2
Magnetic Moment and electronic spectral bands of Copper (II) Complexes

Complexes	μ_{eff} (B.M.)	$\nu_2(\text{cm}^{-1})$ ${}^2B_{1g} \rightarrow {}^2A_{1g}$	$\nu_3(\text{cm}^{-1})$ ${}^2B_{1g} \rightarrow {}^2E_g$
Cu (mbcs) ₂ Cl ₂	1.95	13435	15790
Cu (mbcs) ₂ Br ₂	1.91	13680	15805
Cu (mbcs) ₂ SO ₄	2.01	10970	—
Cu (mbcs) ₂ (CH ₃ COO) ₂	1.54	13500	15510
Cu (mbtsc) ₂ Cl ₂	1.83	13510	15785
Cu (mbtsc) ₂ Br ₂	1.80	13705	17400
Cu mebtsc) ₂ SO ₄	2.03	14560	18350
Cu (mbtsc) ₂ (CH ₃ COO) ₂	1.96	15400	18230
Cu (bbcs) ₂ Cl ₂	1.73	13725	16870

Cu (bbsc) ₂ Br ₂	2.01	14220	16955
Cu (bbsc) ₂ SO ₄	2.04	11400	—
Cu (bbsc) ₂ (CH ₃ COO) ₂	1.57	14285	17060
Cu (bbtsc) ₂ Cl ₂	1.97	14600	17380
Cu (bbtsc) ₂ Br ₂	2.05	15350	17900
Cu (bbtsc) ₂ SO ₄	2.02	13698	16385
Cu (bbtsc) ₂ (CH ₃ COO) ₂	2.00	15240	18310

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Bibliography

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ASSESSMENT OF TEXTILE EFFLUENTS QUALITY USING FISH

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ABSTRACT

Assessment of toxicity of treated textile effluents from one of the Textile industry in Kano (Nigeria) was made by acute toxicity test using fish for 96 hours. Analysis of physicochemical parameters revealed that the effluent quality conformed to the statutory limits set by Environmental Regulatory Agency. There was not much variation in the weight of the fish exposed to different treated textile effluent concentrations. There was no significant variation in the length of the fish exposed to different treated effluent concentration.

There were no deaths of fish after 96 hours. It is recommended that regular laboratory bioassay is necessary for effluent quality assessment.

Keywords: Effluent, Fish, Textile, Toxicity

INTRODUCTION

Textile industries consume large quantities of water and produces large volumes of wastewater from different steps in dyeing and finishing processes. Business and industry play a crucial role in the socio-economic development of a country. However, industrial development is the main cause of depletion of natural resources and degradation of the environment[1]. Industries generate wastes, which can

be damaging to water, air, land resources and quality of life [2]. The issues of industrial pollution and control are gaining importance in Nigeria today. Kano as the second most industrialised city in Nigeria, is witnessing unprecedented levels of environmental degradation. Contaminated air, soil and water from industries are associated with heavy disease burden[3] and this could be part of the reasons for the current shorter life expectancy in the country[4], when compared to the developed nations. Some heavy metals contained in these effluents are known to be carcinogenic [5].

In advanced countries, environmental monitoring agencies are more effective and environmental laws are strictly enforced. General environmental quality of water resources is done on a regular basis [6],[7],[8],[9]. As a result, any abnormal changes in the environment or water quality can easily be detected and appropriate action taken before any outbreak of epidemics. The case is quite the opposite in many developing countries, and environmental laws where they exist are rarely observed.

MATERIALS AND METHODS

The effect of textile effluent on aquatic life was investigated with acute toxicity test described by [10] using

fish. Effluent concentration of 20, 40, 60, 80 and 100% including control (diluted water containing no effluent) were prepared in 12 plastic containers. The pH and electrical conductivity of the solution were taken using pH meter and conductivity meter respectively. The fishes were introduced into the prepared solutions of different concentrations. Each container was labelled appropriately according to its concentration test. Effluent was changed daily because oxidation may degrade or remove the toxicants and also the volatile components in the pollutants may escape [10].

Observation on mortality was made at the following intervals of time after the exposure of the fish: 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, 8 hours, 14 hours, 24 hours, 30 hours, and 48 hours

Fish was considered dead when there was no response to gentle prodding. Any dead fish was removed immediately from the test tank.

Chemical Analysis of Treated effluent

The chemical analysis of treated effluent was done using standard analytical methods of water analysis [11], [12] [13].

Determination of pH and Conductivity

pH and electrical conductivity were determined at the time of sampling in the field. The pH of the sample was measured with a pH meter that had been calibrated with buffer solutions and conductivity was measured with a conductivity meter calibrated with potassium chloride solution.

Determination of Dissolved Oxygen

Dissolved oxygen (DO_2) was determined by Winkler's titration. This was carried out as described by [14]. Manganous chloride and Winkler's reagent were added to the sample immediately after collection of the sample. On coming to the laboratory, the precipitate of manganese hydroxide resulting

from the earlier addition of manganese chloride solution and Winkler's reagent on the field was dissolved by addition of 2.0ml concentrated dihydrogen tetraoxosulphate (VI) acid in the sample. The sample was then thoroughly mixed and 100ml transferred from the sample bottle into a conical flask. This was immediately titrated against standard (0.0125M) sodium hyposulphite solution until only a faint yellow colour remained. Then a few drops of freshly prepared starch solution was added and the sample further treated drop wise against sodium thiosulphate solution until the blue colour disappeared. Each 1.0ml of thiosulphate used was titrimetrically equivalent to 1.0mg O_2 /ml [15].

Determination of Heavy Metals

Heavy metals (Cr, Cu, Zn, Pb, and Cd) were determined by digesting a known volume of effluent sample with analytical grade HNO_3 . The digested effluent was filtered into 20ml standard flask made up to the mark with distilled de-ionised water, and stored in a refrigerated nitric acid pre-washed polyethylene bottle prior to chemical analysis. The effluent extracts were analysed for metals with HACH Spectrophotometer. Each sample was analysed in triplicate and average of the results taken. General laboratory quality assurance measures were always observed to prevent sample

contamination and instrumental errors. The water used throughout the experiment was doubly distilled in an all glass distiller before it was de-ionised. Wavelength setting of spectrophotometers used was done daily by standard instrumental procedure and other equipment used was always calibrated against reference standards.

RESULTS

The results observed during the study are presented in tables 1-4 below

Average mean weight of (A) =36.31g

Average mean weight of (B) =36.15g

In replicate A, the minimum mean weight of the fish used was 35.50g, while the maximum mean weight of the fish used was 37.20g.

In replicate B, the minimum mean weight of the fish used was 35.55g. While the maximum mean weight of the fish used was 37.15g.

The average mean weight in replicates A and B were 36.31g and 36.15g.

It can be observed from the above results that there was no much variation in the weight of the fish exposed to different treated textile effluent concentrations.

Average mean length of (A) =9.67cm

Average mean length of (B) =9.62cm

In replicate A, the minimum mean length of the fish was 9.40cm and the maximum mean length was 10.10cm.

In replicate B, the minimum mean length of the fish was 9.20cm, while the maximum mean length of the fish was 10.00cm.

It can be observed from the results that there was no much variation in the length of the fish exposed to different treated effluent concentration.

Table 3 shows the results of acute toxicity test of treated textile effluents using activated carbons. There were no deaths of fish after 96 hours

DISCUSSION

The initial observation was that, when the fish is introduced into untreated textile effluent moved fast in irregular manners, but this was short lived. Thereafter they came to the surface of the test solution to gulp air.

All these indicate stress of various magnitude caused by the test solution to the fish.

Similar observation of stress imposed by effluent has been reported when fish was introduced into refinery effluent [16].

The fact that the fish in treated effluent experiment survived even after the duration of the experiment implies that all mortality can be attributed to the untreated effluent.

The quality of the treated effluent was generally satisfactory.

The results of physicochemical parameters of treated effluent conform to the federal ministry of environments limit. The result of acute toxicity test for treated effluent showed that there was no mortality in the treated effluent concentration including control for 96 hours as shown in Table 3. This was in agreement with [10] and [17] that a well treated effluent should not be toxic to fish within 96 hours.

[18] Observed that a well treated refinery effluent do not cause any mortality to test organism.

CONCLUSION

Considering the results obtained, we can conclude that the treated textile effluents have no effect on the lives of fish in Kano metropolis. We

recommend that environmental monitoring agencies should include bioassays in their monitoring programmes.

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Table- 1: Mean weight of fish used for treated effluent toxicity test.

Effluent concentration	Mean weight A(gram)	Mean weight B(gram)
Control 0 %	36.20	36.30
20 %	36.40	36.50
40 %	35.85	35.60
60 %	35.70	35.55
80 %	35.50	35.80
100 %	37.20	37.15
Total	217.84	216.90

Table 2 - Mean length of fish used for treated effluent toxicity test.

Effluent concentration	Mean length of A(cm)	Mean length of B (cm)
Control 0%	10.10	10.00

20 %	9.85	9.95
40 %	9.72	9.60
60 %	9.50	9.65
80 %	9.40	9.30
100 %	9.45	9.20
Total	58.02	57.70

Table 3 Result of toxicity test for textile effluents treated with activated carbons on fish after 96 hours.

Percentage concentration of effluent	Number of Dead Fishes Observed											
	0%		20%		40%		60%		80%		100%	
Time Interval/Replicate	A	B	A	B	A	B	A	B	A	B	A	B
15 minutes	-	-	-	-	-	-	-	-	-	-	-	-
30 minutes	-	-	-	-	-	-	-	-	-	-	-	-
60 minutes	-	-	-	-	-	-	-	-	-	-	-	-
2 hours	-	-	-	-	-	-	-	-	-	-	-	-
4 hours	-	-	-	-	-	-	-	-	-	-	-	-
8 hours	-	-	-	-	-	-	-	-	-	-	-	-
15 hours	-	-	-	-	-	-	-	-	-	-	-	-
24 hours	-	-	-	-	-	-	-	-	-	-	-	-
30 hours	-	-	-	-	-	-	-	-	-	-	-	-
48 hours	-	-	-	-	-	-	-	-	-	-	-	-
72 hours	-	-	-	-	-	-	-	-	-	-	-	-
96 hours	-	-	-	-	-	-	-	-	-	-	-	-

Table 4 Levels of colour, COD and heavy metal before and after treatment with activated carbon



Parameter	Raw	1g/250ml	1.5 g/250 ml	2 g/250 ml
Colour	Dark blue	Light yellow	Pale yellow	Colourless
COD	2320	458	189	25
Zn	10.5	2.1	1.2	0.25
Cu	4.2	0.5	0.5	0.1
Cr	0.15	0.03	0.02	0.01
Cd	0.042	0.02	0.01	0.002
Pd	0.42	0.03	0.02	0.01

Mining Big Data: Breast Cancer Prediction using DT - SVM Hybrid Model

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Abstract - Breast Cancer is becoming a leading cause of death among women in the whole world; meanwhile, it is confirmed that the early detection and accurate diagnosis of this disease can ensure a long survival of the patients. This paper work presents a disease status prediction employing a hybrid methodology to forecast the changes and its consequence that is crucial for lethal infections. To alarm the severity of the diseases, our strategy consists of two main parts: 1. Information Treatment and Option Extraction, and 2. Decision Tree-Support Vector Machine (DT-SVM) Hybrid Model for predictions. We analyse the breast Cancer data available from the Wisconsin dataset from UCI machine learning with the aim of developing accurate prediction models for breast cancer using data mining techniques. In this experiment, we compare three classifications techniques in Weka software and comparison results show that DT-SVM has higher prediction accuracy than Instance-based learning (IBL), Sequential Minimal Optimization (SMO) and Naïve based classifiers.

Index Terms - breast cancer; classification; Decision Tree- Support Vector Machine, Naïve Bayes, Instance-based learning, Sequential Minimal Optimization, and weka;

1 INTRODUCTION

Data mining, also known as knowledge discovery in databases is defined as “the extraction of implicit, previously unknown, and potentially useful information from

data”. It encompasses a set of processes performed automatically, whose task is to discover and extract hidden features (such as: various patterns, regularities and anomalies) from large datasets.

Big data is a broad term for datasets so large or complex that traditional data processing applications are inadequate. Analysis of data sets can find new correlations, to “spot business trends, prevent diseases, and combat crime and so on”. Scientists, practitioners of media and advertising and governments alike regularly meet difficulties with large data sets in areas including Internet search, finance and business informatics [1].

Building accurate and efficient classifiers for large databases is one of the essential tasks of data mining and machine learning research [10]. Usually, classification is a preliminary data analysis step for examining a set of cases to see if they can be grouped based on similarity” to each other. The ultimate reason for doing classification is to increase understanding of the domain or to improve predictions compared to unclassified data. Many different types of classification techniques have been proposed in literature that includes DT-SVM, SMO, IBL, etc.

Clustering is a Data mining technique which segments a heterogeneous data into a

number of homogeneous subgroups or clusters. In clustering, the records are grouped together based on self-similarity without any predefined classes or examples. The quality of a cluster is measured by cluster diameter which is the distance between any two objects in a cluster. In this study k-means clustering is chosen because of its popularity and it's proved effectiveness.

In data mining breast cancer research has been one of the important research topics in medical science during the recent years. The classification of Breast Cancer data can be useful to predict the result of some diseases or discover the genetic behavior of tumors. There are many techniques to predict and classification breast cancer pattern. This work empirically compares performance of different classification rules that are suitable for direct interpretability of their results.

Breast cancer is one of the most common cancers among women. Breast cancer is one of the major causes of death in women when compared to all other cancers. Cancer is a type of diseases that causes the cells of the body to change its characteristics and cause abnormal growth of cells. Most types of cancer cells eventually become a mass called tumor. The occurrence of breast cancer is increasing globally. It is a major health problem and represents a significant worry for many women [1].

Early detection of breast cancer is essential in reducing life losses. However earlier treatment requires the ability to detect breast cancer in early stages. Early diagnosis requires an accurate and reliable diagnosis procedure that allows physicians to distinguish benign breast tumors from malignant ones. The automatic diagnosis of breast cancer is an important, real-world

medical problem. Thus, finding an accurate and effective diagnosis method is very important. In recent years machine learning methods have been widely used in prediction, especially in medical diagnosis [2]. Medical diagnosis is one of major problem in medical application. The classification of Breast Cancer data can be useful to predict the outcome of some diseases or discover the genetic behavior of tumors [3]. A major class of problems in medical science involves the diagnosis of disease, based upon various tests performed upon the patient. For this reason the use of classifier systems in medical diagnosis is gradually increasing.

The aim of this dissertation is to develop the various phase. They are:

- Predictive Framework for Breast Cancer Disease
- Hybrid model
- Generation of rule to predict Breast Cancer
- Qualitative measures used for Comparison (accuracy, error rate, sensitivity, and specificity).
- GUI Development

1.2 OVERVIEW

Breast cancer is becoming a leading cause of death among women in the whole world, meanwhile, it is confirmed that the early detection and accurate diagnosis of this disease can ensure a long survival of the patients. In this research work, a decision intelligence technique based support vector machine classifier (DT-SVM) is proposed for breast cancer diagnosis. In the proposed DT-SVM, the issue of model selection and feature selection in SVM is simultaneously solved using Net beans and WEKA

analytical tool. A weighted function is adopted to design the objective function of DT-SVM, which takes into account the average accuracy rates of SVM, the number of support vectors and the selected features simultaneously.

2 RELATED WORKS

Delen et al in their work preprocessed the SEER data for to remove redundancies and missing information. They have compared the predictive accuracy of the SEER data on three prediction models indicated that the decision tree (C5) is the best predictor with 93.6% accuracy on the holdout sample.

Endo et al. implemented common machine learning algorithms to predict survival rate of breast cancer patient. This study is based upon data of the SEER program with high rate of positive examples (18.5 %). Logistic regression had the highest accuracy; artificial neural network showed the highest specificity and J48 decision trees model had the best sensitivity

Kotsiantis et al. did a work on Bagging, Boosting and Combination of Bagging and Boosting as a single ensemble using different base learners such as C4.5, Naïve Bayes, OneR and Decision Stump. These were experimented on several benchmark datasets of UCI Machine Learning Repository.

Bittern et al. used artificial neural network to predict the survivability for breast cancer patients. They tested their approach on a limited data set, but their results show a good agreement with actual survival.

Vikas Chaurasia et al. used RepTree, RBF Network and Simple Logistic to predict the survivability for breast cancer patients.

Djebbari et al. consider the effect of ensemble of machine learning techniques to predict the survival time in breast cancer. Their technique shows better accuracy on their breast cancer data set comparing to previous results. Liu Ya-Qin's [5] experimented on breast cancer data using C5 algorithm with bagging to predict breast cancer survivability.

Bellaachi et al. used naïve bayes, decision tree and back-propagation neural network to predict the survivability in breast cancer patients. Although they reached good results (about 90% accuracy), their results were not significant due to the fact that they divided the data set to two groups; one for the patients who survived more than 5 years and the other for those patients who died before 5 years.

Tsirogiannis's et al. applied bagging algorithm on medical databases using the classifiers neural networks, SVM'S and decision trees. Results exhibits improved accuracy of bagging than without bagging.

3 RELATED METHODS

The overall design procedure is shown is shown in Figure 3.1.

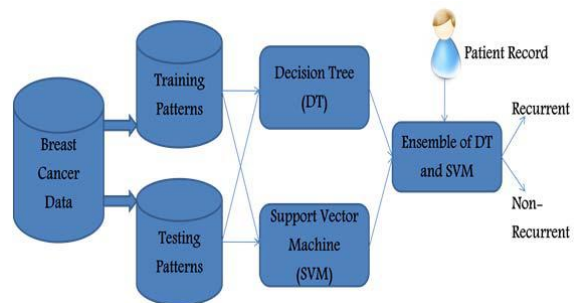


Figure.3.1: Ensemble Model for Breast cancer identification

The design is the structure of any scientific work. It gives direction and systematizes the research. Most scientists are interested in getting reliable observations that can help the

understanding of a phenomenon. DT – SVM method has been adopted in this research was so carefully designed.

3.1 EXPERIMENTAL DESIGN

Classification predicts categorical class labels (discrete or nominal) and also classifies data (constructs a model) based on the training set and the values (class labels) in a classifying attribute and uses it in classifying new data. The figure 3.2 shoes classification of new data.

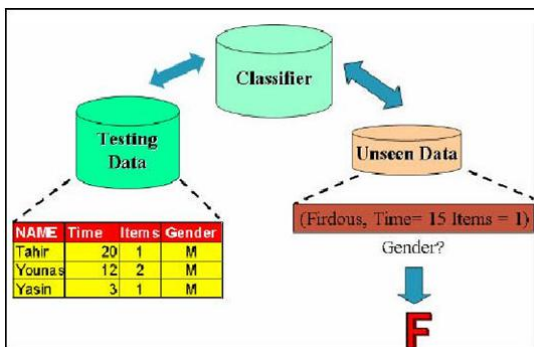


Figure 3.2: Data classification

3.1.1 SUPPORT VECTOR MACHINE

Classification in SVM is an example of Supervised Learning. Known labels help indicate whether the system is performing in a right way or not. This information points to a desired response, validating the accuracy of the system, or be used to help the system learn to act correctly. A step in SVM classification involves identification as which are intimately connected to the known classes is called feature selection. Feature selection and SVM classification together have been used even, when prediction of unknown samples is not necessary. They can be used to identify key sets which are involved in whatever processes distinguish the classes. The flow diagram for the SVM method is shown is given in figure 3.3.

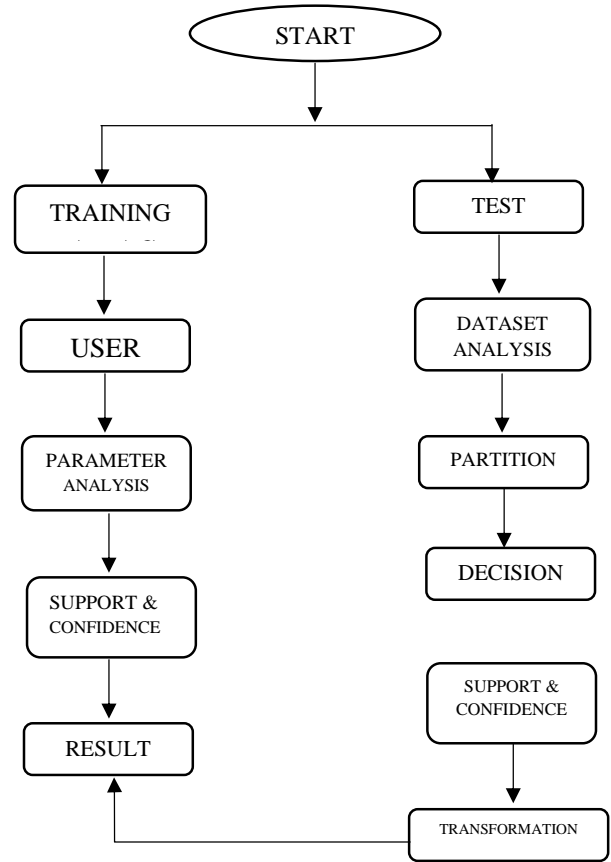


Figure 3.3: SVM Data Flow

3.1.2 Decision Tree

DT is a most popular and powerful classification technique where each internal node (non-leaf node) denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node (or terminal node) holds a class label. DT with four decision nodes and five leaf nodes are shown in figure 3.5. The top most nodes in a tree are the root nodes. DT is so popular because construction of DT classifiers does not require any domain knowledge or parameter setting and, therefore, is appropriate for exploratory knowledge discovery. Various decision tree based techniques are widely accepted and applied on health care diagnosis process. On the other hand some statistical technique like

SVM is also used as classifier for health care diagnosis. Interactive Dichotomiser 3 (ID3) and C4.5 are the two very popular DT algorithms proposed by Quinlan [20]. ID3 uses Entropy and Information Gain to construct a decision tree.

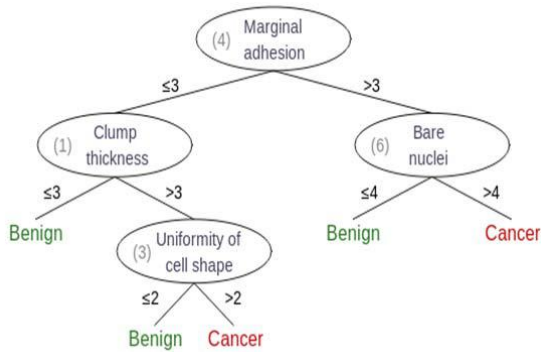


Figure 3.4: Decision Tree with 4 decision nodes and 5 leaf nodes

Entropy: A decision tree is built top-down from a root node and involves partitioning the data into subsets that contain instances with similar values (homogenous). ID3 algorithm uses entropy to calculate the homogeneity of a sample. If the sample is completely homogeneous the entropy is zero and if the sample is an equally divided it has entropy of one.

To build a decision tree, we need to calculate two types of entropy using frequency tables as follows:

- a) Entropy using the frequency table of one attribute:

$$E(S) = \sum_{i=1}^c - P_i \log_2 P_i$$

- b) Entropy using the frequency table of two attributes:

$$E(T, X) = \sum_{c \in X} P(c) E(c)$$

Information Gain: The information gain is based on the decrease in entropy after a dataset is split on an attribute. Constructing a decision tree is all about finding attribute that returns the highest information gain (i.e., the most homogeneous branches).

3.1.3 INSTANCE BASED LEARNING

IBL is a basic instance-based learner which finds the training instance closest in Euclidean distance to the given test instance and predicts the same class as this training distance. If several instances qualify as the closest, the first one found is used. IBL algorithms do not construct extensional CDs. These functions are two of the three components in the following framework that describes all IBL algorithms:

- Similarity Function: This calculates the similarity between training instances i and the instances in the concept depiction. Similarities are numeric-valued.
- Classification Function: This obtains the similarity functions results and the classification performance records of the instances in the concept description. It returns a classification for i .
- CD Updater: This retains records on classification performance and decides which instances to include in the concept description. Inputs include i , the classification results, the similarity results, and a current concept description. It returns the modified concept description.

3.1.4 SEQUENTIAL MINIMAL OPTIMIZATION

SMO is an algorithm for solving the quadratic programming (QP) problem that arises during the training of SVM. SMO is widely used for training support vector machines and is implemented by the popular LIBSVM tool.

SMO is an iterative algorithm for solving the optimization problem described above. SMO breaks this problem into a series of smallest possible sub-problems, which are then solved analytically.

3.2 DATA SOURCES

In this study, we have performed our conduction on the Wisconsin Breast Cancer Dataset (WBCD) taken from UCI machine learning repository (UCI Repository of Machine Learning Databases). The dataset contains 699 instances taken from needle aspirates from patients' breasts, of which 458 cases belong to benign class and the remaining 241 cases belong to malignant class. It should be noted that there are 16 instances which have missing values, in this study all the missing values are replaced by the mean of the attributes. Each record in the database has nine attributes. These nine attributes were found to differ significantly between benign and malignant samples.

3.3 DATA ANALYSIS

1. Number of Instances: 699
2. Number of Attributes: 10 + class attribute

S.NO	ATTRIBUTE	DOMAIN
1.	Sample code number	id number
2.	Clump Thickness	1-10
3.	Uniformity of Cell Size	1-10
4.	Uniformity of Cell Shape	1-10
5.	Marginal Adhesion	1-10
6.	Single Epithelial Cell Size	1-10
7.	Bare Nuclei	1-10
8.	Bland Chromatin	1-10

9.	Normal Nucleoli	1-10
10.	Mitoses	1-10
11.	Class	2 - Benign, 4 for malignant

Table 3.1 Attribute Information: (class attribute has been moved to last column)

3. Missing attribute values: 16

- There are 16 instances in Groups 1 to 6 that contain a single missing (i.e., unavailable) attribute value, now denoted by "?".

4. Class distribution:

- Benign: 458 (65.5%)
- Malignant: 241 (34.5%)

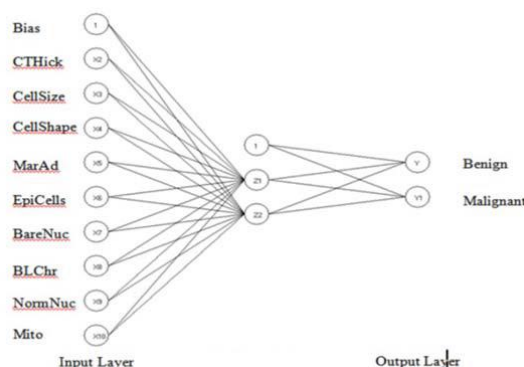


Figure 3.5: Diagrammatic Representation of Breast Cancer Attributes

4 RESULTS & DISCUSSION

The proposed DT-SVM diagnostic system is implemented using Weka tool with Java platform. For SVM, LIBSVM implementation was utilized. The empirical experiment was conducted on Intel Quad-Core Xeon 5130 CPU (2.0 GHz) with 4GB of RAM.

In order to guarantee the valid results, the k-fold Crossover Validation (CV) was used to evaluate the classification accuracy [45].

Data was divided into ten subsets. Each time, one of the ten subsets is used as the test set and the other nine subsets are put together to form a training set. Then the average error across all ten trials is computed. The advantage of DT-SVM method is that all of the test sets are independent and the reliability of the results could be improved. We attempted to design our experiment using two loops. The inner loop is used to determine the optimal parameters and best feature subset. The outer loop is used for estimating the performance of the SVM classifier.

We selected Breast cancer data set and selected different class of patient groups from the collection for our experiments. The group data is pre-processed and made as simple text files thereby removing all the headers, replies and other non-related information. The preprocessed data from these selected classes are divided as 60% training data and 40% testing data. But we selected only 10 parameters for training and around 400 patients' documents for testing. The feature selection was simple and did not involve any special techniques, to test the classifier with such features. In our implementation of the classifier we used below interface to train the SVM. The classes which we selected for our experiments are different age groups, breast size and menopause. The classifier was trained with these classes and then tested with the test data.

The figure 4.1 is act as an interface to feed individual patients data to predict the response which is diagnosed against the classified ones using DT-SVM. Show method used to view all available data set.

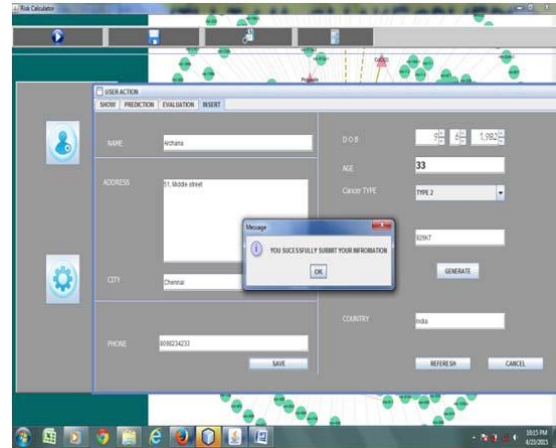


Figure 4.1 Interface to feed individual patient data

To forecast the severity of breast cancer with help of slider by feeding the field values are given in figure 4.2. The attribute values are also displayed in chart.



Figure 4.2: Predictive framework to forecast the severity of cancer.

The figure 4.3 is used to evaluate the dataset based on the class distribution benign and malignant with predefined decision rule by calculating the support & confidence values.

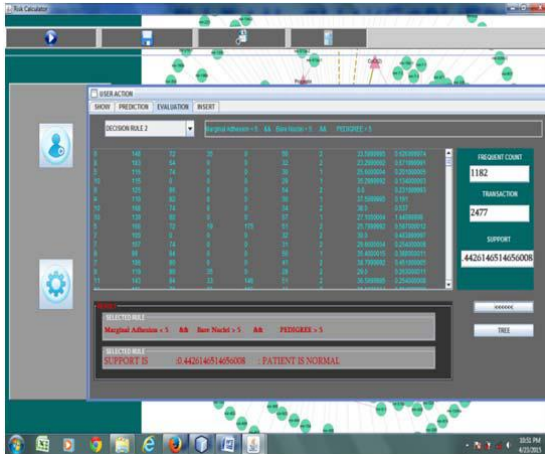
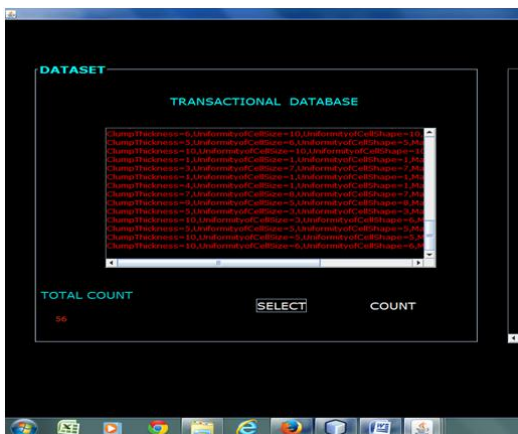


Figure 4.3: Rule to evaluate dataset for class malignant

To find the rule to predict breast cancer using DT, the transaction database will be imported are given in figure 4.4. The number of transactions will be calculated with respect to the attribute values. It also shows the Class distribution: Benign, Malignant.

In order to find the rule based on transactional database. We must truncate the discarded data by calculating the minimum support threshold through interesting measures such as support and confidence values are shown in figure 4.5.



hFigure 4.4: Imported transaction database to find the rule



Z

Figure 4.5: Calculation of Minimum Support Threshold values

The truncated database will be imported to a DT (ID3) algorithm to find the predictive rule for breast cancer. In figure 4.6 present the complete DT with 25 decision nodes with three leaf nodes with class of malignant.

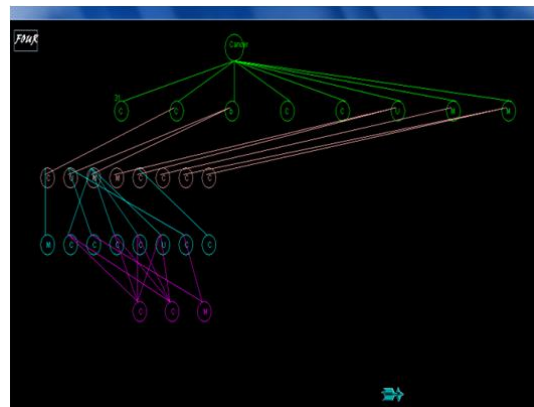


Figure 4.6: Generation of Final Decision Tree

We have designed a Prototype of Breast cancer disease prediction model. This model will predict the breast cancer's disease class based on the rules created by ID3 algorithms. Figure 4.1 shows the interface for input, which takes Medical profiles of a patient such as age, sex, blood pressure and blood sugar etc as input and it

can predict about presence or absence of Breast cancer disease. The path from root to leaf node shows if the patient has these combinations of cell values is high, and then the patient is affected by cancer. This is the rule we generate through DT.

It has been observed that the classes which are predicted at the top level of the tree have good accuracy and the ones predicted at the lower levels have poor accuracy. In our experiment which was classified at the root node has 95% accuracy.

DESCRIPTION	ACCURACY	ERROR RATE	CORRECTLY CLASSIFIED INSTANCE	INCORRECTLY CLASSIFIED INSTANCE
DT+SVM	91%	2.58	459	240
IBL	85.23%	12.63	184	515
SMO	72.56%	5.96	325	374
NAÏVE	89.48%	9.89	291	408

The performance of a chosen (IBL, SMO and Naïve based) classifiers are performed through weka tool and it's validated based on error rate and accuracy. The classification accuracy is predicted in terms of Sensitivity and Specificity. The evaluation parameters are the specificity, sensitivity, and overall accuracy. Hence DT+SVM perform well in classifying the breast cancer data, compared to all other algorithms.

From the above figures and table we find that highest accuracy of Classification model is DT - SVM (91%), low error rate (2.58%), correctly classified instance (459) and incorrectly classified instance (240) in breast cancer data as shown in Figure 4.11, 4.12, 4.13 and 4.14.

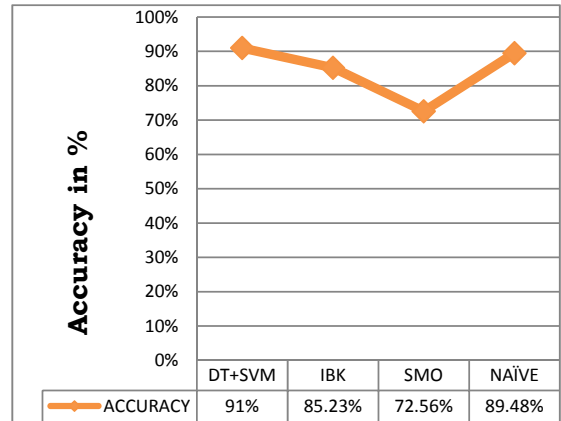


Figure 4.11: Accuracy of Classification Methods

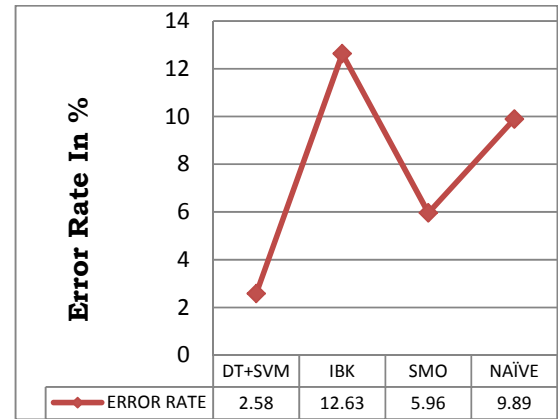


Figure 4.12: Error Rate of Classification Methods

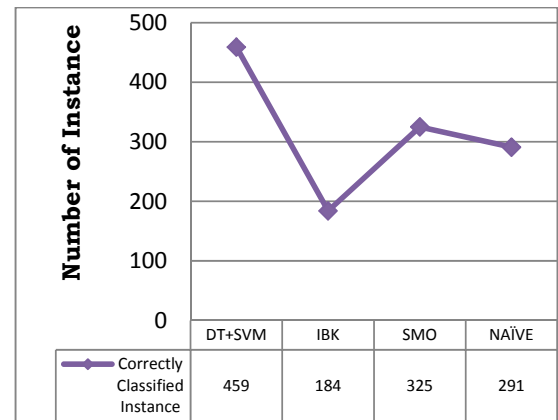


Figure 4.13: Correctly Classified Instance of Classification Methods

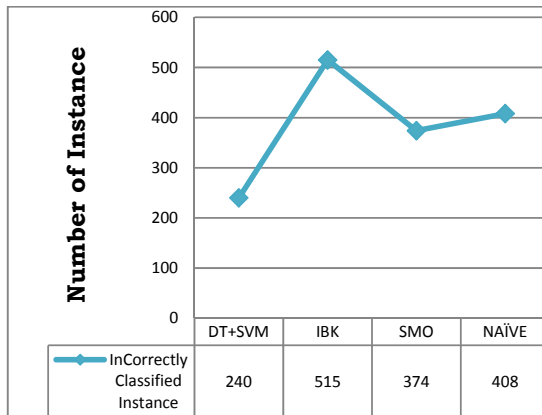


Figure 4.13: InCorrectly Classified Instance of Classification Methods

5 CONCLUSION

This work proposed a hybrid classification algorithm for breast cancer patients which integrates DT and SVM algorithms. The proposed algorithm was composed of two main phases. The first phase is Information treatment and option extraction followed by DT-SVM hybrid model predictions. Classification had two main phases, Training and Testing phases. The input parameters for SVM were optimized using DT algorithm. The SVM algorithm was used to classify breast cancer patients into one of two classes (Benign/Malignant).

In comparison of data mining techniques, this research used accuracy indicator to evaluate classification efficiency of different algorithms. The proposed algorithm was compared with different classifier algorithms using Weka tool. Specifically, we used popular data mining methods: DT-SVM, SMO, IBL, and Naïve. An important challenge in data mining and machine learning areas is to build precise and computationally efficient classifiers for Medical applications.

The experimental results given in the Figure 4.10 and Table 4.1 showed the effectiveness of the proposed algorithm. Overall, DT-SVM classification accuracy is better than other classifier algorithm. However, from a relatively low error rate, the results show that the DT-SVM will be the best prognosis in clinical practice.

The optimum breast cancer disease predictive model obtained in this study adopts DT-SVM classification algorithm, this research may provide references for future research on selecting the optimal predictive models to lower the incidence of breast cancer.

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INVESTIGATION OF WEAR BEHAVIOUR OF Al 6061 ALLOY REINFORCED WITH SiC, Al₂O₃ AND E GLASS FIBER

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Abstract

Aluminium 6061 has been used as matrix material for its excellent mechanical properties coupled with good formability. Numerous technological challenges present in casting techniques for obtaining a proper distribution of reinforcement in the matrix. In this work Al 6061 alloy act as a matrix and Al₂O₃, SiC, E glass fiber are used as reinforcement. Composites are fabricated by liquid metallurgy technique (stir casting) for decreasing the castings fault and to improve the proper mixing of reinforcement and matrix. Al 6061 alloy is melted at 680° C and then preheated reinforcements are added to maintaining stirrer speed around 180 RPM. The smallest amount of magnesium is added for enhancing usability and then molten metal is transferred into the mold cavity for machining composite as per the ASTM standards to conduct a tribological test in Pin on Disc apparatus. The Sliding wear tests are conducted at various loads, Speeds, Sliding distances. Experimental results tells the minimum wear is found in 10% wt of Al₂O₃, 6% wt of SiC and 4%wt of E glass fiber compared with Al 6061 alloy.

Keywords: Al 6061, Al₂O₃, SiC, E glass fiber, Stir casting, Pin on Disc. liquid metallurgy technique, preheated reinforcements, Pin on Disc apparatus.

1.Introduction

Aluminium based metal matrix composites have evoked a keen interest in recent times for potential applications in marines, aerospace and automotive industries owing to their superior strength to weight ratio, good wear and corrosion resistance. Composite materials are having their desirable properties, which include high specific stiffness, low density, controlled co efficient of thermal expansion, high specific strength, and superior dimensional stability at elevated temperatures. As the dispersed phase is

compared to matrix phase it is stronger. So it is called as reinforcement phase. In this work the various aspects of the wear behavior of MMC's have been investigated. Metal Matrix Composites (MMCs) have resistant with the ceramic particulates and tender to the significant performance advantages over pure metals and alloys. MMC's are adapt with the best properties of the two components, such as ductility and toughness of the matrix. Generally aluminium alloys are having low density and good adaptability, good corrosion resistance and high thermal and electrical conductivity. The objective of the present study is to investigate the wear behaviour of al 6061 reinforced with Al₂O₃, SiC and E glass fiber.

2. Literature survey

Prashant Sharma, et.al.[1] have studied the properties of hybrid metal matrix composites containing Al,SiC,E glass fiber. His experimental results, says when increasing the reinforcement compositions the tensile, hardness are slightly increased. Satyappa basavarajappa, et.al.[2] have studied the Dry Sliding Wear Behaviour of Hybrid Metal Matrix Composites.The experiment results, says the wear rate has been increased with the increasing load and decreased with increasing speed. Al-qutub, et.al [3] has studied the Wear properties of 6061 aluminum alloy composite. This experiment results, says depending on the load, the wear resistance increased by the reinforcement and also, the transition load from mild to sever wear, was increased due to the addition of the reinforcement. S. Venkat Prasat, et.al. [4] have investigated the Parameters on the Dry Sliding Wear Behaviour of Aluminium/Fly ash/Graphite Hybrid Metal Matrix Composites. From his investigation results shows a at high sliding speeds, mechanically mixed layer (mml) and a lubricating film of graphite were formed between the composite pin and the steel counter face and they

reduced the chance of direct metallic contact, thereby lowered the wear rate. Ozben et.al [5] investigated about the Machinability of MMC and observed MMC was very different from traditional materials because of abrasive reinforcement element. This was due to abrasive element causes more wear on cutting tools. Flank wear of cutting tool are also increased with increase in reinforcement ratio. WANG et.al [6] investigated the wear performance of Hybrid metal matrix composites using Aluminium oxide (Al_2O_3) fibers and Silicon carbide particles as reinforcements with aluminium cast alloy A536 as matrix and two different orientations of fibers, PR-orientation and N-orientation and three different ratios of reinforcements.. They observed that the wear resistance of the specimens with the N-orientation of the fibers is better than that with the PR-orientation for all the three hybrid ratios. The coefficient of friction decreases when the temperature increases. Furthermore, although the hybrid ratio has little effect on the coefficient of friction, the fiber orientation had a greater effect on this. SURESH et.al [7] investigated the wear behaviour of Al6061MMCs and its relation with Processing & microstructure. They concluded the wear rate and coefficient of friction decreased linearly with increasing weight percentage of Al_2O_3 . The wear rate increase as the sliding speed increases. The best results of minimum wear have been obtained at 8% weight fraction of Al_2O_3 . Hariharan et.al [8] observed that the wear resistance of the composite is increased as the percentage of the TiB_2 increases. And also the increased volume fraction of the TiB_2 particles contributed to increase the strength of composites. R.L.Deius et.al [9] says the adhesive wear of Al-Si alloy and aluminium composites containing discontinues reinforcement phases, such as the role of reinforcement phase encountered by the material.

3. Preparation of Al alloy

Generally The Al alloy is produced by various methods such as Stir casting, powder metallurgy, squeeze casting process. Here, the stir casting process is mostly used and most adaptable. And also the additional benefit of this process is the near net shape formation of the composites by conventional boundary process. Stir casting method is low cost and easy to put the operation. The basic process is to put into the second phase of the melt via stirring. Additionally it is difficult to allocate particles with

small diameters owing to the poor wet ability between the matrix and reinforcement.

4. Experimental setup

4.1. Specimen preparation

The MMC's were prepared by using cast aluminium alloy Al 6061 as matrix and Al_2O_3 , SiC, Eglass fiber as reinforced materials. In the hybrid MMC's the reinforcement materials were used on different proportions. Table 1 shows the percentage composition of the materials. The ratios are randomly selected to the field of casting process.



Fig 1 Al 6061 alloy Composite with 10%,20%,30% compositions

Table 1 composition of composite materials

Al 6061(%)	Al203(%)	SiC(%)	Eglass fiber(%)
90	5	3	2
80	10	6	4
70	15	9	6

4.2. Wear test machine

The wear characteristics of casting Al alloy is tested using pin on disk apparatus. The pin specimen is held strongly beside the rotating steel counter disk with the help of an applied load.

4.3. Matrix material

In this investigation 6061 aluminium alloy is used as a matrix material for preparing the composites. Table 2 shows the rate of chemical compositions of Al 6061 alloy.

Table 2 chemical composition

Element	Mg	Si	Fe	Cu	Cr	Mn	Al
Weight %	1.0	0.8	0.7	0.3	0.2	0.15	Remainder

5. Experimental Procedure

5.1. Stir Casting Process



Fig 2 Stir casting machine

The matrix alloy was reinforced with 10% wt of Al_2O_3 , 6% wt of SiC and 4%wt of E glass fiber compared with Al 6061 alloy by stir casting process. The production process of matrix alloy and composites is as follows: Al 6061 alloy is melted at $680^\circ C$ and then preheated reinforcements are added to maintaining stirrer speed around 180 RPM. The smallest amount of magnesium is added for enhancing usability and then molten metal is transferred into the mold cavity for machining.

5.2. Wear Test Machine

The wear characteristics of casting Al alloy is tested using pin on disk apparatus. The pin specimen is held strongly beside the rotating steel counter disk with the help of an applied load. The pin Specimen is pressed against the disk at a specific load usually by means of an arm or level and attached weights. The amount of wear is determined measuring appropriate linear dimensions of both specimens before and after test, or by weighing both specimens before and after test.

5.2.1 Pin On Disc Apparatus Test



Fig 3 Wear test – pin on disc machine

A pin-on-disc machine was used to investigate the dry sliding wear behavior of the aluminum alloy 6061 and Al_2O_3 , SiC, E glass fiber composites as per ASTM standards. That the Sliding wear tests are conducted at various loads, Speeds, Sliding distances. It is noted that three samples were tested for each conditions in the analysis.

The wear rate was determined using weight loss method. The wear of the composite was studied as a function of the applied load. In the wear test the pin (specimen) was pushed next to the counterpart rotating against EN 31 steel disc with hardness 56-58 HRC by applying the load. An around strain gauged friction-detecting arm holds and loads the pin specimen vertically into a rotating hardened steel disc. After running throughout the sliding distance of 1884 m for 7 min 57 seconds, the specimen were removed, cleaned with acetone, dried and weighed to find the weight loss due to wear. The difference in the weight measured before and after the test gives the wear of the specimen. The wear was calculated using weight loss method.

6. Results & Discussion

6.1. Sem micrographs of the mmc's:

The Scanning electron microscope images of the Cast Al6061 alloy with three different compositions are shown in figure 3a,b&c. The microscope clearly indicates the Wear portions of the material.

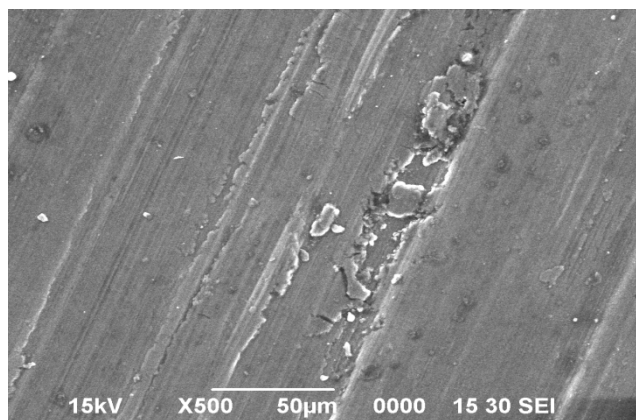


Fig 4a) SEM micrographs Al6061 10% composition.

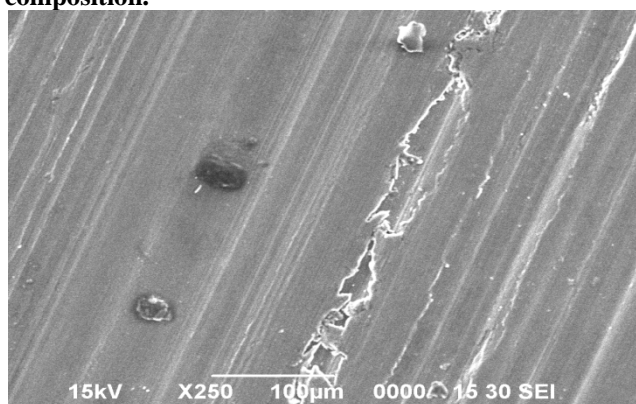


Fig 4b) SEM micrographs Al6061 20% composition.

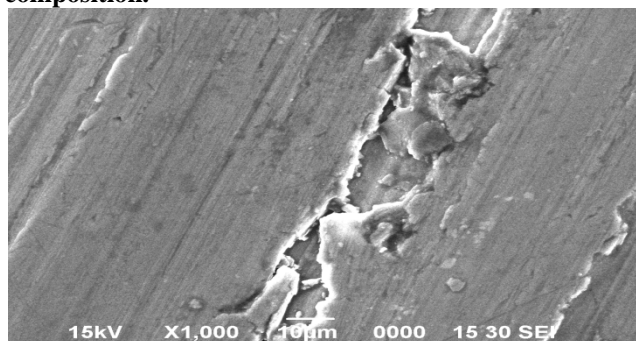


Fig 4c) SEM micrographs Al6061 30% composition.

6.2.Calculation of Wear rate

Table 3 Parameters of calculating wear rate

LOAD	SPEED	DISTANCE
10	2	1000
20	3	1750
30	4	2500

Table 4 variation in wear rate for Al 6061 composite alloy

S.NO	COMPOSITION	TRIAL	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	WEIGHT LOSS (g)	WEAR RATE (mm ³ /km)
1	Al 6061 alloy composite with 10% reinforcement	I	6.6	6.4	0.2	0.0002
		II	6.4	6.1	0.3	0.0003
2	Al 6061 alloy composite with 20% reinforcement	I	5.3	5	0.3	0.0003
		II	5	4.6	0.4	0.0004
3	Al 6061 alloy composite with 30% reinforcement	I	3.8	3.4	0.4	0.0004
		II	3.4	3.1	0.3	0.0003

The above table shows the variation of wear rate with applied load for Al 6061 alloy composites. It can be observed from the figure that as the applied load increases the wear rate also increases. At the initial phase, little change in wear rate was observed for trail 1 and 2 as the applied load increases more change in the wear was observed. The wear of the Al

6061 alloy composite with 10% reinforcement is less than that of other compositions for all applied load.

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7. References

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PARAMETRIC STUDY AND COMPARISON OF I-GIRDER BRIDGE WITH DIFFERENT SUPPORT CONFIGURATION

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ABSTRACT

A study of I-girder with same cross-section, same number of support and same number of intermediate diaphragm but with 4 different support configurations is done. Commercial available software STAAD PRO has been used to carry out linear analysis of these I-girder bridges. Grillage method of analysis has been used to analyze the bridges. The linear analysis has been carried out for the dead load (self weight) and live load of Indian Road Congress (IRC) class 70R LOADING, CLASS A1 LOADING, CLASS A TWO LANE AND CLASS A FOUR LANE for eccentricity loading as per IRC is done.

The paper presents a parametric study for deflection, bending and shear for different support configuration. It is found that the continuous span with equally spaced support is superior to other three support configuration. It can be stated that the obtained results will provide guidance to bridge designers.

Keywords – I-GIRDERS; diaphragm; bending moment; shear force; support configuration.

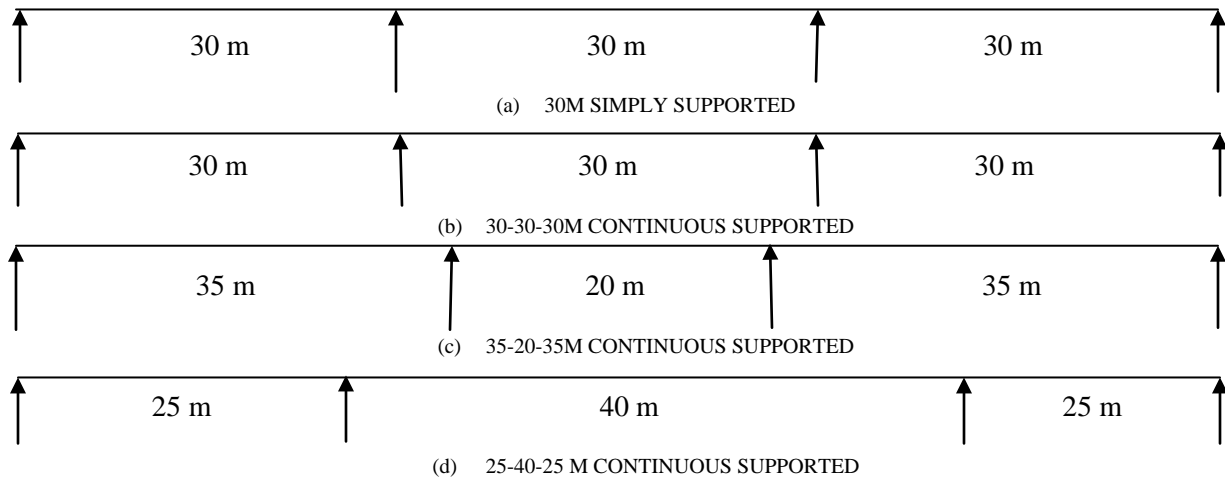
1. INTRODUCTION

I-Girder have gained wide acceptance in freeway and bridge system due to their structural efficiencies, better stability, serviceability, economy of construction and pleasing aesthetics. Analysis of prestress I-girder bridge is very complex because of its three dimensional behavior consisting of torsion, bending and shear. Diaphragms are used to connect all the girders at mid span and on the support to hold all the girders together which also reduces deflection. Greater span will give greater bending moment and thus depth of cross section will also increase and more amount of concrete and prestressing force will be required. While giving support configuration to a bridge one must take care that the difference between sudden changes in bending moment is not too high (that is no shooting moment). Thus the shear force will be less.

2. PROBLEM DEFINATION

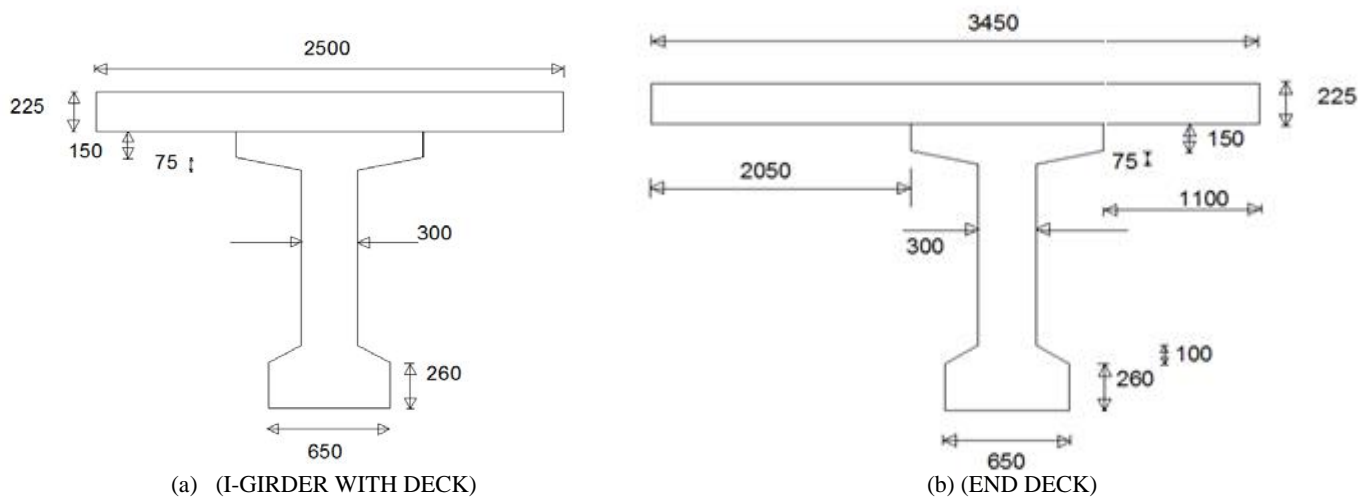
In the present work comparison of I-girder Bridge with four different support configuration namely:

- a. 30-30-30m continuous span
- b. 30-30-30m simply supported span
- c. 25-40-25m continuous span
- d. 25-40-25m simply supported span



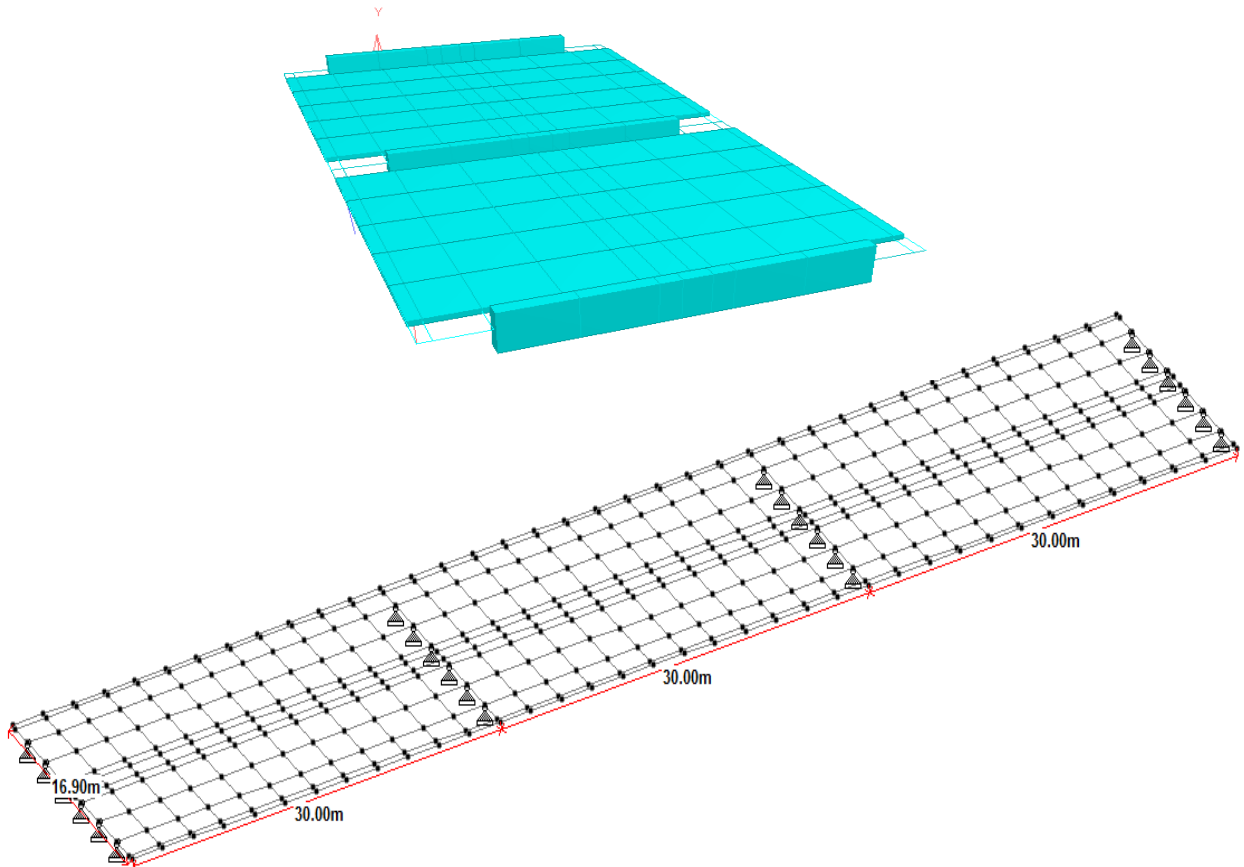
The analysis of the bridge was done taking into consideration same area of cross section of I-girder and same length of bridge, that is 90 m. Also the number of support was kept same, that is four nos. The linear analysis has been carried out for the dead load (self weight) and live load of Indian Road Congress (IRC) class 70R LOADING, CLASS A loading for bridge using STAAD PRO. Deflection, bending moment, shear force was calculated and the comparison of four bridges has been done for various support configuration.

2.1 CROSS SECTION DETAILS



3. STAAD MODELLING AND DESCRIPTION

STAAD PRO is a commercially available analysis and design software also used for analysis of bridge including moving loads. The grillage modeling was done for the analysis of I-girder bridge.



Section property to the girders was give by conducting the I_{xx} , I_{yy} and area of the section including the deck.

Gross section property to the end girder was given by calculating the I_{xx} , I_{yy} and area of the figure (a). And gross section property to the intermediate girder was given by calculating I_{xx} , I_{yy} and area of the figure (b).

Material property was given to the girder such as density, poissons ratio, damping etc. This modeling gives stiffness to the bridge in the direction of the girder (i.e. x direction). To give stiffness in z direction. Dummy cross beams were provided at a distance of 2.1 m. stiffness was given to the dummy cross beams but no density was given so that there is no overlapping of self weight. Diaphragms were provided on the support and also on the mid span of all the four bridges.

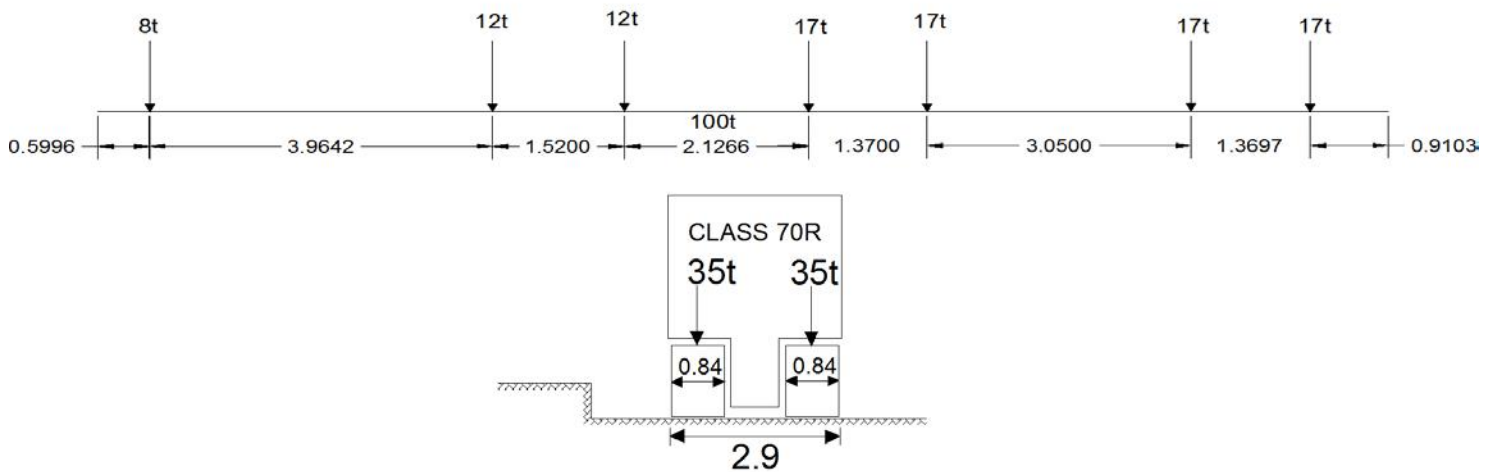
3.1 LOADING PLACEMENT

IRC class 70R load was first applied and checked for deflection and bending moment and similarly class A 1 LANE, class A 2 LANE and class A 4 LANE loading was applied and checked for deflection and bending moment. The loading was placed as moving load which was at a distance of 2.5 m.

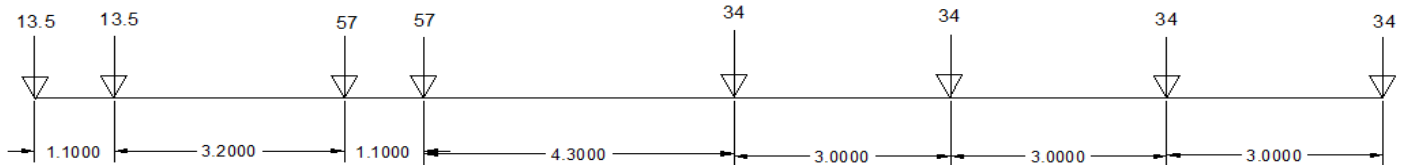
4. TRANSVERSE LOADING PLACEMENT

4.1 70R LOADING

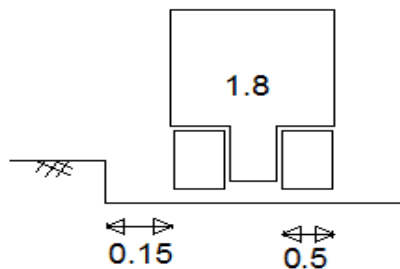
a. CASE 1



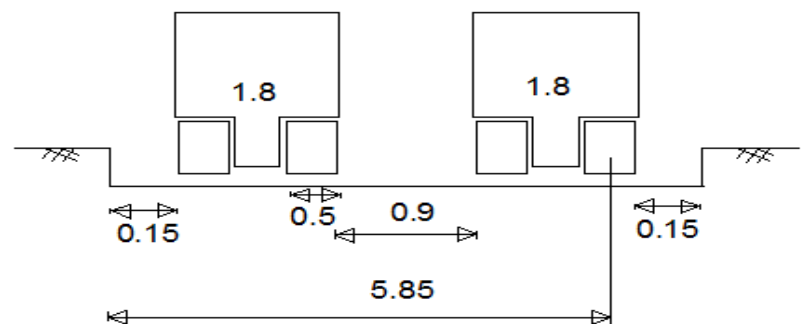
4.2 CLASS A LOADING



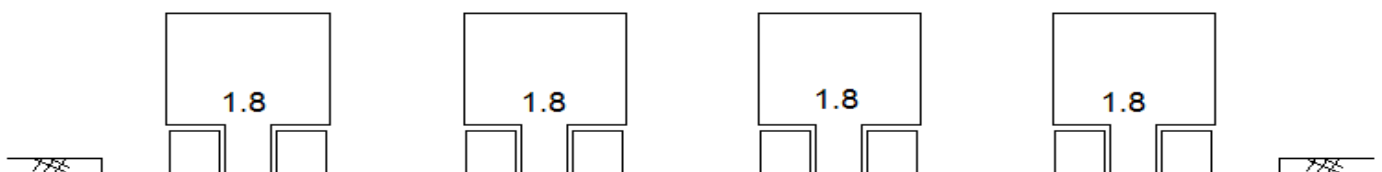
a. CASE 1



b. CASE 2



b. CASE 3



5. RESULTS AND COMPARISON

(Due to the limitation of space the results like BM, SF and Deflection of dead load at a particular section (L/2,L/4,L) bridge are represented graphically).

5.1 30-30-30M SIMPLY SUPPORTED

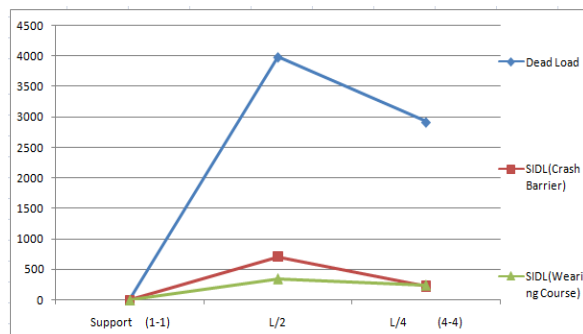
COMPARISON OF EXTERNAL AND INTERNAL GIRDER FOR DEAD LOAD

PARAMETERS	EXTERNAL GIRDER (max.)	INTERNAL GIRDER (max.)
Deflection (mm)	28.45	28.43
Bending Moment (kN.m)	5268.73	5023.82
Shear Force (kN)	168	126

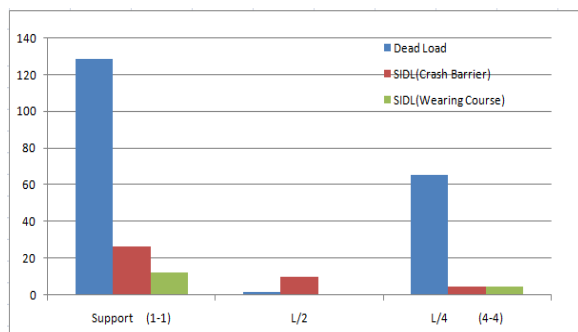
COMPARISON OF EXTERNAL AND INTERNAL GIRDER FOR LIVE LOAD

PARAMETERS	EXTERNAL GIRDER	INTERNAL GIRDER
Deflection	18.89	12.62
Bending Moment	3488.4	2085.2
Shear Force	120	62.3

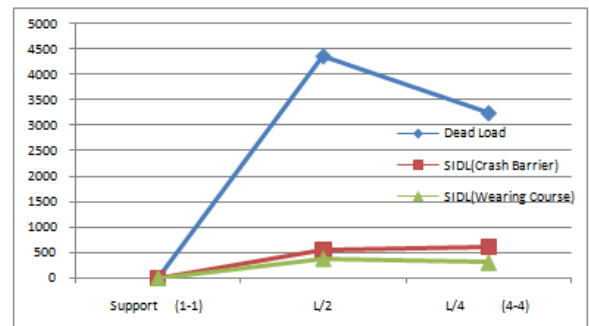
EXTERNAL GIRDER:



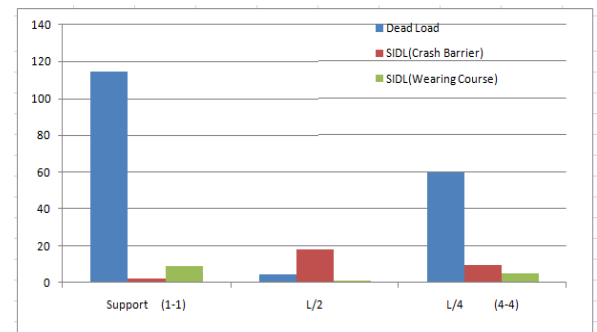
LONGITUDINAL BENDING MOMENT



INTERNAL GIRDER:



LONGITUDINAL BENDING MOMENT



SHEAR FORCE

SHEAR FORCE

From the above table & graphs it is observed that the difference between B.M & Deflection is quite less in both the cases i.e. dead load and live load. In case of dead load the S.F in external girder is moderately higher than the internal girder but in case of moving load the S.F in external girder is twice as that of internal girder.

5.2 30-30-30M CONTINUOUS SUPPORTED SPAN

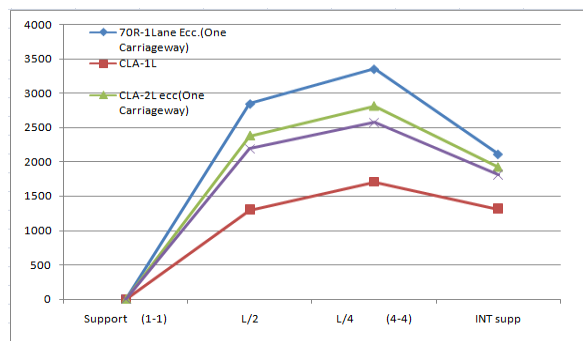
COMPARISON OF EXTERNAL AND INTERNAL GIRDER FOR DEAD LOAD

PARAMETERS	EXTERNAL GIRDER (max.)	INTERNAL GIRDER (max.)
Deflection (mm)	20.627	24.64
Bending Moment (kN.m)	5618.75	2789.78
Shear Force (kN)	215.2	129.96

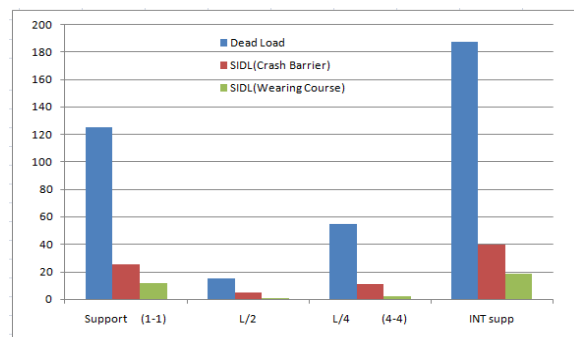
COMPARISON OF EXTERNAL AND INTERNAL GIRDER FOR LIVE LOAD

PARAMETERS	EXTERNAL GIRDER	INTERNAL GIRDER
Deflection	18.89	12.94
Bending Moment	3350.2	1030
Shear Force	140	58

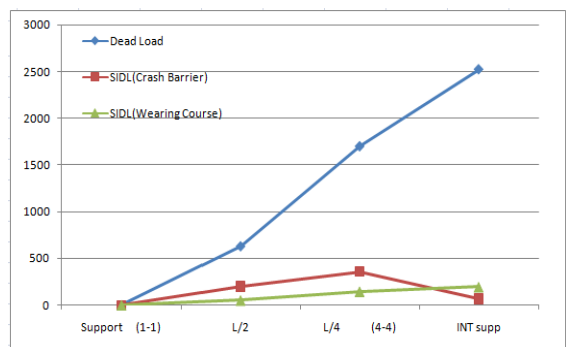
EXTERNAL GIRDER



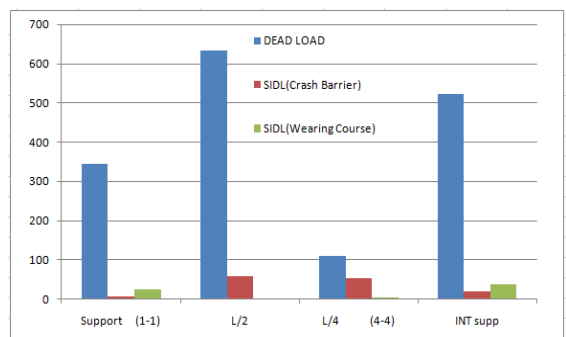
LONGITUDINAL BENDING MOMENT



INTERNAL GIRDER



LONGITUDINAL BENDING MOMENT



SHEAR FORCE

SHEAR FORCE

From the above table & graphs it can be observed that the B.M & S.F in the external girder is almost twice as that of internal girder. Whereas there is no great difference in deflection on the girders. In case of moving load the S.F, Deflection & B.M value of internal girder is less than the half of that of the external girder.

5.3 35-20-35 M CONTINUOUS SUPPORTED SPAN

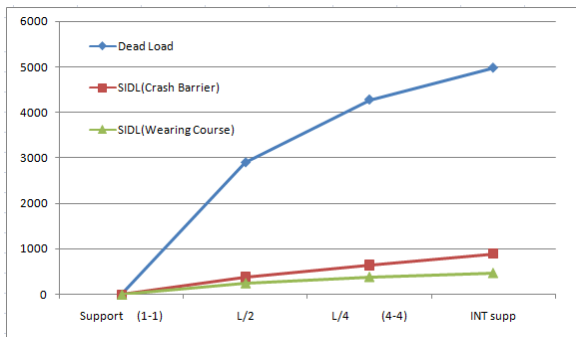
COMPARISON OF EXTERNAL AND INTERNAL GIRDER FOR DEAD LOAD

PARAMETERS	EXTERNAL GIRDER (max.)	INTERNAL GIRDER (max.)
Deflection (mm)	39.18	43.85
Bending Moment (kN.m)	6332.03	3002.145
Shear Force (kN)	283.19	139.6

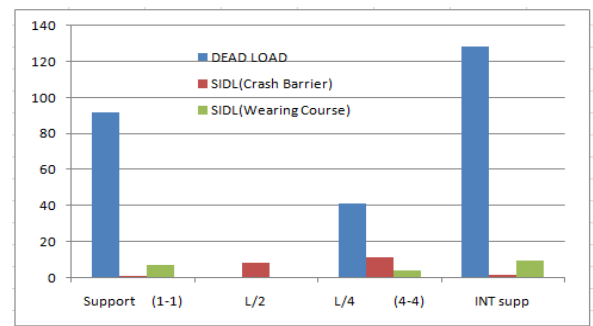
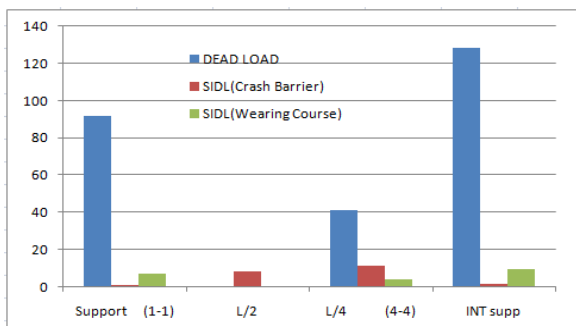
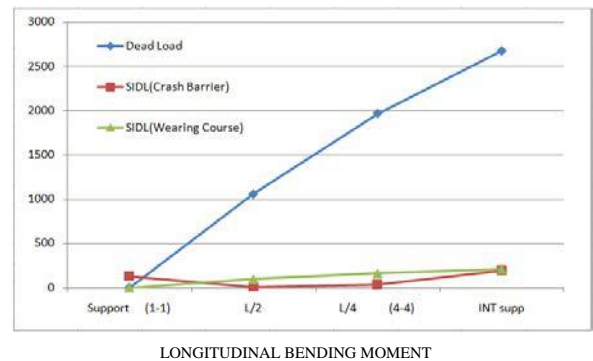
COMPARISON OF EXTERNAL AND INTERNAL GIRDER FOR LIVE LOAD

PARAMETERS	EXTERNAL GIRDER	INTERNAL GIRDER
Deflection	19.31	16.22
Bending Moment	3119.4	998
Shear Force	146	65.3

EXTERNAL GIRDER



INTERNAL GIRDER



SHEAR FORCE

SHEAR FORCE

From the above table & graphs it can be observed that the B.M & S.F in the external girder is almost twice as that of internal girder. Whereas there is no great difference in deflection on the girders. In case of moving load the S.F, Deflection & B.M value of internal girder is less than the half of that of the external girder.

5.4 25-40-25 M CONTINUOUS SUPPORTED SPAN

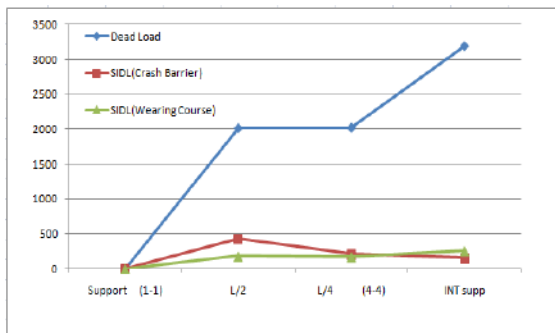
COMPARISON OF EXTERNAL AND INTERNAL GIRDER FOR DEAD LOAD

PARAMETERS	EXTERNAL GIRDER (max.)	INTERNAL GIRDER (max.)
Deflection (mm)	37.71	42.95
Bending Moment (kN.m)	7462.98	3589.36
Shear Force (kN)	272.33	140.52

COMPARISON OF EXTERNAL AND INTERNAL GIRDER FOR LIVE LOAD

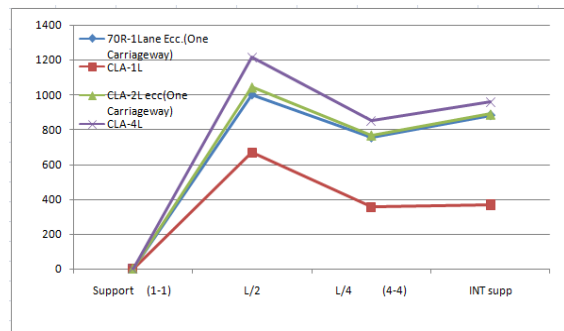
PARAMETERS	EXTERNAL GIRDER	INTERNAL GIRDER
Deflection	27.71	22.28
Bending Moment	3666	1214
Shear Force	142	64

EXTERNAL GIRDER

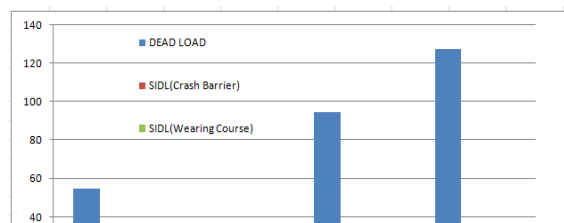
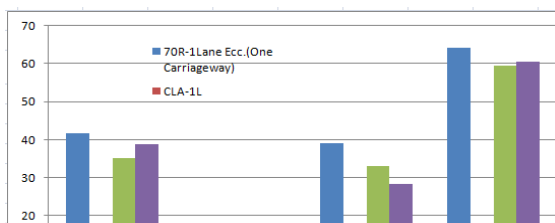


LONGITUDINAL BENDING MOMENT

INTERNAL GIRDER



LONGITUDINAL BENDING MOMENT



SHEAR FORCE

SHEAR FORCE

From the above table & graphs it can be observed that the B.M & S.F in the external girder is almost twice as that of internal girder. Whereas there is no great difference in deflection on the girders. In case of moving load the S.F, Deflection & B.M value of internal girder is less than the half of that of the external girder.

6. COMPARISON OF SPANS

The comparison of different support configuration was done by comparing maximum values of shear force, Bending moment and Deflection of different spans. The below table gives a brief idea about the behavior of the bridge under different loading conditions.

6.1 EXTERNAT GIRDER:

PARAMETER	LOAD TYPE	30 SIMPLY	30-30-30 CON.	35-20-35 CON.	25-40-25 CON.	
COMPARISON OF BENDING MOMENT						
B.M.	DEAD LOAD	5268	4660	6332	7463	
	LIVE LOAD	7R	3488	3350	3119	2726
		CL-A-1	1820	1708	2010	1805
		CL-A-2	2956	2813	2982	2610
		CL-A-4	2465	2571	2754	2421
DESIGN VALUE	8756	8010	9451	10189		
COMPARISON OF SHEAR FORCE						
S.F.	DEAD LOAD	268	245	283	273	
	LIVE LOAD	7R	120	140	146	142
		CL-A-1	81	93	106	104
		CL-A-2	98	116	135	129
		CL-A-4	93	109	129	124
DESIGN VALUE	388	385	429	415		
COMPARISON OF DEFLECTION						
DF.	DEAD LOAD	28.45	20.62	39.18	37.71	
	LIVE LOAD	7R	18.89	16.05	19.30	26.00
		CL-A-1	11.41	9.37	11.45	15.48
		CL-A-2	17.06	14.53	18.1	27.71

		CL-A-4	14.64	13.52	16.76	22.91
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6.2 INTERNAT GIRDER:

PARAMETER	LOAD TYPE	30 SIMPLY	30-30-30 CON.	35-20-35 CON.	25-40-25 CON.	
COMPARISON OF BENDING MOMENT						
B.M.	DEAD LOAD	5024	2790	3002	3589	
	LIVE LOAD	70R	2083	706	998	881
		CL-A-1	1254	267	441	368
		CL-A-2	1967	646	989	888
		CL-A-4	1960	707	1084	957
DESIGN VALUE	7107	3496	4086	4546		
COMPARISON OF SHEAR FORCE						
S.F.	DEAD LOAD	126	130	140	141	
	LIVE LOAD	70R	62	58	65	64
		CL-A-1	19	11	14	13
		CL-A-2	55	47	60	59
		CL-A-4	55	48	61	60
DESIGN VALUE	188	188	205	205		
COMPARISON OF DEFLECTION						
DF.	DEAD LOAD	28.43	24.64	43.85	42.95	
	LIVE LOAD	70R	12.62	11.90	14.63	19.62
		CL-A-1	6.47	5.73	7.30	10.18
		CL-A-2	11.94	11.48	14.28	19.47
		CL-A-4	11.89	11.42	16.21	22.29

7. CONCLUSION

In this paper results of linear analysis of I-girder Bridge with different support configuration namely

- a. 30-30-30m simply supported span.
- b. 30-30-30m continuous span.
- c. 35-20-35m continuous span.
- d. 25-40-25m continuous span.

The result presented highlights the effect of spacing of the supports on the behavior of the bridge in terms of deflection, bending moment and shear force. This detailed study is carried out using STAAD. Pro software and grillage modeling is done. It can be concluded that from the presented study that continuous span with equally spaced support is superior to other three support configurations. The following points highlights the reason of considering 30-30-30m continuous span to be the most efficient configuration of supports.

- The maximum design Bending moment of concluded span is much lesser than the other three configurations
- The difference between sudden changes in Bending moment is not too high. Thus while designing the girder the prestressed cable profile will also be smooth.
- The design shear force values of other three configurations are much quite higher than the concluded span.

- The deflection value is less in case of 30-30-30 continuous span while the deflection values of other three configurations are much higher.

It can also be believed that the result presented in this paper will be of valuable guidance to the designers.

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THANK YOU

ENHANCING THE STRENGTH OF WELD BEAD AND REDUCING THE COST IN SUBMERGED ARC WELDING BY USING RED MUD

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Abstract:

Red mud is a waste product produced during alumina extraction from bauxite by the Bayer's process and has become a major issue in connection with its disposal. As the aluminium demand in the world is increasing, the disposal of red mud waste into the environment also increases, bringing with its environmental issues coupled, however, a potential for the waste to generate a huge amount of unutilized resources still contained in the red mud, such as TiO_2 , Fe_2O_3 , Al_2O_3 , SiO_2 and others. As a possible useful utilization of the disposable waste, red mud can be used as a submerged arc welding flux for welding purpose. Here granular flux is about to be used. By mixing Red mud with Flux in Submerged arc welding, the welding cost maybe considerably reduced to its extent. The strength of weld bead is about to be increased and it is found by using Destructive test and Non Destructive test.

Keyword: Saw, Red mud, Flux, Submerged arc welding

1. Introduction:

Submerged arc welding (SAW) is a common arc welding process. It requires anon-continuously fed consumable solid or tubular electrode. The Molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under a blanket of granular fusible flux consisting of lime, silica, manganese oxide,

calcium fluoride, and other compounds. When molten, the flux becomes conductive, and provides a current path between the electrode and the work. This thick layer of flux completely covers the molten metal thus preventing spatter and sparks as well as suppressing the intense ultraviolet radiation and fumes that are a part of the shielded metal arc welding process.

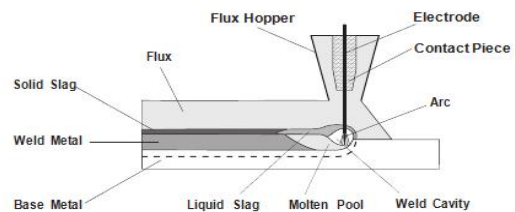


Fig. 1 working of submerged arc welding

2. Parameters of SAW:

Table 1: Parameters of SAW

PARAMETERS	SPECIFICATIONS
Wire Feed Speed	2.5 to 10 m/min
Welding Speed	120m/min to 1800 m/min
Capacity Of Flux Container	Min 5 kg
Welding Current Range	150 to 1200 Amps

Welding Voltage	DC voltage 20 to 46 volts
Max Welding Current	1000 Amps to 1140 Amps
Wire Diameter	2.4mm to 6.3mm
Nozzle Tip Clearance	2.5 to 6mm

3. Red mud:

Red mud is a waste product produced during alumina extraction from bauxite by the Bayer's process. It is a solid waste Residue of digestion of bauxite ores with caustic soda for Alumina Production. Its disposal remains a worldwide issue in terms of Environmental Concerns. During the past decades, extensive work has been done by a lot of researchers to develop various economic ways for the utilization of red mud. The cost of red mud available is about Rs 30. It is majorly available in Madras Aluminium Company, Hindustan Aluminium Company in Alappuzha, Belgam and Ranchi.

4. Objective:

Following are some of the objective which is as follows,

- Reuse the Waste and Convert into Reasonable Use.
- Reduce the cost of flux which induced in SAW.
- Increase the of strength of the weld bead

5. Preparation of flux:

Red mud used in this project is from Hindalco (Aditya Birla Group) Belgum, Karnataka. Initially Red mud has moisture content. And it is dried through atmospheric air. Then the foreign particles are removed by using sewing process. Then flux is allowed to be heated at the temperature of 260°C for the duration of 2 hours. Then flux is kept at 200°C for an hour. It is used

as flux for submerged arc welding to take over the welding parameters.



Fig. 2 flux oven

6. Preparation of specimen:

Initially Mild steel is choosing as a parent metal for SAW. Then surface is made to polished, it is done because to remove the rust.



Fig. 3 Preparation of specimen

7. Welding:

Welding is done with the different combination of flux. Initially Red mud is used as a flux without heating but weld bead is not good. Then the Red mud is treated with furnace after treating the Red mud the weld bead improves compare than the previous one. Then the Red mud is mixed with the Flux like as the range between 50 % - 80%, and welding is done.

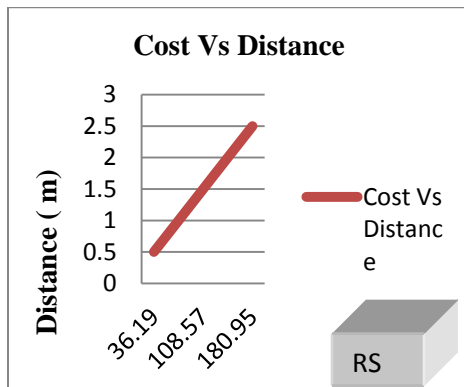


Fig. 4 Experimental Setup

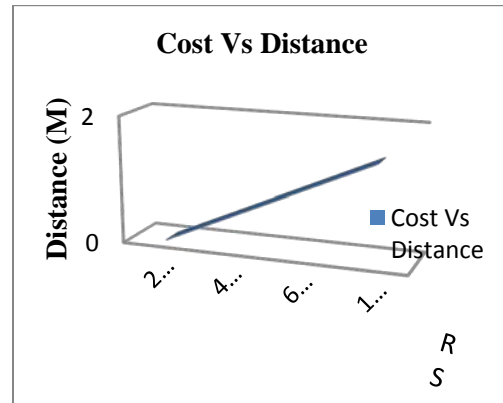
For an every 0.5 meters nearly 0.5 Kg of Flux is about to be consumed. Incase if Red mud is utilized for this type of flux, then nearly cost of the welding can be considerably reduced to its extent.

The following graph 1 show the Cost Vs Distance, it denotes for an every 0.5m the amount of cost consumes Rs.36.19. Incase red mud is utilized for this purpose, the cost can be reduced to considerably as high Percentage.

The percentage of improvement is calculated by that for a 1 m the amount of normal flux consumed is Rs 72.38 while when the Red Mud is added with the flux than the welding cost is Rs 42.7. Therefore the improvement is about to be 40 %.



Graph 1: Cost Vs Distance



Graph 2 : Cost Vs Distance

8. Conclusion:

The Waste Product from Bayer's Process is about to be used in an effective way. The mixture of Red mud and the flux is 70% and 30 % respectively. This mixture shows the better weld bead compared with 80 % and 20% mixture of Red mud and flux respectively. Further different combination will be tested. And also destructive test and non destructive test will be carried out.

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Review of Biodiesel Production, Emissions and Performance characteristics of Mahua oil

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Abstract

This paper presents a brief review on the current status of biodiesel production from Mahua oil and its performance and emission characteristics as diesel engine fuel. This review is based on the reports on Mahua oil production process and its characteristics were published in the current literature by different researchers. Biodiesel was produced from raw Mahua oil by Transterification process. The main aim of the Transterification process was to reduce the amount of free fatty acid. Biodiesel of Mahua oil is also called methyl (MOME) or ethyl (MOEE) ester. It was completely miscible with diesel oil, thus allowing the use of blends of petro-diesel and biodiesel in any percentage. Presently, biodiesel is blended with mineral diesel and used as fuel. Biodiesel fueled CI engines perform more or less in the same way as that fueled with the mineral fuel. Exhaust emissions are significantly reduced due to the use of Mahua oil biodiesel or blends of biodiesel and mineral diesel.

Keywords: Review, Mahua oil, Biodiesel, CI engine.

1..Introduction

The most harmful effect of our present day civilization is global warming and environmental pollution. With rapid industrialization and urbanization, we are making our planet unsafe for us and for the generations to come. We are now all well aware of the lethal effects of pollution. India is already the fifth largest greenhouse gas emitter of the world and is expected to become the third

largest GHG emitter by the year 2015 with China topping the list. The vehicle population throughout the world is increasing rapidly; in India, the growth rate of automotive industry is one of the largest in the world. It is quite evident that the problem cannot be solved with the conventional fossil fuels, however stringent the emission control norms may be. This demands the search for a suitable alternative to conventional fossil fuels.

Many researches are going on to replace diesel fuel with a suitable alternative fuel like biodiesel. Non-edible sources like Mahua oil, Karanja oil, Neem oil, Jatropha oil, Simarouba oil etc. are being investigated for biodiesel production. Fatty acids like stearic, palmitic, oleic, linoleic and linolenic acid are commonly found in non-edible oils. Mahua oil (*Madhuca Indica*) is one of the forest based tree-borne non-edible oils with large production potential of about 60 million tons per annum in India. The Mahua tree belongs to the genus *Madhuca*. The tree, its seed and flowers had been very useful in Indian economy for a long time. The flowering season extends from February to April. It is rich in sugar (73 %) and next to cane molasses; it constitutes the most important raw material for alcohol fermentation. The yield of alcohol is 405 liters from one ton of dried flower. The kernel of the Mahua fruit contains about 50% oil. The expelled cake is relevant to recover the residual oil. Fresh oil is yellow in colour, while commercial oil is generally greenish. As this tree grows mainly in forest area and also in waste and fallow land, its cultivation would not produce any impact on food production but

would in an attempt is made in this paper to study the feasibility of Mahua methyl ester and its blends with diesel fuel for a compression ignition engine. Sharanappa et al. (2009) had undergone the development of Mahua trees grown in draught prone areas and found abundantly over several parts of India. The seeds are collected and oil is extracted at village level expellers, million tons of oil will be available for lighting lamps in rural area. Mahua oil is considered for preparing ghee, but in India considered as non-edible oil. Mahua is substitute for kerosene. Due to increase in awareness and growth in research in this area the Mahua, an alternative source of fuel by replacing diesel. The properties like density, viscosity, flash and fire point of Mahua oil under test are higher, and calorific value is lower, and are in the range of 86% that of diesel.

1.2. Biodiesel Production

Researchers are trying to find several ways to make biodiesel from different feed stocks like edible and non-edible vegetable oils, waste cooking oil, animal tallow, algae etc. Most of the researchers prepared biodiesel by transesterification process from the raw feedstocks using a base catalyst. Shashikant and Hifjur (2006) reduced the high FFA (17%) level of crude Mahua oil to less than 1% for using Mahua oil as a biodiesel in diesel engine. They took the process parameters of methanol (0.32 v/v), H₂SO₄ as catalyst (1.24% w/v), 1.26 h reaction at 60°C temperature. After pretreatment step, settling time of minimum one hour was required for removal of methanol–water mixture. This process gave yield of Mahua biodiesel as 98%. Properties of the biodiesel satisfy both American and European standards for biodiesel. Kian and Suhaimi (2012) produced biodiesel from low quality crude jatropha oil by Transterification process by using modified natural zeolite as a solid catalyst. The process parameters were 20:1 molar ratio of methanol to oil, of 5wt% catalyst and 70°C reaction temperature. Finally they got the optimum yield in which the biodiesel content exceeded 96.5%.

Shakinaz et al. (2006) had undergone a study of production of biodiesel using microwave technique. Microwave irradiation was used for the production of biodiesel. Biodiesel from Jatropha oil was obtained using a methanol/oil molar ratio of 7.5:1, potassium hydroxide as catalyst. Radio frequency microwave energy helped for improving the separation process at reaction rate (2 min instead of 150 min). By using the microwave technique, no pretreatment is required. This technique paved way to increase the yield and time controlled process. Hasan et al. (2013) produced biodiesel from neem seeds, its properties was close to diesel. The methodology of esterification process were selected and carried out by 1000ml raw neem oil, 300ml methanol and sodium hydroxide on mass basis as a catalyst usually kept in oven to form methyl ester, and initially to reach equilibrium condition at temperature 55-66°C. Next step to separate ester and glycerine by stimulating continuously and allow settling under gravity for 24 h. Thus the separated ester contains 3% to 6% methanol and soap agents. The methanol was removed by vaporization. The biodiesel had some catalyst; it was removed by warm water mix with ester. Kinematic viscosity lay between 1.9 to 6.0 according to the ASTM D6751 specification. Hence, 0.95 ltr biodiesel was production from 1 ltr neem oil.

Priya et al. (2013) described that the transesterification along with the alkaline catalysts was the well known process for the preparation of biodiesel. In Taguchi method ANOVA were used to analysis and optimize the experimental parameters which included catalyst concentration, catalyst type, reaction time and oil to alcohol molar ratio for the production of Mahua oil methyl ester. The results showed that the optimized experimental condition were oil to the

alcohol molar ratio as 1:15, catalyst used in the process is sodium hydroxide and 5 min of reaction time. In addition the analysis result

concluded that the catalyst type was the major influencing parameter in number of experimental trials for the production of Mahua oil methyl ester. In future this work must be carried out for estimation of multiple parameters in production of Biodiesel.

Javidialesaadi and Raeissi (2013) focused on minimizing the production costs and searching a permanent oil source for green fuel. In this work, high free fatty acid oils were used for esterification reaction and the main parameters were analysed experimentally. The investigation showed that there was no change occurs in altering methanol-to-oil ratio, the amount of catalyst and time for the progress of the reaction compared to diesel fuel. Daming et al. (2012) recalled the history and some advance improvement in the production of biodiesel. This paper reviewed various types of biodiesel, processing, the characteristics and cost of biodiesel production. The application of biodiesel in automobile industry, the huddles of biodiesel industry development and the biodiesel policy were clearly explained.

Giovanilton et al. (2011) produced biodiesel from soybean oil by transesterification with ethanol. Optimum conditions for the production of ethyl esters were the following: mild temperature at 56.7 °C, reaction time in 80 min, molar ratio at 9:1 and catalyst concentration of 1.3 M. For esterification reaction, H₂SO₄ was added as a catalyst and for transesterification KOH was added as the catalyst with methanol. Widayat et al. (2013) produced biodiesel from the rubber seed by situ method. They focus on influence of reaction time, concentration of acid catalyst and ratio of raw material to methanol. This process took 120 minutes at 60°C with maximum yield of FAME 91.05% at H₂SO₄ 0.25% (v/v) and ratio of raw material to methanol (1:3). Based on the results, ratio of raw material to methanol was quite important to increase yield of FAME significantly.

Lieke et al. (2014) produced biodiesel by two step process. The first step process which was designed for 3 hours reaction time at 30°C and 5.8% of ozone using either 1 or 1.5 weight % KOH at various percent weight of supporting catalyst had proved simultaneous reaction for both ozonolysis and transesterification. The short chain methyl esters (methyl hexanoate, methyl octanoate and methyl nonanoate) were effectively produced for the first step process using 5.8% mol ozone at 30°C for 3 hours either for 1 or 1.5 weight % KOH at various percent weight of extracted supporting catalyst. From this reaction, the esters predicted by ozone reaction were sufficiently produced. The highest short chain methyl esters and long chain methyl esters produced in the first step process was 85.722 mg/liter and 655.286 mg/ltr respectively, which used 17.3 weight % ash and 1.5 weight % KOH. The presence of extracted ash in methanol as supporting catalyst enhanced the production of total methyl esters compared to that without the presence of ash in the first step process. Higher temperature (60°C) in the second step process without the presence of ozone gave enough vibration of energy, to increase rate of transesterification and decrease the viscosity. However, longer time reaction at higher temperature would lead in the losses of total methyl esters.

Padhi and Singh (2010) produced biodiesel from Mahua oil through the Esterification. The conditions for produce biodiesel were 8% Sodium Methoxide, 0.33% v/v alcohol/oil ratio, 1 hr reaction time, 65°C temperature and 150% v/v excess alcohol. They concluded this was the best condition for biodiesel production. Kapilan and Reddy (2008) produced biodiesel from Mahua oil methyl esters (MOME) were prepared by transesterification using potassium hydroxide (KOH) as catalyst and test the conversion of vegetable oil to biodiesel by nuclear magnetic resonance (NMR) testing method. They studied the performance characteristics fuelling with Mahua biodiesel in a diesel engine. They

concluded B20 gave higher thermal efficiency and lower specific fuel consumption than diesel fuel.

Nanbanita et al. (2014) studied about the transesterification process and factors to be effected (oil to alcohol ratio, concentration of catalyst used, temperature, stirring rate and reaction time) in the biodiesel production process. The process parameters were optimized and a maximum biodiesel yield of 94% had been achieved. They tested the properties of the biodiesel like density, flash point, calorific value and viscosity are close to the diesel. The present analysis revealed that biodiesel from refined Mahua oil was quite suitable as an alternative to diesel. Edmilson et al. (2014) produced biodiesel from Residual oils and also check the viability and degradation level of production process. Residual bovine, chicken and soybean oils were used for biodiesel production process. They used four transesterification methods, using acidic and basic catalysis and, gas chromatography with flame ionization detector (GC-FID). They concluded use of acidic catalysis at a lower temperature were the most efficient in the biodiesel production process.

Dulari et al. (2013) revealed the possibility of utilizing bioethanol obtained from Madhuca Indica flower as an alternative fuel in a direct injection (DI) diesel engine. The following conclusions were declared by authors, the nitric oxide (NO) and smoke emissions were found to be lesser by about 4% and 20% and also the bioethanol produced from Madhuca Indica flower can be used as a potential alternative fuel replacing 5% of petroleum diesel. In addition the BMDE5 emulsion gave a better performance and lower emissions. Vaibhav et al. (2006) had studied the epoxidation of Mahua oil by using hydrogen peroxide. The effects of the following parameters, such as temperature, hydrogen peroxide-to-ethylenic unsaturation mole ratio, acetic acid-to-ethylenic unsaturation mole ratio, and stirring speed, on the epoxidation rate as

well as on the oxirane ring stability and iodine value of the epoxidised Mahua oil (EMO) were studied and also the effects of these parameters on the conversion to the epoxidised oil were studied and the optimum conditions were established.

3.Performance and Emission Characteristics

Navindgi et al. (2012) developed an experimental study to evaluate the performance of CI engine with different blends of Mahua biodiesel under varying operating conditions. The brake specific fuel consumption and brake thermal efficiency of the engine and emissions are measured to evaluate and analyze the behavior of the diesel engine running on biodiesel at two injection pressures like 180 bar and 240 bar and temperatures of 30, 50 and 70° C. They concluded the comparison of diesel, Mahua methyl ester oil and its blends under varying operating conditions. Himangshu and Veeresh (2013) investigated on this paper is more concerned with an experimental investigation to study the diesel engine emission characteristics using Mahua oil methyl ester with the help of a three way catalytic converter with diesel exhaust fluid by running the engine in steady state conditions and also they concluded that the hydro carbon emission and nitrogen oxides emission also lower.

Sharanappa et al. (2009) investigated an engine performance such as brake specific fuel consumption, brake specific energy consumption and exhaust gas temperature and emissions (CO, HC and NO_x). Brake specific energy consumption decreased and thermal efficiency of engine increased when operating on 20% biodiesel than that operating on diesel. The amount of CO and HC in exhaust emission decreased, whereas NO_x increased with increase in percentage of Mahua biodiesel in the blends. Mahua biodiesel blended gave better result compare to diesel up to 20% without affecting the engine performance. Hifjur et al. (2013) investigated the Performance of a diesel engine with blends of biodiesel and high-speed diesel

and the experiments were also conducted to assess soot deposits on engine components, such as cylinder head, piston crown, and fuel injector tip, and addition of wear metal in the lubricating oil of diesel engine when operated with the biodiesel blend (B10) for 100 h. Various fuel properties of MO, SRO, MSO, biodiesel obtained from this mixture of oils, and its blends with HSD (B10 and B20) were determined as per the ASTM standards.

Santhosh et al. (2013) discussed the Mahua oil and mixed with diesel from 15%, 25%, 35% & 45% of volume in running diesel engine. Biodiesel was extracted by transesterification process of Mahua oil with methyl ester in presence of magnesium phosphate as catalyst. Exhaust Gas Temperature emissions & emissions (CO, HC, NO_x & CO₂) were measured and to evaluate the power output, brake thermal efficiency and specific fuel consumption. The brake thermal efficiency for biodiesel in comparison to diesel engine is a better option for part load. The specific fuel consumption for the Mahua oil in the blend is more than 25% of diesel. Santhanakrishnan et al. (2013) conducted an experiment to measure specific fuel consumption, brake thermal efficiency and hydrocarbon emission. Biodiesel was extracted by transesterification process of Mahua oil with methanol in presence of sodium hydroxide as catalyst. Using biodiesel in diesel engine, it would decrease the engine's efficiency and increase the specific fuel consumption which could be overcome by using ceramic coatings in engine. Due to coating, the brake thermal efficiency of low heat rejection biodiesel engine was 13.41% higher at maximum load condition compared to conventional biodiesel engine. The specific fuel consumption of biodiesel blend in low heat rejection engine was 10.41% higher at maximum load condition. The unburned hydrocarbon emission of biodiesel blend in low heat rejection engine is 17.1% lower than the conventional engine at maximum load.

Shruthi and Rahul (2013) studied the combustion and performance characteristics fuelling with various blends of Mahua oil biodiesel (20%, 40% and 60%) in single cylinder DI engine at constant speed of 1500 rpm. The delays were consistently shorter for M100, varying between 9.9° and 6.2° crank angle lower than diesel with the difference increasing the load. However, further research and development on the additional fuel property measures, long-term run and wear analysis of biodiesel fueled engine was also necessary along with injection timing and duration for better combustion of biodiesel in diesel engines. Swarup and Bhabani (2014) concluded that the brake thermal efficiency and exhaust gas temperature increases and the specific fuel consumption was reduced with reduce the percentage of additive in all the test fuels. Emissions of CO, HC, smoke and NO_x decrease with increase in mixing percentage in the biodiesel fuel. Kapilan et al. (2009) prepared Mahua oil biodiesel from Mahua oil by transesterification using methanol and potassium hydroxide. They compared the fuel properties of MOB with the diesel and ASTM standards. It was close to the diesel and ASTM standards. They found the low CO, HC and smoke emissions from the MOB, B5 and B20 blends compared to diesel. The B5 and B20 blend results in higher efficiency as compared to diesel fuel. The B5 blend results in higher efficiency than the B20 blend. Sukumar Puan et al. (2005) used Mahua oil methyl esters as biodiesel. They found Brake thermal efficiency of Mahua Oil Ethyl Ester (26.36%) was higher than diesel (26.42%). Emissions of carbon monoxide, hydrocarbons, oxides of nitrogen and Bosch smoke number were reduced around 58, 63, 12 and 70%, respectively, in case of MOEE compared to diesel. Based on this study, MOEE can be used a substitute for diesel in diesel engine.

Lakshmikanth and Arunkumar (2013) conducted experiment with the help of Mahua oil biodiesel and its 50% blend with diesel in

four strokes, direct injection compression ignition diesel engine. The performance tests are carried out in short term engine. The performance characteristics of different blends were predicted and compare with diesel. The performance test concluded the fuel consumption and exhaust gas temperature were maximum for Mahua oil biodiesel and its blends and also it showed the break thermal efficiency was lower than diesel. Hence, without any modification the engine operated well in Mahua biodiesel. Ratnakara et al. (2009) investigated experimentally on a single cylinder for variable compression ratio in C.I engine using Mahua oil as the fuel. The experiments were done at standard test conditions of about 70°C cooling water temperature and at a uniform speed of 1500rpm for 7 various compression ratios(13.2,13.9, 14.8, 15.7, 16.9, 18.1and 20.2). The performances as well as exhaust analysis were done to find the exact compression ratio. The results concluded that 15.7 compression ratio is the best for Mahua oil. It also shows the thermal efficiency is maximum and also fuel consumption and the exhaust gas temperatures were minimal at this compression ratio.

Sundheer Nandi (2013) studied the performance characteristics of transesterified Mahua oil diesel blends. The thermal efficiencies of transesterified Mahua oil were higher at 25% diesel blends. The cost of transesterified Mahua oil was low compared to the cost of diesel. They found Mahua oil blended with diesel was more economical and best alternate for diesel fuel. Sitaramaiah et al. (2013) produced Mahua oil biodiesel by considering various parameters for esterification and transesterification process at optimal experimental condition. The experiment were carried out in diesel engine, the Mahua methyl ester's performance, emission and combustion characteristics were analyzed and the results were compared with diesel fuel. The result clearly showed that there was an increase in brake thermal efficiency and brake specific fuel consumption is minimized. CO, HC and NO_x

emission were considerably reduced as compare to diesel. In addition the analysis concluded the blend B20 gives optimal performance than other blends. Eman and Cadence (2013) investigated characteristics of biodiesel produced from palm oil via base catalyst transesterification process. To find the optimum yield value of biodiesel ,three important parameters were selected such as reaction temperature 40, 50, and 60 °C, reaction time 40, 60 and 80 and methoxide ratio 4:1, 6:1 and 8:1.By conducting the experiments the optimum yield value 88% was achieved by the parameters such as reaction temperature 60°C ,reaction time 40minutes and methoxide ratio 6:1.from the optimum yield value, the physical properties were calculated like, density is 876.0 kg/m³, kinematic viscosity of 4.76 mm²/s, cetane number of 62.8, flash point of 170 °C, cloud point of 13°C. The produced biodiesel had similar properties of ASTM D 6751, and EN 14214.

Narinder singh et al. (2013) investigated the characteristics and emission performance of Mahua oil with different blends of ethanol contains 5, 10 and 15 percent, its volume denoted in M5, M10 and M15 respectively. The experiment was conducted on single cylinder CI engine to study brake horse efficiency, brake specific fuel consumption and brake thermal efficiency under load condition. The experimental results of BHP increased with increase in % of ethanol and M5 it was maximum. The specific fuel consumption increased with increase on more Mahua oil blend. Emission of carbon monoxide is high in the Mahua oil biodiesel but it can be reduced by addition of ethanol. Emission of smoke quantity were high in full load, it was controlled by adding blends at high loads. Haiter Lenin et al. (2013) analyzed the performance, emission and combustion behavior of Mahua methyl esters and its blends with diesel as fuel in diesel engine. The performance tests were carried out for various ratios such as 25% and 50% of Mahua methyl ester fuel blends at different loading conditions. The test result showed that

brake thermal efficiency, smoke density and NO_x were higher than that of diesel. There was no change in CO_2 emissions; HC and CO emissions were drastically reduced compared to the diesel engine. The carbon release from the engine was minimized which control the environmental pollution. The result also concluded that the B25 fuel was optimized alternative fuel for diesel engine.

Solaimuthu et al. (2012) compared the Mahua oil and its different blends with diesel to investigate the engine performance, combustion and emission characteristics in four stroke tangentially vertical single cylinder kirloskar 1500 rpm direct injection diesel engine. The experiment was performed at various static injection timings of 19° , 20° , 21° , 22° and 23° bTDC with nozzle opening pressure of $250 \times 10^5 \text{N/m}^2$. This investigation showed that B25 fuel was best one to replace diesel at an injection timings of 20° which also save 25% of petro-diesel. Chandrakasan and Palanisamy (2011) explained the effect of injection timings on performance, combustion and emission characteristics in diesel engine. They conduct he test in uniform ignition pressure of 220 bar and various injection timings about 22° , 23° and 24° at optimal load conditions. The result concludes that the B25 at an injection timing of 22° gives high performance almost equal to pure diesel which also saved 25% of fuel consumption. In addition the emission of HC, CO and NO_x was reduced.

Sukumar puhan et al. (2005) analysed the performance and emission characteristics of Mahua oil methyl, ethyl and butyl ester in four stroke DI diesel engine. The experimental result showed that the methyl ester have high thermal efficiency compared to all other ester and diesel. NO_x emission was lower in ethyl ester than other ester. When compare to diesel fuel, CO and NO_x emission were lower for MOME, MOEE, MOBE but CO_2 emission was slightly high than diesel. This paper concluded that MOME was the best alternate fuel for diesel

than other esters. Senthil and Thundil (2013) experimentally investigated the effect of fuel injection timing and in-take air temperature using pure ethanol blend biodiesel fuel which was done in four stroke, DI diesel engine. The tests were carried out at constant speed (1500 rpm) and load (2 kW) at 1.1 bar intake manifold pressure with various injection timing such as 12, 15, 18, 21 and 24 CA bTDC and inlet temperature 40°C and 60°C . The test concluded that when there was advancing in injection timing result in maximizing in-cylinder pressure, temperature, heat release rate and NO_x emission. It also showed that increase in inlet temperature reduce the CO and HC emission.

Lokanadha and Appa rao (2013) conducted experiments on DI diesel engine with neat diesel, Mahua oil methyl ester (MOME) and MOME with dimethyl carbonate and they concluded that the Mahua oil methyl ester (MOME) is blended with viscosity improver DMC to decrease the viscosity. In addition the heat release curves and the combustion pressure curves indicate smoother combustion in case of 6% DMC additive. Compared to diesel the emissions are considerably reduced the HC emission reduced by 11.6 % for 6 % DMC blend with Mahua oil methyl ester.

4. Conclusion

From the study of literature reviews, Mahua oil biodiesel was one of the better alternatives to mineral diesel as fuel in compression ignition engine. And also the review shows that transesterification process is the best and most popular way to produce the biodiesel. The efficiency and quality of biodiesel are significantly higher than the conventional fuels. The characteristic of emission like NO_x , CO and other toxic smokes can be reduced by Mahua oil biodiesel. Great demands, unstable price, non biodegradability are the major issues for the current conventional fuels. For such kind of problems, the people think about the alternative sources. Today, biodiesel is an non-

toxic, increasingly attractive, biodegradable and shows the good replacement to fossil fuel.

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STUDY ON DEFECTS IN STRAIGHT TUBE BUTT WELDING

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Abstract

For various purposes in Boiler assembling, Tubular Products like Economizer Re heaters, Super heaters are needed. Straight tube butt welding (STB Welding) is a process in which straight tubes are welded. In this process many small tubes are joined to form lengthy tubes. By these lengthy tubes the tubular products are manufactured. In STB welding various defects occurs. These defected joints are rejected. This rejection increases the production time and production costs. The root causes for the defects are found and studied. The important parameters that affect the weld quality in STB were found. The suitable remedies are suggested for overcoming the defects.

Keywords: STBW, MIG Welding, Visual Inspection, Parameters, Remedies.

1. Introduction

Welding is a process of joining two or more pieces of the same or dissimilar materials to achieve complete coalescence. This is accomplished by fabrication of vastly different components including critical structures like water wall panel, heat exchanger, pressure vessels, etc. Welding can be done with or without the application of filler materials called electrode. Welding joins different metals / alloys with the help of a number of processes in which heat is supplied either electrically or by means of a gas torch. In order to join two or more pieces of metal together by one of the welding processes, the most essential requirement is heat, pressure may also be employed, but this is not, essential in many processes. In the course of time, temperature difference in a body is reduced by heat flowing from different

region of higher temperature of those of lower temperature. This process takes place in all substances such Assistant liquids and gases and also in solids. In comparison to other process of joining the metal, STB process can give 100% of strength and efficiency.

The objectives of the project are to reduce the defects in Straight Tube Butt Welding (STBW) machine. This is founded through a survey which is done on the welded joints by the STBW machine.

2. Straight Tube Butt Welding

Metal inert gas welding process (MIG) is widely used process in STBW process. MIG welding process is one of the many versatile processes grouped under the headings, Gas metal Arc welding process (GMAW). Among the group, MIG welding process was the first to be discovered. This was the result of the attempt made during 1940's to develop a suitable welding process for steel and also a mechanize the same. Today it is a well established semi-automatic process, which can be easily mechanized or automated with a wide range of applications.

2.1 Principle

It is an arc welding process where in coalescence is produced by heating the jobs with an electric arc establish between a continuously fed metal electrode and the job. No flux is used but the arc and molten metal are shielded by an inert gas, which may be argon, helium, CO₂ or a gas mixture. In MIG, the electrode is in the form of a write continuously feed from a spool. The rate of feeding the wire is controlled. GMAW is generally used because of its

high productivity, it is also easy to use and it creates high quality welds at a lower overall cost. GMAW is generally done using DECP (Direct Current Electrode Positive) or DCRP. Alternating current is never used. DCEN (Direct Current Electrode Negative) is used with only one special electrode, called an emissive electrode. GMAW can be done using solid wire, flux cored or a specially coated solid wire electrode. The shielding gas or gas mixture must be used with GMAW. For every pound of solid electrode wire used, 92-98% becomes deposited Assistant weld metal. Some spatter occurs in the GMAW process. Very little stub loss occurs when continuously fed wire is used. There is a very thin glass like coating over the weld bead after GMAW. No heavy slag is required because a gas shields the weld area.

2.2 Machine Description

The GMAW unit consists of the following major components: Welding gun, Wire drive, Gas supply and suitable valves, Welding machine, Water supply system, Control unit.

2.3 Working

As the name itself indicates the machine can handle only straight seamless steel tubes. The work (i.e.) straight seamless steel tubes are held using chucks and it is automatically fed through the checks by rollers. The rollers are driven using hydraulic motors. At the middle of both the chucks there is a presence of bar stop. The bar stop is used to align the tubes during welding. In order to weld tubes with uneven thickness inserts are used. There is a presence of control panel to control the process parameters such as current, voltage, chuck speed, wire feed and oscillator speed etc. The wire feed is done by wire feeding mechanism and can be controlled using control panel while joining the tubes, the root layer is first welded by fixing some parameters and then oscillator is made to operate and the second layer is welded. The movements of welding torch and bar stop are automatically controlled pneumatically. The welding torch is water-cooled. The operating parameters plays an important role in weld quality and the defects are mainly caused due to the changes in operating parameters for each material separate operating parameter should be fixed.

3. Inspection

Visual inspection, which is the most widely used inspection method, is also the quickest, easiest, and cheapest. The only equipment commonly used is a magnifying glass (1 OX or less) and a flashlight or extension. Other tools, such as a bore scope and dental mirrors, are useful for inspection inside vessels, pipe, or confined areas. Visual inspection is always required in weld evaluation. However, it will not reveal interval defects or minute surface defects.

3.1 Examination prior to welding

Before welding, the faces and edges should be examined for laminations, blisters, scabs, and seams. Heavy scale, oxide films, grease, paint, oil, and dirt should be removed. Edge preparation, alignment of parts, and fit up should be checked. Welding specifications should be specific and state that all weld joints must be inspected for compliance with requirements for preparation, placement of consumable inserts, alignment, fit-up, and cleanliness.

3.2 Examination of welds during welding

Specifications should state that welds must be examined for conformance to the qualified welding procedure, detection of cracks in root pass, weld bead thickness, slag and flux removal, and preheat and inter pass temperatures, where applicable.

3.3 Examination of welds after welding

Specifications should state that welds must 'be examined for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds. A weld is considered acceptable by visual inspection if:

(1) The weld has no surface flaws such as cracks, porosity, unfilled craters, and crater cracks, particularly at the end of welds.

(2) The weld metal and base metal are fused. The edges of the weld metal should blend smoothly and gradually into the adjacent base metal. There should be no unacceptable overlap or undercut.

(3) The weld profiles conform to referenced standards and specifications. The faces of fillet welds may be slightly convex, flat, or slightly concave, as determined by use of suitable gages or templates. The minimum size of each fillet leg is specified on the applicable drawings or welding procedure. For butt welds, the amount of weld bead reinforcement or the height of the surface of the weld above the base metal surface should be no greater than the welding specification allows (These standards should be developed early in a job, and should represent acceptable, borderline, and reject able conditions. When there are several critical joints, a separate standard may be prepared for each).

4. Defects

Most of the defects encountered in welding are due to an improper welding procedure. The following defects are found in STBW using visual inspection method:

4.1 Incomplete Penetration

When the weld bead does not penetrate the toe of a fillet weld but only bridges across it. Welding current has the greatest effect on penetration. Incomplete penetration is usually caused by the use of too low welding current and can be eliminated by simply increasing the ampere. Other causes can be the use of too slow travel speed and an incorrect torch angle. Both will be allow the metal to rise in front of the arc acting as a cushion to prevent penetration. The arc must be kept on the leading edge of the weld puddle.

4.2 Lack of Fusion

The most common cause to lack of fusion is poor welding technique. Either the weld puddle is too large (travel speed too slow) and the weld metal has been permitted to roll in front of the arc. Again the arc must be kept on the reading edge of the puddle. When this is done the weld puddle will not get too large and cannot cushion the arc. Another cause is the very wide weld joint. If the arc is directed down the centre of the joint the molten weld metal will only flow and cost against the side wall of the base plate without melting them. The heat of the arc must be use to melt the base metal. This is accomplished

by making the joint narrower or by directing arc towards the base plate. When multiples welding thick material aspic bead technique should be used whenever possible after the root passes. Large weld beats bridging the entire gap must be avoided.

4.3 Under cutting

The under cutting is a defect that appears as a groove in the parent metal directly along the edges of the weld. It is most common in lap fillet welds. But can also be encountered in fillet and butt joints. This type of defects is most commonly caused by improper welding parameters particularly the travel speed and arc voltage. When the travel speed is too high, the weld bead will be very peaked because of its extremely fast solidification. The force of surface tension have drawn the molten metal along the edges of the weld bead and piled it up along the center. Melted portions of the base plate are affected in the same way. The undercut groove is where the melted base materials has been drawn in to the weld and not allow towed back properly because of the rapid solidification. Decreasing the arc travel speed will gradually reduce the size of the undercut and eventually eliminate it. When only small or intermittent under cuts are present, raising the arc voltage is using a leading torch angular also correcting action. In both cases, the weld will become flatter and welding will improve.

4.4 Porosity

The most common causes of porosity are atmosphere contamination, excessively oxidized work piece surface, in add quote deoxidizing alloys in the wire and the presence of foreign matter, can be caused by Inadequate shielding gas flow, Excessive shielding gas flow.

4.5 Longitudinal cracking

Longitudinal on center line cracking of the weld bead is not often encounter in MIG welding. These defects occur only when the weld is too small to with stand the service stress involved.

4.6 Burn Through

It is melting of particles of pipe metal due to excess of heat. Burn through forms due to unbearable heat over that is a main cause of burn through. When there is gap in root of weld joint burn through occurs. Some time welding arc temperature raises when welding current increases is higher arc temperature leads to burn through.

4.7 Excessive Penetration

Portion of weld that have completely penetration in to the tube wall causing metal drips in tube I.D. due to improper weld nozzle centering.

5. Results and Discussions

The root causes for these defects are analyzed using visual inspection and here we suggest some remedies to overcome the defects and also found the important process parameters which affect quality of welding.

5.1 Remedies

To avoid Lack of Penetration Weld joints must not be narrow, Welding current should be adjusted to appropriate level, Electrode feed must be in a control level, Wire should be placed at the center of groove, Arc length should not be too long, and Rotation of the chucked must be control, sufficient root opening. To avoid Lack of Fusion Sufficient heat input, correct size of electrode should be chosen, Position of electrode should be corrected, clean weld surface before welding, Torch oscillation should not be too narrow, proper gas mixture. To control the Undercut, travel speed should not be too long, Welding voltage should be maintained at correct level, The chosen electrode should not have large diameter, Arcs should not be too long, Clean weld surface prior to welding, Welding current must not be too high, Electrode should not be inclined at time of welding. To eliminate use low-hydrogen welding process, increase shielding gas flow, one pre-heat or increase heat input, clean joint faces and adjacent surfaces, change welding conditions and techniques, use copper-silicon filler metal reduce heat input, use E6010 electrodes, use electrodes with basic slagging reactions. Proper alignment of tubes in root of weld joint, Bore should be concentric at ends, Welding current should be adjusted to appropriate level,

Rotation of chuck must be controlled, Wire stick out should not be too short to avoid excess Penetration.

5.2 Parameters

The various parameters that affect the weld quality in STB are as follows.

1. Weld current
2. Arc voltage
3. Arc travel speed
4. Chuck speed
5. Gas mixture
6. Wire feed rate
7. Oscillator speed.

6. Conclusions

In this project all the possible welding defects occurring in Straight Tube Butt Welding Machine (STBW) is analyzed. For each type of defect the remedial action is suggested. Using these suggestions we can reduce the welding defects. The important parameters which affect the STBW were also found.

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Reduce Traffic of Data on Network with Bloom filter

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Abstract—In recent time, Data is exponentially increasing so there is problem in quick search. Time, Storage & Processing also main issues for big data so optimization can be done by implementing bloom filter in it. Hadoop is a bunch of technology & have capacity to store large amount of data on Data nodes. So various operations is required on data set. Bloom filter technique is probabilistic data model for getting data into array so that no need to travel all data in network. With implementation of this filter mapper can reduce the amount of data travel. This paper giving the concept to reduce traffic of data on network with efficient manner through probabilistic model of Bloom filter.

Keywords: Big Data, Hadoop, MapReduce, Bloom filter

1. INTRODUCTION

Today, there is demand of quick and accurate result. So need to store data in proper manner with power of easily retrieval. With explosion of data in recent scenario only traditional database is not enough to handle it. With high rate of changing data on web applications there is need of database which can perform to provide consistency as well as partition tolerance. Present database system work with vertical enhancement that give scale-in facility for system. That is not enough for huge database like LinkedIn, facebook, Amazon etc. That huge amount of data need to have horizontal enhancement that give scale-out property. By this enhancement any number of node can be added with system.

For Big data there is use of MapReduce [1] programming model that perform operation on single large file so that there is no need to split data.

Companies like facebook, twitter, linkedin etc start using hadoop Hadoop Ecosystem include MapReduce, Apache Hive, PigLatin, Sqoop, flume, zookeeper and HBase. HBase is column oriented database. Its structure consist column family in which different columns are defined with unique row id.

In this paper, part1 describe the Introduction of the basics of MapReduce and Bloom filter. Part 2 gives the basic information of Hadoop components and detail description of HBase. Part 3 shows the proposed implementation on HBase with Bloom filter. Finally part 4 concludes the whole paper.

1.1 BASICS OF MAPREDUCE

MapReduce is a programming model for data processing. Hadoop can run MapReduce programs written in various languages. MapReduce works by breaking the processing into two phases: the map phase and the reduce phase. Each phase has key-value pairs as input and output, the types of which may be chosen by the programmer. The programmer also specifies two functions: the map function and the reduce function. MapReduce is framework that works in distributed environment with server and client infrastructure. Map' process generate intermediate result that need to be process further for resultant, 'reduce' phase start working preceded by shuffle and sort function. If there are 'P' no. of servers in cluster then shuffle phase has traffic $O(P^2)$ flows [2].

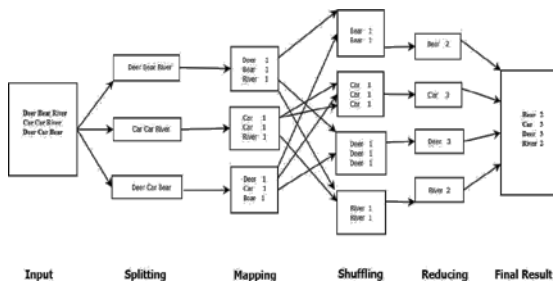


Fig. 1: Example of MapReduce

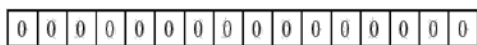
MapReduce consist several phases as shown in fig. 1 splitting, mapping, shuffling after that reducing. Map phase makes key value pair with default key value is page offset and passes these to reduce phase [1]. Reduce phase accept these value pair implement logic on that [1].

1.2 BASICS OF BLOOM FILTER

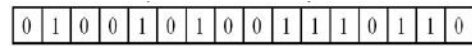
Bloom filter is probabilistic data structure which is space efficient with little error allowable when there is test performed. It's data structure is developed by Burton H. Bloom in 1970 [3]. Bloom filter stores elements in an array using hash functions. Let say set $S = \{x_1; x_2; \dots; x_n\}$, construct data structure to answer queries about presence of element existence like Is y in S ? This query does not provide direct result, it just provide idea about data's presence. It also deal with some allowable errors with Bloom filter.

1.2.1. CALCULATION OF BLOOM FILTER:

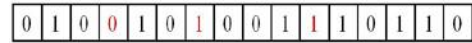
Size of bloom filter decides FP probability so it should be optimal choice for storing data. If it is less than required then FP probability may be increase or if it is more than optimal then searching will not get affected. In array all 0 represent not presence of element and all 1 indicate presence of element. If in searching any element remains 0 then it decide that element is not present in an array.



Hash each item x_j in S dataset k times. If $H_i(x_j) = a$, set $B[a] = 1$



To check if y is in S , check B at $H_i(y)$. All k values must be 1



Possible to have a false positive, all k values are 1, but y is not in S .

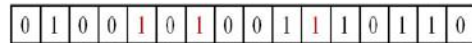


Fig 2: Basic Bloom filter

For step wise derivation let assume there are 'm' bit array consider as bloom filter that consist 'n' elements of 'k' bits. Probability to set any bit of array '1' by hash function is '1/m' then probability not set it to 1 will be '1-1/m', if it is not set 1 by any n member of array then probability '(1-1/m)ⁿ' since there are k bits in message then probability will become '(1-1/m)^{nk}'.

If element found in array i.e. 1 then it should be '1- (1-1/m)^{nk}'. For complete message found in array probability becomes 'f' i.e.

$$f = (1 - (1 - 1/m)^{nk})^k \approx (1 - e^{-kn/m})^k \quad (1)$$

Since item can also indicate FP in bloom filter so FP mostly depend with size of bloom filter. So that should be optimal as FP probability can obtain the minimum $(1/2)^k$ when optimum value of k is,

$$k = (m/n)\ln 2 \quad (2)$$

Size of bit array m is can be chosen as [4]

$$m = -(n \ln p) / (\ln 2)^2 \quad (3)$$

1.2.2 ALGORITHM OF BLOOM FILTER

A) Creation of Bloom filter.

{

BmFilter

(set A, hash functions, integer m) returns filter

filter = allocate m bits

foreach a^i in A:

foreach hash function h^j :

filter [$h^j(a^i)$]=1

end foreach

end foreach

return filter

g
}

B) Algorithm for adding elements in array of Bloom filter. At time of adding elements there is need to hash that element.

{

for (i=1...k)

do

hash of all object (x) with hash function;

if (array [position] == 0 then)

array [position] = 1;

}

C) Algorithm for checking presence of element.

{

while array[position] == 1 and i < k;

do

x is member of list;

if array[position] == 0 then

x is not member of list;

increment position;

}

2. HADOOP ECOSYSTEM

Hadoop Ecosystem includes MapReduce, Apache Hive, PigLatin, Sqoop, Flume, zookeeper and HBase. Hadoop is not only single software infect it is bunches of technology.

In fig 3, Unstructured or structured data flow through flume or sqoop that can be stored in distributed manner. It will process with MapReduce functions, for further data techniques Hive or Piglatin will work. Apache Oozie is scheduler which schedule of task to run. In fig 3, Unstructured or structured data flow through flume or sqoop that can be stored in distributed manner. It will process with

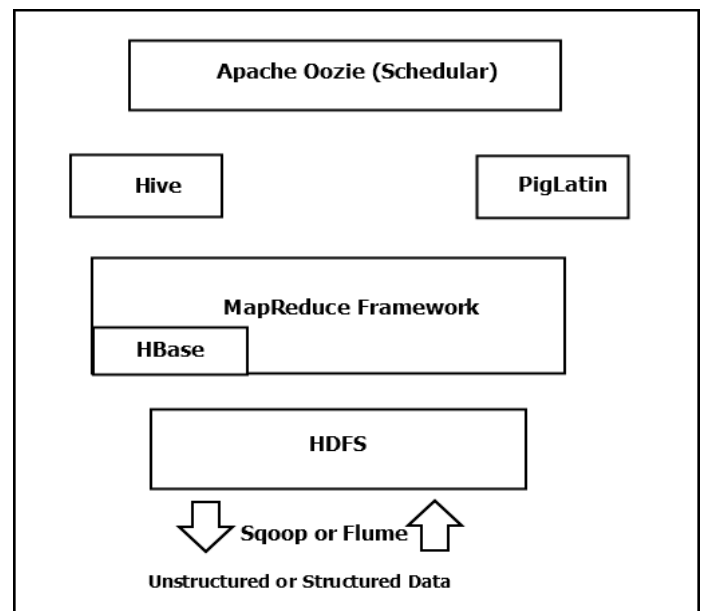


Fig 3: Hadoop Ecosystem

MapReduce functions, for further data techniques Hive or Piglatin will work. Apache Oozie is scheduler which schedule of task to run.

2.1 FUNDAMENTAL OF HBASE

HBase is an open source, non-relational, distributed database modeled after Google's Big Table and written in Java. HBase store data in HDFS and it is random, real time access to database [5]. HBase structure consist columns with column family in which several columns created with unique row-id.

HBase is approached over traditional RDBMS. Its features are :

- It is Column-Oriented in comparison to RDBMS.
- It has flexible schema so that column can be added anywhere.
- No need to define blank column as null.
- Tight integration with MapReduce.
- It is good for semi-structured and structured data.

Facebook use HBase for storing database and provide facilities for chat, messaging etc. [6]. Facebook users make interaction with web layer, that store data in separate HBase cluster. HBase it-self use HDFS to store data [5]. HBase Master, HRegion Server and HBase Client are the main component of HBase.

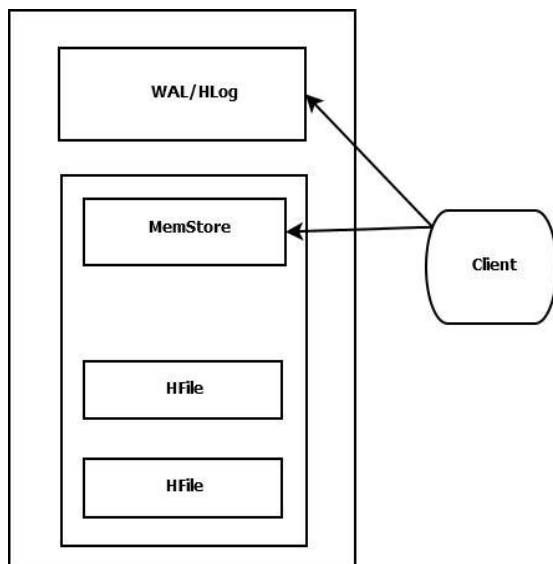


Fig 4: HBase write path

In Fig 4: In HBase data is written in two places
 1) WAL/HLog
 2) MemStore
 MemStore is write buffer, data keep add on in this until memory will be filled. [7]

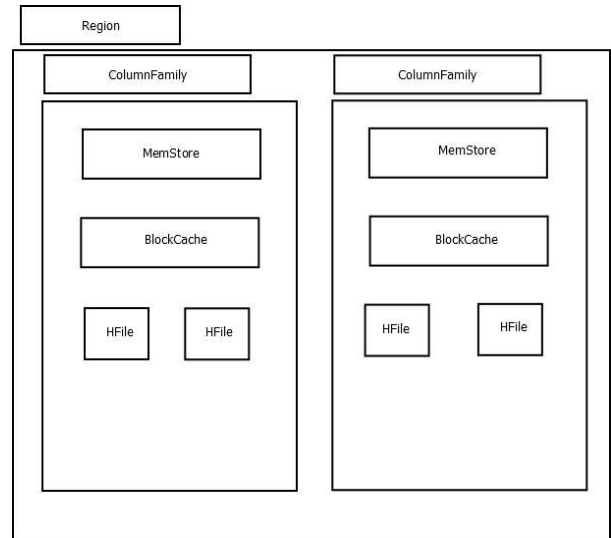


Fig. 5: Column family structure for read

In fig 5, Each column family consists only one MemStore but it may have many HFile. Each HFile size is 64KB in HBase. HBase maintain index of HFiles. A region server may have many region servers as in fig 6. [8] HMaster that decided by zookeeper is responsible to assign the regions to each HRegion server when HBase get started. Zookeeper provides coordination services with HMaster. Many distributed application including HBase [9] using Zookeeper. many real time application such as stormy[10] and twitter storm [11] also using services of zookeeper.

3. PROPOSED ARCHITECTURE

HBase have capacity to store large amount of data. Data can be loaded using pig, sqoop, using HBase shell and client API. HBASE have region servers for hadoop interface. [8]

Code that use to load data to HBase[8]

```
raw_data = LOAD 'input.csv' USING
```

```
PigStorage(',') AS
```

```
(listing_id : chararray, fname : chararray, lname : chararray);
```

```
dump raw_data;
```

```
STORE raw_data INTO
```

```
'hbase://sample_names USING
```

```
org.apache.pig.backend.hadoop.hbase.HBaseStorage('info:fname info:lname');
```

Data can be loaded through sqoop to HBase.
 Code that loading data to HBase by sqoop. [8]
 sqoop import

```

-connect jdbc:mysql:// <ip address><database
name >
-username <username_for_mysql_user >
-password<password>
-table<mysql_tablename>
-hbase-table<hbase_target_name>
-column-family<column_family_name>
-hbase-row-key<row_key_column>
-hbase-create-table
  
```

Data that store in HBase create HFiles that shifted to datanodes[8] from which datanodes can be treated with same manner with namenode as server.

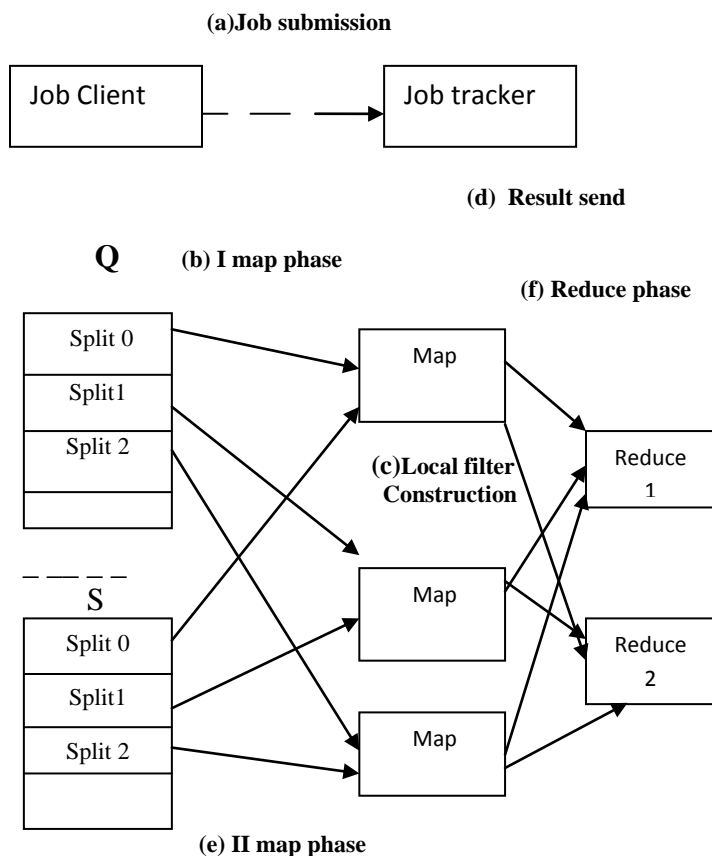


Fig 6: Proposed Implementation of Bloom filter

A. Whole Scenario

As fig 6 showing the proposed implementation of filter for fast accessing data on datanode.

(a)Job Initialization: Job is initialize and submitted to namenode. Where jobtracker run. Namenode contain all information that need to executed in hadoop. job tracker read job files from distributed file system then create map reduce function.

(b) I Map Phase: Jobtracker assign task for tasktrackers. These tasktrackers keep sending signals to prove its aliveness.

(c) Local Filter Creation: bloom filter need to create in each mapper. each mapper create <key, value> pair based on bloom filter that produce intermediate results. Each mapper have its own result after that combined result are send to jobtracker.

(d) Result combination: tasktrackers need to send result to jobtracker. This time tasktrackers will send only filtered records. Filter records having all information but it take less space to provide all.

(e) II Map Phase : This record also perform same work as I map phase. now all that submit to jobtracker where first record already there. now there is perform of join operation on both filters.

(f) Reduce Phase: This phase collect all intermediate records and run reduce function to provide results in output path.

B. Bloom filter construction

Each mapper create bloom filter array which store large amount od data in small size. this will transfer to jobtracker where operation may be implemented. Jobtracker construct global filter to execute operation.

4. CONCLUSION

In this paper, We provide to decrease rate of transfer of data. Using Bloom filter technique that implement on datanodes reduce the size of data travel that need to use in join operations. Datanodes will send array of different data sets that store Bloom filtered data to

jobtrackers. So according to this scenario, operation that need to be done on whole data set, will work with only stored array of Bloom filtered data that is reduce amount in size.

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Effect of static magnetic fields and blood lymphocyte cells transformation

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Abstract

The effected of static magnetic field on blood lymphocyte cells transformation was studied in this work , blood samples from 3 healthy fill people were collected.

Some of them are considered as control. The rest were exposit to magnet field of different file densities.

Having values 0.1, 0.2, 0.3, 0.4, and 0.5 tests for different exposure times which are 30, 60, 90, 120, 180 and 180 minutes. The blood cells were stimulated with photo heamgg luteinize. Then they are inoculated for 72 hours and the magnetic increases lymphatic transformation percentage to about double value compared to control cells. The exposure time increase the percentage also.

Introduction:

The magnetic field is one of the important fields that have a direct impact in our day life. It is utilized to generate electricity, attracting heavy Bowie loside its application in non destructive testing and controlling process storing information in computers can also be done by magnetic materials [1, 2, 3]

Magnetic field is also useful in medical diagnosis and therapy [4,5].

It can be used in medical imaging this technique is known as magnetic Resonance imaging techniques specially for soft tissue [6,7].

Recently magnetic field is used in therapy for curing some diseases [8,9] this effect may be related to effect of magnetic field on cells water, blood, stimulation of growing and activity of cells, blood and immune system [10,11] unfortunately these researches do not have little work and the effect of magnetic field on immune system specially Lymphocyte cells.

The results of research to use magnetic field in curing some disease motivate to do this research which is concerned with the effect of static magnetic and methods are written in sections section 3 is concurred with result.

The discussion and conclusion are exhibited in section 4 and 5 respectively.

(2-1) Materials and methods:

In this work blood samples were exposed to magnetic field having different strengths at different exposure times.

(2-2) magnetic field generates:

The magnetic field generate consist of two coils wound around to magnetic bars.

The coils are delivered by dc current dc generator.

Blood sample:

The experiment was done on blood sample for three healthy fit person. 5ml is collected for each person. The blood samples were treated by heparinised sterile tubes after one hour from samples are 150 blood samples.

(2-3) Magnetic exposure:

The samples are exposed to static magnetic field by using dc current the samples were located between. Two magnetic piles which can move apart freely with maximum distance of 12cm. the magnetic field was changed by changing the current value, the blood samples were put in water path of 37i when exposed to magnetic field. The control samples are exposed is different magnetic fields of intensities 0.1, 0.2, 0.3, 0.4 and 0.5 tesla respectively for each magnet strength the exposure time is changed to be 60, 90,120,150 and 180 minute.

(2-4) The lymphocyte test:

The lymphocyte test and analysis blood samples were for 72 hours at 37°C then the blood cells were inoculated and developed by coma day the percentage of transformation cells of lymphocyte cells were determined as shown in the tables below The percentage of transformation cells to lymphocyte cells for control and exposed samples and their relation to magnetic field intensity and exposure time were displayed graphically.

3. The following tables and graphs shows effect of magnetic field and exposure time on lymphocyte transformation.

Table 1: exposures time 30 min Transformation percentages.

No of S	Control	0.1T	0.2T	0.3T	0.4T	0.5T
S1	36	57	62	60	60	60
S2	25	45	54	49	51	52
S3	31	49	57	55	56	55

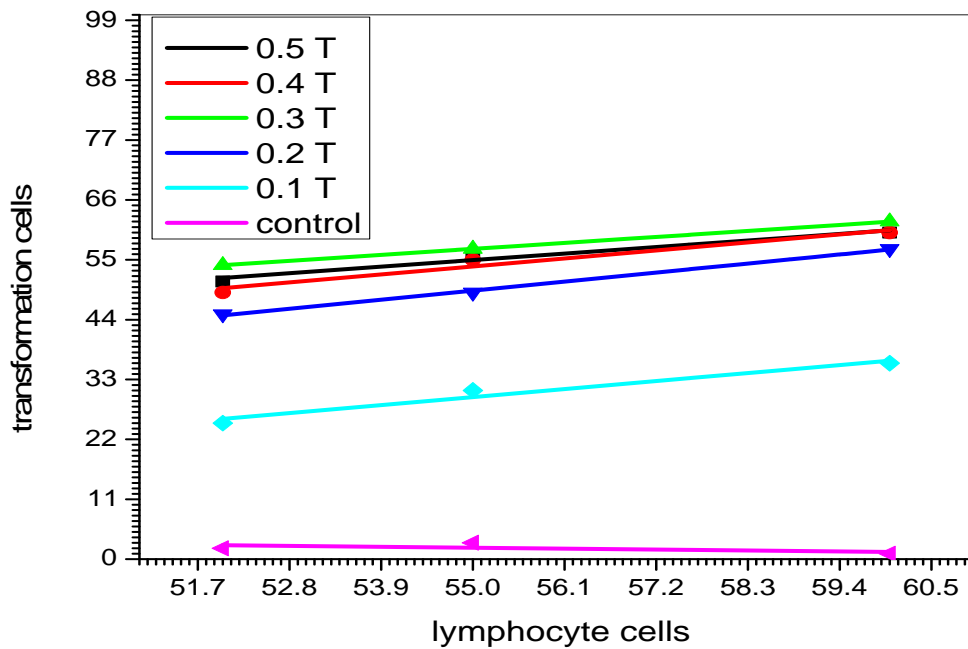
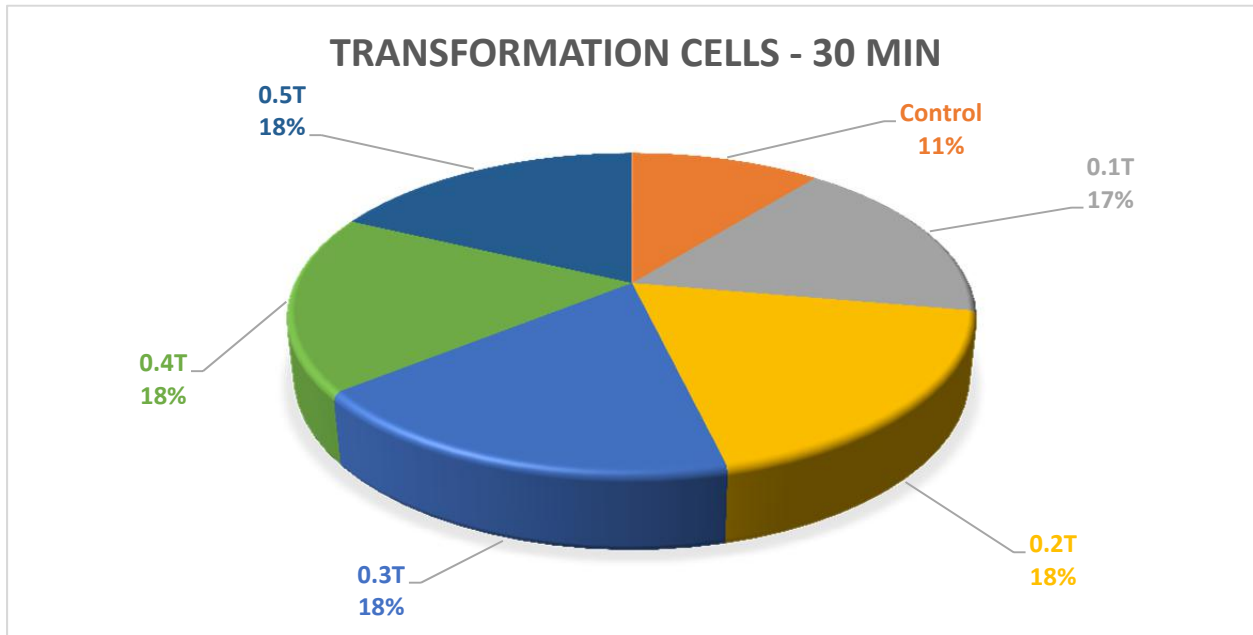


Fig (1) effect of static magnetic field within the range (0.1T-0.5T) on the blood samples transformation for Lymphocyte stimulated with phytohemagglutinine (PHA), at 30 min time of exposure.

Table 2: exposures times 60 min Transformation percentages.

No of S	Control	0.1T	0.2T	0.3T	0.4T	0.5T
S1	36	59	67	64	62	64
S2	28	56	60	61	59	62
S3	33	59	65	60	58	61

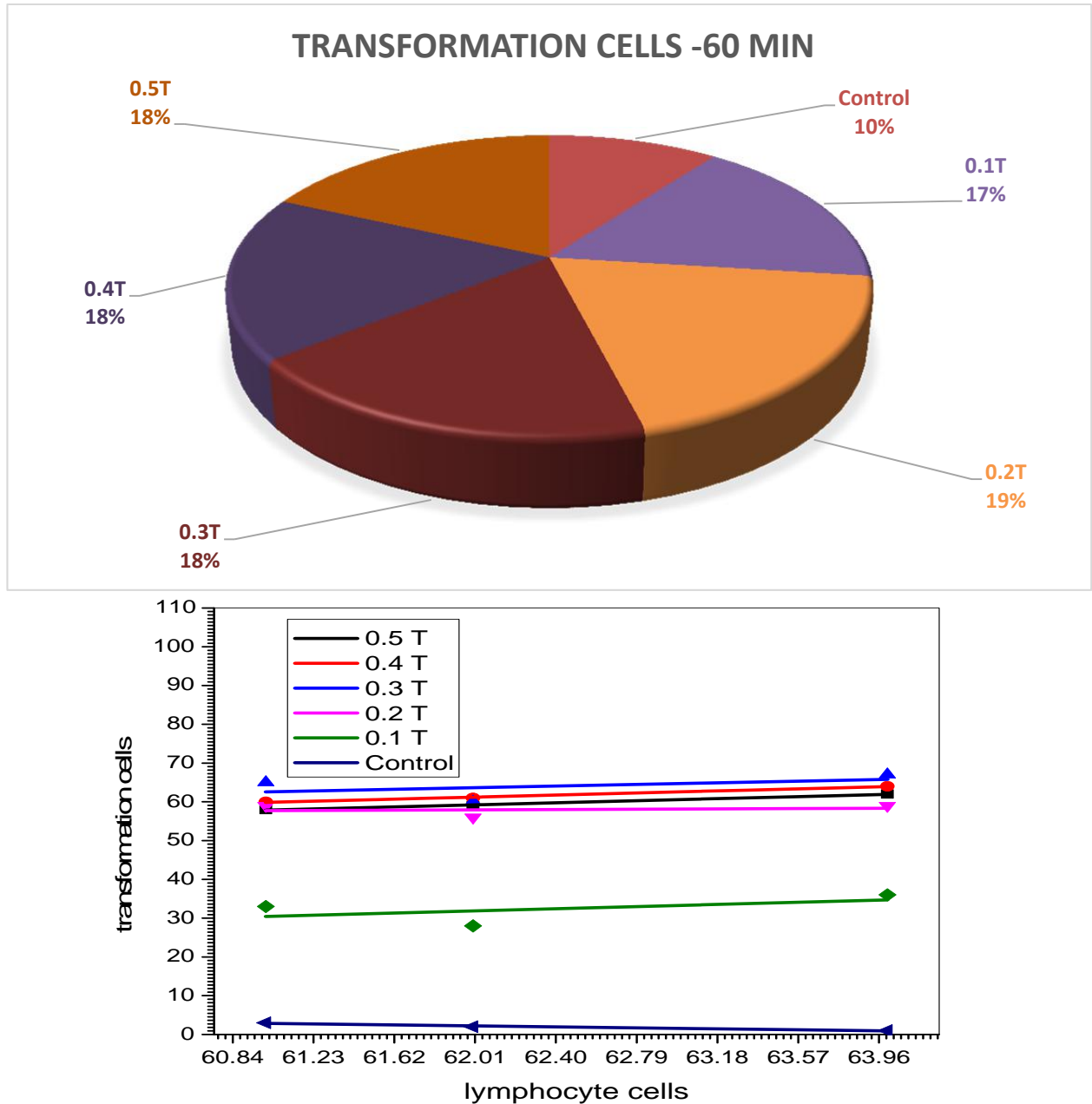
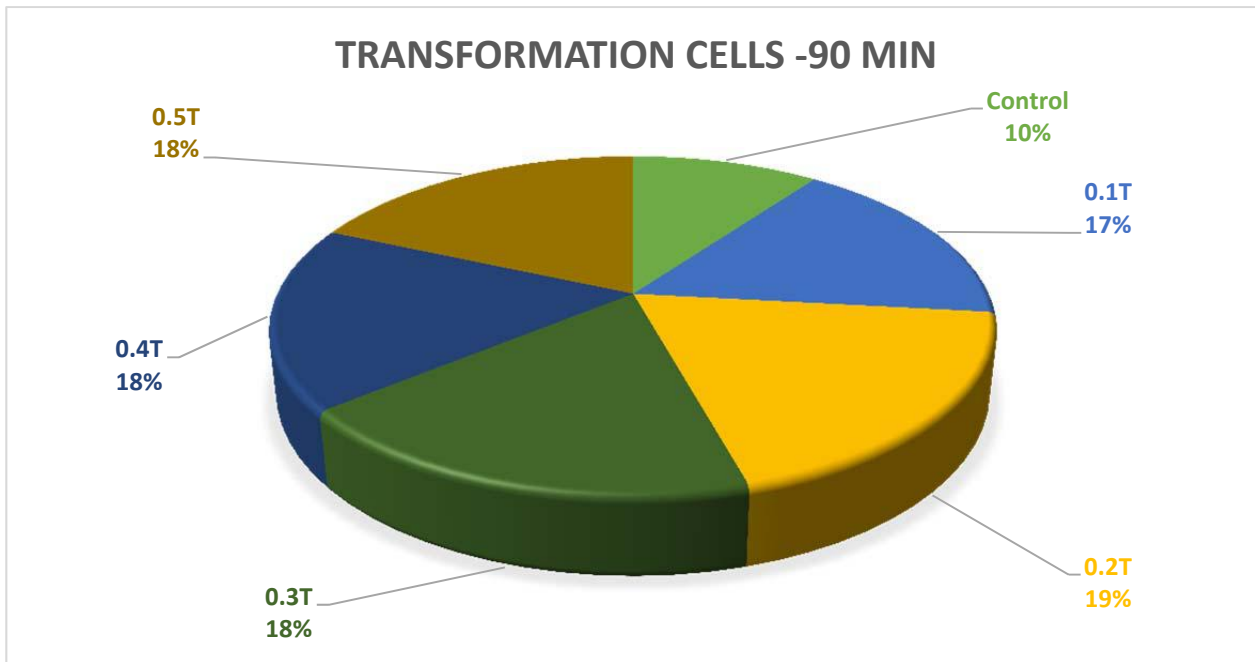


Fig (2) effect of static magnetic field within the range (0.1T-0.5T) on the blood samples transformation for Lymphocyte stimulated with phytoheha magglutinine (PHA), at 60 min time of exposure.

Table 3: exposures times 90 min Transformation percentages.

No of S	Control	0.1T	0.2T	0.3T	0.4T	0.5T
S1	36	60	68	66	63	66
S2	28	57	61	60	58	63
S2	33	62	66	61	59	60



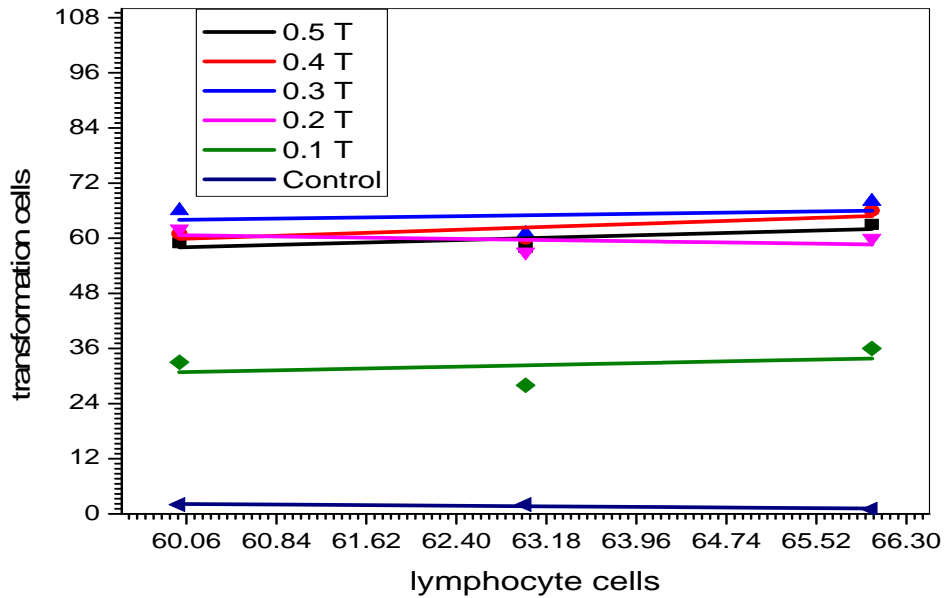
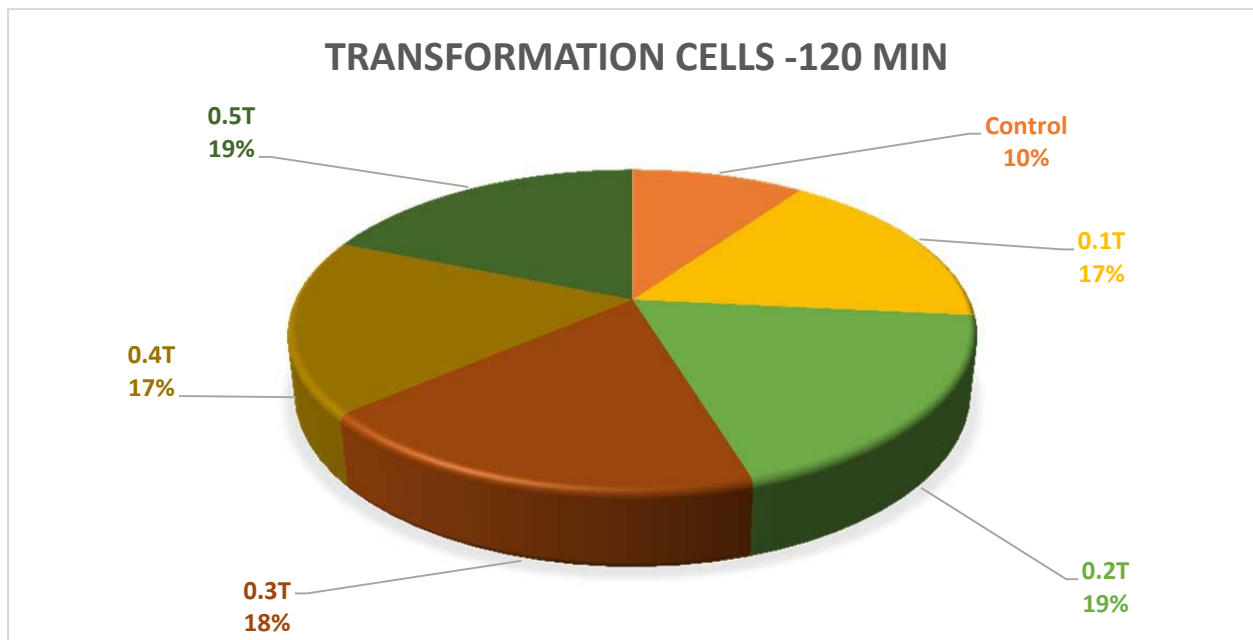


Fig (3) effect of static magnetic field within the range (0.1T-0.5T) on the blood samples transformation for Lymphocyte stimulated with phytohemagglutinine (PHA), at 90 min time of exposure.

Table 4: exposures times 120 min Transformation percentages.

No of S	Control	0.1T	0.2T	0.3T	0.4T	0.5T
S1	36	62	69	68	65	69
S2	28	59	63	62	60	64
S3	33	63	67	62	59	60



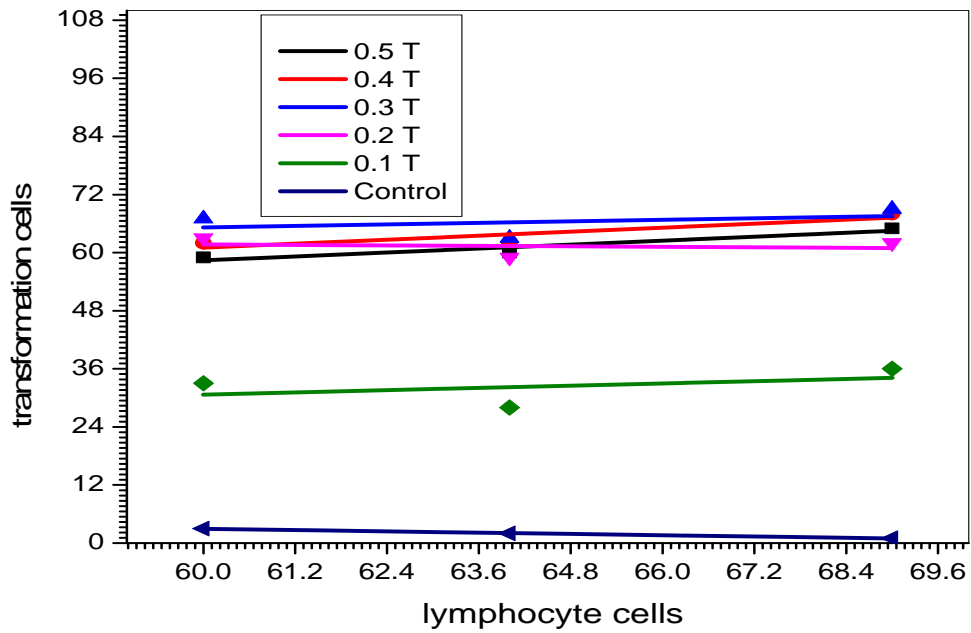


Fig (4) effect of static magnetic field within the range (0.1T-0.5T) on the blood samples transformation for Lymphocyte stimulated with phytohemagglutinine (PHA), at 120 min time of exposure.



Table 5: exposures times 180 min Transformation percentages.

No of S	Control	0.1T	0.2T	0.3T	0.4T	0.5T
S1	36	77	79	77	76	78
S2	28	71	79	70	68	62
S3	33	73	78	77	75	76

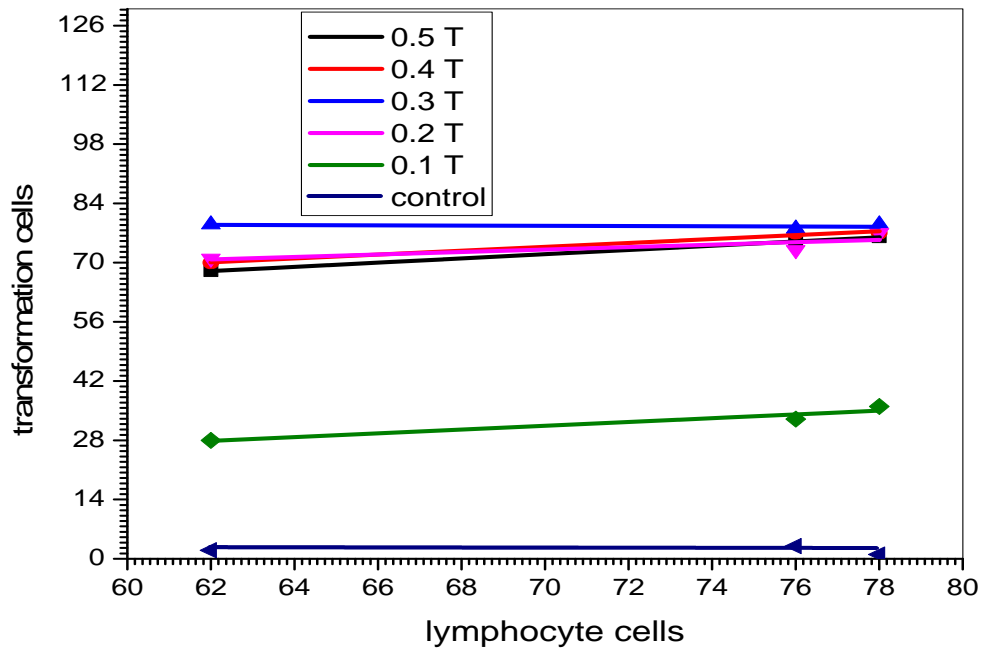
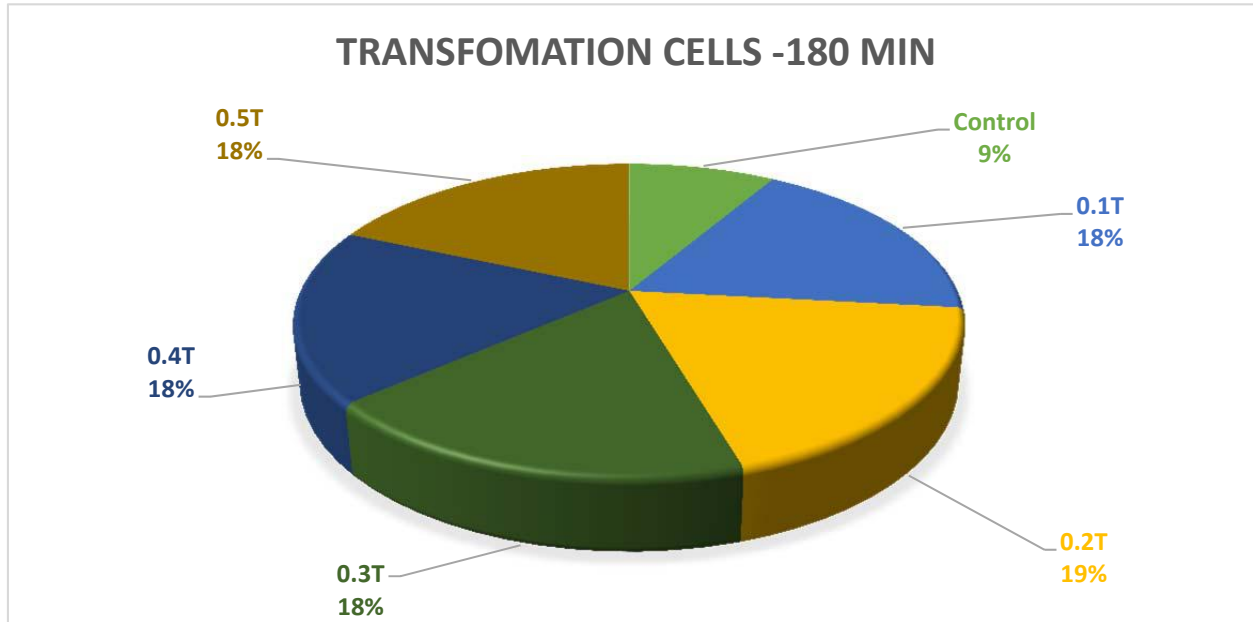


Fig (5) effect of static magnetic field within the range (0.1T-0.5T) on the blood samples transformation for Lymphocyte stimulated with phytohemagglutinine (PHA), at 180 min time of exposure.



DC Magnetic device

Discussion

In view of the figures (1-5) It is clear that the application of static magnetic fields increases to control samples transformation. the percentage increases upon increasing the magnetic field density from 0.1 to 0.2 false then it almost stop increasing after that with fluctuation percentage in the range of (1—17) percentage. The exposure time in general increases transformation percentage for all applied magnetic strengths.

Conclusion

The exposure of blood to magnetic fields increases lymphocyte transformation percentage considerably. The percentage increases when increasing exposure time.

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CFD Approach in the Design of Radial Flow Centrifugal Pump Impeller

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Abstract

Pumps are used in the process of transferring fluids from one place to other and these pumps have a vital role in the domestic and industrial areas. This project deals with the application and need of CFD analysis in the pump industries. For this purpose, we have made a design and analysis of impeller used in Domestic Open well Radial flow water pumps. The impeller selected is of enclosed type, which is commonly used in domestic water pumps. In this project we have designed an impeller for a domestic need using formulas formulated by *Dr. K.M Srinivasan*, in the book *Rotodynamic Pumps*. The impeller is modelled using CAD software and analyzed using CFD package. The CFD output is cross checked with desired requirements, so as to state the accuracy and need of CFD analysis.

Keywords: CFD analysis, Open well pump, Radial flow impeller.

1. Introduction

Pump plays a vital role in transfer of fluids, as they are the basic source of suction. These pumps are of many types, based on their construction, type of operations, flow types, applications, etc., Design of such pumps are made using the thumb rule which is practiced in the industries. Standard design procedure have not been yet defined, as there are many design formulas formulated by great scientists like *Labanoff [1]*, *John Tuzson*, *Stepanoff*, *KM Srinivasan [2]*, *Turton*, etc., Since these formulas are theoretical, validation of the final product is obtained after many trials leading to Man, Machine and Money wastages.

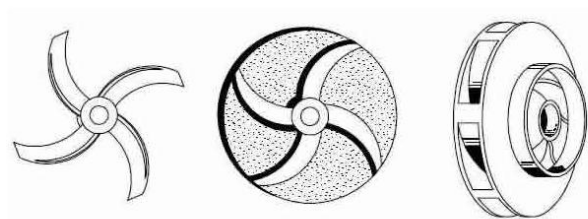
To avoid this type of wastages, scientists have designed many software which are capable of analyzing the various flow parameters under varied flow conditions. The hydraulic part of the pump comprises of Casing and Impeller. In this work, the design of Impeller is carried out, whereas the casing design is dependent of impeller design.

2. Impeller

The impeller is a rotating component of a centrifugal pump, usually made of iron, steel, bronze, brass, Aluminum or plastic, which transfers energy from the motor that drives the pump to the fluid being pumped by accelerating the fluid outwards from the center of

Aluminum or plastic, which transfers energy from the motor that drives the pump to the fluid being pumped by accelerating the fluid outwards from the center of rotation. The velocity achieved by the impeller transfers into pressure when the outward movement of the fluid is confined by the pump casing. Impellers are usually short cylinders with an open inlet (called an eye) to accept incoming fluid, vanes to push the fluid radially, and a splined, keyed or threaded bore to accept a drive-shaft.

Impellers can be Open, Semi-open, or Enclosed. The open impeller consists only of blades attached to a hub. The semi-open impeller is constructed with a circular plate (the web) attached to one side of the blades. The enclosed impeller has circular plates attached to both sides of the blades. Enclosed impellers are also referred to as shrouded impellers.



Open type

Semi-open type

Enclosed type

Fig. 1 Types of Impeller

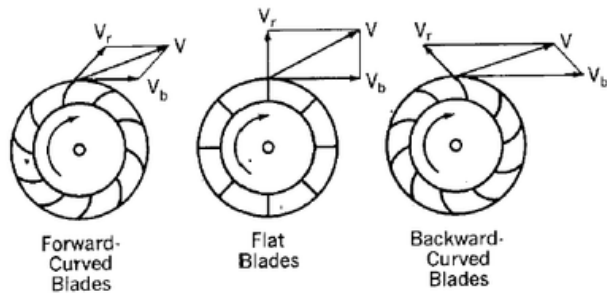


Fig. 2 Types of Vane profile

3. Impeller Design

Design is the application of scientific and mathematical principles to practical ends to form efficient and economical structures, machines, processes, and systems. Design of centrifugal impeller is done using K. M. Srinivasan method. Impeller design parameters are calculated using his procedure by giving head, volume flow rate and pump speed as input.

3.1 Specification of pump

Head: 24m
 Discharge: 95lpm = 1.583lps
 Power: 1hp = 746W
 Speed: 2880rpm
 Pipe size: 25 X 25 mm

3.2 Calculated parameters

The following are the parameters calculated using the above said method and these are the parameters which help in generating the impeller vane profile.

Specific Speed = 38.5
 Power input to the pump = 1.84hp
 Shaft Diameter = 25 mm
 Outer Diameter of impeller = 144 mm
 Velocity of fluid at the impeller inlet = 5.43 m/s
 Inner Diameter of impeller = 36 mm
 Inlet blade angle = 19.25°
 Impeller width at inlet = 10 mm
 Blade angle at outlet = 23.76°
 Number of blades = 4

3.3 Vane profile development

The vane profile can be developed by using Point by Point method, Single arc method, Multi arc method and Error Triangle method. In this work, Point by Point method is selected, and the vane profile parameters are calculated

and the profile is traced. The more number of points we employ, the tracing of the profile is made easy. In this case we have selected 7 trace points.

Table 1: Vane Profile Parameters

S. No	r	Cm	b	w	C _m /w	δ	t
1	18	1.44	32	5.46	0.26	5	28.27
2	27	1.39	28.3	5.06	0.27	5	42.41
3	36	1.34	24.7	4.67	0.29	5	56.54
4	45	1.29	21	4.27	0.30	5	70.68
5	54	1.25	17.3	3.87	0.32	5	84.82
6	63	1.2	13.7	3.48	0.35	5	98.96
7	72	1.15	10	3.08	0.37	5	113.09

Table 2: Vane Profile Parameters (continued)

δ/t	sin β	β	B	Δr	x
0.17	0.44	26.14	113.18	0.009	99.94
0.11	0.39	23.13	86.69	0.009	77.52
0.08	0.37	22.11	68.35	0.009	61.70
0.07	0.37	21.98	55.05	0.009	49.98
0.05	0.38	22.40	44.91	0.009	40.87
0.05	0.39	23.30	36.83	0.009	33.50
0.04	0.41	24.72	30.16	-	-

Table 3: Vane Profile Parameters (continued)

Δθ	θ	
	Radians	Degrees
0.89	0	0
0.69	0.895	51.5
0.55	1.597	91.5
0.44	2.156	123.3
0.36	2.602	149.1
0.30	2.970	170.2
-	3.272	187.5

From the above table, the coordinate points of “r” and “θ” are taken and the vane profile is traced. The following image represents the vane profile traced using Uni Graphics software and this impeller is with forward curved vanes.

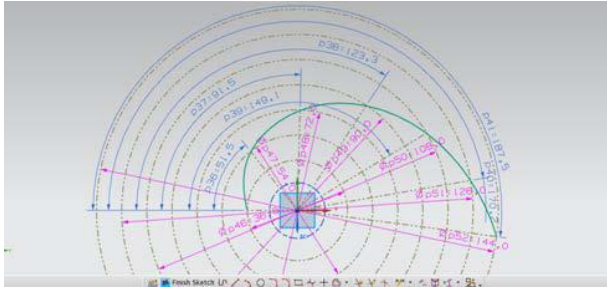


Fig. 3 Vane profile traced using CAD package

3.4 Modelling using CAD software

The above profile is then developed into a model using Uni Graphics. Some considerations are made while developing the model. Considerations like, the impeller is without hub portion, the shrouds are flat, etc., this made because, in this work, we have concentrated in the analysis of impeller's vane profile. Hence the parameters associated with Casing are neglected. The following image is the model developed using Uni Graphics.

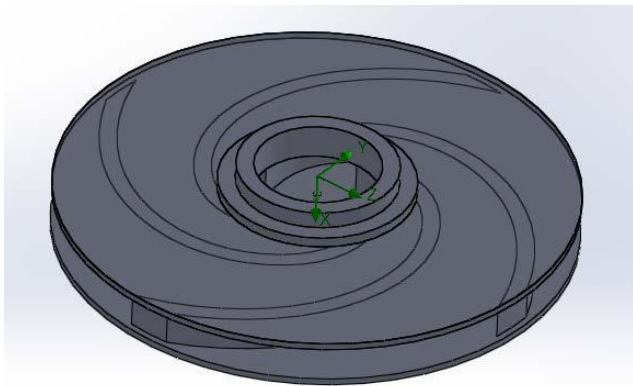


Fig. 4 Impeller modeling using CAD package

4. CFD analysis

The designed impeller is analyzed using a CFD package. For our work, we have used Fluid Flow Simulation which is a product of Solid Works. The following are the assumptions made while using CFD approach.

1. Incompressible flow
2. No-slip boundary condition
3. Gravity effects are negligible
4. Fluid properties are not functions of temperature

4.1 Boundary Conditions

Boundary conditions plays a major role in any mode of analysis, because, the output of any analysis is purely based on the input parameters. The following image shows the boundary conditions like Inlet velocity, Environmental pressure and rear wall. In this analysis, a circular ring is modelled around the impeller vane outlet, this is to capture the outlet flow parameters. It acts like a dummy wall.

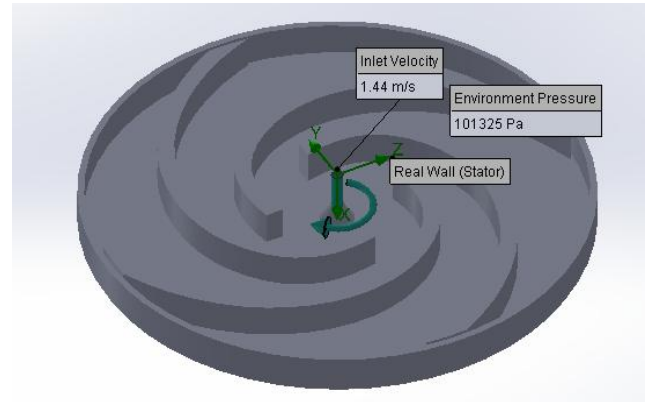


Fig. 5 Boundary Conditions used for CFD analysis

4.2 CFD results

After setting up the input parameters, the solver is set to compute the parameters, and the flow properties are traced as contours and vectors.

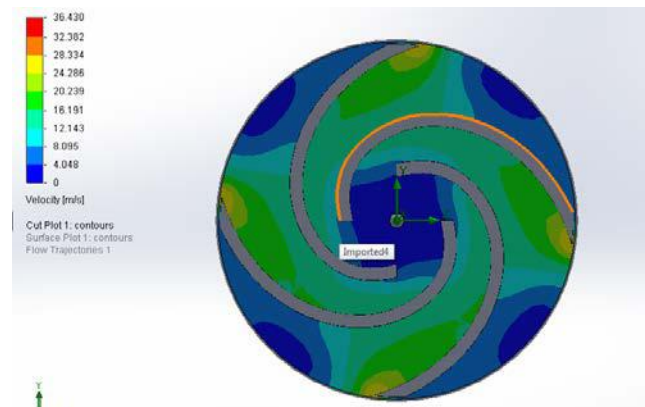


Fig. 6 Velocity plots of water inside the Impeller

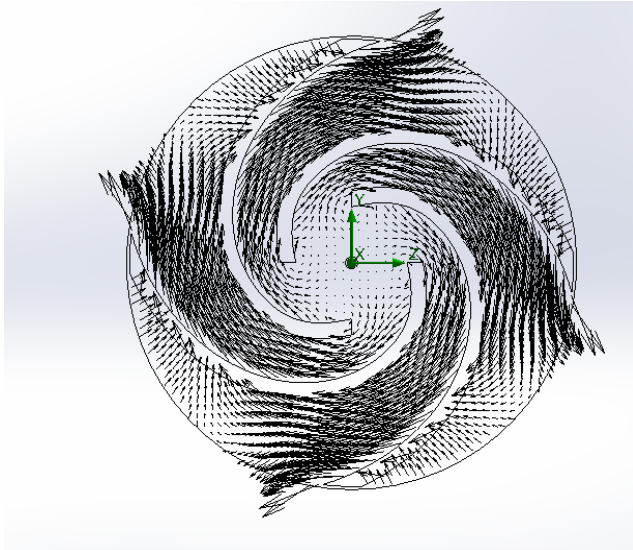


Fig. 7 Velocity Vectors of the water flow

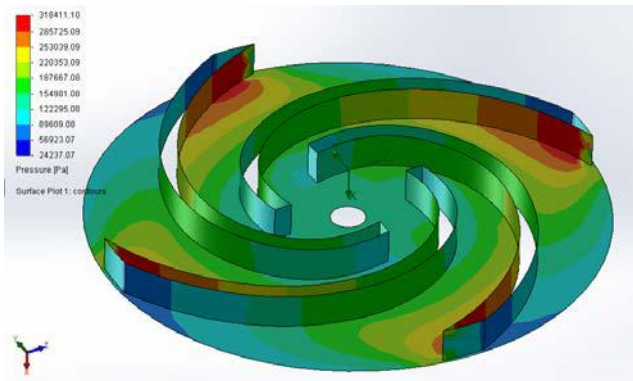


Fig. 8 Pressure plots of the water inside Impeller

Total pressure developed in the fluid (P) = 141744.4773 Pa
 Fluid flow rate (Q) = 0.001445 m³/s
 Total moment created by water on the impeller (T) = 10.4104 Nm
 Hydraulic efficiency of the impeller $\eta_h = \frac{PQ}{\omega T}$
 Hh = 65.5 %
 Total head generated (H) = $\frac{P}{\rho g} = 30.62$

The discharge obtained by CFD simulation is 0.00144 m³/s whereas expected discharge is 0.00153 m³/s.

Reduction in discharge occurs due to the losses (Friction, Turbulence) that occurs in impeller.

4. Conclusion

An impeller was designed for the input details using standard formulas and the vane profile was traced accordingly. Since the simulation is done only for the impeller's hydraulic part, the front and rear shrouds and hub portions are neglected in the modelling. The output of the simulation is close enough to the theoretical calculations. Hence it can be stated that, the usage of CFD analysis is worthy when compared to trial and error methods, thus reducing the time for various prototypes, and reducing the financial investments for each trials.

4.1 Future works

The future works for this paper will be designing an appropriate casing for the above designed impeller and conducting a combined flow analysis to predict the actual performance of the pump.

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Ranking of Octagonal Fuzzy Numbers for Solving Multi Objective Fuzzy Linear Programming Problem with Simplex Method and Graphical Method

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Abstract

In this paper a ranking procedure based on Hexagonal Fuzzy numbers, is applied to a Multi-objective Linear Programming Problem (MOLPP) with fuzzy coefficients. By this ranking method any multi objective Fuzzy Linear Programming problem (MOFLPP) can be converted in to a crisp value problem to get an optimal solution. This ranking procedure serves as an efficient method wherein a numerical example is also taken and the inference is given.

Keywords

Octagonal fuzzy number, Simplex method, Graphical method, α – level set.

Introduction

Ranking fuzzy number is used in decision-making process in an economic environment. In an organization various activities such as planning, execution, and other process takes place continuously. This requires careful observation of various parameters which are all in uncertain in nature due the competitive business environment globally. In fuzzy environment ranking fuzzy numbers is a very important decision making procedure. The idea of fuzzy set was first proposed by Bellman and Zadeh [1], as a mean of handling uncertainty that is due to imprecision rather than randomness. The concept of fuzzy linear programming (FLP) was first introduced by Tanaka et al. [11, 12] Zimmerman [18] introduced fuzzy linear programming in fuzzy environment. Multi-objective linear programming was introduced by Zelenly [17]. Lai Y.J – Hawng C.L [5]

considered MOLPP with all parameters having a triangular possibility distribution. They used an auxiliary model and it was solved by MOLPP. Zimmerman [18] applied their approach to vector maximum problem by transforming MOFLP problem to a single objective linear programming problem. Qiu – Peng Gu , and Bing – Yuan Cao [7] solved fuzzy linear programming problems based on fuzzy number distance. Tong Shaocheng [13] focused on the fuzzy linear programming with interval numbers. Chanas [2] proposed a fuzzy programming in multi objective linear programming. Verdegay[14] have proposed three methods for solving three models of fuzzy integer linear programming based on the representation theorem and on fuzzy number ranking method . In particular , the most convenient methods are based on the concept of comparison of fuzzy numbers by the use ranking numbers by the use ranking functions.

Preliminaries

Definition-1

If X is a collection of objects denoted generically by X then the fuzzy subset \bar{A} of X is defined as a set of ordered pairs.

$$\bar{A} = \{(x, \mu_A(x)) \mid x \in X\}$$

Where $\mu_A(x)$ is called the membership function for the fuzzy set \bar{A} . The membership function maps each element of X to a membership grade or membership value between 0 and 1.

Definition-2

A fuzzy set A of the universe of discourse X is called a normal fuzzy set implying that there exist atleast one $x \in X$ such that $\mu_A(x) = 1$.

Definition-3

The family of sets consisting all the subsets of a particular set A referred to as the power set of A and is indicated by $P(A)$.

$$(ie) \mid P(A) \mid = 2^{\mid A \mid}$$

α – Cuts

The α - cut (or) α - level set of fuzzy set \bar{A} is a set consisting of those elements of the universe X whose membership values exceed the threshold level α that is

$$\bar{A}_\alpha = \{ x / \mu_{\bar{A}}(x) \geq \alpha \}$$

Remark

- The membership function of \bar{A} specifies the degree of membership of elements x in fuzzy set \bar{A} (Infact $\mu_{\bar{A}}$ shows the degree that $x \in \bar{A}$).
- A fuzzy set is convex \Leftrightarrow if all its α – cuts are convex.
- The octagonal fuzzy number is convex as their α – cuts are convex sets in the classical sense.

Definition:

A fuzzy number is a normal octagonal fuzzy number denoted by $(a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8)$ where $a_1 \leq a_2 \leq a_3 \leq a_4 \leq a_5 \leq a_6 \leq a_7 \leq a_8$ are real numbers and its membership function $\mu_{\bar{A}}(x)$ is given below

$$\mu_{\bar{A}}(x) = \begin{cases} 0 & \text{for } x < a_1 \\ k \left(\frac{x - a_1}{a_2 - a_1} \right) & \text{for } a_1 \leq x \leq a_2 \\ k & \text{for } a_2 \leq x \leq a_3 \\ k + (1-k) \left(\frac{x - a_3}{a_4 - a_3} \right) & \text{for } a_3 \leq x \leq a_4 \\ 1 & \text{for } a_4 \leq x \leq a_5 \\ k + (1-k) \left(\frac{a_6 - x}{a_6 - a_5} \right) & \text{for } a_5 \leq x \leq a_6 \\ k & \text{for } a_6 \leq x \leq a_7 \\ k \left(\frac{a_8 - x}{a_8 - a_7} \right) & \text{for } a_7 \leq x \leq a_8 \\ 0 & \text{for } x \geq a_8 \end{cases}$$

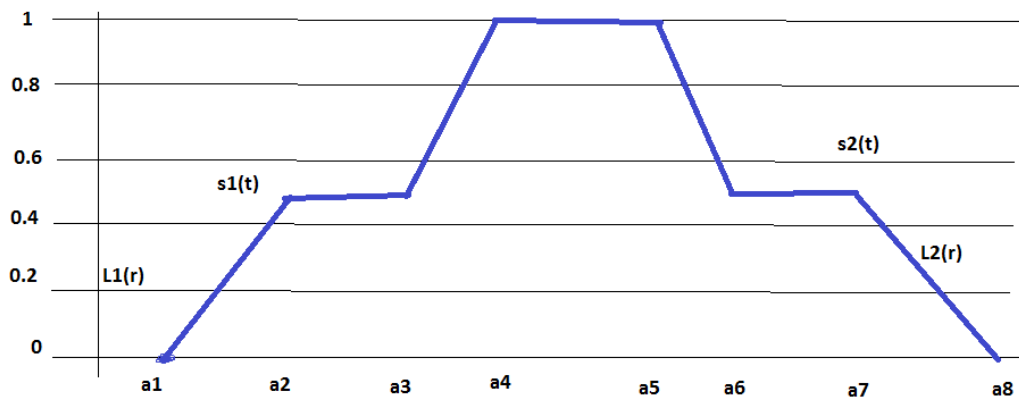


Fig -1 Graphical representation of a octagonal fuzzy number

Ranking of octagonal Fuzzy Numbers:

A number of approaches have been proposed for the ranking of fuzzy numbers. In this paper for a octagonal fuzzy number $\bar{A}_{oc} = (a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8)$, a ranking method is devised based on the following formula.

$$R(\bar{A}_{oc}) = \left(\frac{2a_1 + 3a_2 + 4a_3 + 5a_4 + 5a_5 + 4a_6 + 3a_7 + 2a_8}{28} \right) \left(\frac{7}{28} \right)$$

Let $\bar{A}_{oc} = (a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8)$ and $\tilde{N}_{oc} = (n_1, n_2, n_3, n_4, n_5, n_6, n_7, n_8)$ be two octagonal fuzzy numbers then

$$\begin{aligned} \bar{A}_{oc} \Leftrightarrow \tilde{N}_{oc} &\Leftrightarrow R(\bar{A}_{oc}) = R(\tilde{N}_{oc}) \\ \bar{A}_{oc} \geq \tilde{N}_{oc} &\Leftrightarrow R(\bar{A}_{oc}) \geq R(\tilde{N}_{oc}) \\ \bar{A}_{oc} \leq \tilde{N}_{oc} &\Leftrightarrow R(\bar{A}_{oc}) \leq R(\tilde{N}_{oc}) \end{aligned}$$

METHOD OF SOLVING MULTI OBJECTIVE FUZZY LINEAR PROGRAMMING PROBLEM:

In this paper we discuss a multi –objective Fuzzy linear Programming Problem in constraints conditions with fuzzy coefficients.

$$\begin{aligned} &\text{Maximize } z_1 = d_1 y \\ &\text{Minimize } z_2 = d_2 y \\ &\text{Subject to } \bar{A}_H X \leq \bar{e}, X \geq 0 \end{aligned}$$

Where $d_{ij} = (d_{i1}, d_{i2}, \dots, d_{in})$ is an n-dimensional crisp row vector , $\bar{A}_H = \bar{a}_{ij}$ is an $m \times n$ fuzzy matrix , $\bar{e} = (e_1, e_2, e_3, \dots, e_m)^T$ is an m-dimensional fuzzy line vector and $X = (x_1, x_2, x_3, \dots)^T$ is an n-dimensional decision variable vector .

We now consider a bi-objective fuzzy linear programming problem with constraints having fuzzy coefficients is given by

$$\begin{aligned} &\text{Maximize } z_1 = d_{11}x_1 + d_{12}x_2 + \dots + d_{1n}x_n \\ &\text{Minimize } z_2 = d_{11}x_1 + d_{12}x_2 + \dots + d_{1n}x_n \\ &\text{Subject to } \bar{a}_{i1}x_1 + \bar{a}_{i2}x_2 + \bar{a}_{i3}x_3 + \bar{a}_{i4}x_4 + \dots + \bar{a}_{in}x_n \leq \bar{e}_i \\ &x_1, x_2, x_3, \dots, x_n \geq 0, i=1, 2, 3, \dots, m. \text{ where fuzzy numbers are octagonal,} \end{aligned}$$

Where

$$\begin{aligned} \bar{a}_{i1} &= \bar{a}_{i11}, \bar{a}_{i12}, \bar{a}_{i13}, \bar{a}_{i14}, \bar{a}_{i15}, \bar{a}_{i16}, \bar{a}_{i17}, \bar{a}_{i18} \\ \bar{a}_{i2} &= \bar{a}_{i21}, \bar{a}_{i22}, \bar{a}_{i23}, \bar{a}_{i24}, \bar{a}_{i25}, \bar{a}_{i26}, \bar{a}_{i27}, \bar{a}_{i28} \\ &\dots \\ &\dots \\ \bar{a}_{in} &= \bar{a}_{in1}, \bar{a}_{in2}, \bar{a}_{in3}, \bar{a}_{in4}, \bar{a}_{in5}, \bar{a}_{in6}, \bar{a}_{in7}, \bar{a}_{in8} \\ \bar{e} &= \bar{e}_{i1}, \bar{e}_{i2}, \bar{e}_{i3}, \bar{e}_{i4}, \bar{e}_{i5}, \bar{e}_{i6}, \bar{e}_{i7}, \bar{e}_{i8} \end{aligned}$$

By the ranking Algorithm, the above MOFLPP is transformed into a MOLPP is as follows:

$$\begin{aligned} &\text{Maximize } z_1 = d_{11}x_1 + d_{12}x_2 + \dots + d_{1n}x_n \\ &\text{Minimize } z_2 = d_{11}x_1 + d_{12}x_2 + \dots + d_{1n}x_n \end{aligned}$$

Subject to,

$$\begin{aligned} &2(a_{i11}x_1 + a_{i21}x_2 + \dots + a_{in1}x_n) + 3(a_{i12}x_1 + a_{i22}x_2 + \dots + a_{in2}x_n) + \\ &4(a_{i13}x_1 + a_{i23}x_2 + \dots + a_{in3}x_n) + 5(a_{i14}x_1 + a_{i24}x_2 + \dots + a_{in4}x_n) + \\ &5(a_{i15}x_1 + a_{i25}x_2 + \dots + a_{in5}x_5) + 4(a_{i16}x_1 + a_{i26}x_2 + \dots + a_{in6}x_n) + \\ &3(a_{i17}x_1 + a_{i27}x_2 + \dots + a_{in7}x_n) + 2(a_{i18}x_1 + a_{i28}x_2 + \dots + a_{in7}x_n) \\ &\leq 2e_{i1} + 3e_{i2} + 4e_{i3} + 5e_{i4} + 5e_{i5} + 4e_{i6} + 3e_{i7} + 2e_{i8} \\ &x_1, x_2, x_3, \dots, x_n \geq 0, i=1, 2, 3, \dots, m \text{ -----(1)} \end{aligned}$$

Using (1), this can be converted into a single objective problem subject to the constraints with transformed crisp number coefficients and hence solved accordingly.

Similarly, multi-objective problems with more than two objectives can also be solved using the above procedure, here in the very first stage itself the problem is transformed into a crisp problem and afterwards there will be no more fuzziness in the constraints as well as in the problem.

Simplex Method Algorithm

Step 1: Determine a starting basic feasible solution.

Step 2: Select an entering variable using the optimality condition. Stop if there is no entering variable; the last solution is optimal. Else, go to step 3.

Step 3: Select a *leaving variable* using the feasibility condition.

Step 4: Determine the new basic solution by using the appropriate Gauss-Jordan computations. Go to step 2.

Numerical Example

Consider,

$$\text{Max } Z = 60x_1 + 70x_2$$

Subject to

$$\tilde{a}_{11}x_1 + \tilde{a}_{12}x_2 \leq \bar{e}_1$$

$$\tilde{a}_{21}x_1 + \tilde{a}_{22}x_2 \leq \bar{e}_2$$

$$x_1, x_2 \geq 0$$

Where

$$\tilde{a}_{11} = (11, 12, 14, 16, 16, 8, 7, 6)$$

$$\tilde{a}_{12} = (8, 7, 5, 4, 4, 3, 2, 1)$$

$$\tilde{a}_{21} = (2, 3, 6, 7, 7, 1, 8, 4)$$

$$\tilde{a}_{22} = (4, 5, 3, 2, 2, 7, 9, 8)$$

$$\bar{e}_1 = (120, 130, 140, 150, 150, 110, 90)$$

$$\bar{e}_2 = (115, 120, 124, 125, 125, 130, 128, 127)$$

Subject to constraints.

$$2(11x_1+8x_2)+3(12x_1+7x_2)+4(14x_1+5x_2)+5(16x_1+4x_2)+5(16x_1+4x_2)+4(8x_1+3x_2)+3(7x_1+2x_2)+2(6x_1+x_2)\leq(120+130+140+150+150+110+90)$$

$$2(2x_1+4x_2)+3(3x_1+5x_2)+4(6x_1+3x_2)+5(7x_1+9x_2)+2(4x_1+8x_2)\leq(115+120+124+125+125+130+128+127)$$

$$\text{Max } Z=60x_1+70x_2$$

Subject to constraints.

$$339x_1+121x_2+s_1=890$$

$$143x_1+126x_2+s_2=994$$

Simplex method

Step:1

The initial basic feasible solution is

CB	YB	XB	X1	X2	S1	S2	RATIO
0	S2	890	339	121	1	0	890/121 ←
0	S2	994	143	126	0	0	994/126
Zj		0	0	0	0	0	
Cj			60	70	0	0	
Zj - Cj	=	0	-60	-70	0	0	

STEP:2

Enter x_2 and skip s_2

CB	YB	XB	X1	X2	S1	S2	RATIO
70	X2	890/121	339/121	1*	1/121	0	7.35
0	S1	-8134/121	25411/121	0	126/121	0	0
Zj		62300/121	196	70	70/121	0	
Cj			60	70			
Zj - Cj	=	514.8	136	0	0.56	0	

Maximize $Z=514.8$ at $x_1=0; x_2=7.35$

Similarliy we can calculate simplex method in Minimize $Z=$ (- Maximize Z)

Therefore minimize $z = -159$ at $x_1 = 2.65$; $x_2 = 0$

GRAPHICAL METHOD

Maximize $Z = 60x_1 + 70x_2$

Subject to constraints

$$339x_1 + 121x_2 \leq 890$$

$$143x_1 + 126x_2 \leq 994$$

Solution

Given that Max $Z = 60x_1 + 70x_2$

Subject to constraints

$$339x_1 + 121x_2 = 890 \text{-----} \rightarrow (1)$$

$$143x_1 + 126x_2 = 994 \text{-----} \rightarrow (2)$$

Put $x_1 = 0$ in eqn 1 $\Rightarrow 121x_2 = 890 \Rightarrow$

$x_2 = 7.35$

A(0, 7.35)

put $x_2 = 0$ in eqn 1 $\Rightarrow 339x_1 = 890 \Rightarrow$

$x_1 = 2.65$

B(2.65, 0)

Put $x_1 = 0$ in eqn 2 $\Rightarrow 126x_2 = 994$

C(0, 7.88)

$x_2 = 7.88$

Put $x_2 = 0$ in eqn 2 $\Rightarrow 143x_1 = 994 \Rightarrow x_1 = 6.95$

D(6.95, 0)

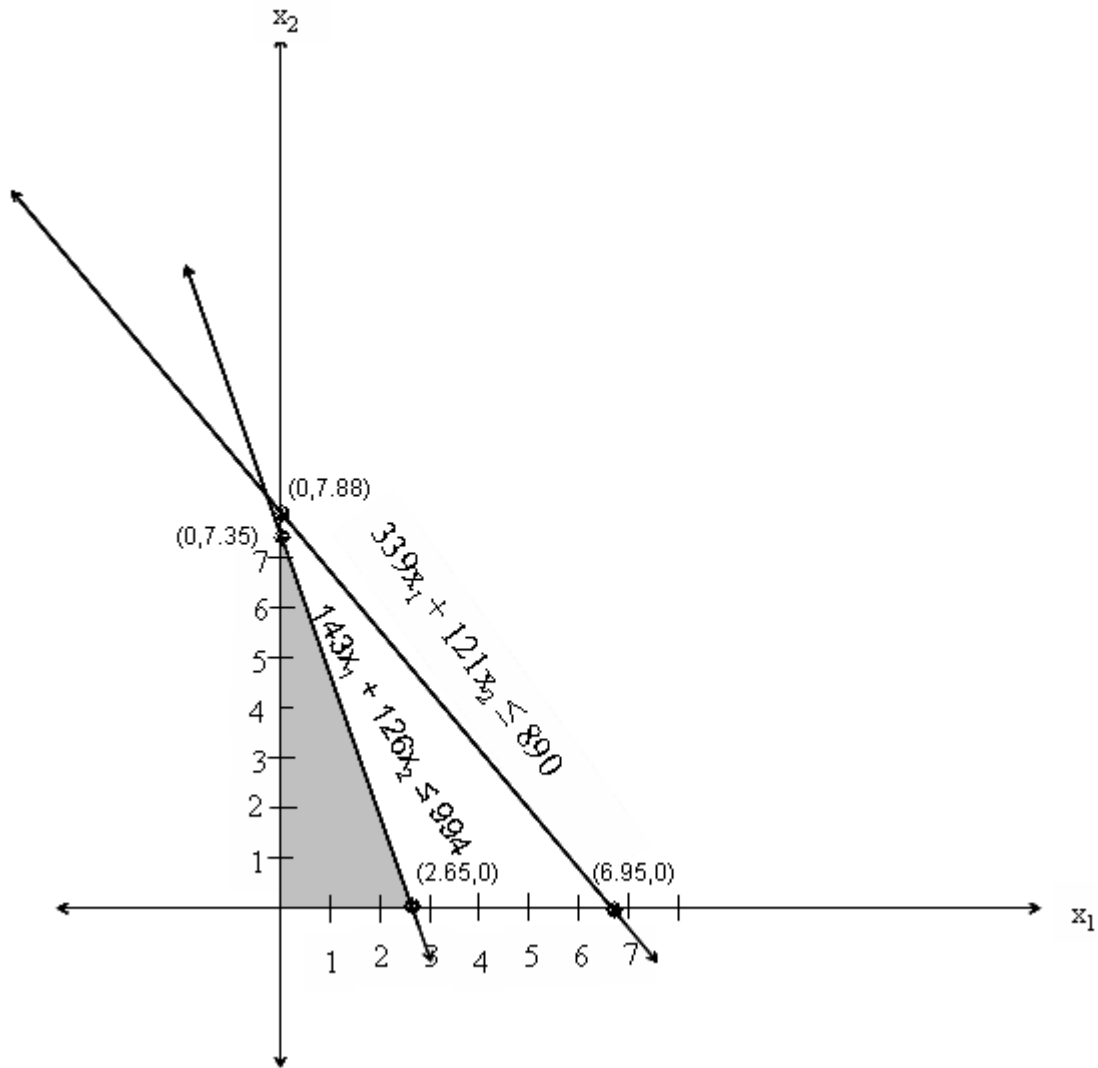


Fig -2 Graphical method

(x_1, x_2)	Max $z = 60x_1 + 70x_2$
A(0,0)	Max $Z = 0$
B(2.65,0)	Max $Z = 159$
C(0,7.35)	Max $Z = 514.5$

Comparison of result obtained by using Simplex method and Graphical method.

Simplex Method	Graphical Method
Maximize $Z = 514.8$ at $X_1 = 0$ and $x_2 = 7.88$	Maximize $Z = 514.5$ at $X_1 = 0$ and $X_2 = 7.35$
Minimize $Z = 159.10$ at $X_1 = 2.75$ and $X_2 = 0$	Minimize $Z = 159$ $X_1 = 2.65$ and $X_2 = 0$

RESULTS AND DISCUSSIONS:

As per the above table, we have obtained the nearest value from both simplex method and graphical method. But Simplex Method results is accurate value.

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APPLICATION OF AIR HEATER AND COOLER USING FUZZY LOGIC CONTROL SYSTEM

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ABSTRACT

This research paper describes the design and implementation of an autonomous room air cooler using fuzzy rule based control system. The rule base receives two crisp input values from temperature and humidity sensors, divides the universe of discourse into regions with each region containing two fuzzy variables, fires and rules, and gives the output singleton values corresponding to each output variable. Three defuzzifiers are used to control the actuators ; cooler fan, water pump and room exhaust fan. The results obtained from the simulation were found correct according to the design model. This research work will increase the capability of fuzzy logic control systems in process automation with potential benefits. MATLAB-simulation is used to achieve the designed goal.

Keywords : Fuzzy logic control, MATLAB simulation.

Introduction:

The control system design, development and implementation need the specification of plants, machines or processes to be controlled. A control system consists of controller and plant, and requires an actuator to interface the plant and controller. The behavior and performance of a control system depend on the interaction of all the elements. The dynamical control systems design, modeling and simulation in local and distributed environment need to express the behavior of quantitative control system of multi-output variables control environment to establish the relation between actions and consequences of the control strategies.

Computational Intelligence(CI) is a field of intelligence processing related with different branches of computer sciences and engineering. The fuzzy systems are

Paradigm of CI. The contemporary technologies in the area of control and autonomous processing are benefitted using fuzzy sets.

The user based processing capability is an important aspect of fuzzy systems taken into accounts in any design consideration of human centric computing system. The human centricity plays a vital role in the areas of intelligent data analysis and system modeling. The elements of fuzzy sets belong to varying degrees of membership or belongingness. Fuzzy sets offer an important and unique feature of information granules. A membership function quantifies different degrees of membership. The higher the degree of membership $A(x)$, the stronger is the level of belongingness of this element to A . Fuzzy sets provide an ultimate mechanism of communication between humans and computing environment.

The fuzzy logic and fuzzy set theory deal with nonprobabilistic uncertainties issues. The fuzzy control system is based on the theory of fuzzy sets and fuzzy logic. Previously a large number of fuzzy inference systems and defuzzification techniques were reported. These systems/techniques with less computational overhead are useful to obtain crisp output. The crisp output values are based on linguistic rules applied in inference engine and defuzzification techniques.

The efficient industrial control with new techniques of fuzzy algorithm based on active rule selection mechanism to achieve less sampling time ranging from milliseconds in pressure control, and higher sampling time in case of temperature control of larger installations of industrial furnaces has been proposed.

Basic structure of the proposed model:

The basic structure of the proposed model of autonomous water room cooler consist of room air cooler and air heater with fuzzy logic control system. The room cooler mounted in room has heater fan, a cooler fan, a water pump to spread water on its boundary walls of grass roots or wooden shreds. A room exhaust fan, humidity and temperature sensors used to monitor the environment of room are mounted in the room. The sensors with amplification and voltage adjustment unit are connected with the two fuzzifiers of the fuzzy logic control system. Four outputs of defuzzifiers: heater fan speed control, cooler fan speed control, water pump speed control and room exhaust fan speed control are connected through actuators.

Simplified design algorithm of fuzzy logic for room air cooler system:

This simplified design algorithm is used to design the fuzzifier, inference engine, rule base and defuzzifier for the autonomous room air heating and cooling system according to the control strategy of the processing plant to archive the quantity and quality of the desire needs to maintain the room environment.

This design work uses five triangular membership function equally determined over a scale range of 0°C to 40°C for the temperature input and 0% to 100% relative humidity inputs. The five fuzzy membership functions for temperature inputs are termed as: cold 0-10°C, cool to 0-20°C, normal 10-30°C. As for humidity input, the five fuzzy membership functions are: dry 0%-25%, not too dry 0%-50%, moist 25%-75%, not too wet 50%-100%, and wet range 75%-100%. This fuzzy logic model aims to determine the amplitude of the voltage signal 0-5v to be sent to the four actuators for: heater fan speed, cooler fan speed, water pump speed and room exhaust fan speed to maintain a constant and desired environment. Her no time constrain is applied. Four outputs of this proposed system are: heater fan speed, cooler fan speed, water pump speed and room exhaust fan speed. Each output variable consist of five membership functions: Stop 0-5, Low 0-50, Medium 40-60, Fast 50-90, Very fast 90-100.

Fuzzifier:

The set points of fuzzifiers use the data of two input variables, “Temperature” and, “Humidity”. Their occupied region description, membership functions and range are given in TABLE 1 and TABLE 2.

Table 1
Membership Functions And Ranges Of Input Variable Temperature

Membership Function (Mf)	Ranges	Region Occupied
Cold	0-10	1
Cool	0-20	1-2

Normal	10-30	2-3
Warm	20-40	3-4
Hot	30-40	4

Table 2
Membership Functions And Ranges Of Input B Variable Humidity

Membership Function (MF)	Ranges	Region occupied
Dry	0-25	1
Not too Dry	0-50	1-2
Moist	25-75	2-3
Not too Wet	50-100	3-4
Wet	75-100	4

For each input variable, five membership functions are used

The five membership functions , “Cold”, “Cool”, “Normal”, “Warm”, “Hot” are used to show the various ranges of input fuzzy variables “TEMPERATURE” in a plot consisting of four regions.

The five membership functions, “Dry”, “Not too Dry”, “Moist”, “Not too Wet” , “Wet” are used to show the various ranges of input fuzzy variable “HUMIDITY” in a plot also consisting of four regions.

The linguistic values are the mapping values of the fuzzy input variables with the membership functions occupied in the regions. As we are using two variables, therefore four linguistic values. The mapping of input fuzzy variables with the functions in four regions is listed in TABLE 3.

Table 3
Linguistic Values of Fuzzifiers Outputs In All Regions

Input Variables	Linguistic Fuzzifiers Outputs	Region 1	Region 2	Region 3	Region 4

Temperature	f_1	$f_1 [1]$	$f_1 [2]$	$f_1 [3]$	$f_1 [4]$
	f_2	$f_1 [2]$	$f_1 [3]$	$f_1 [4]$	$f_1 [5]$
Humidity	f_3	$f_2 [1]$	$f_2 [2]$	$f_2 [3]$	$f_2 [4]$
	f_4	$f_2 [4]$	$f_2 [3]$	$f_2 [4]$	$f_2 [5]$

Table 4
Rule Mapping For Regions Occupied

Case No.	Regions Occupied		Rules $f_n [m]=$ Membership value, where $n=$ No. of input variable, $m=$ No of membership func-
	Temperature Input variable 1	Humidity Input variable 2	
1	1	1	$R_1=f_1 \wedge f_3 = f_1 [1] \wedge f_2 [1]$ $R_2=f_1 \wedge f_4 = f_1 [1] \wedge f_2 [2]$ $R_3=f_2 \wedge f_3 = f_1 [2] \wedge f_2 [1]$ $R_4=f_2 \wedge f_4 = f_1 [2] \wedge f_2 [1]$
2	1	2	$R_1=f_1 \wedge f_3 = f_1 [1] \wedge f_2 [2]$ $R_2=f_1 \wedge f_4 = f_1 [1] \wedge f_2 [3]$ $R_3=f_2 \wedge f_3 = f_1 [2] \wedge f_2 [2]$ $R_4=f_2 \wedge f_4 = f_1 [2] \wedge f_2 [3]$
3	1	3	$R_1=f_1 \wedge f_3 = f_1 [1] \wedge f_2 [3]$ $R_2=f_1 \wedge f_4 = f_1 [1] \wedge f_2 [4]$ $R_3=f_2 \wedge f_3 = f_1 [2] \wedge f_2 [3]$ $R_4=f_2 \wedge f_4 = f_1 [2] \wedge f_2 [4]$
4	1	4	$R_1=f_1 \wedge f_3 = f_1 [1] \wedge f_2 [4]$ $R_2=f_1 \wedge f_4 = f_1 [1] \wedge f_2 [5]$ $R_3=f_2 \wedge f_3 = f_1 [2] \wedge f_2 [4]$ $R_4=f_2 \wedge f_4 = f_1 [2] \wedge f_2 [5]$
5	2	1	$R_1=f_1 \wedge f_3 = f_1 [2] \wedge f_2 [1]$ $R_2=f_1 \wedge f_4 = f_1 [2] \wedge f_2 [2]$ $R_3=f_2 \wedge f_3 = f_1 [3] \wedge f_2 [1]$ $R_4=f_2 \wedge f_4 = f_1 [3] \wedge f_2 [2]$

6	2	2	$R_1=f_1^{f_3} = f_1[2]^{f_2[2]}$ $R_2=f_1^{f_4} = f_1[2]^{f_2[3]}$ $R_3=f_2^{f_3} = f_1[3]^{f_2[2]}$ $R_4=f_2^{f_4} = f_1[3]^{f_2[3]}$
7	2	3	$R_1=f_1^{f_3} = f_1[2]^{f_2[3]}$ $R_2=f_1^{f_4} = f_1[2]^{f_2[4]}$ $R_3=f_2^{f_3} = f_1[3]^{f_2[3]}$ $R_4=f_2^{f_4} = f_1[3]^{f_2[4]}$
8	2	4	$R_1=f_1^{f_3} = f_1[2]^{f_2[4]}$ $R_2=f_1^{f_4} = f_1[2]^{f_2[5]}$ $R_3=f_2^{f_3} = f_1[3]^{f_2[4]}$ $R_4=f_2^{f_4} = f_1[3]^{f_2[5]}$
9	3	1	$R_1=f_1^{f_3} = f_1[3]^{f_2[1]}$ $R_2=f_1^{f_4} = f_1[3]^{f_2[2]}$ $R_3=f_2^{f_3} = f_1[4]^{f_2[1]}$ $R_4=f_2^{f_4} = f_1[4]^{f_2[2]}$
10	3	2	$R_1=f_1^{f_3} = f_1[3]^{f_2[2]}$ $R_2=f_1^{f_4} = f_1[3]^{f_2[3]}$ $R_3=f_2^{f_3} = f_1[4]^{f_2[2]}$ $R_4=f_2^{f_4} = f_1[4]^{f_2[3]}$
11	3	3	$R_1=f_1^{f_3} = f_1[3]^{f_2[3]}$ $R_2=f_1^{f_4} = f_1[3]^{f_2[4]}$ $R_3=f_2^{f_3} = f_1[4]^{f_2[3]}$ $R_4=f_2^{f_4} = f_1[4]^{f_2[4]}$
12	3	4	$R_1=f_1^{f_3} = f_1[3]^{f_2[4]}$ $R_2=f_1^{f_4} = f_1[3]^{f_2[5]}$ $R_3=f_2^{f_3} = f_1[4]^{f_2[4]}$ $R_4=f_2^{f_4} = f_1[4]^{f_2[5]}$
13	4	1	$R_1=f_1^{f_3} = f_1[4]^{f_2[1]}$ $R_2=f_1^{f_4} = f_1[4]^{f_2[2]}$ $R_3=f_2^{f_3} = f_1[5]^{f_2[1]}$ $R_4=f_2^{f_4} = f_1[5]^{f_2[2]}$
14	4	2	$R_1=f_1^{f_3} = f_1[4]^{f_2[2]}$ $R_2=f_1^{f_4} = f_1[4]^{f_2[3]}$ $R_3=f_2^{f_3} = f_1[5]^{f_2[2]}$ $R_4=f_2^{f_4} = f_1[5]^{f_2[3]}$

15	4	3	$R_1=f_1 \wedge f_3 = f_1[4] \wedge f_2[3]$ $R_2=f_1 \wedge f_4 = f_1[4] \wedge f_2[4]$ $R_3=f_2 \wedge f_3 = f_1[5] \wedge f_2[3]$ $R_4=f_2 \wedge f_4 = f_1[5] \wedge f_2[4]$
16	4	4	$R_1=f_1 \wedge f_3 = f_1[4] \wedge f_2[4]$ $R_2=f_1 \wedge f_4 = f_1[4] \wedge f_2[5]$ $R_3=f_2 \wedge f_3 = f_1[5] \wedge f_2[4]$ $R_4=f_2 \wedge f_4 = f_1[5] \wedge f_2[5]$

Fuzzifier converts the input crisp value into the linguistic fuzzy values. The output of fuzzifier gives the linguistic values of fuzzy set for the two input variables, two fuzzifiers are used which are shown in Table 5.

Each fuzzifier consist of : a multiplier : which converts the input voltage range 0-5v into the crisp value 0-40 for temperature by multiplying the input with 10, and the crisp value 0-100 for humidity by multiplying the input with 25, comparators ; used to decide the region occupied by input variable, subtractors; used to find the difference of crisp value from the end value of each region, multiplexer; using the address information from the region selection and inputs from the four subtractors, multiplex the four values because the system is designed for the four predefined regions, divider; used to divide the difference value in each selected region by 10 to find the mapping value of membership function with the input variable value of temperature in that region, and to find the mapping value of membership function for input variable value of humidity, divide the difference value in each selected region by 25, a second fuzzy set subtractor; used to find the active value of the second fuzzy set by subtracting the first active fuzzy set value from 1. The general internal hardware structural scheme of a fuzzifier for four regions and the results of fuzzification are shown in TABLE 5 for mathematical analysis.

Table 5
Results of Fuzzification

Input variables	Input voltage(u)	Values	Region selection	Fuzzy set calculation
Temperature	1.9 volts	$X=10u=19$	$10 \leq x < 20$ Region -2	$f_1=(20-19)/10=0.1$ $f_2=1-f_1=1-0.1=0.9$

Humidity	0.8 volts	$X=25u=20$	$0 \leq x < 25$	$f_3 = (30-20)/25 = 0.4$ $f_4 = 1 - f_3 = 1 - 0.4 = 0.6$
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Inference Engine

The inference engine consists of four AND operators, these are not the logical ANDs but select minimum value input for the output. This inference engine accepts four inputs from fuzzifier and applies the min-max composition to obtain the output R values. The min-max inference method uses min-AND operation between the four inputs. Fig. 7 shows this type of inference process. Number of active rules = m^n , where m = maximum number of overlapped fuzzy sets and n = number of inputs. For this design, $m = 5$ and $n = 2$, so the total number of active rules are 25. The total number of rules is equal to the product of number of functions accompanied by the input variables in their working range. The two input variables described here consisted of five membership functions. Thus, $5 \times 5 = 25$ rules were required which are shown in TABLE 6.

Table 6
Total Number of Rules

Temperature (°C)	Humidity %	Speed of Heater Fan	Speed of Cooler Fan	Speed of Water Pumb	Speed of Room Exhaust Fan
Cold	Dry	High	Stop	Fast	Fast
Cold	Not too dry	Medium	Stop	Medium	Slow
Cold	Moist	Medium	Stop	Medium	Slow
Cold	Not too wet	Low	Stop	Low	Slow
Cold	Wet	Low	Low	Stop	Slow

Cool	Dry	Medium	Stop	Medium	Slow
Cool	Not too dry	Low	Stop	Low	Stop
Cool	Moist	Low	Stop	Low	Stop
Cool	Not too wet	Stop	Low	Low	Medium
Cool	Wet	Stop	Low	Stop	Medium
Normal	Dry	Stop	Low	Medium	Slow
Normal	Not too dry	Stop	Low	Medium	Slow
Normal	Moist	Stop	Stop	Medium	Stop
Normal	Not too wet	Low	Low	Stop	Slow
Normal	Wet	Low	Low	Stop	Slow
Warm	Dry	Stop	Stop	Low	Stop
Warm	Not too dry	Stop	Stop	Low	Stop
Warm	Moist	Medium	Medium	Stop	Slow
Warm	Not too wet	Low	Low	Medium	Slow
Warm	Wet	Low	Low	Medium	Slow
Hot	Dry	Stop	High	High	Stop
Hot	Not too dry	Stop	High	High	Slow
Hot	Moist	Stop	High	High	Medium
Hot	Not too wet	Stop	High	Medium	Medium
Hot	Wet	Stop	High	Low	Stop

In this case only 4 rules are required for the particular values of the two variables because each value of two variables in a region corresponds to mapping of two functions. The corresponding mapping values of $f_1[2]$, $f_1[3]$, $f_2[3]$, $f_2[4]$ were used to establish the 4 rules. Here $f_1[3]$ means the corresponding mapping value of membership function “Cool” of temperature in region – 2 and the similar definitions are for the others.

$$R_1 = f_1 \wedge f_3 = f_1[2] \wedge f_2[3] = 0.1 \wedge 0.4 = 0.1$$

$$R_2 = f_1 \wedge f_4 = f_1[2] \wedge f_2[4] = 0.1 \wedge 0.6 = 0.1$$

$$R_3 = f_2 \wedge f_3 = f_1[3] \wedge f_2[3] = 0.9 \wedge 0.4 = 0.4$$

$$R_4 = f_2 \wedge f_4 = f_1[3] \wedge f_2[4] = 0.9 \wedge 0.6 = 0.6$$

Rule Selector

The rule selector receives two crisp values of temperature and humidity. It gives singleton values of output functions under algorithm rules applied on design model. For two variables, four

rules are needed to find the corresponding singleton values S1, S2, S3 and S4 for each variable according to these rules are listed in Table 7.

Table 7
Illustration of Rules Applied Model

Rule No.	Inputs		Singleton values of outputs				Singleton Values
	Temperature	Humidity	Speed of Heater Fan	Speed of cooler Fan	Speed of water pump	Speed of Room exhaust Fan	
1	Cool	Dry	Medium= 0.50	Stop =0.1	Medium= 0.50	Fast =0.70	S1
2	Cool	Not too dry	Low= 0.25	Stop= 0.1	Low= 0.25	Medium= 0.50	S2
3	Normal	Dry	Stop= 0.1	Low= 0.25	Medium= 0.50	Slow= 0.25	S3
4	Normal	Not too dry	Stop= 0.1	Low = 0.25	Medium= 0.50	Slow= 0.25	S4

The rule base accepts two crisp input values, distributes the universe of discourse into regions with each region containing two fuzzy variables, fires the rules, and gives the output singleton values corresponding to each output variable.

Defuzzifier

In this system, three defuzzifiers control the actuators; speed of heater fan, speed of cooler fan, speed of water pump, speed of room exhaust fan. The membership functions of the three output variables, and the detail of each plot is given in TABLE 8.

Table 8
Output Variables Membership Functions

MF _s	Range	Speed of Heater Fan	Speed of Cooler Fan	Speed of Water Pump	Speed of Room Exhaust Fan
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MF₁	0-5	High	Stop	Medium	Medium
MF₂	0-50	Low	Low	Low	Slow
MF₃	40-60	Low	Medium	Medium	Medium
MF₄	50-90	Stop	High	High	Fast
MF₅	70-100	Stop	Very high	Very high	Very fast

The defuzzification process provides the crisp value outputs after estimating its inputs. In this system 8 inputs are given to each of three defuzzifiers. Four values of R1, R2, R3, R4 from the outputs of inference engine and four values S1, S2, S3, S4 from the rule selector are shown in Fig. 10. Each defuzzifier estimates the crisp value output according to the center of average (C.O.A) method using the mathematical expression, $\sum S_i * R_i / \sum R_i$, where $i = 1$ to 4. Each output variable membership function plot consists of five functions with the same range values for simplification. Fig.12 shows the design arrangement of a defuzzifier. One defuzzifier consists of : one adder for $\sum R_i$, four multipliers for the product of $S_i * R_i$, one adder for $\sum S_i * R_i$, and one divider for $\sum S_i * R_i / \sum R_i$. Finally a defuzzifier gives the estimated crisp value output.

RESULTS AND DISCUSSION

The designed values for three outputs; cooler fan speed, water pump speed and room exhaust fan $\sum R_i = R_1 + R_2 + R_3 + R_4 = 0.1 + 0.1 + 0.4 + 0.6 = 1.2$

Table 9

Designed Value For Heater Fan Speed

I	S_i	R_i	S_i*R_i
1	0.50	0.1	0.05
2	0.25	0.1	0.025
3	0.1	0.4	0.04
4	0.1	0.6	0.06

$$\sum S_i * R_i = 0.175 \text{ \& } \sum R_i = 1.2$$

$$\sum S_i * R_i / \sum R_i = 0.175 / 1.2$$

$$= 0.1457$$

$$= 14.57\% \text{ of Heater fan speed.}$$

Table 10

Designed Value For Heater Fan Speed

I	Si	Ri	Si*Ri
1	0.1	0.1	0.01
2	0.1	0.1	0.01
3	0.25	0.4	0.1
4	0.25	0.6	0.15

$$\sum Si * Ri = 0.27 \text{ \& } \sum Ri = 1.2$$

$$\sum Si * Ri / \sum Ri = 0.27 / 1.2$$

$$= 0.225$$

= 22.5% of Cooler fan speed.

Table 11

Designed Value For Water Pump Speed

I	Si	Ri	Si*Ri
1	0.50	0.1	0.05
2	0.25	0.1	0.025
3	0.50	0.4	0.2
4	0.50	0.6	0.3

$$\sum Si * Ri = 0.575 \text{ \& } \sum Ri = 1.2$$

$$\sum Si * Ri / \sum Ri = 0.575 / 1.2$$

$$= 0.4792$$

= 47.92% of Water pump speed.

Table 12

Designed Value For Exhaust Fan Speed

I	Si	Ri	Si*Ri
1	0.70	0.1	0.07
2	0.50	0.1	0.05
3	0.25	0.4	0.1
4	0.25	0.6	0.15

$$\sum S_i * R_i = 0.37 \text{ \& } \sum R_i = 1.2$$

$$\sum S_i * R_i / \sum R_i = 0.37 / 1.2$$

$$= 0.3083$$

$$= 30.83\% \text{ of Exhaust fan speed.}$$

Using mathematical expression $\sum S_i * R_i / \sum R_i$ the crisp values for output variables were determined and the results were found according to the MATLAB simulation. These results are compared in TABLE 14 and found correct according to the design model.

MATLAB simulation was adapted according to the arrangement of membership functions for four rules as given in TABLE 12.

Table 13
Arrangement of Membership Functions For
Simulation

Rule no	Inputs		Outputs			
	temperature	Humidity	Speed of Heater Fan	Speed of Cooler Fan	Speed of Water Pump	Speed of Room Exhaust Fan
1	Cool	Dry	Medium	Stop	Medium	Fast
2	Cool	Not too dry	Low	Stop	Low	Medium
3	Normal	Dry	Stop	Low	Medium	Slow
4	Normal	Not too dry	Stop	Low	Medium	Slow

In Fig. 13 the same values of input variables, Temperature = 28, and Humidity = 40 are shown. Various values of input and output variables match the dependency scheme of the system design. The simulated values were checked using MATLAB-Rule.

The correctness of results shows the validity of the simplified design work for processing system using fuzzy control system.

Table 14
Comparison of Simulated And Calculated
Result

Result	Speed of Heater Fan	Speed of Cooler Fan	Speed of Water Pump	Speed of Room Exhaust Fan
Design values	14.57	22.5	47.92	30.83
MATLAB Simulation	11.9	20.3	49.1	27.8
% error	6.3	4.8	5.6	7.1

Simulation Graphs Discussion

This system was simulated for the given range of input variables. The given value of: Temperature = 19 lies in region 2 of the range 10-20 and Humidity = 20 lies in region 3 of the range 0-25. The four rules were applied for MATLAB simulation according to this range scheme. In this design model, the speed of heater fan and the speed of cooler fan depends upon the selected value of temperature sensor, water pump and exhaust fan speeds depend on the value of humidity. The simulated and calculated results are according to the reliance scheme.

The cooler fan speed is directly proportional to temperature and it does not depend upon the humidity. The water pump speed is inversely proportional to humidity and it does not depend upon the temperature. The exhaust fan speed is directly proportional to humidity.

Fuzzy Transportation Problem of Hexagon Number with α - cut and Ranking Technique

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Abstract

In this paper we are presenting a ranking technique with alpha cut optimal solution for solving transportation problem, where fuzzy demand and supply are all in the form of Hexagonal fuzzy number. The main aim of this paper is to introduce a new operation for addition, subtraction, multiplication of Hexagonal fuzzy numbers on the basis of alpha cuts sets of fuzzy numbers. In an organisation, where a number of alternatives and variables such as production, inventory, financial management, costing and various other parameters are involved. This ranking procedure serves as an efficient method wherein a numerical example is also taken and the inference is given.

Keywords

Robust Ranking method, Hexagonal fuzzy numbers, α -optimal solution, Fuzzy transportation problem.

1. Introduction

The Fuzzy Transportation Problem (FTP) is one of the special kinds of fuzzy linear programming problems. A fuzzy transportation problem is a transportation problem in which the transportation costs, supply and demand quantities are fuzzy quantities. To deal quantitatively with imprecise

information in making decisions Bellman and Zadeh and Zadeh introduced the notion of fuzziness. Fuzzy transportation is the transportation of fuzzy quantity from the fuzzy origin to fuzzy destination in such a way that the total fuzzy transportation cost is minimum. The objective of the fuzzy transportation problem is to determine the shipping schedule that minimizes the total fuzzy transportation cost, while satisfying fuzzy supply and demand limits.

The Fuzzy set Theory has been applied in many fields such as Management, Engineering etc. In this paper a new operation on Hexagonal Fuzzy number is defined where the methods of addition, subtraction, and multiplication has been modified with some conditions.

2. Preliminaries

2.1 Definition

Let X be a nonempty set. A fuzzy set A in X is characterized by its membership function $A : X \rightarrow [0, 1]$, where $A(x)$ is interpreted as the degree of membership of element x in fuzzy A for each other $x \in X$.

2.2 Interval Number

Let R be the set of real numbers. Then closed interval $[a, b]$ is said to be an interval number, where $a, b \in R, a \leq b$.

2.3 Fuzzy Number

A Fuzzy set A of the real line R with membership function

$\mu_{\tilde{A}}(X) : R \rightarrow [0, 1]$ is called fuzzy number if

- i. A must be normal and convex fuzzy set;

- ii. The support of \tilde{A} , must be bounded
- iii. α_A must be closed interval for every $\alpha \in [0, 1]$

3. Hexagon Fuzzy Number

The Fuzzy number H is a hexagonal fuzzy \tilde{A}_H is a hexagonal fuzzy number denoted $\tilde{A}_H(a, b, c, d, e, f; 1)$ and its member function $\mu_{\tilde{A}_H}(x)$ is give below.

$$\mu_{\tilde{A}_H}(x) = \begin{array}{ll} y - a / b - a & a \leq y \leq b \\ 1 & b \leq y \leq c \\ d - y / d - c & c \leq y \leq d \\ 0 & \text{Otherwise} \\ y - c / d - c & c \leq y \leq d \\ 1 & d \leq y \leq e \\ f - y / f - e & e \leq y \leq f \\ 0 & \text{Otherwise} \end{array}$$

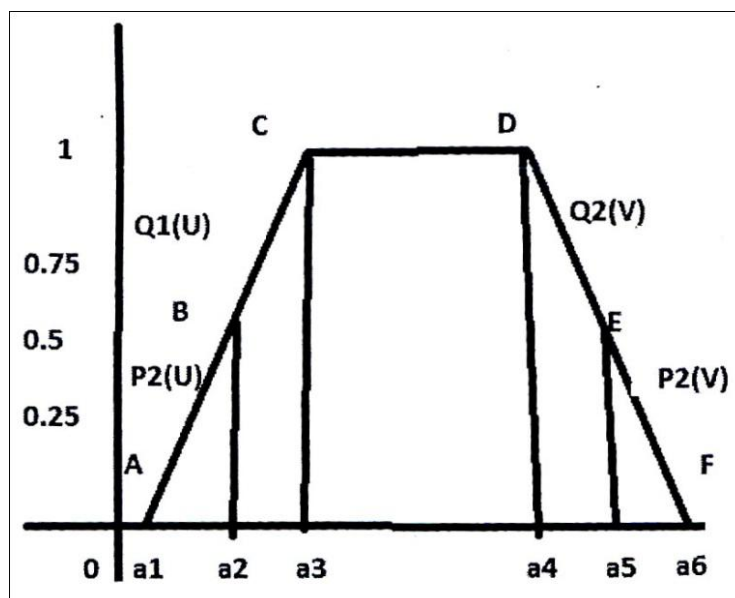


Figure 1 : Graphical representation of a Hexagonal fuzzy number

3.1 Arithmetic operations on Hexagonal fuzzy number

Let $\tilde{A}_H = (a_1, a_2, a_3, a_4, a_5, a_6)$ and $\tilde{N}_H = (n_1, n_2, n_3, n_4, n_5, n_6)$ be two hexagonal fuzzy numbers, then

- i. $\tilde{A}_H (+)\tilde{N}_H = (a_1 + n_1, a_2 + n_2, a_3 + n_3, a_4 + n_4, a_5 + n_5, a_6 + n_6)$
- ii. $\tilde{A}_H (-)\tilde{N}_H = (a_1 + n_1, a_2 + n_2, a_3 + n_3, a_4 + n_4, a_5 + n_5, a_6 + n_6)$
- iii. $\tilde{A}_H (*)\tilde{N}_H = (a_1 + n_1, a_2 + n_2, a_3 + n_3, a_4 + n_4, a_5 + n_5, a_6 + n_6)$

3. Robust Ranking Technique

Robust Ranking Technique satisfies the following properties,

- i. Compensation
- ii. Linearity
- iii. Additivity

It provides results which are consist human intuition . If \tilde{A} is a fuzzy number then the Robust ranking is defined by

$$R(\tilde{A}_H) = \int_0^1 (0.5) (a_{h\alpha}^L, a_{h\alpha}^U) d\alpha \text{ where } (a_{h\alpha}^L, a_{h\alpha}^U)$$

Is the α level cut of the fuzzy number \tilde{A}_H . In this paper we find the rank of the objective

Numerical Example

A Company has six sources S_1, S_2, S_3, S_4, S_5 and S_6 and six destination D_1, D_2, D_3, D_4, D_5 and D_6 ; the fuzzy transportation cost for unit quantity of the product from i^{th} source j^{th} destination is

B_{ij} Where $[b_{ij}]_{3 \times 4} = (1,2,3,4,5,6) (1,3,4,6,7,8) (8,9,7,8,6,5,4) (2,6,5,4,3,2)$
 $(3, 6, 5, 4, 3, 2) (2,3,5,6,7,5) (4,7,6,5,2,1) (3,4,5,6,7,5)$
 $(1,5,6,7,6,2) (1,8,7,6,5,6) (5,9,4,6,7,6) (8,7,1,0,6,5)$

And fuzzy availability of the product at source are $(2,3,5,6,2,1), (5,10,12,17,11,10), (8,10,12,12,6,4)$ and the fuzzy demand of the product at destination are $(5,8,8,7,5,4), (5,1,6,7,5,4,2), (2,3,1,3,5,7)$ and $(3,6,9,12,15,13,18)$.

Then the problem becomes as

Table – 1

	FD1	FD2	FD3	FD4	Supply
FS_1	(1,2,3,4,5,6)	(1,3,4,6,7,8)	(8,9,7,6,5,4)	(2,6,5,4,3,2)	(2,3,5,6,2,1)
FS_2	(3,6,5,4,3,2)	(2,3,5,6,7,5)	(4,7,6,5,2,1)	(3,4,5,6,7,5)	(5,10,12,17,11,10)
FS_3	(1,5,6,7,6,2)	(1,8,7,6,5,6)	(5,9,4,6,7,6)	(8,7,1,0,6,5)	(8,10,12,12,6,4)
Demand	(5,8,8,7,5,4)	(5,1,6,7,5,2)	(2,3,1,3,5,7)	(3,6,9,12,15,18)	

Solution

The fuzzy transportation problem can be formulated in the following mathematical programming from

$$\text{Min } x = R(1,2,3,4,5,6) y_{11} + R(1,3,4,6,7,8) y_{12} + R(8,9,7,6,5,4) y_{13} + R(2,6,5,6,7,5) y_{14} + R(3,6,5,4,3,2) y_{21} + R(2,3,5,6,7,5) y_{22} + R(4,7,6,5,2,1) y_{23} + R(3,4,5,6,7,5) y_{24} + R(1,5,6,7,6,2) y_{31} + R(1,8,7,6,5,6) y_{32} + R(5,9,4,6,7,6) y_{33} + R(8,7,0,6,5) y_{34}$$

$$R(H) = \int_0^1 (0.5) (a_{h\alpha}^L, a_{h\alpha}^U) d\alpha$$

$$\text{Where } = \{(b-a)\alpha + a, d - (d-c)\alpha\} + \{(d-c)\alpha + c, f - (f-e)\alpha\}$$

$$R(1, 2, 3, 4, 5, 6) = \int_0^1 (0.5) (\alpha + 1 + 4 - \alpha + \alpha + 3 + 6 - \alpha) d\alpha$$

Similarly

$$R(1,3,4,6,7,8) = 9.75; R(8,9,7,6,5,4) = 13; R(2,6,5,4,3,2) = 7.75; R(3,6,5,4,3,2) = 8$$

$$R(2,3,5,6,7,8) = 9.75; R(4,7,6,5,2,1) = 9; R(3,4,5,6,7,5) = 10.25; R(1,5,6,7,6,2) = 10; R(1,8,7,6,5,6) = 11.5; R(5,9,4,6,7,6) = 11.75; R(8,7,1,0,6,5) = 7;$$

Rank of all supply

$$R(8,10,12,12,6,4) = 19; R(2,3,5,6,2,1) = 9.75; R(2,3,1,3,5,7) = 6.25;$$

$$R(3, 6, 9, 12, 15, 18) = 21;$$

Table after ranking

Table 2

	FD₁	FD₂	FD₃	FD₄	Supply
FS ₁	7	9.75	13	7.75	19
FS ₂	8	9.75	9	10.25	7.5
FS ₃	10	11.5	11.25	7	23.5
Demand	13	9.75	6.25	21	

Table after applying Matrix Minima method

Table 3

	FD₁	FD₂	FD₃	FD₄	Supply
FS ₁			7		
	7	9.75	13	7.75	19
FS ₂		6		9.75	
	8	9.75	9	10.25	7.5
FS ₃		2.5		21	
	10	11.5	11.25	7	23.5
Demand	13	9.75	6.25	21	

The Transportation cost is

$$\begin{aligned}
 & (13)(7) + (9.75)(6) + (10.25)(9.75) + (11.5)(205) + (7)(21) \\
 & = 393.6875 \\
 & = 393.7
 \end{aligned}$$

Conclusion

We have thus obtained an optimal solution for fuzzy transportation problem using hexagon fuzzy numbers. The new arithmetic operations of hexagon fuzzy numbers are employed to get the fuzzy optimal solutions. Moreover the fuzzy transportation problem using Robust's ranking indices, numerical example show that by this method we can have the optimal solution as well as the crisp and fuzzy optimal total cost. By using Robust's [10] ranking method we have shown that the total cost obtained is optimal. We can conclude that the solution of fuzzy transportation problems can be obtained by Robust's ranking method effectively.

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An Assessment Of Video Quality Using Watermark

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Video applications are much prevalent because of their recurrence in use on web these days. The watermarking can be utilized to appraise the video quality by assessing the watermark debasement. The image watermarking strategy for the video quality estimation is established on a 3-level discrete wavelet change (DWT). Here also propose a quad tree decomposition of video for watermarking embedding algorithm to keep the balance between watermarks intangibility and its capacity to adapt up to errors. The watermark is inserted into the tree structure of a image with fitting implanting quality chose by measurably examining the attributes of the image. The correlated DWT coefficients over the DWT subbands are classified into Set Partitioning in Hierarchical Trees (SPIHT). Those SPHIT trees are again decomposed into an arrangement of bitplanes. The insertion and extraction of the watermark in the cover video is discovered to be less difficult than other technologies. The True Detection Rates (TDsssR) determine the video quality by comparing extricated watermark and original watermark. The exactness of the quality estimation is made to approach that of Full-Reference measurements by referring True Detection Rate. In this manner proposed plan has great computational effectiveness for practical applications.

Keywords: —Quad tree decomposition, DWT based watermark embedding, HVS masking, SPIHT tree structure, Watermarking based image quality estimation.

Watermarking is the process of hiding digital information in a carrier. The hidden information may or may not contain any relation with the carrier. Digital watermarks could be used to verify the authenticity or integrity of the carrier signal. Here we are using the embedded watermark to estimate the quality of the video. Video quality is a feature of a video passed through a video transmission or processing system, any video degradation occurring is measured against the original video. The quality can be estimated by using objective metrics. This metrics classification depends on the amount of information available on the original image, the received image, or whether there is an image present at all. Full Reference (FR) metrics evaluate the quality difference by comparing the original video signal against the received video signal.

In this scheme, the watermark embedding strength is estimated by analyzing the quality degradation characteristics of the cover video and no iterative adjustment loops are used, which appreciably improves the computational efficiency. The HVS masking are used to guide the watermark embedding process. This scheme is based on watermarking and tree structure in the DWT domain. The Set Partitioning in Hierarchical Trees (SPIHT) has become one of the most popular image and video coding method. Its efficiency which is accomplished by exploiting the inherent similarities between the sub bands in the wavelet decomposed image. Both the DWT and SPIHT provide a good summarization of local region

characteristics of an image which is important for watermark embedding. Here all the correlated DWT coefficients across the sub bands are grouped together using the SPIHT tree structure. The scheme is experienced in terms of PSNR, SSIM and under JPEG compression.

The rest of the paper is organized as follows. Section II specify the literature review. Section III and Section IV present the proposed watermark embedding scheme in detail. Section V describes the watermark extraction and quality evaluation scheme. Section VI concludes the paper and discusses future work.

II LITERATURE REVIEW

In [11], introduce a practical quality-aware image encoding, decoding and quality analysis system. Here use a reduced-reference image quality assessment algorithm based on a statistical model of natural images and a previously developed quantization watermarking-based data hiding technique in the wavelet transform domain. An effective way for digital watermarking, copyright protection, a process which embeds (hides) a watermark signal in the host signal to be protected is suggest in [2]. A new method introduce for assessing perceptual image quality. Here proposed SSIM indexing approach, which are analyses on structural similarity of the images. It depends on the image formation point of view and also for quality estimation scheme in [7]. Here [8], explains challenges in the video watermarking. LSB replacement

does not provide robustness therefore it is not applicable for digital watermarking. Using different techniques it is easy to extract LSB embedded watermarks. The DCT domain watermarking, is extremely challenging to JPEG compression and random noise. In case of wavelet domains, this is highly resistant to both compression and noise. There will be minimal amounts of visual degradation. Also suggest HVS masks are tremendously preferred to analyze video sequences of frames to embed watermark.

III THE PROPOSED WATERMARK SYSTEM

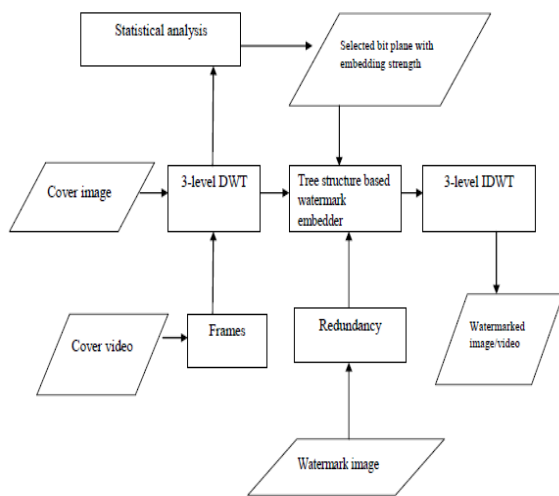


Fig 1 Watermark embedding process

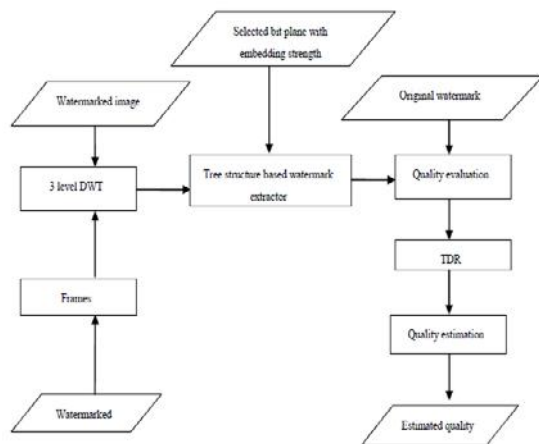


Fig 2 Watermark extraction and quality estimation.

Watermarking is used to estimate the quality of video. Select the cover medium as video and also select watermarking input as image. The watermark video has to convert into frames. Then each frame will experience, decomposition, embedding and extraction. The watermark

embedding strength is estimated by analyzing the quality degradation of the cover image. The HVS masking are used to guide the watermark embedding process. The correlated DWT coefficients are grouped together using the SPIHT tree structure. The DWT decomposed image is further decomposed into a set of bitplane images. The binary watermark bits are embedded into the selected bitplanes. After the watermark embedding, the inverse 3-level DWT is applied to achieve the watermarked image. To estimate the degradation of the image quality, extract watermark from the watermarked image. By evaluating the original watermark with the extracted watermark consequences the quality degradation information. The TDR of the extracted watermark will be calculated to evaluate the degradation of the watermark. The quality degradation of the image will be estimated by mapping the TDR to a quality value referring to the "Ideal Mapping Curve".

Cover Image and Watermark Acquisition and Preprocessing

Digital video is a succession of still images, and a lot of image watermarking techniques can be extended to video in a straightforward manner. The cover video is selected and then it is converted into frames. Also select a text image for watermarking with a particular image size, which will be later converted into grayscale image. The length of the original watermark sequence denoted as len . For the accuracy of watermark bit extraction at the receiver side, every bit in the real watermark is repeated a few times to get a redundant watermark sequence for watermark embedding. In this proposed scheme, set $Redundancy=3$ and the real watermark sequence is repeated $Redundancy-1$ times to get the redundant watermark sequence with $Redundancy * len$ bits long.

SPIHT Tree generation and Data Embedding

The tree structure based watermark embedder is designed to embed the binary watermark bits into the selected bitplanes of the selected DWT coefficients of the selected trees. The tree structure based watermark embedder has three functions, forming the tree structure, selecting the trees and the DWT coefficients for the watermark embedding and embedding the binary watermark bits into the selected bitplanes of the selected coefficients.

The Formation of the Tree Structure: The tree structure is formed by categorizing the DWT coefficients with inherent similarities across all the DWT subbands. The correlated coefficients build up the parent-descendants relationship and form a tree.

The Selection of Trees and DWT Coefficients: For the applications of the watermarking based quality estimation, it is desirable to embed watermark throughout the cover image so that, even the watermarked image is locally tampered, the extracted watermark can still reflect the quality degradation of the cover image. According to the

length of the watermark sequence, the trees for watermark embedding are chosen using the position separation key. To keep the embedded watermark invisible and limit the image quality degradation caused by the watermark embedding, the watermark bits are not embedded into the LL subband of the DWT decomposed image and the watermark bits are not embedded into the bitplanes higher than 5, where the least significant bitplane is bitplane 1. The watermark bit assignment is denoted as $A_{wb} = [a_1, a_2, a_3]$, where a_1, a_2 and a_3 are the number of watermark bits to be embedded in the DWT level 1, 2 and 3 in every selected tree. For watermark embedding, the redundant watermark sequence is divided into W_{seg} .

$$\omega_{seg} = \left\lfloor \frac{Redundancy * len}{\sum A_{wb}} \right\rfloor = \left\lfloor \frac{Redundancy * len}{a_1 + a_2 + a_3} \right\rfloor \quad (1)$$

where len is the length of the watermark sequence.

To minimize the quality degradation of the cover image caused by the watermark embedding, two strategies are used for the tree selection:

- (a) The trees selected from the three DWT orientations are non-overlapping in position.
- (b) The trees are selected throughout the DWT decomposed image.

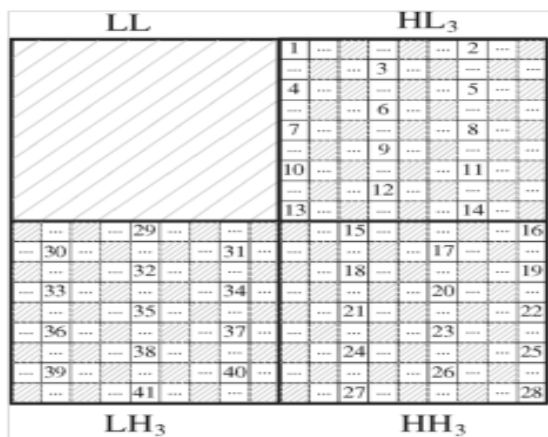


Fig 3: The tree selection from the three DWT orientations.

The watermark embedding: The binary watermark bits are embedded into the selected bitplanes of the selected DWT coefficients. Here, the watermark bit denoted as ω , the DWT coefficient bit on the selected bitplane represent as c and the watermarked DWT coefficient bit as c_ω . Then, the watermark bit will be embedded using the following

$$c_\omega = \begin{cases} c, & \text{if } c = \omega \\ \omega, & \text{if } c \neq \omega \end{cases} \quad (2)$$

Here the schema is based on watermarking and tree structure in the DWT domain. The Set Partitioning in Hierarchical Trees (SPIHT) is most efficient way to exploit the inherent similarities across the subbands in the wavelet

decomposed image. The DWT and SPIHT together provide a good summarization of local region characteristics of an image. All the correlated DWT coefficients across the subbands are grouped together using the SPIHT tree structure. The DWT decomposed image is further decomposed into a set of bitplane images. Then, each DWT coefficient is decomposed into a sequence of binary bits. The binary watermark bits are embedded into the selected bitplanes of the selected DWT coefficients of the selected trees. The HVS masking is used to guide the bitplane selection. The higher frequency DWT subbands and less significant bitplanes are more sensitive to distortions, and vice versa. Therefore, the robustness of the watermark depends on the selection of bitplanes for watermark embedding and the percentages of the watermark bits embedded into the three DWT levels. Thus, for different selected trees, the watermark embedding strengths are different.

The watermark embedding mainly consists of three steps. Shown in Fig 5.

- (1) At first decompose cover image using 3-level DWT which results the DWT decomposed image. The 3-level DWT decomposed subbands are denoted as shown in Fig. 4.
- (2) Then embed the watermark with embedding strength based on SPIHT the tree structure. The output of the watermark embedder is the watermarked DWT image.
- (3) After that apply 3-level IDWT to the watermarked DWT image to obtain the watermarked image.

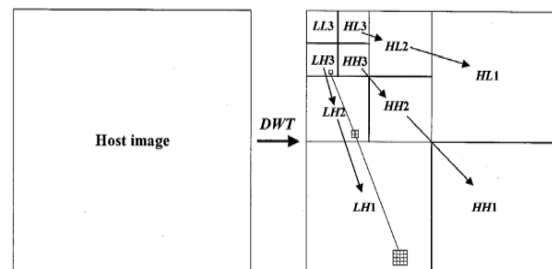


Fig 4: 3-level DWT Decomposition

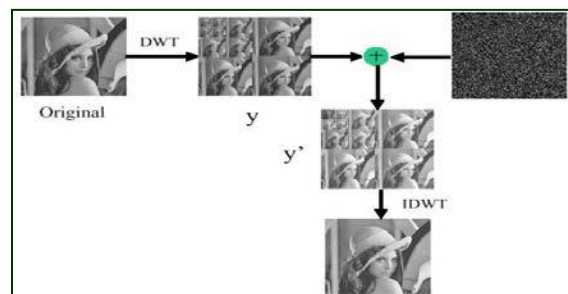


Fig 5: The watermark embedding

IV WATERMARK EMBEDDING STRENGTH

The watermark embedding strength is mainly controlled by the observed watermark bit assignment and the bit plane selection.

I. The observed watermark bit assignment

The watermark bit assignment is denoted as $A_{wb} = [a_1, a_2, a_3]$. According to the image content complexity, the watermark bits are assigned to the 3 DWT levels in the selected tree using the following steps:

- Analyze the content complexity of the cover image and calculate a complexity index.
- Categorize the test images into different groups according to their complexity indices.
- Assign watermark bits to the 3 DWT levels of the cover image. The watermark bit assignment will be the same for all the selected trees in one image and may be different for different images.

The content complexity of the cover image is assessed using the following equation

$$complexity = \sum_{i=1}^n (N_i * 2^i) \quad (3)$$

Here the quad-tree decomposed images are achieved using the threshold $T_{int}=0.17$, where the maximum intensity value of the cover image is not bigger than 1.

(a) The complexity indices are divided into 6 groups. One integer index is associated with one group.

$$Gindex = \begin{cases} 1, & V_c > t_1 \\ 2, & t_1 \geq V_c > t_2 \\ 3, & t_2 \geq V_c > t_3 \\ 4, & t_3 \geq V_c > t_4 \\ 5, & t_4 \geq V_c > t_5 \\ 6, & t_5 \geq V_c > 0 \end{cases} \quad (4)$$

where Gindex is the group index, V_c is the complexity index. t_1, t_2, t_3, t_4, t_5 and t_6 are the empirical grouping thresholds. These thresholds may be different for different distortions.

(b) With the group indices, the watermark bits are assigned to the images.

$$A_{ob} = \begin{cases} [27 \ 0 \ 0], & Gindex = 1 \\ [19 \ 7 \ 1], & Gindex = 2 \\ [13 \ 12 \ 2], & Gindex = 3 \\ [8 \ 15 \ 4], & Gindex = 4 \\ [1 \ 16 \ 4], & Gindex = 5 \\ [0 \ 8 \ 4], & Gindex = 6 \end{cases} \quad (5)$$

And

$$\sum A_{ob} = \begin{cases} 27, & \text{when } Gindex = \varepsilon[1,2,3,4] \\ 21, & \text{when } Gindex = 5 \\ 12, & \text{when } Gindex = 6 \end{cases} \quad (6)$$

Using the equation $W_{seg} = \lfloor Rlen / \sum A_{wb} \rfloor$ trees are selected for the watermark embedding. The Rlen represents

the length of the redundant watermark sequence. Images having different complexity value so the number of selected trees, W_{seg} and the position separation key, N_{sep} , may be different.

The HVS Masking:

The four factors greatly affect the behavior of the HVS mask are band sensitivity, background luminance, edge proximity and texture sensitivity. The product of the four factor results the human visual system masking. For each DWT sub band, individual HVS mask are generated. Therefore calculate nine HVS mask generated for a single image. In this proposed tree structure each HVS mask is mapped into bit plane indices based on the distribution of the HVS mask.

(a) Band sensitivity or frequency masking:

$$M_F(l, \theta) = M_1(\theta) \cdot M_2(l) \quad (7)$$

Where

$$M_1(\theta) = \begin{cases} \sqrt{2}, & \text{if } \theta = 2 \\ 1, & \text{o.w} \end{cases} \quad (8)$$

$$M_2(l) = \begin{cases} 1, & \text{if } l = 1 \\ 0.32, & \text{if } l = 2 \\ 0.16, & \text{if } l = 3 \end{cases} \quad (9)$$

$$\theta = \begin{cases} 1, & \text{for HL blocks} \\ 2, & \text{for HH blocks} \\ 3, & \text{for LH blocks} \end{cases} \quad (10)$$

(b) Background luminance:

$$M_L(l, i, j) = 1 + I(l, i, j) \quad (11)$$

$$= \begin{cases} 2 - \frac{1}{256} I_{LL} \left(\left\lceil \frac{i}{2^{L_r-l}} \right\rceil, \left\lceil \frac{j}{2^{L_r-l}} \right\rceil \right), & \text{if } I(i, j, k) < 0.5 \\ 1 + \frac{1}{256} I_{LL} \left(\left\lceil \frac{i}{2^{L_r-l}} \right\rceil, \left\lceil \frac{j}{2^{L_r-l}} \right\rceil \right), & \text{o.w} \end{cases}$$

(c) Spatial masking or edge proximity

$$M_E(l, i, j) = \sum_{k=0}^{L_r-l} \rho \sum_{\theta=1}^3 \sum_{x=0}^1 \sum_{y=0}^1 \left[I_{k+\theta}^\theta \left(x + \left\lceil \frac{i}{2^k} \right\rceil, y + \left\lceil \frac{j}{2^k} \right\rceil \right) \right]^2 \quad (12)$$

Where ρ is a weighting parameter and the suggested value for ρ is presented in the following equation.

$$\rho = \begin{cases} \frac{1}{4}, & \text{if } k = 0 \\ \frac{1}{16^k}, & \text{if o.w} \end{cases} \quad (13)$$

(d) Texture sensitivity

$$M_T(l, i, j) = \text{var} \left\{ I_{LL} \left(x + \left\lceil \frac{i}{2^{L_r-l}} \right\rceil, y + \left\lceil \frac{j}{2^{L_r-l}} \right\rceil \right) \right\} \quad (14)$$

where $x = \{0,1\}$ and $y = \{0,1\}$.

Finally the HVS mask calculated

$$M_{HVS} = \alpha \cdot M_F \cdot M_L \cdot M_E^\beta \cdot M_T^\gamma \quad (15)$$

where M_{HVS} denotes the HVS mask; α is a scaling parameter. The value for α is 1/2, which implies that intensity variations having values lower than half of $M_F \cdot M_L \cdot M_E^\beta \cdot M_T^\gamma$ are assumed invisible. The suggested value for β and γ is 0.2. The binary watermark bits are not embedded in the LL subband. Therefore, one HVS mask calculated for one DWT subband. So for a single frame there will be nine HVS mask generated.

V EXTRACTION & QUALITY ESTIMATION

The image group index transmitted from the sender side is used to retrieve the watermark bit. The bitplane indices for watermark extraction are obtained by calculating the HVS masks of the distorted watermarked image. In one tree, the bitplane indices for all the DWT coefficients on each DWT level are averaged. This strategy effectively reduces the watermark extraction error caused by the bitplane selection in the watermark extraction scheme. Recall that $Redundancy=3$. The extracted redundant watermark sequence is used to recover the three distorted watermarks. Then, the three distorted watermarks are compared bit by bit and the watermark is extracted using equation.

$$\omega_e(i, j) = \begin{cases} 1, & N_1 \geq N_0 \\ 2, & N_1 < N_0 \end{cases} \quad (16)$$

Where $\omega_e(i, j)$ is the extracted watermark bit with coordinates (i,j), N_1 is the number of extracted 1 s and N_0 is the number of extracted 0 s. Then, the extracted watermark is compared with the original watermark bit by bit and the True Detection Rates (TDR) is calculated using equation

$$TDR = \frac{\text{Number of correctly detected watermark bits}}{\text{Total number of watermark bits}} \quad (17)$$

The image quality is estimated by mapping the calculated TDR to a quality value by referring to a mapping function.

$$\hat{Q} = f(TDR) \quad (18)$$

where \hat{Q} is the estimated quality, $f(\bullet)$ is the mapping function, which is the "Ideal Mapping Curve". When the calculated TDR is mapped onto the "Ideal Mapping Curve", it could possibly lie between two neighboring TDR values on the curve. In this case, linear interpolation is used to estimate the image quality.

VI CONCLUSION

The proposed scheme has good computational efficiency to estimate the video quality. Based on the tree structure, the binary watermark is embedded into the selected bit planes of the selected DWT coefficients with watermark embedding strength. The watermark embedding strength is assigned to an image by pre-analyzing its content

complexity in the spatial domain and the perceptual masking effect of the DWT decomposed image in the DWT domain. To reduce the loss of video quality, watermark is not embedded in the approximation sub band during watermark embedding. In future work, the proposed scheme will be further developed to estimate the quality of an video distorted by multiple distortions.

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