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Evaluation of Formation Damage and Assessment of Well Productivity of Oredo Field, Edo State, Nigeria

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ABSTRACT: *-Formation damage can**incur**considerable cost for remediation and deferred production. Thorough understanding of the formation damage mechanisms, stringent measures for its control and prevention, and effective and efficient treatments are the keys for optimum production strategies for oil and gas fields. WELL 4X was investigated in this study to properly diagnosed and evaluate productivity in OREDO FIELD and Bottom Hole Pressure survey was used from Bottom Hole Pressure analysis in addition to the information of the well production history and reservoir data available to determine and assess the extent of the formation damage in the well. The WELL 4X was stimulated using Acid Foam Diversion Techniques to enhance reservoir productivity and increase economic operations. The stimulation job done on the well showed a peak increase of production from 850 bbl/day to 3200 b/d before it declined to 2150 bbl/day, and finally maintained an average stabilized rate of 2000 bbl/day. It has to be established that the treatment method on WELL 4X using Acid Foam Diversion Techniques and the Bottom Hole Pressure survey conducted on the WELL 4X in OREDO FIELD is found to be efficient in the determination and evaluation of formation damage.*

KEYWORDS: *- (Bottom Hole Pressure, Formation Damage, Permeability, Stimulation, Well 4X)*

I. INTRODUCTION

Producing formation damage is the impairment to reservoir (reduced productivity) caused by wellbore fluids used during drilling/completion and workover operations. It is a zone of reduced permeability within the vicinity of the wellbore (skin) as a result of alien-fluid invasion into the reservoir **rock**(***Dake, 1978).*** This reduced production results in an indeterminate reduction of the efficient exploitation of hydrocarbon reservoirs. The situation is both undesirable economically and operationally, hence, it is considered as a difficult problem to the oil and gas **industry**(***Leontaritis et al., 1994).*** As a result conducting an in-depth analysis of the producing formation to customize a fluid specific in **OREDO FIELD** that will help minimize formation damage and thus increase production rate is of paramount interest to the general economics of the field.As expressed by ***Amaefule et al., 1988***, "Formation damage is an expensive headache to the oil and gas industry." ***Bennion,1999*** described formation damage as, "The impairment of the invisible, by the inevitable and uncontrollable, resulting in an indeterminate reduction of the unquantifiable!" Formation damage assessment, control, and remediation are among the most important issues to be resolved for efficient exploitation of hydrocarbon reservoirs (***Civan, 2005).***Formation damage does not occur naturally.

It is caused by physio-chemical, chemical, biological, hydrodynamic and thermal interactions of porous formation, particles, and fluids and mechanical deformation of formation under stress and fluid shear. Fluids introduced into the formation during various operations carried out to bring a well on stream and also during the life of the well have the potential of reducing the well permeability and impairing productivity. Formation damage can occur due to any one of the following physical or chemical interaction between invading liquid phase and the reservoir rock constituents. This problem leads mainly to potential clay swelling, wettability alteration and potential water blocking.Formation damage indicators include permeability impairment, skin damage, and decrease of well performance. As stated by ***(Civan, 2000),*** "Formation damage is not necessarily reversible" and "What gets into porous media does not necessarily come out." ***Beadie, 1995*** called this phenomenon "the reverse funnel effect." Therefore, it is better to avoid formation damage than to try to restore it.

A verified formation damage model and carefully planned laboratory and field tests can provide scientific guidance and help develop strategies to avoid or minimize formation damage. Properly designed experimental and analytical techniques, and the modeling and simulation approaches can help understanding diagnosis, evaluation, prevention remediation, and controlling of formation damage in oil and gas **reservoirs.**The consequences of formation damage are the reduction of the oil and gas productivity of reservoirs and non-economic operation. Therefore, it is essential to develop experimental and analytical methods for understanding and preventing and/or controlling formation damage in oil and gas-bearing formations (***Gary and Rex, 2005).***The laboratory experiments are important steps in reaching an understanding of the physical mechanisms of formation damage phenomena. "From this experimental basis, realistic models which allow extrapolation outside the scale able range may be constructed" (***Civan, 2000).*** These efforts are necessary to develop and verify accurate mathematical models and computer simulators that can be used for predicting and determining strategies to avoid and/or mitigate formation damage in petroleum reservoirs (***Odeh, 1968)***. Invasion of solids fluid and formation that can leads to particle plugging or fine migration is also another serious concern of formation **damage**.The measure of formation damage is called "skin"(***Jones and Watts, 1971).*** The formation damage obviously reduces well deliverability, drainage efficiency and ultimate recovery. These parameters are key factors to determine the reservoir performance and field development, production test, pressure build-up test or drawdown test indicates formation **damage**(***Matthews and Russels, 1967).*** Comparison with offsets well and careful analysis of production history prior to completion, workover and remedial works indicates formation damage. These indicators are useful tools employed in the investigation of the cause, analysis, severity and location of the damage.

[1]. Over the last five decades, a great deal of attention has been paid to formation damage issues for two primary reasons:
[2]. Ability to recover fluids from the reservoir is affected very strongly by the hydrocarbon permeability in the near-wellbore region. Although we do not have the ability to control reservoir rock properties and fluid properties, we have some degree of control over drilling, completion and production operations. Thus, we can make operational changes, minimize the extent of formation damage induced in and around the wellbore and have a substantial impact on hydrocarbon production.
[3]. Being aware of the formation damage implications of various drilling, completion and production operations can help in substantially reducing formation damage and enhancing the ability of the well to produce **fluids**(***Marek, 1979)***.

Aims of the study : The fact that all wells are susceptible to damage is indisputable as such this study goals were to carry out a stimulation program to minimize formation damage and improve well productivity while maintaining the integrity of the formation and to assess and determine the damage level in the formation.

Scope of the study:The study mainly dwells on Bottom Hole Pressure (BHP) Survey, Production history and Well Production Logging Data. Examinations of well performance before and after stimulation job were studied. Adequate analyses on observations from collected field data from **Nigerian Petroleum Development Company(NPDC, 1997) OREDO FIELD** were made.

II. COMMON FORMATION DAMAGE CAUSES, TREATMENTS AND PREVENTION

Barkman and Davidson (2003),Piot and Lietard (2000),Amaefule et al., (1988),Bennion and Thomas, (1991, 1993), and many others have described in detail the various problems encountered in the field, interfering with the oil and gas productivity of the petroleum reservoirs. **Amaefule et al., (1988)** listed the conditions affecting the formation damage in four groups:

-Type, morphology, and location of resident minerals; -In situ and extraneous fluids composition; -In situ temperature and stress conditions and properties of porous formation; and -Well development and reservoir exploitation practices.

Amaefule et al., (1988) classified the various factors affecting formation damage as the following: (1) Invasion of foreign fluids, such as water and chemicals used for improved recovery, drilling mud invasion, and workover fluids; (2) Invasion of foreign particles and mobilization of indigenous particles, such as sand, mud fines, bacteria, and debris; (3) Operation conditions such as well flow rates and wellbore pressures and temperatures; and (4) Properties of the formation fluids and porous matrix. **Table 2.1** by **Hower, (1977)** delineates the common formation damage mechanisms in the order of significance. ***Bishop, (1997)*** summarized the various formation damage mechanisms described by ***Hower, (1977)*** and ***Bennion and Thomas (1993)*** as the following ***(after Bishop, ©1997 SPE; reprinted by permission of the Society of Petroleum Engineers):***

[1]. Fluid–fluid incompatibilities, for example emulsions generated between invading oil-based mud filtrate and formation water.
[2]. Rock–fluid incompatibilities, for example contact of potentially swelling smectite clay or deflocculatabl kaolinite clay by non-equilibrium water-based fluids with the potential to severely reduce near wellbore permeability.
[3]. Solids invasion, for example the invasion of weighting agents or drilled solids.
[4]. Phase trapping/blocking, for example the invasion and entrapment of water-based fluids in the near wellbore region of a gas well.

Table 2.1: Formation Damage Quick Reference Guide (Hower, W. F., 1977)

Damage	Cause	Treatment	Prevention
Mechanize particle plugging	Dirty drilling fluids and invasion	4Cl acid of Hcl/Hf back flowing	Use compatible fluid
Fines migration	Excessive kotinite chlorides or illites	Hcl/Hf acid over flush 5' out	Bring well on slowly with no high PH fluids
HF precipitate	Sodium, Calcium or Potassium in formation for fluids	Insoluble None	NH_4CL over flush, HCl preflush
Iron precipitation	Excessive Iron in formation or fluid	HCl acid	Sequestering agent acetic acid preflush
Fluid loss control residue	Inefficient removal	Gels/$CaCO_2$/Salt HCl and sand. Esters oil soluble resin-xylene	Prepack perforation before placing. Do not use resin in sand control situation
Organic deposition	Asphaltenes and paraffins cool fluid in formation with strong acid	Xylene or Toluene soak	25 GPF Xylene ahead of acid treatment
Scale	Minerals in produced water	Carbonates HCl and hydride or gypsum	Analyse produced fluid may require routing treatment
Mechanism wettability changes	Oil based fluid acid additives	Mutual solvent soak	Xylene in gas well
Emulsions	Incompatible fluids	Lab. Recommendations	Lab. Test before acid. Do not use fluid carbon surfactants in oil or condensate wells.
Water block	Excessive fluid losses, water conning excessive illite clays	HCl + HF + Methanol	Limit fluids in gas well. Include methanol in acid in gas wells.

(a). Drilling Induced Formation Damage

Wells have to be drilled as fast as possible for economic reasons. To increase the penetration rate, it is appealing to reduce the fluid loss or control the drilling fluid. During drilling of 10, 000 ft. well approximately 600 reservoir barrels of fluid may be lost in a typical formation. High value of filtrate invasion may result from deliberate choice of high penetration rates. The liquid phase of a drilling fluid contains many potentially-damaging compounds because filtrate invasion can be very deep **(Table 2.2).** The plugging of the reservoir-rock pore spaces can be caused by the fine solids in the mud filtrate or solids dislodged by the filtrate within the rock matrix. To minimize this form of damage is to minimize the amount of fine solids in the mud system and fluid loss ***Civan, (2000).***

Table 2.2: Depth of Filtrate Invasion

Time (Days)	Oil-Based Drilling Fluid (Inch)	Low-Oil Based Drilling Fluid	Water-Based Drilling Fluid
1	1.2	3.3	7.7
5	4.6	1.1	12
10	7.7	17	18
15	10	21	23
20	12	23	27
25	14	29	31
30	16	32	34

III. RESEARCH METHODOLOGY

(a).History and Status of WELL 4X (OREDO FIELD): The **OREDO FIELD** considered was assigned **WELL 4X** due to the sensitive nature of the data ***(NPDC 1997).*** The well was drilled to a depth of **1147 ft.** and completed as two string dual (TDS) on **A8.2 Sands** in April 1991. The WELL came on stream in February 1992. During a well re-entry in March 1993, both intervals were consolidated to arrest sand production. Interval Gravel Pack (IGP) was installed across both intervals during a re-entry in 1994 to arrest high sand production since **Eposand consolidation** was not effective to arrest the sand production.

A8.2 (9846.28″ - 9856.17″): IGP: When the interval came on stream in February 1992, the production rate was 700 – 800 b/d. sand of about 2ppt and water cut of 22 % was noticed in December 1992. The water cut rose steadily to about 51 % in April 1996 thus necessitating a water exclusion job in May 1996. After the water exclusion job, the water cut subsided to 8.1 %. The well was observed to have experienced a drastic drop in productivity index from 36.4 b/d/psi in March 1992 to 3.48 b/d/psi in February 1996 due to the encroachment of water. This indicated impairment as such the well was re-entered to install IGP across this interval. The BHP survey on **WELL 4X A8.2 Interval Gravel Pack analyses** is shown in **Table 4.1.**

(b). Stimulation Programmeof BHP Data of WELL 4X

The well is stimulated by investigating the following rock and fluid properties

Permeability K

$$K = \frac{162.6Qo\mu o\beta o}{mh} \quad (1)$$

Total skin

$$S = 1.151[\frac{P1hr-Pwf}{m} - log\left[\frac{K}{\emptyset\mu oCt\, rw^2}\right] + 3.23] \quad (2)$$

Damage skin due to formation damage

$$S_d = \frac{hp}{ht}[s - sp] \quad (3)$$

$$S = S_d[\frac{ht}{hp}] + Sp \quad (4)$$

Where $S_d$is the skin due to formation damage

$$Sp = [\frac{ht}{hp} - 1]\,[ln\left[\frac{ht}{rw}\sqrt{\frac{KH}{KV}}\right]\uparrow^{-2}] \text{ Assuming } \frac{KH}{KV} = 1 \quad (5)$$

Where S_p is the skin due to incomplete perforation

Pressure drop due to total skin

$$\Delta Pskin = 0.869ms \quad (6)$$

Pressure drop due to damage skin

$$\Delta Pskin = 0.869ms \times m.S_d \quad (7)$$

Pressure drop due to incomplete perforation skin damage

$$\Delta Pskin = 0.869 \times m.S_p \quad (8)$$

Productivity Index (J)

$$J = \frac{QO}{Pr-Pwf} \quad (9)$$

Flow Efficiency

$$F.E = \frac{(P^*-Pwf-\Delta Pskin)}{P^*-Pwf} \times 100 \quad (10)$$

Damage Ratio

$$DR = \frac{1}{F.E} \quad (11)$$

Estimated Damaged Ratio

$$EDR = \frac{(Pmt-Pff)}{m(logtp+2.65)} \quad (12)$$

R – Factor

$$\frac{\Delta Pskin}{P^*-Pwf} \quad (13)$$

Hence, if r> 0.60, it means the well needs to be stimulated

Radius of Investigation

$$R_1 = [\frac{K\Delta t}{948\emptyset\mu Ct}]^{0.5} \quad (14)$$

Transmissibility

$$\frac{Kh}{\mu} \quad (15)$$

Treatments of A8.2 Sand of WELL 4X: Subsequent to the configuration of the presence of formation damage, treatment programme recommended was initiated in the well using the following:

Coiled Tubing Stimulation for WELL 4X

Perforation 9846.28″ - 9856.17″

Tubing Size $2\frac{2''}{3}$

Treatment Programme Requirement using Acid Foam Diversion Techniques: Stimulation of interval to remove any near wellbore damage caused by the migration of formation sand or fines was done using "**Acid**

Foam Diversion Techniques" and the following treatment procedure were employed.

[1]. A drift was made to the well nipple to make sure that the tubing was free
[2]. The coiled tubing surface was run to tubing tail while circulating with diesel. The hole was circulated clean.
[3]. Stimulation chemicals were pumped into the perforation as per treatment recipe.
[4]. The well was opened up and produced clean
[5]. The well was produced to potential bean up steps of $\frac{16}{64}$ ″ to a maximum bean of $\frac{36}{64}$ ″ while monitoring for sand, GOR and water.

IV. RESULTS AND DISCUSSION

Results

Table 4.1: Reservoir Data for WELL 4X

Description	Unit	Value
h	Ft.	37.784
r_w	Ft.	0.362
K	Md	1698
Ø	%	18.7
P_d	Psia	3587
Sand/reservoir name		A8.2
T	^oF	185
J	bbl/d/psi	0.854
GLR	scf/bbl	139.2
C_f	Psi^{-1}	8.91×10^{-5}
S_g		0.705
μ_O	Cp	0.238
S_{gw}		1.100
Water salinity	ppm	94712
A	Acre-ft.	2010.4
P_r	Psig	4377
B_o	bbl/stb	1.805

Table 4.2: Completion Data for WELL 4X

Description	Unit	Value
Productivity casing size	Inches	9 5/8
Casing weight	lbs./ft.	58
Casing grade	Types	N-80
Casing depth	Ft.	11347
Tubing size	Inches	3 ½
Tubing weight	lbs./ft.	9 1/2
Performance diameter	Inches	1.12
Top packer size/type	Inches	9 5/8 A5D Packer
Top packer depth	Ft.	9588.40
Sand exclusion	Types	IGP
Flow at surface	Types	Tubular
Performance shot density	SPF	12
Gravel pack length	Ft.	30

Table 4.3: Production Report Data for WELL 4X before Stimulation

Date	Size (Inch)	THP (Psig)	Gross Production (B/D)	BS & W (%)	GOR (scf/bbl)	Sand (ppt)
02/92	20	460	780	1	200	2
02/93	22	460	950	1	200	2
12/93	24	500	1300	2	250	4
03/94	36	360	2500	9	150	7
08/94	40	310	3200	16	150	9
02/95	44	280	3170	18	150	9
11/95	42	280	3080	22	180	8
04/96	42	290	3000	52	200	7
12/96	24	250	1750	23	300	4
05/97	36	150	850	10	175	2

Table 4.4: Production Data for WELL 4X after Stimulation

Date	Bean Size (/64 Inch)	THP (Psig)	Gross Production Rate	BS & W (%)	Sand (ppt)
10/97	36	150	2150	0	10

02/98	40	180	2050	1	14
09/98	16	310	1900	2	12
02/99	20	280	1000	0	8
11/99	22	250	1000	1	10
04/00	28	200	920	0	16
12/00	32	200	900	0	12
04/01	36	190	800	0	10
11/01	36	160	700	2	14
03/20	36	170	600	1	18
11/02	36	150	550	1	22

Table 4.5: Production performance of offset wells completed on the same sand/formation

Wells	Size (/64)	THP (Psig)	Gross production rate	BS & W	GOR (scf/stb)	Sand (ppt)
9X	40	500	980	20	105	12
7X	22	100	1800	2	170	0
2X	48	200	3420	5	300	6
4X	36	180	650	5	280	4

Table 4.6: Pressure versus Time Readings for WELL 4X

Δt (hrs.)	Pws (Psia)	(tp + Δt)/Δt
0	2685	0
1	2763	721
2	2805	361
4	2819	181
5	2825	145
7	2828	104
9	2830	81
12	2831	61
20	2831	37
60	2837	13
120	2840	7
300	2842	3.4
420	2842	2.7
550	2842	2.3
620	2843	2.2
720	2843	2.0

Table 4.7: Stimulated BHP Data for WELL 4X

Data	Unit	Value
K	Md	774
S		14.65
Sd		3.36
ΔPskin	Psi	101.8
ΔPskin damage	Psi	23.4
J	Stb/d/psi	6.203
F.E	%	37.2
DR		3
EDR		3.6
Transmissibility	Md ft./cp	26093.2
ΔPskin perforation	Psi	35.58
R – Factor		0.628

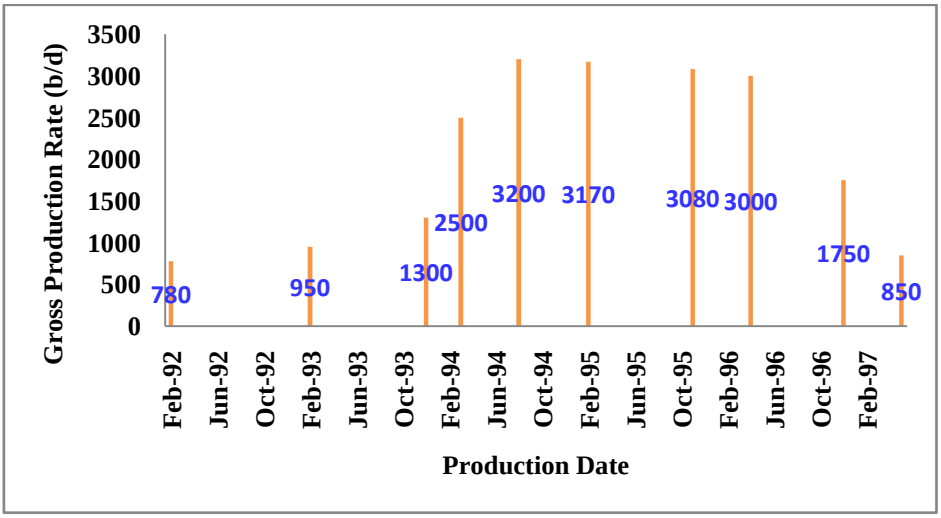

Figure 4.1: Production Rate of WELL 4X before Stimulation

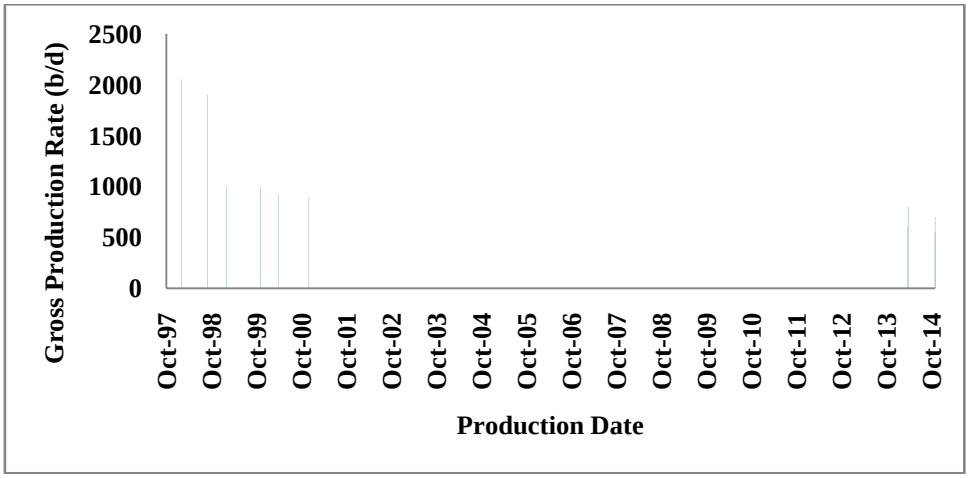

Figure 4.2: Production Rate of WELL 4X after Stimulation

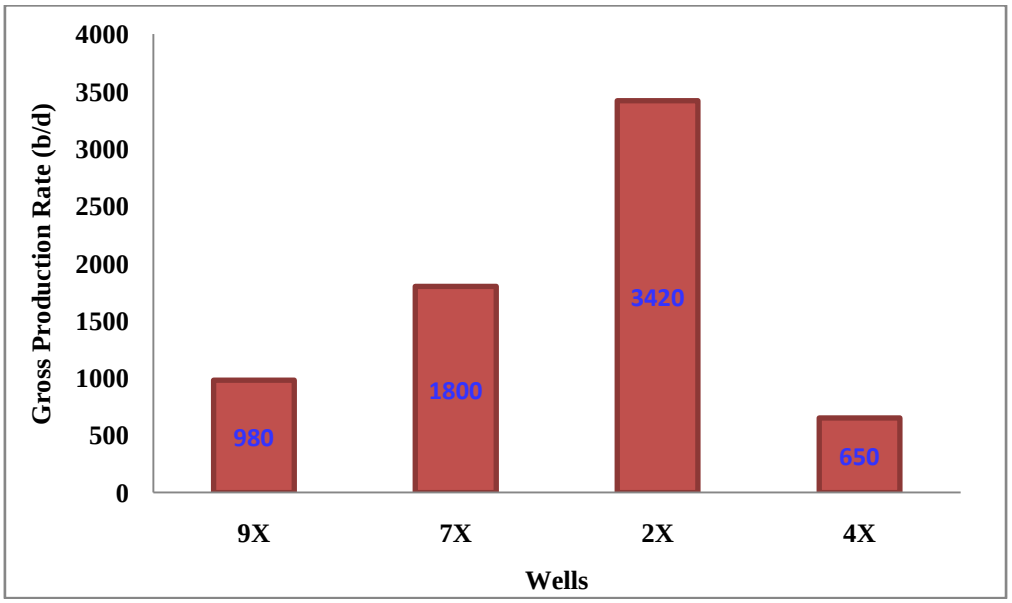

Figure 4.3: Comparison of WELL 4X with Offset Wells

III. DISCUSSION OF RESULTS

Analyses of Production Data of WELL 4X: Before stimulation **(Table 4.3),** the production rate was lower to the production rate obtained after stimulation **(Table 4.4)** as were shown in **Figures 3.1** and **3.2** respectively. The appreciable increase in the production after the well has been treated shows that the treatment techniques were very effective and efficient. The decline in production rate observed in the well was due to the increase in water encroachment into the well and the reduction of tubing head pressure over the period.

Analyses based on comparison with offsets wells completed on the same sand/formation: Table 4.5 and **Figure 3.3** shows the recent production tests conducted on wells of the same block. It is observed that all the wells are producing reasonably except **WELL9X** that seems to be declining. This does not in any way suggest impairment as such decline may be as a result of reservoir sand permeability, completion configuration, reservoir pressure or position of the well in the reservoir.

Pressures versus Time Evaluations of WELL 4X: The available data **(Table 4.6)** of the well BHP survey taken in **1997** as presented in the well history and corresponding drop in pressure rates suggest that the well interval is significantly impaired. The stimulation job in **1997** has little significance on the production rate.

Analyses of the BHP Data of WELL 4X: From **Table 4.7**, the high permeability shows the measure with which the fluid can flow through the formation except that the interval around the wellbore has been significantly damaged. The total skin of 14.65 indicates flow restriction, hence the presence of damage and reason for stimulation programme to be initiated. The flow efficiency of about 40% indicates the flow capacity of the well. The low rate of flow capacity shows that the well is producing far below its potential and the need for efficient stimulation to be introduced. The damaged and estimated damaged ratio of average 3 shows that the well deliverability should have been thrice its present production rate. The radius of investigation of 2441 ft. show the radial distance from the well where the pressures have been significantly affected by the active well. The high well transmissibility shows the well potentials and the measure of the reservoir rock to produce fluid.

Analyses of the Well Performance after Survey : The total skin value of **14.65** estimated from the BHP survey show that the well is damaged with considerable percentage of pressure drop due to total skin of about 102 Psi **(Table 4.7).** After the stimulation job done by **"Acid Foam Diversion Techniques"**, the well produces reasonably from **650 b/d** with a choke performance of ″42/64″ and skin due to damage of 3.27 to **2150 b/d** with a bean size of ″42/64″ at a significant amount of THP and BS & W. The sudden and gradual decline of the production rate in December 2002 to about 550 b/d was due to mechanical action on the well like production logging tools and sand injection which causes formation damage. However, it is concluded that the treatment method introduced in the well was very active and efficient.

IV. CONCLUSION AND RECOMMENDATIONS

Conclusion : To make decision on the presence and/or degree of permeability alteration of a well, formation damage valuation on wells are required to generate the necessary sets of information. Based on the analyses of data conducted on **WELL 4X**, the following conclusion could be made:

(1). The improvement in the production rate suggests that the stimulation job initiated in the well was effective and successful.
(2). The sharp decline of the production rate suggests mechanical action in the well which may be from production logging tools.
(3). The gradual decline of the amount of production in the well suggests the need to carry out sand control programme.

Recommendations : The following recommendations become vital based on the conclusion deduced from **WELL 4X.**

(1). Investigation on the sharp decline in production rate as a result of mechanical problem should be further carried out to ascertain the cause and also to checkmate it.
(2). Reservoir conditions are prone to alterations and as such continuous production data update before carrying out any treatment job should be done to avoid any likely failure.
(3). Intensive efforts should be consciously directed to formation damage preventive measures from drilling to production, well completion to workover activities. It is important that mandatory tests be run with all the chemicals and mixtures that are to be used on the job and the **WELL 4X** sand should be reconsolidated.

NOMENCLATURE

∅	Porosity
A	Cross sectional area
BHP	Bottom Hole Pressure
Bo	Oil formation volume factor
BOPD	Barrel Oil per day
BS & W	Base Sediment and Water
Ct	Total compressibility factor
DR	Damage ratio
F.E	Flow efficiency
GOR	Gas-Oil Ratio
γ_w	Wellbore radius
h	total reservoir thickness
h_p	height of perforation
h_t	Height of interval
IGP	Internal Gravel Packing
J	Productivity index
K	Permeability
K_a	Average permeability
K_h	Horizontal permeability
K_v	Vertical permeability
m	Horner's plot slope
P^*	Reservoir pressure
P1hr	Extrapolated pressure
ppt	Part per thousand
Pwf	Flowing well pressure
Pws	Static well pressure
Qo	Oil production rate
r_a	Effective wellbore radius
r_e	damage radius
S	Skin factor
S_d	Skin due to formation damage
S_g	Gas saturation
S_o	Oil saturation
S_p	Skin due to incomplete perforation
S_w	Water saturation
t_p	Flow period before BHP Tests
ΔP	Pressure change
ΔPskin damage	Pressure drop due to damage skin
ΔPskin	Pressure drop due to skin
Δt	Change in tine
μo	Oil viscosity
EDR	Estimated damage ratio
R – Factor	Radius of investigation
ΔPskin perforation	Pressure drop due to incomplete perforation skin damage
NPDC	Nigerian Petroleum Development Company

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Predicting Churners in Telecommunication Using Variants of Support Vector Machine

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ABSTRACT : Customer acquisition and customer retention are one of the most competitive factors in most of the companies. Due to ever increasing competitions of customers in companies, the company owners are unable to maintain the customer satisfaction which leads to customer churn. The customer wishes to leave the service of the company causes churn. Most of the sectors are affected by churn problems. Telecommunication is one of the main industries that are affected by churn problem. Prediction of customers who are at risk of leaving a company is known as churn prediction and it is imperative for sustainable growth of a company. Supervised classification technique suits best for solving this problem. This research work employs the variants of Support Vector Machine such as Proximal Support Vector Machine, Active Support Vector Machine and Lagrangian Support Vector Machine for creating the prediction models and the best model is recognized based on predictive accuracy.

KEYWORDS : Churn prediction, customer churn, churner, non-churner and customer acquisition.

I. INTRODUCTION

In the world of ever increasing competition on the telecommunication, companies have become observant that they should put much effort not only to convince customers but also to keep hold of existing customers. Churners are persons who quit a company's service for certain reasons. One of the major reasons for predicting churn is that it costs less to retain existing customers than to acquire new customers. Churn prediction methods gives the prediction about customers who likely to churn in the near future whereas churn management helps on the other side which aims to identify such churners and to carry out some positive actions to minimize the churn effect. Churn prediction is a binary classification task which differentiates churners and non-churners. The concept of customer relationship management has gained its importance in marketing domain. Many previous CRM-related researches have used data mining techniques to analyze and understand customer behaviors and characteristics. In general, churn means to role of the customers who are about to move their usage of service to a competing other provider. There are two basic categories of churners, voluntary and involuntary. Voluntary churn occurs when the customer initiates termination of the service contract. Involuntary churners are the customers that the telecommunication company decides to remove from the subscribers list.

II. LITERATURE SURVEY

Many prediction algorithms have been proposed so far to predict the customer churn. In the research work [1], the author applied the well known data mining methodology CRISP-DM (cross-industry standard process for data mining) to investigate network usage behaviors of the ISP (Internet service providers) subscribers in Taiwan. They used Attribute-Oriented Induction (AOI) method for discovering characteristics and discrimination knowledge of ISP customers from the ISP traffic data. Authors in [2] proposed three different techniques which are decision tree, support vector machine, and neural network for classification. K-mean techniques for clustering. A system developed in [3] focused genetic programming approach to predict churn and proposed the intelligent churn prediction technology to develop a new hybrid model to improve the performance and accuracy for churn prediction.

Also SVM and K-mean cluster was performed. In [4], the authors proposed various classification techniques to find number of features subset in different size and dimension. The experiments were carried out using decision tree J48, C5.0 classification. In this research work [5], the churn prediction model has been proposed by various classification techniques like decision tree, logistic regression and neural network. They have mainly focused on neural network. The neural network was modeled to get an insight about the importance of three types of features in the demographic, billing and usage features. Authors in [6] proposed new subset of features in order to improve the accuracy of customer churn prediction in the wireless telephony industry. The new features were categorized as contract-related features, call patterns description features, and calls pattern changes description features. To evaluate the features, experiments based on two probabilistic data mining algorithms Naïve Bayes and Bayesian Network, were performed their results are compared to those obtained from using C4.5 decision tree, a widely used algorithm in many classification and prediction tasks. In existing research work, various researchers proposed classification technique like decision tree, support vector machine, neural network. From the literature it was well appreciated that Support Vector Machine is a powerful classification technique with high generalization power than other classification algorithms. Hence in this research work the variants of support vector machine proposed by Olvi Mangasarian [11] have been used to automate the prediction of churners. The proposed methodology models the churn prediction as a binary classification task and the classification task is implemented using variants of SVMs such as PSVM, ASVM and LSVM. The prediction model has been trained using training dataset and the trained model is built. Finally the trained model is used to predict whether the customer is churner or non-churner. Various stages of the proposed implementation are described in section IV.

III. SUPPORT VECTOR MACHINE

Support vector machines (SVM) are learning systems that use a hypothesis space of linear functions in a high dimensional feature space, trained with a learning algorithm from optimization theory that implements a learning bias derived from statistical learning theory. The support vector machine is a training algorithm for learning classification and regression rules from data.The geometrical interpretation of support vector classification is that the algorithm searches for the optimal separating surface, i.e. the hyper plane that is equidistant from the two classes. This can be extended to multi-class problems. Kernel functions are then introduced in order to construct non-linear decision surfaces.

PROXIMAL SUPPORT VECTOR MACHINE: A simpler classifier called proximal support vector machine was recently implemented wherein each class of points is assigned to the closest of two parallel planes in input and feature space that are pushed apart as far as possible. This formulation, leads to an extremely fast and simple algorithm for generating a linear or non linear classifier that is obtained by solving a single system of linear equations.

In PSVM the point of departure is that, the optimization problem of standard linear SVM is replaced by the following problem subject to the constraints

$$\min_{(\mathbf{w},\gamma,\mathbf{y})} \nu \frac{1}{2}\|\mathbf{y}\|^2 + \frac{1}{2}(\mathbf{w}^T\mathbf{w} + \gamma^2)$$

$$D(Aw - e\gamma) + y = e$$

There is no non-negativity constraint on **y**, because now 'y' represents deviation of the point from the plane passing through the centroid of the data cluster (A+ or A-) of which the point belongs.

The Karush-Kuhn-Tucker (KKT) necessary and sufficient optimality conditions for this equality constrained optimization problem are obtained by setting equal to zero the gradients with respect to w, γ, y, u of the Lagrangian:

$$L(w, \gamma, y, u) = \frac{\nu}{2} y^T y + \frac{1}{2}(w^T w + \gamma^2) - u^T[D(A\mathbf{x} - e\gamma) + y - e]$$

Where u is the lagrangian multipliers associated with equality constraints.

From the first three equations we have

$$w = A^T Du \qquad \gamma = -e^T Du$$

Substituting w, γ, y in the fourth equation we get u in terms of the given data D and A.

$$\frac{\partial L}{\partial w} = w - A^T Du = 0$$
$$\frac{\partial L}{\partial r} = \gamma + e^T Du = 0$$
$$\frac{\partial L}{\partial y} = vy - u = 0$$
$$\frac{\partial L}{\partial u} = D(Aw - e\gamma) + y - e = 0$$
$$[D(AA^T - ee^T)D]u + \frac{u}{v} = e$$
$$D(AA^T Du - ee^T Du) + \frac{u}{v} = e$$
$$[D(AA^T - ee^T)D + \frac{I}{v}]u = e$$
$$u = [\frac{I}{v} + D(AA^T - ee^T)D]^{-1} e$$
$$u = [\frac{I}{v} + HH^T]^{-1} e$$

where H= D[A – e]. The explicit solution for w, γ, y can be obtained using the above u. But it requires inversion of possibly massive m x m matrix. To overcome this, Sherman-Morrison-Woodbury formula for matrix inversion is used, which results in which requires only inversion of

$$\mathbf{u = v(I - H(\frac{I}{v} + H^T H)^{-1} H^T)e}$$

the dimension of which is only (n+1) x (n+1), n is the number of predictor variables. Once u is obtained w and γ, can be obtained from the corresponding equations. The classification of new instance is based on the following

$w^T x - \gamma > 0$ then $x \in A^+$

$w^T x - \gamma < 0$ then $x \in A^-$

$\gamma + e^T Dt = 0$

$vy - t = 0$

$D(KDu - e\gamma) + y = e$

LAGRANGIAN SUPPORT VECTOR MACHINE: A fast and extremely simple algorithm, LSVM, has the ability to handle massive problems. Lagrangian support vector machine uses Karush Khun Tucker optimality condition for solving optimization problem.

The problem is to find u using Karush-Kuhn-Tucker necessary and sufficient optimality conditions are

$$\min f(u) = \frac{1}{2} u^T Qu - e^T u$$
$$u \geq 0$$
$$0 \leq u \perp Qu - e \geq 0$$

For any a and b two real vectors, we have

Thus the iterative scheme which constitutes LSVM algorithm is

$$0 \le a \perp b \ge 0 \Leftrightarrow a = (a - \alpha b)_+ \alpha > 0$$
$$u^{i+1} = Q^{-1}[e + ((Qu^i - e) - \alpha u^i)_+]$$
$$i = 0,1,2.....$$

Algorithm converges linearly if: $0 < \alpha < 2/\nu$. In practice α is taken as $1.9/\nu$. This Fast Newton iterative method which requires the inversion of single matrix of the order of the input space plus one.

ACTIVE SUPPORT VECTOR MACHINE: Active support vector machine algorithm proposes an iterative method for determining the dual variable u. This method partitions the variable u into basic and non-basic variables. The non basic variables are those which are set to zero. The values of the basic variables are determined by finding the gradient of the objective function with respect to these variables, setting equal to zero and solving the resulting linear equations for these basic variables. If any basic variable takes on a negative value after solving linear equations, then it is set to zero and becomes non basic. Consider the following standard linear SVM with control parameter $\nu>0$

$$\frac{\partial L}{\partial w} = w - A^T Du = 0$$
$$\frac{\partial L}{\partial r} = \gamma + e^T Du = 0$$
$$\frac{\partial L}{\partial y} = \nu y - u = 0$$
$$\frac{\partial L}{\partial u} = D(Aw - e\gamma) + y - e = 0$$
$$L(w,\gamma,y,u) = \frac{\nu}{2} y^T y + \frac{1}{2}(w^T w + \gamma^2) - u^T[D(Aw - e\gamma) + y - e]$$

Lagrangian of this problem is given by

$$\text{Minimize} \quad \nu e^T y + \frac{1}{2} w^T w$$
$$\text{subject to} \quad D(A\mathbf{x} - e\gamma) + y \ge e$$

Substituting w, γ,y in the fourth equation we get u as below

$$D(AA^T Du - ee^T Du) + \frac{u}{\nu} = e$$
$$[D(AA^T - ee^T)D]u + \frac{u}{\nu} = e$$
$$[D(AA^T - ee^T)D + \frac{I}{\nu}]u = e$$
$$u = [\frac{I}{\nu} + D(AA^T - ee^T)D]^{-1} e$$
$$u = [\frac{I}{\nu} + HH^T]^{-1} e$$

where H=D[A -e]. By applying Sherman Morrison Woodbury formula

$$\mathbf{u} = \nu(\mathbf{I} - \mathbf{H}(\frac{\mathbf{I}}{\nu} + \mathbf{H}^{\mathrm{T}}\mathbf{H})^{-1}\mathbf{H}^{\mathbf{T}})\mathbf{e}$$

which requires the inversion of matrix of dimension only (n+1) x (n+1), n is the number of predictor variables instead of m x m matrix. Substituting back in the Lagrangian function and simplifying we get the following dual function in terms of u.

$$\min \ f(u) = \frac{1}{2}u^T Qu - e^T u$$
$$u \geq 0$$

IV. EXPERIMENT AND RESULTS

Three experiments have been carried out by implementing the variants of SVMs such as PSVM, ASVM and LSVM. These SVMs are implemented in matlab. The data are collected from a private telecommunication company. Since the churn prediction task is modeled as binary classification the class label +1 and -1 are assigned for churners and non-churners respectively. The SVM based models are built and the performance of trained models is evaluated using 10-fold cross validation for its predictive accuracy, learning time and number of support vectors.

DATA ACQUISITION: Data acquisition is an important task in any prediction problem. The information about 750 customers is collected from a private telecommunication company for the churn prediction implementation. 23 different attributes pertaining to customer entities such as customer id, customer name, area, state, account length, area code, phone number, international plan, voice mail plan, number of voice mail messages, total day minutes, total day calls, total day charge, total evening minutes, total evening calls, total evening charge, total night minutes, total night calls, total night charge, total international minutes, total international calls, total international charge, number of customer service calls etc., are gathered. The high ranked attributes are selected using information gain attribute evaluation feature selection method for improving the performance of the classification.

CLASSIFICATION USING PSVM: The regularization parameter C is assigned values ranging from 0.1 to 1. It is observed that the training was stabilized for C = 0.4. The results of PSVM based prediction model are shown in Table I.

Table I. Results of PSVM

Parameter C	Prediction Accuracy	Learning Time (in secs)	Number of Support Vectors
0.1	99.34	0.56	325
0.2	98.67	0.67	423
0.3	99.42	0.51	321
0.4	100	0.34	463
0.5	99.78	0.65	221
0.6	98.34	0.43	452
0.7	97.23	0.55	242
0.8	99.42	0.46	419
0.9	99.1	0.54	190
1	99.23	0.64	460

CLASSIFICATION USING LSVM: The regularization parameter C is assigned values ranging from 0.1 to 1. It is observed that the training was stabilized for C = 0.5. The results of LSVM based prediction model are shown in Table II.

Table II. Results of LSVM

Parameter C	Prediction Accuracy	Learning Time (in secs)	Number of Support Vectors
0.1	84.01	0.76	219
0.2	84.19	0.87	322
0.3	84.23	0.51	210
0.4	84.4	0.54	176
0.5	85.5	0.43	228
0.6	85.52	0.43	201
0.7	85	0.32	212
0.8	85.46	0.48	139
0.9	85.39	0.72	107
1	85.42	0.61	216

CLASSIFICATION USING ASVM: The regularization parameter C is assigned values ranging from 0.1 to 1. It is observed that the training was stabilized for C = 0.4. The results of ASVM based churn prediction model are shown in Table III.

Table III. Results of ASVM

Parameter C	Prediction Accuracy	Learning Time (in secs)	Number of Support Vectors
0.1	86.41	0.90	258
0.2	86	0.56	321
0.3	86.16	0.69	299
0.4	86.25	0.54	362
0.5	85.01	0.78	357
0.6	86.21	0.88	219
0.7	84.15	0.87	356
0.8	84.30	0.89	289
0.9	85.45	0.76	331
1	83.46	0.79	304

COMPARATIVE ANALYSIS: The comparative analysis of all three experiments has been carried out and the comparative results indicate that PSVM based classification model yields a better performance when compared to other models. The comparative results of PSVM, LSVM and ASVM in terms of accuracy, learning time and average number of support vectors are shown in Table IV and illustrated in Figure.1, Figure.2 and Figure.3.

Table IV – Comparison of accuracy, learning time and number of support vectors

Classifier	PSVM	LSVM	ASVM
Accuracy (%)	100	85.5	86.25
Learning time (in secs)	0.34	0.43	0.54
Average number of support vectors	352	203	309

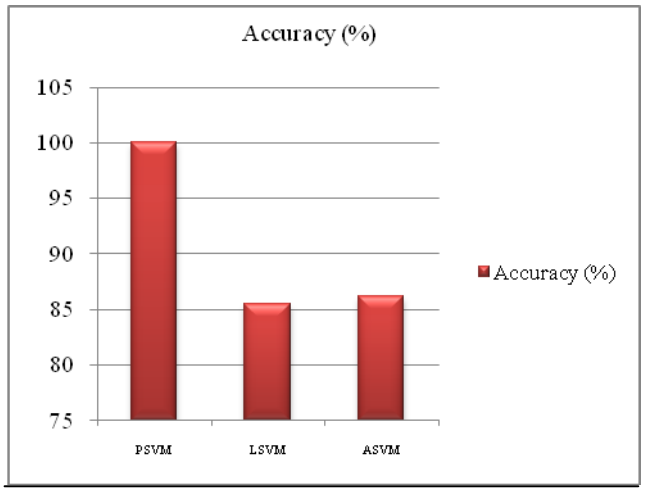

Figure 1: Accuracy of various SVMs

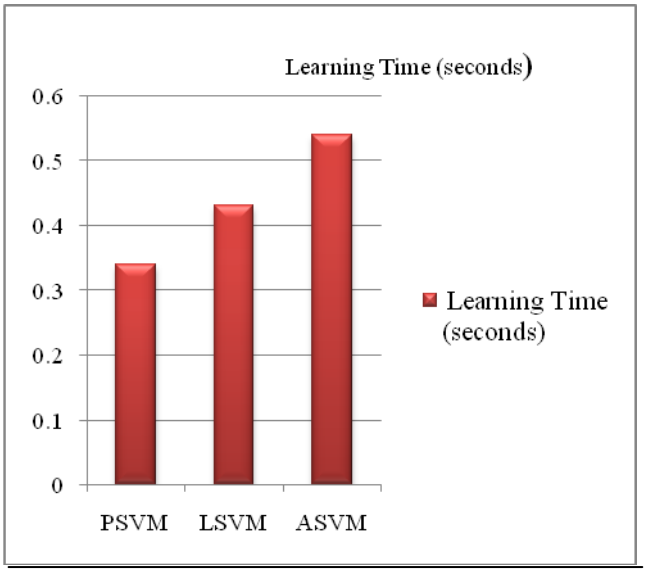

Figure 2: Learning time of various SVMs

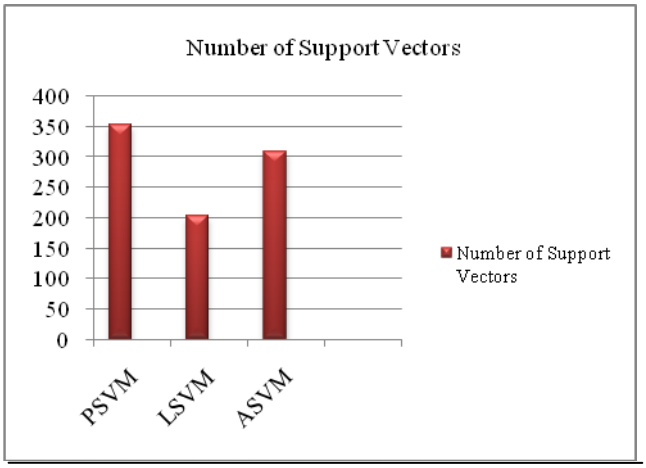

Figure 3: Number of support vectors of various SVMs

From the comparative analysis, it is observed that the number of support vectors in PSVM model is high, which consumes more memory. But the PSVM model is more efficient in terms of predictive accuracy and

computational time. Since predictive accuracy plays the vital role in real time predictions, the PSVM model can be appropriately used in churn prediction and can be implemented in high end systems thus compromising the memory.

V. CONCLUSION

This paper, demonstrates the application of various SVMs in modeling churn prediction as binary classification task. The proximal support vector machine, lagrangian support vector machine and active support vector machine were employed in building the predictive models. Performance of the learned models was evaluated based on their predictive accuracy, learning time and number of support vectors. The most efficient model comparing to the existing churn prediction models was found to be PSVM based churn prediction model and was recommended for predicting whether the telecom customer is churner or non-churner.

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Appraisal of Construction Project Procurement Policies in Nigeria

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ABSTRACT: *The success of performance of public sector projects in Nigeria is tied to the impact of procurement strategy or policy used in providing the building. Procurement policies significantly influence the success of construction projects since they are designed to provide solutions to specific project needs or conditions. The Nigerian construction industry was analyzed with particular emphasis on public sector procurement. The general performance of public sector projects in Nigeria was broadly assessed and quite unfortunately the literature review has criticized public sector procurement in Nigeria of been inefficient for efficient project delivery. Equally the respondents to the survey data obtained from the questionnaire distributed and oral interview conducted suggest that projects are affected by the procurement strategy adopted for project delivery. A significant number of the questionnaire respondents believe that performance of projects could be improved using alternative or hybrid procurement strategies. Recommendations were proffered in order to mitigate or reduce completely the challenges and complexities faced by public project procurement schemes in Nigeria.*

KEYWORDS : *Procurement, performance, construction projects, procurement strategy*

I. INTRODUCTION

Construction projects are time consuming undertakings which are considered successful if delivered on time, to an appropriate budget and to a quality desired by the owner [1]. In recent times, apart from the above mentioned indicators of project success, health and safety, and environmental performance have also become important aspects of project performance. Many literatures and studies of the construction industry have analyzed projects and tried to identify factors affecting project performance. Though the factors found are numerous, a lot of the studies "indicate that procurement related factors have significant effects on construction project performance" [2].Procurement systems have evolved globally with innovations in process improvement and service delivery. However, these trends have been largely ignored by developing countries. Nigeria has shown a significant regression in procurement processes in comparism to the heavy investment channeled into the sector. "Though different studies have confirmed the use of various types of modern procurement methods for project delivery in Nigeria" [2], the "traditional procurement route which has been widely criticized as an ineffective procurement route is the most often used" [3].In view of the above, this research seeks to assess the impact of procurement strategies used on construction project performance through the evaluation of public sector construction project's and investigating the impact of procurement practices on the projects performance.

Nigerian construction industry : The role the construction industry plays in an economy cannot be overemphasized. The Nigerian construction industry has served the Nigerian economy significantly with the creation of direct and indirect employment nationally. From the 80's till present day, the industry has grown to about 125 times its former size but this growth when put in perspective leaves a lot to be desired. The construction sector accounted for 1.4% of the Nigerian gross domestic product (GDP), in comparison to 1981 where the industry accounted for 5.8%. This decline is mainly due to the country's GDP growing 495 times in the same period [4].

Despite the construction industry having had an impressive growth rate of above 10% over the past few years, Nigeria still has only 30% of its 193,200 km road network paved. The general infrastructure and amenities in the country has been described as abysmal when compared to the investment that has gone in to the sector [4].Government funding for new and existing projects has increased steadily [4]. Projects like the national rail revival, renovation of all airports, power station construction and many others have ensured the construction industry remains vibrant. However, unless the effectiveness of the industry is improved the industry will continue to stagnate. Analyzing the factors restraining the industry from achieving the required growth will be crucial in helping improve the performance of the construction projects.

Public sector construction in Nigeria : The performance of the Nigerian public sector procurement has been reassessed in recent times through various professional bodies and government schemes. The establishment of the bureau of public procurement and even the re enactment of the procurement act in 2007 have not improved the level of performance of the industry. Research undertaken to assess the Nigerian procurement sector by have showed weak correlation between methods of procurement used and project performance. With many professionals advocating for use of new procurement methods, there is a need to question the impact if/any of using modern procurement strategies. This research intend on analyzing how effective the procurement strategies used in Nigeria are and the impact measure the impact it has had on performance of projects.

II. A REVIEW OF PROCUREMENT IN NIGERIA

Procurement in construction is carried out through the application of a procurement strategy. The aim of a procurement strategy is to achieve the optimum balance of risk, control and funding for a particular project" [6]. Construction is an endeavor that involves various risk and this risks differ depending on the procurement strategies employed.[7] Classified procurement systems as separated systems, integrated procurement systems, management oriented procurement systems and discretionary system. [8], [9] and [6] have all adopted a similar classification but while [11] relied on a relationship approach in his subdivision, [7], [8] and [6] either added a few additional classes or removed discretionary system [8].

Procurement Selection : Choice of procurement route is influenced by factors like the conventional time-cost-quality model, project strategy, client organization, financial objectives, level of integration of design and construction required, risk management and project constraints [10], [7] and [11] all partially adopt the Nedo's list of factors which included client requirements of the project such as: Speed, cost certainty, time certainty, flexibility, responsibility, complexity, quality level, risk level, price competition and disputes& arbitration.[11] suggests that [12], [7] and [11] categorization all have deficiency in that they ignored market related and other factors might not apply for all procurement variants, Some of the factors are disputable From the prevalent literatures researched, the factors seem to be either influenced by the client's requirements to those from external influences, constraints and risks as aptly highlighted by [10]. Client's selection criteria have varied from the selecting of options that have worked before by experienced clients to reliance on the advice of consultants [9], to single unitary choice by default [2], to one-off/strategic selection methods usually based on experimental models [11].

Procurement Challenges : In Nigeria, the procurement process has largely remained same though there are evidences of the use of many modern procurement methods [3], and [2] . Procurement has also been adversely affected by kidnappings, vandalism, civil unrests and other such factors which have increased the risks associated with procurement. The Nigerian procurement industry is going through a period of revival which resulted in the enactment of Procurement Act in 2007. Public procurement in Nigeria before the enactment of the Procurement Act was based on Treasury Circulars of 1958 which are now ineffective, outdated and encouraged poor procurement practices. Professionals in the Nigerian construction industry have overwhelmingly applauded the development and have described the Act as having the right strategy to help make procurement transparent, accountable and encourage good practice in procurement [13].However, despite the triumph of enacting a Procurement Act the Nigerian public procurement is still bedeviled by challenges due to the lack of widespread knowledge of the processes, blatant refusal to comply by some , political interference and many other external and internal factors too numerous to mention.Bureau of Public Procurement (BPP) Public sector procurement in Nigeria is currently regulated by the Bureau of Public Procurement (BPP). The World Bank in collaboration with specialist from the Nigerian private sector carried out an assessment which resulted in a Country Procurement Assessment Report (CPAR).The report highlighted some weaknesses in Nigerian public sector procurement.

Project Performance : [14] Describes construction project performance as not only concerned with past performance, but also is about the process of improvement. [15] noted that in construction. Performance measurement has evolved from the scientific measurement of individual work which was

popularized by Frederick Taylor to various adaptations of that system such as; measuring value-added work, continuous time study, and sensor based work measurement [14]. However, most of the systems are more suited to manufacturing and are seldom ever used in construction performance measurement [14].Project performance in construction is traditionally measured using financial measures [15]. Financial measures though easily measurable, have been criticized as an ineffective measure of performance [14]. This is largely because it measures past performance without necessarily giving indications of the future [15]. Other factors usually considered when measuring performance of construction projects as listed by [15]. Research over the years have attempted to identify systems that can be used to measure performance, some of the widely known systems are:

Balanced Scorecard (BSC): this is a system of measuring performance that was created by Robert Kaplan. This method seeks to measure the performance from four perspectives which in the conceptual model included; the financial perspective, client perspective, growth perspective and the internal business process perspective [14].Though this system has been widely accepted, [15] remarked that it was too simplistic, not a complete measuring system and could result in the measuring of parameters which might be nice to know but which have no real effect on the project. [15] also added that the model does not account for the possibility of relationship between measures and the supplier's perspective.Performance Metrics: this is a system where performance is measured using agreed metrics. This performance measuring system relies on the metrics chosen and as a result an effort to choose the right metrics is key [20] cited from [15]. In recent years, measurement of performance has benefitted from innovations like Benchmarking, Total Quality Management (TQM) and other methods which have been adopted from the manufacturing industry. Performance where highlighted by Sir John Egan's Rethinking Construction. Nick Raynsford, the then UK Minister for Construction in his foreword for a KPI Report on construction observed that the challenge of selecting performance measures has been largely dealt with (KPI Report, 2000). Cost Performance in construction projects is described by [16] as the most important parameter of a project and driving force of overall project success. Traditionally, cost and time performances are regarded as the main performance indicators in measuring construction projects [3]. [4] however states that in developing countries like Nigeria, time performance is considered as it affects the project cost. Cost performance in construction projects are usually considered by using the four cost related measures [16].

Effects of Procurement Strategies on Construction Project Performance : Procurement strategies by their definition in practice identifies the best way for achieving project objectives and as such seems inevitably related to project performance. This view is shared by many authors who have invested time and resources to the understanding of construction project performance. A research conducted by the Chartered Institute of Building (CIOB) in 2010 titled "Procurement in the Construction Industry" found that 87% of the construction participants sampled believe that good procurement is synonymous with successful project performance.

Construction Project Cost Performance in the Nigerian Public Sector : Public sector projects in Nigeria have always rightly or wrongly been criticized for lack of performance by the populace. Construction projects in particular are routinely scrutinized by industry participants and the wider public. The public scrutiny is further exacerbated by the high number of abandoned projects, frequent collapse of buildings, widespread accusations of corrupt practices and the general public distrust of the government.Construction project performance in Nigeria has been plagued by high fluctuation of materials, fraudulent practices and kickbacks [17], inadequate cash flow and financial difficulties [18], and general poor performance [13].Public sector projects in Nigeria have most-often used traditional procurement strategy and as such it has received the most attention with many researchers blaming the strategy for time and cost overruns in construction projects [2]. [3] in his research on housing projects in Nigeria found the assertions that the traditional strategy leads to cost and time overrun to be untrue for housing projects below the five million thresholds. Despite [3] research, public construction project cost performance and its relationship with the procurement route used is still contentious. The Nigerian Secretary to the Government (SGF) remarked that Nigeria has one of the highest construction cost in the world [5]. Cost performance of construction projects is an area where all stakeholders agree needs improvement. There is also a need for awareness within and outside the industry on the factors affecting the performance.

III. RESEARCH STRATEGY

The research used a simple approach of analyzing data obtained in relation to public sector project in Nigeria. Quantitative data relating to the kpi's originated from findings from the semi-structured questionnaires. Qualitative data was used to confirm or dismiss findings and also enabled ethnographic understanding of the case.The questionnaire was divided into three categories namely; General Information of professionalism of

respondents, acceptance level in practice of different contractual documents, level of exposure to different Procurement routes and their Performance in projects, and finally their perception of hybrid or different procurement routes been used for projects they have been involved in and how effective it would have contributed to project success. The questionnaire was web- based using www.smartsurvey.co.uk and a total number of 41 respondents filled the questionnaire with 4 incomplete responses and 38 complete responses. The responses where from construction professionals in Nigeria that were selected using a snowballing approach, with respondents mainly coming from Facebook, LinkedIn and other online construction forums.

CHART 1: respondent's acceptance of different contractual procedures based on contractual documents

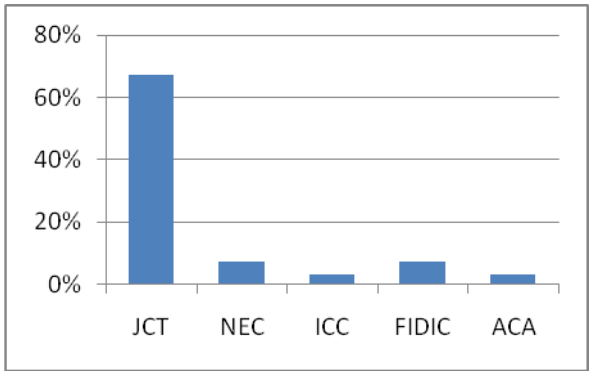

Chart 1 shows a pattern on the acceptance of different contractual procedures based on contractual documents. Responses for tendering options used in public sector procurement indicate that 67.7% of respondents have used JCT while only about 20% of the respondents have used either NEC, ICC, FIDIC or ACA. [17] in his review of procurement in the Nigerian construction industry highlighted the lack of pervasiveness of procurement option as one of the weaknesses of the Nigerian construction industry. [19] in his paper on public procurement challenges, cited lack of knowledge as a problem for developing countries. This highlights the opinion of construction workers in Nigeria that the most traditional contractual document (JCT) is still the most sought after or embraced document for contractual obligations in Nigeria thereby serving as a hindrance factor for other contractual contract documents to be exploited.

CHART 2: How often have you encountered the use of the following procurement methods in public construction projects?

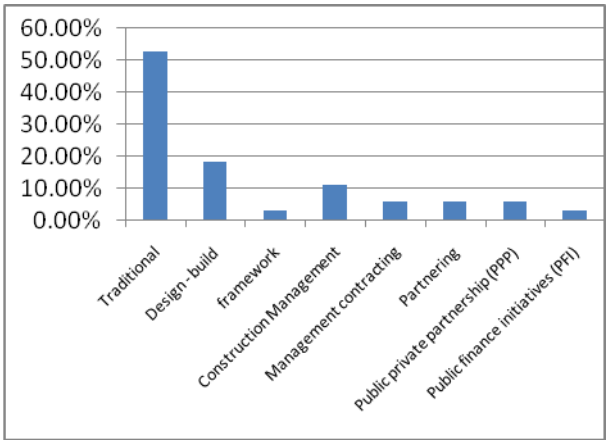

Chart 2 shows a response percentage to the degree of acceptance of different procurement strategies namely the PFI, PPP, Management contracting, Construction management and partnering and the traditional method. The information also highlights the knowledge gap in some procurement strategies that can be adopted in procurement undertakings and also shows that gradually a reasonable acceptance of different contractual options is emerging amongst practitioners and government projects.

CHART 3: Could some of the project challenges be mitigated by using alternative procurement strategy?

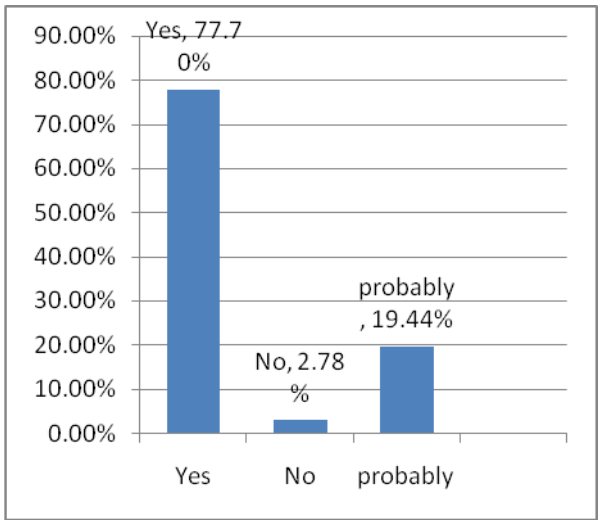

Chart 3 shows the perception of experts or respondents in the industry in seeing alternative procurements strategy as a way to improve project delivery and performance. It was observed that the provisions in which the respondents largely selected 'No' had more 'maybe', which could mean that there is a lack of knowledge on the subject area. Interestingly, the lesser known provisions are those most recommended in reports like 'rethinking Construction' and 'Procurement in the Construction Industry' by CIOB (2010) among other recent procurement reports. Public sector procurement in Nigeria has in recent years made giant strides in terms of regulations and growth. However despite the developments, literatures researched and the data obtained from this questionnaire suggests that there is still a long way to go especially in terms of embracing modern procurement strategies.

IV. CONCLUSIONS AND RECOMMENDATIONS

The conclusions reached from this research work on the impact of procurement strategy on performance of projects are discussed as follows:

Nigerian Construction Industry

The industry has benefitted from high public sector funding ([4] and [20]), New Procurement Act ([20] , [17]and [13]) and availability of labor. Its weaknesses are; large infrastructure deficit ([21] and [18]), inadequate legislation ([13] and [20]). Despite the weaknesses, [4], [5] and [17] among others have identified opportunities such as; infrastructure deficit, new construction bills, political instability [22] and globalization ([23] and [22]). Fraudulent practices and kickbacks [17], and financial difficulties [30] have plagued construction.The Nigerian construction industry needs to take bold steps to address the large Infrastructure deficit and high rate of public sector projects abandonment. Public Sector Procurement in Nigeria the enactment of the governing body as stipulated by the Procurement Act of 2007 needs to be carried out while some areas such as bidding procedures used and some bottlenecks preventing the use of some procurement options need to be reviewed. Public sector clients need to explore the use of modern Procurement strategies for the procurement of projects. The Knowledge gap in terms of the variety of procurement options available to public sector clients needs to be looked into by professionals in the sector.It is the researcher's opinion that further study in these areas is required. Assessing the pervasiveness of modern procurement strategies in the Nigerian construction industry, Procurement and Project performance are topics which though been the subject of a lot of research, could benefit from a lot more research. This is even more pertinent for developing countries like Nigeria with scarce resources, large populations, large infrastructure deficit and relatively less know-how. The subject areas needs further research in order to enable the industry bridge the knowledge gap.

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Assessment of Cost Impact in Health and Safety on Construction Projects

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ABSTRACT : *The study assesses the cost impact of Health and Safety management within the construction industry. The purpose of the study is to help identify the impact of cost directly to projects. Toward this end, a field survey was conducted with a sample of fifty contractors selected in a given geographical region with high density of construction work. Data were collected using structured questionnaires and analyzed using a tabular presentation identifying percentages of given responses. The results reveal that contractors are aware that health and safety compliance is correlated with the scope of their operations. The study results also reveal that the accident and injury rates in the Nigerian construction industry are high. Thus, the results reveal the challenges facing Nigerian contractors and companies in terms of high cost incurred as a result of injuries and hazards on site.. The findings indicate the need for effective health and safety management and regulation and control of activities in the Nigerian construction industry more definitively.*

KEYWORDS : *Health and safety, construction organizations, occupational-accidents, cost*

I. INTRODUCTION

Workplace Health and Safety on its own is a global challenge to the sustainable development of our society and civilization. According to the international labour office, work related accidents and illnesses contribute 3.9 percent of all deaths and 25 percent of the world's population suffers a minor or major occupational accident or work related disease in any one year [1]. Other than the moral concerns, the economic cost is huge. The poor performance of the construction industry in some key areas has been lamented and one of such areas is health and safety, which is regarded as a key performance indicator in the construction industry [2]. The acceptance of Health and Safety Management System (HSMS) demonstrate in real terms, the readiness of an organization to minimize the frequency and brutality of work related accidents, ill health and damage to property [2]. [3] believes that the construction industry has hinged the successful management of construction projects on the traditional parameters of Cost, Time and Quality. The growing rate of construction accidents has increased the awareness of construction health and safety, thereby involving its inclusion as part of project performance criteria.[4] stated that the non-existent and/or lack of enforcement of the health and safety regulations, and byelaws is one of the major causes of building failures opining that health and safety in construction is a highly practical guide to help any professional understand the implications of health and safety legislations for the role in a project. This implies that there is expected to be a realistic plan to help adopt a health and safety culture in the construction industry. In the recent past in Nigeria, especially 2005 till date, death tolls, permanent disability and severe environmental threat had been on the increase through collapse of buildings and major operational accidents especially in Abuja, Lagos and Port Harcourt ([4]; [5]**.** It is against this backdrop that this research was carried out to examine the cost impact on health and safety management on construction projects, with the intent to proffer suitable solutions to the problem which will serve as a roadmap for effective construction project delivery. This research is aimed at identifying the effect of health and safety in the successful delivery of construction projects by investigating if there is an existing framework for health and safety implementation or conformance on construction/project site and also to identify the cost implication for non-adherence to existing health and safety policies in construction site.

Study Area : The area of study for this research is Abuja. Abuja is the capital city of Nigeria, with an estimated

population of 5million (National Population Commission, 2006).

II. Health and Safety Performance of the Nigerian Construction Industry

Over the decades, construction industry has geared efforts towards improving its health and safety performance. However, these efforts have been shifted from monitoring safety performance to preventive measures of improving safety performance. The health and safety performance of the industry remains a glaring challenge in its effort to tackle the developmental initiative of many nations including Nigeria [1].[2] opined that Nigeria falls within the category of countries having no adaptive health and safety laws and regulations, where organizations allocate little resources to health and safety management, rarely keep, report, or release accurate records of accidents and injuries on site, leading to poor health and safety performance. He further suggests that effective management of health and safety is motivated by various factors of which could be centered on the need to abide by existing rules and regulations, a consideration of human lives that are involved (socio-humanitarian perspective), or on the direct and indirect cost involved (financial-economic perspective). In the same vein, [6] reveals that legislation on health and safety are endorsed by parliament including International Labour Organization (ILO) conventions however their implementation by the relevant government bodies is poor. Construction within developing countries often fails to meet the needs of modern competitive businesses in the marketplace; and rarely provides best value for clients and taxpayers. [7], Added that the construction sector of developing countries also demonstrates poor performance in respect of health and safety due to the absence of any rigid safety and construction laws.

Health and Safety Performance Cost : In order to maintain a healthy working environment, the cost of safety are those incurred in order to comply with legal requirements with respect to accident prevention, to implement measures to prevent accidents during construction work and to improve health and safety conditions in all areas of the work performed.The cost of health and safety was generally perceived as a necessary and beneficial business expense [1]. According to [8], avoidance or reduction of accident and work-related ill health costs per se does not appear to be the primary motivating factor for effective health and safety management. However, [8] acknowledged that health and safety failures might ultimately impact on the financial performance of an organization through any of the higher level factors like customers and client expectation, workers morale, productivity, efficiency and service delivery etc.In view of the above position, [9] argue that safety investment cannot be absolute and a rational judgment for safety cost is required and maintain that costs associated with rigorous safety parameters in developing countries might simply be unjustifiable and that the stakeholders cannot bear the safety cost for economic survival if the real cost of accident is too low in the economy. ([10] estimates that the cost of implementing Health and Safety systems within a construction company lies between 0.5% and 3% of total project costs.

Cost of Accident (CoA) : The Cost of Accident (CoA) is the final measure that can readily be related to by all stakeholders as it can be expressed as a percentage of organizational business volume or construction completed. It could also be categorized as being either direct or indirect which collectively constitutes the total Cost of Accident and it is noted that in South Africa, the estimated CoA is around 5% of the value of the completed construction as cited by [11]. [10] establishes that the indirect costs of accidents are 14.2 times the direct costs. A report from the Health and Safety Authority Research Series (HSARS 02/2007) shows that Employer costs from the accidents included salary costs for replacement staff or overtime payments, production and productivity losses, retraining costs, personal injury claim compensation, repair bills, medical & travel expenses and increased supervision. Literature has enabled us ascertain the likely hood of negligence of health and safety compliance in construction projects. The empirical analysis would further provide us with detailed insight to this phenomenon.

III. THE RESEARCH METHODOLOGY ADOPTED FOR THE STUDY

Haven reviewed related literatures on various research methods and strategies, this study decided to adopt the quantitative methods of approach which can be used as a tool to enquire into social or human problem based on testing a theory composed of variables, measured with numbers and examined using statistical procedures in order to determine whether the predictive overview of the theory hold true.

Sampling Size : Sampling size of sixty (60) professionals in the construction industry were targeted for this research however, fifty (50) of the sample size was accessible.

Sampling Technique : The study adopts probability sampling technique also known as random sampling technique; in which every respondent in the defined population were given equal chance during the administration of the questionnaire. This was achieved by ensuring the number of questionnaire administered to

each of the respondent equals the calculated size.

IV. RESEARCH POPULATION

For the purpose of this research, the target population of interest includes construction professionals such as project managers, consultants, contractors, and all other workers who are directly involve in construction project sites in the Federal Capital Territory Abuja. Information was gathered from professionals involved in project execution in the construction industry.

Questionnaire Design/Survey : The questionnaire developed and used in the study comprised questions with fixed response categories along with open-ended and close-ended questions. The questionnaires were divided into three parts; (part A, B, and C). The part 'A' requested profiles of respondents/construction Company (e.g. Years of experience of respondent, position of respondent, name and location of company, years of existence of the company, number of projects carried out over the last five years). The part 'B' raised response on the health and safety implementation policy and compliance level of the company. Part 'C' raised questions on the cost implications of health and safety policy on construction project.

Method of Analysis of Data : The study employed the use of descriptive statistical methods of analysis to analyze the collected data in order to achieve the objectives of the study as discussed.

V. DATA ANALYSIS

Analysis of Company/Respondents Profile : The total number of questionnaires administered during the course of this work is 60 and only 84% (50) was returned. The sampled population shows a response rate of 6 project managers (12%), 4 consultants (8%), 8 contractors (16%), 20 workers (40%) and 12 numbers of other construction site workers (24%).

Table 4.1: Response rate among sampled population

Research population	Administered questionnaire	Questionnaire Response rate/return rate	Percentage(%) 0f response
Project manager	8	6	12%
Consultants	8	4	8%
Contractors	10	8	16%
Workers	20	20	40%
Others	14	12	24%
Total	**60**	**50**	**100%**

Table 4.2: Years of experience of the construction professionals

Years of experience	Frequency	Percentage (%)
Less than 1 year	0	0
1-3 years	8	16
3-5 years	24	48
5-10 years	11	22
More than 10 years	7	14

The table clearly shows the experience of all the construction professionals sampled in the research work. The result shows that there is no professional whose experience is below 1 year as the response shows that they have been working with the construction company to know the state of health and safety on the construction site in the FCT Abuja.

Table 4.3: Number of projects executed in the last five years

Number of projects	Frequency of response	Percentage response (%)
Less than 10	0	0
11-20	0	0

21-30	5	10
More than 30	45	90

The table shows the number of project executed by the sampled construction sites in the last five years. 45 (90%) respondents says they had executed more than 30 projects in the last five years and only 5 (10%) claim to have executed 21-30 within same last five years. This shows that majority of the construction industries in the FCT Abuja have been carrying out numerous construction projects and may have experienced health and safety issue in one way or another.

Health and Safety Implementation Policy and Level of Compliance : The table below presents the response of the respondents when asked about their opinion as to the implementation of health and safety policy in their construction site. Their response is based on ticking 'NO' or 'YES'.

Table 4.4: Health and safety implementation policy

QUESTIONS	NUMBER OF RESPONSE "YES"	NUMBER OF RESPONSE "NO"	PERCENTAGE (%) RESPONSE "YES"	PERCENTAGE (%) RESPONSE "NO"
Is there an existing framework for health and safety implementation in your company?	42	8	84%	16%
Is there a clear safety policy for your company and project?	44	6	88%	12%
Is there a proper documentation for accidents and policy violation during the execution of your projects?	18	32	36%	64%
Is there any sign post indicating a restricted or danger zone in your project site?	36	14	72%	28%

Table 4.4 shows clearly that 84% of the respondents said there is a framework for health and safety policy implementation in their construction site while 16% were of the response that there was no health and safety implementation policy in their construction site. In respect to whether there is a clear policy for the Construction Company and projects, 88% agrees there is clear and safety policy for their company while only 12% of the respondents have a contrary opinion. 64% of the respondents said there is no proper documentation for accidents and policy violation during the process of executing their project while 36% agrees that there is proper documentation of accidents and policy violations. The availability of sign post indicating a restricted of danger zone in the construction site were agreed to by 72% of the respondents while 28% claims there is no such thing in their construction site . To conclude the above result clearly shows that despite the implementation of health and safety policy and frame work in the construction site, there is still lack of proper documentation of occurring site incidents and violations of construction site policy in the construction site.

Table 4.5: Strict measure against contactors/subcontractors that make a safety violation

QUESTION	Percentage(%) response of 'YES'	Percentage(%) response of 'NO'	If 'YES', how?	If 'NO', why?
Is there strict measure taken against any contractor/subcontractor who makes a safety violation during the execution of their project?	38% (19)	62% (31)	Measures taken through immediate suspension and fining of contractor	No measure taken on any contractor/subcontractors who makes safety policy violation

Table 4.5 reveals that 38% of the respondents are of the opinion that strict measures have so far being taken against any contractor subcontractor who fails to comply with or violate the existing health and safety policy in the construction site and that the measures taken against them include suspension from work which this is assumed as a way of punishing the contractor. Contrary to this response, 62% 0f the respondents claimed that no any measure or forms of strict action has been taken against the contractors and subcontractors who violates or did not comply with safety policies.

Cost Implications of Health and Safety Policy on Construction Site : This part presents the analysis of the cost implications of health and safety policies on construction project site. The table below shows the opinion of the sampled population in respect to whether the implementation of health and safety programs on the

construction site increases the project cost or not.

Table 4.6: cost implications of health and safety programs on construction site

Construction professionals	Number of 'YES' response	Number of 'NO' response	Percentage(%) response of 'YES'	Percentage(%) response of 'NO'
Project manager	5	1	10%	2%
Consultants	4	0	8%	0%
Contractors	8	0	16%	0%
Workers	18	2	36%	4%
others	9	3	18%	6%
Total	44	6	88%	12%

The table shows the response of all the construction site officials concerning the cost implications arising from the implementation of health and safety programs on the construction sites at the FCT Abuja and the total response ratio of yes to no is 88:12%. 5(10%) of the project managers responded that the implementation of health and safety programs in the construction project site increases the cost of the project while 1(2%) of the sampled population of project managers says it doesn't. All the consultants 4 (8%) believed that implementing a health and safety programs in the construction site will definitely increase the project cost. All contractors 8 (16%) also agreed it increases the project cost. 18(36%) of the construction workers are of the opinion that health and safety programs when implemented on the construction site will increase the cost of the project while 2 (4%) disagree with that opinion. Finally, 9 (18%) of other construction site officials also agreed that health and safety program implementation increases the cost of the project and only 3 (6%) said it doesn't. the above analysis clearly reveals that majority of construction workers were of the opinion that implementing health and safety program on the construction site goes a long way increasing the cost of the project. This could be perceived as being the reason why many construction professionals at the FCT Abuja gives little or no attention to health and safety issues on the construction project sites.

Table 4.7: the aspect of project cost grossly affected by construction site accidents

Cost aspect of project	Response frequency	Percentage response
Prime cost	6	12%
Preliminary cost	4	8%
Overall project cost	39	78%
Other cost	1	2%

From the above table (table 4.7), 6 (12%) of the sampled population said the prime cost aspect of a project is affected more by the accidents which usually occurs on construction sites. 4(8%) said the cost aspect affected by the accidents on construction site is the preliminary cost aspect of the project, 39(78%) the overall project always bears the effects of any claims and extra additional work which may arise as a result of accident on the site while only 1(2%) of the respondent believes that the accident affect other cost aspect of the project.

VI. DISCUSSION

The analyses of data as presented above specify that there are health and safety framework and policy in the construction site as revealed by 42(84%) of the sampled population . The finding is an indication that construction companies have health and safety policy in place. Despite the presence of this framework, 36(64%) of the respondent claims there was no proper documentation of accidents and policy violation in the construction site. This present the bad situation on which the construction project sites at the FCT Abuja is presently at. On the other hand the compliance to this policies and framework are unfortunately below the average (percentage compliance is between 0-15% as revealed by 30(60%) 0f the respondent. The findings also highlighted the availability of safety equipment on construction site and ranked the presence of health personnel and first aid kit, safety helmet, foot wear and safety and fire extinguishers on site as 1st 2nd and 3rd respectively. The findings also revealed that the respondents agree that implementing a health and safety policy increases the cost of the projects. In the same view health and safety issues result in claims, delays and additional work in the project. The findings also indicated that the overall construction cost is the most grossly affected by accident and injuries with a response rate of 39(78%) as compared to the prime cost, preliminary cost and other aspects of the project cost.

VII. CONCLUSION

it was discovered that construction companies have one a framework for health and safety policy

installed on construction site, but unfortunately do not comply with the policy. Despite haven identified the necessary equipment for a workable healthy and safe construction site, full compliance is still below the average. This has resulted in some forms of policy violation by the contractors and improper documentation of accidents on site since no strict measure is taken against anyone who breach conformance to the regulating policy.The analysis of the data also revealed that implementing health and safety programs on construction site tend to increase the overall cost of the project. In this vein, non-conformance to the policy which often result to accident also increase the overall cost of the project.Majority of the respondents amounting to 82% of the total respondent strongly agreed that the health and safety of the employees have a great impact on determining the quality output of the construction project. Unsafe design, poor safety planning and high rate of accidents were identified as an obstacle which inhibits the quality of construction output. If there are noticeable rates of accident in a particular construction site, and the management failed to put in place adequate safety measures, it may affect the health and productive capacity of the workers which in turn may affect the overall project delivery.It is hereby recommended that actions be taken to improve the health and safety of employees on any project site. Where health and safety policies are put in place, a unit or group should be saddled with the responsibility of make sure there is above the average compliance. The following should be put into consideration:

[1]. Appointment of a safety officer by a construction company to primarily ensure or enforce health and safety policies e.g., ensuring that workers on site always wear safety boots and helmets, etc.
[2]. On the job as well as off the job training should be provided to employees on their health and safety and its impact on the output of the project.
[3]. Cases of accidents and injuries should be acknowledged so as to make provision for accident investigation which aid effective accident control in future projects.
[4]. Regulating agencies e.g. the ministry of works and productivity should appoint his agent which will carry out regular and spontaneous visits to construction sites in order to keep the contractors in checks.
[5]. Severe measures and punishments should be meted out to contractors who violate safety policy, and where there is a recurring violation of policies, the contractor certificate may be rescinded.

This research was aimed at assessing the impact of health and safety on the delivery of construction projects. It was deduced that health and safety have an impact on the delivery of a construction project either in terms of cost or quality. However the research was unable to determine precisely how health and safety impact on the quality of a project output.

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Design Method of Reinforced Concrete Shear Wall Using EBCS

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ABSTRACT :*Concrete shear walls or structural walls are often used in multistory buildings to resist lateral loads such as wind, seismic and blast loads. Such walls are used when the frame system alone is insufficient or uneconomical to withstand all the lateral loads or when partition walls can be made load bearing, replacing columns and beams. The analysis and design of buildings with shear walls became simple using commercially available computer programs based on the finite element method (FEM) and subsequent implementation of stress integration techniques to arrive at generalized forces (axial, shear, and moments). On the other hand, design engineers without such facilities or those with computer facilities lacking such features use simple method of analysis and design by taking the entire dimensions of the walls. This is done by considering the shear walls as wide columns of high moment of inertia and following the same procedure as for columns. The primary purpose of this paper is believed that structural engineers working in the analysis and design of high-rise buildings will be benefited from the design shear wall by using EBCS: 2-1995 and EBCS:8-1995codes and its results.*

KEYWORDS*-concrete shear wall, Ethiopian building code standard (EBCS), lateral loads, moment of inertia, stress integration techniques.*

I. INTRODUCTION

Shear walls are deep relatively thin vertically reinforced concrete beams .They are commonly used in the structures to resist the effects of gravity loads and storey shears. Shear walls are vertical elements in the lateral force resisting system that transmit lateral forces from the diaphragm above to the diaphragm below or to the foundation . Shear walls may also bearing walls in the gravity load system or they may be components in dual system framed so as to resist only lateral loads.

Walls may be subjected to both vertical (gravity) and horizontal (Wind or Earthquake) forces. The horizontal forces are both in plane and out of plane. When considered under their in plane loads walls are called shear walls. When considered under their out of plane loads they are called normal walls. Walls will be designed to withstand all vertical loads and horizontal forces both parallel to and normal to the flat surface with due allowance for the effect of any eccentric loading or overturning forces generated. Any wall whether or not intended as part of the lateral force resisting system is subjected to lateral forces unless it is isolated on three sides(both ends and top) in which case it is classified as non structural. Any wall that is not isolated will participate in shear resistance to horizontal forces parallel to the wall. Since it tends to deform under stress when the surrounding framework deforms. The distribution of lateral loads on shear walls varies with their height. For example under lateral wind loading this distribution may vary from nearly uniform on a wall in a tall building to a single concreted force on a wall in a low building.

B.K. Thakkar [1] developed a methodology for generation of interaction diagrams for shear walls, thereby enabling a more accurate description of the capacity of the shear wall cross section under the effect of axial compression and lateral bending.ManojS. Medhekar and SudhirK.Jain [5] presented a worked example on shear wall design conformed to IS: 456-1978 and IS: 4326-1976. As IS: 456 and IS: 4326 do not give the specifications for the same,

A detailed commentary is included in their study regarding behavior and strength characteristics of R.C shear wall to explain the basis of theIS: 456-1978 and IS:4326-1976 specifications.M.Tomii and F.Esaki [6] presented a design method of reinforced concrete monolithic framed shear walls whose columns do not fail in shear by an earthquake and whose horizontal shear capacity is dominated by slip failure of their in filled panel wall.Under the large overturning effects caused by earthquake forces, edges of shear walls experience high compressive and tensile stresses. To ensure that shear walls behave in a ductile way concrete in the wall end regions must be reinforced in a special manner to sustain these load reversals without losing strength. End regions of a wall with increased confinement are called boundary elements. The special confining transverse reinforcement in boundary elements is similar to that provided in columns of R.C. frames. Sometimes the thickness of shear wall in these boundary elements is also increased. R.C walls with boundary elements have substantially higher bending strength and horizontal shear force carrying capacity and are therefore less susceptible to earthquake damage than walls without boundary elements.Special design checks are required to ensure that the net cross section area of wall at an opening is sufficient to carry the horizontal earthquake force. Door or window openings can be provided in shear walls but their size must be small to ensure least interruption to force flow through walls. Moreover openings should be symmetrically located. If opening are very small their effect on the overall state of stress in a shear wall is minor. Large openings have more pronounced effect and if large enough result in a system in which typical frame action predominates. Openings commonly occur in regularly spaced vertical rows throughout the height of the wall and the connection between the wall sections is provide by either connecting beams (or Spandrels) which form a part of the wall or floor slabs or a combination of both. If the openings are do not line up vertically and (Or horizontally) the complexity of the analysis is greatly increased. In most cases a rigorous analysis of a wall with openings is not required. Strut and tie procedure s that depict shear walls as consisting of compression struts and tension ties are useful tools for the evaluation of shear walls with openings.

If the design of the wall with openings the deformations must be visualized in order to establish some approximate method for analyzing the stress distribution to the wall. The major points that must be considered are the lengthening and shortening of the extreme sides (boundaries) due to deep beam action , the stress concentration at the corner junctions of the horizontal and vertical components between openings and the shear and diagonal tension in both the horizontal and vertical components.The ease of methods of analysis for walls with openings is greatly dependent on the relative rigidities of the piers and spandrels as well as general geometry of the building. Reinforced concrete and reinforced masonry shear walls are seldom simple walls. Whenever the walls has the doors, windows or other openings the wall must be considered as an assemblage of relatively flexible components (Column segments and wall piers) and relatively stiff elements (wall segments).A column segment is a vertical member whose height exceeds three times its thickness and whose width is less than two and half times its thickness. Its load is predominantly axial. Although it may contribute little to the lateral force resistance of the shear wall its rigidity must be considered. When a column is built integral with a wall the portion of the column that projects from the face of the wall is called pilaster. A wall pier is a segment of a wall whose horizontal length is between two and half to six times its thickness and whose clear height is at least two times its horizontal length. And wall segments are components that are longer than wall piers. They are the primary lateral load resisting components in the shear wall.There are many types of reinforced concrete shear walls which are used in buildings to carry forces. Shear walls are oblong in cross section that is one dimension of the cross section is much longer than the other while rectangular cross section is common; L and U shaped sections are also used. Thin walled hollow R.C shafts around the elevator core of the buildings also acts as shear walls and should be taken advantage to resist earthquake forces. Shear walls ranges from simple rectangular types and the flanged walls(called the bar bell type walls with boundary elements) These are formed by columns and wall in between, coupled shear walls , rigid frame shear walls, framed walls with in-filled frames, column supported shear walls and core type shear walls. And based on behavior shear walls also be classified as Shear –Shear walls usually low rise shear walls, Ordinary –moment shear walls usually high rise shear walls to resist high winds and cyclones and ductile moment shear walls meant for seismic regions which have good energy dissipation characteristics under reversed cyclic loads.

Horizontal forces at any floor or roof level are generally transferred to the ground (foundation) by using the strength and rigidity of shear walls and partitions. A shear wall may be considered analogous to a cantilever plate girder standing on end in a vertical plane where the wall performs the function of a plate girder web the pilasters or floor diaphragms function as web stiffeners and the integral reinforcement of the vertical boundaries functions as flanges.

Axial , flexural and shear forces must be considered in the design of shear walls .The tensile forces on shear wall elements resulting from the combination of seismic uplift forces and seismic overturning moments

must be resisted by anchorage into the foundation medium unless the uplift can be counteracted by gravity loads mobilized from neighboring elements.In foundation effects the rotation at the foundation can greatly influence the overall rigidity of shear wall because of rigidity nature of the shear wall itself .However the rotational influence on relative rigidities of walls for purposes of horizontal force distribution may not be as significant. Considering the complexities of soil behavior a quantitative evaluation of the foundation rotation is generally not practical but a qualitative evaluation will be provided.In framework effects the relative rigidity of concrete or unit masonry walls with nominal openings is usually much greater than that of the building framework. Therefore the walls tend to resist essentially all or a major part of the lateral force. For a building with rigid diaphragms there is a torsional moment and a rigidity analysis is required. It is necessary to make a logical and consistent distribution of story shears to each wall. An exact determination of wall rigidities is very difficult but is not necessary because only relative rigidities are needed. Approximate methods in which the deflections of portions of walls are combined usually are adequate.

Wall deflections: The rigidity of a wall is usually defined as the force required causing a unit deflection. Rigidity is expressed in Kips per inch. The deflection of a concrete shear wall is the sum of the shear (Fig. 1) and flexural deflections (Fig. 2). In case of solid wall with no openings the computations of deflection are quite simple. However when the shear has openings as for doors and windows the computations for deflection (Fig. 3) and rigidity are much more complex. An exact analysis considering angular rotation of elements, rib shortening etc is very time consuming .For this reason several short cut approximate methods have been developed. These do not always give constant or satisfactory results. A conservative approach and judgment must be used.

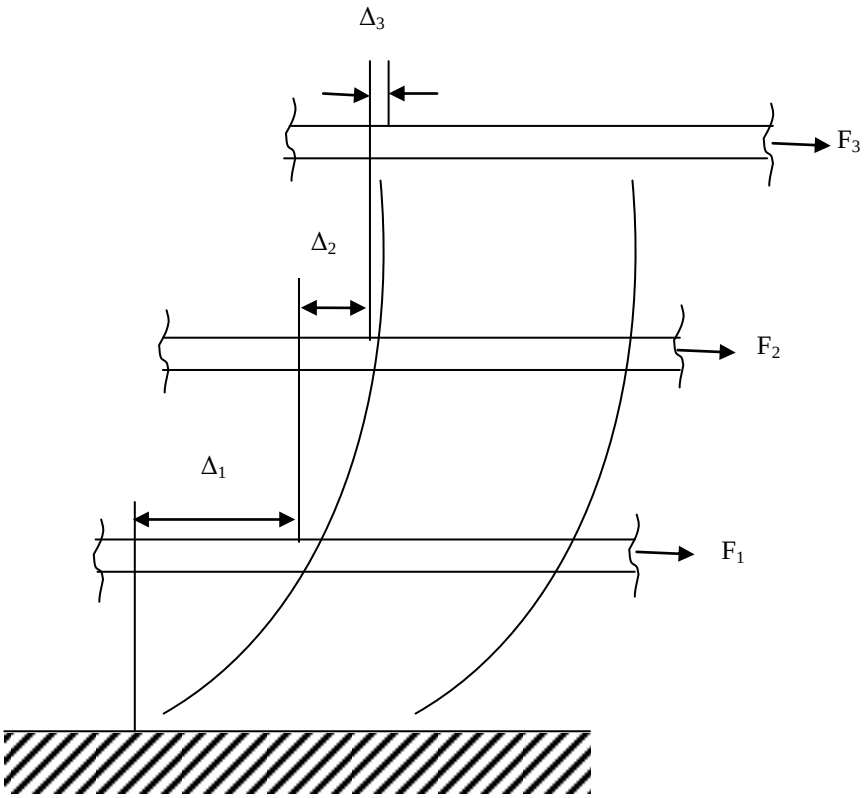

Fig. 1 Shear Deformation

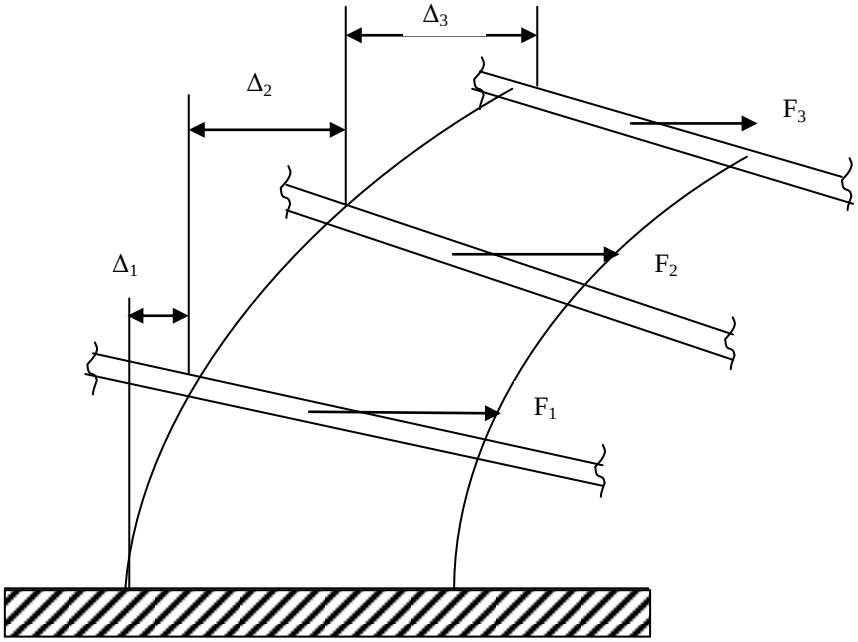

Fig. 2 Flexural Deformation

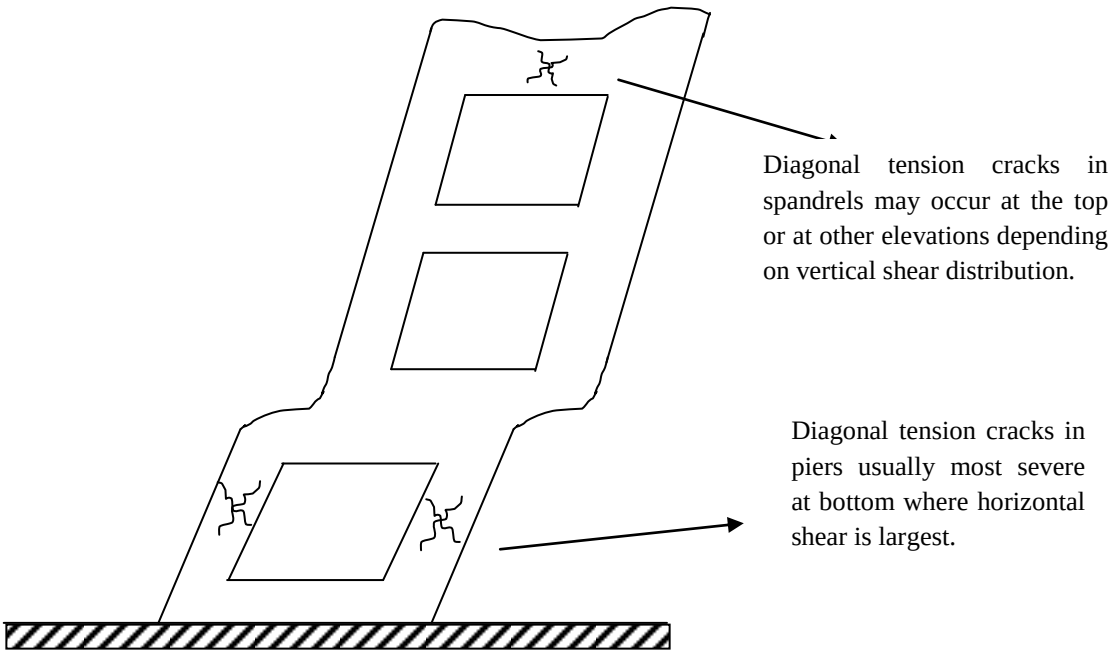

Fig. 3 Deformation shear wall with opening

II. METHODS OF ANALYSIS

Approximate methods for analyzing walls with openings are generally acceptable. For the extreme cases the procedure is straight forward. For other cases a variety of assumptions may be used to determine the most critical loads on various elements thus resulting the conservative design. When however the reinforce requirements or the resulting stresses of this approach appear excessively large the strut and tie procedure or a more rigorous analysis may be justified.

Resistance of shear walls to in-plane lateral loading may be determined according to one of the methods presented below. Each method is briefly summarized and the assumptions involved in formulation of

the methods are presented. The appropriate method should be determined by the building designer or wall designer in accordance with the provisions. Analysis methods are presented with sufficient detail to allow the user to implement each method without consulting other sources. The first three methods such as Perforated Shear Wall Method, Segmented Shear Wall Method, Ni-Karacabeyli's Method need input of unit shear resistance values. Alternatively, the shear wall resistance can be estimated using analytical methods such as Shear through Panel Rotation, Alternate Rational Analyses. The term shear wall rather misleading as such walls behave more like flexural members. However the most important property of shear walls for seismic design as different design for wind is that it should have good ductility under reversible and repeated overloads. In planning shear walls we should try to reduce bending tensile stresses due to lateral loads as much as possible by loading them with as much gravity force as it can safely take .They should also be laid symmetrically to avoid tensional stresses. Determination of the forces in these walls is part of structural analysis. Therefore here the concern if design .In the design general dimensions, vertical m, horizontal reinforcements, shear strength requirements, adequacy of boundary elements, flexural strength, required development anchorage, openings in shear walls, discontinuity in shear walls and shear strength of construction joints are dealt.

III. DESIGN PROBLEM

A shear wall of length 4 m and thickness 300 mm is considered and subjected to the following forces with the grade of concrete f_{cd}=25 N/mm^2 and strength of steel f_{yd}=415 N/mm^2

Table 1: Forces considered for design of shear wall

Loading	Axial Load (KN)	Moment (KNm)	Shear force (KN)
DL+LL	2500	1000	80
EQ	400	6000	900

Calculation of material strength

Height of the wall = 4m

Using EBCS:2-1995 code provision

Design strength of materials (Steel and Concrete):

Concrete:

$$\gamma_c = 1.5 \text{ for class} - 1 \text{ workmanship EBCS} - 2 \text{ Table } 3.1$$

$$f_{cd} = \frac{0.85 f_{ck}}{\gamma_s} = \frac{0.85(25\text{mpa})}{1.5} = 14.17 \text{ mpa}$$

$$f = 0.21 \frac{f_{ck}{}^{2/3}}{\gamma_c} = 0.21 \frac{(25)^{2/3}}{1.5} = 1.197\text{mpa}$$

E_{cm}=29Gpa

Steel:

γ_s= 1.15for class-1 workmanship

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{415\text{mpa}}{1.15} = 360.87\text{n/mm}^2$$

Design Load calculations: The given load combinations are used for the design according to EBCS:2-1995:

Combination 1= 1.3DL+1.6LL
Combination 2= 0.75 Combination 1+EQX
Combination 3= 0.75 Combination 1-EQX
Combination 4= 0.75 Combination 1+EQY
Combination 5= 0.75 Combination 1-EQY

The calculated axial load, moment and shear force to be considered for the design by using the above combinations are shown in the following table:

Table 2: Calculation of Axial load, Moment and shear force using load combinations

Load combination	Axial Load (KN)	Moment (KNm)	Shear force (KN)
Combination 1	2500	1000	80
Combination2	2275	6750	960
Combination3	1475	-5250	-840
Combination4	2275	6750	960
Combination5	1475	-5250	-840

From the five load combinations the maximum values obtained are:

N_{sd}=2500 kN
M_d=6750 kN
V_d=960 kN

Determination of design eccentricity in both directions:

$$e_{tot}=e_a+e_o+e_2$$

Accidental (additional) eccentricity due to various imperfections:

- $e_a=L_e/300 \geq 20mm$, EBCS: 2-1995 section 4.4.3
  Where: Le=is the effective buckling length of the wall.
  Assuming the top end of the shear wall to be simply supported.

- $L_e=0.7L$

Where L =Length of wall height.
L_e=0.7(4) =2.8m.

Therefore, e_a= (2800/300)=9.33 mm<20mm

Considered e_a=20mm

Determination of design eccentricity in H-direction:

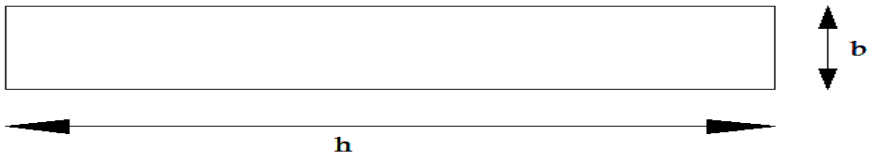

Fig 4 : Cross section of the wall

First order eccentricity:

$$e_o=\frac{M_d}{N_{sd}}=\frac{6750}{2500}=2.7m=2700mm$$

Second order eccentricity:

- *Checking the slenderness of the wall:*A wall may be considered as short walls when the ratio of its effective height to its thickness does not exceed 7. Otherwise it shall be considered slender.

$$\frac{H_e}{t}\leq 7, \text{Short wall}$$

$$\frac{H_e}{t}>, Slendorwall$$

Where He =Effective height of the wall.

- *Effective height of the wall:*

The effective height of reinforced concrete walls in non-sway mode is given by:
He= βH
Where: H= is the Story height of the wall.
β=is the coefficient which is determined from the following equation.

$$\beta=\begin{cases} 1.00 \text{ for walls with two edges restrained} \\ \frac{1}{1+\frac{L}{(3b)^2}} \geq 0.3 \text{, for walls with three edges restrained.} \\ \text{For walls with four edges restrained} \begin{cases} = \frac{1}{(2\frac{L}{b})}, L > b \\ = \frac{1}{1+\frac{L}{(3b)^2}}, L \leq b \end{cases} \end{cases}$$

Where: b is the width of the wall measured center-to-center of the bracing walls, or width measured from the center of a bracing wall to the free edge.
In our case the wall is bar belled type i.e. the wall is restrained in with two edges with walls on each edge.

$$\beta = 1$$

$$He=\beta H = 1(4) = 4m.$$

$$\frac{H_e}{t} = \frac{4000}{300} = 13.33$$

$$> 7, so the wall is slender and we should account for second order eccentricity$$

$$e_2 = 0.4t(\frac{L_e}{10t})^2$$

Where t=thickness of the wall in our case t=300mm

$$e_2 = 0.4(300)(\frac{2800}{10(300)})^2 = 104.53mm$$

$$e_{tot} = e_a + e_o + e_2$$

$$e_{tot} = 20mm + 2700mm + 104.53mm = 2824.53mm$$

Relative eccentricity:
The relative eccentricity, for a given direction, is the ratio of the total eccentricity, allowing for initial eccentricity and second-order effects in that direction, to the wall width in the same direction.

$$e_{rel} = \frac{e_{tot}}{h} = \frac{2824.53}{5000} = 0.56$$

Determination of design eccentricity in B-direction:

- First order eccentricity: no moment is carried in this direction as it is carried by the perpendicular walls, M_d=0

$$e_o = \frac{M_d}{N_{sd}} = 0$$

- Second order eccentricity: $e_2 = 0.4t(\frac{L_e}{10t})^2$

  Where t=thickness of the wall in our case t=b
  e_2=104.53mm

$$e_{tot} = e_a + e_o + e_2$$

$$e_{tot} = 20mm + 0 + 104.53mm = 124.86mm$$

- Relative eccentricity:

The relative eccentricity, for a given direction, is the ratio of the total eccentricity, allowing for initial eccentricity and second-order effects in that direction, to the column width in the same direction.

$$e_{rel} = \frac{e_{tot}}{b} = \frac{124.86mm}{300mm} = 0.415$$

- Equivalent eccentricity: e_{eq}

$$e_{eq} = e_{tot}(1 + k \propto)$$

Where:
e_{eq}= total eccentricity in the direction of the larger relative eccentricity
k=relative eccentricity ratio.
α=is obtained from table 4.1 of EBCS: 2-/1995(which is given below) as a function of the relative normal Force,

$$v = \frac{N_{sd}}{f_{cd} \times A_c}$$

Table 3: Function of the Relative normal force

v	0	0.2	0.4	0.6	0.8	≥ 1.0
∝	0.6	0.8	0.9	0.7	0.6	0.5

- Relative eccentricity ratio: The eccentricity ratio, for a given direction, is the ratio of the total eccentricity, allowing for initial eccentricity and second-order effects in that direction, to the column width in the same direction.

  Relative eccentricity ratio, k

$$K = \frac{\text{small relative eccentricty}}{\text{larger relative eccentricity}}$$

$$K = \frac{0.415}{0.565} = 0.734$$

- Relative normal force, $v = \frac{2500KN}{(14.17\times10)^2\ KN/m^2\ (0.3\times0.5)} = 0.1176 \geq 1$

  Therefore $v = 0.1176$

$e_{eq} = e_{tot}(1 + k \propto)$;

e_{tot} = **total eccentricity in the direction of the larger relative eccntricity**; $e_{tot} = 2824.53mm$

Therefore $e_{eq} = 2824.53(1 + (0.734)(0.7176)) = 4312.26mm$

Design moment calculation:

Design moment, $M_{sd} = e_{eq} \times N_{sd}$

M_{sd}= (4.31226m)(2500 kN)=10780.65 kN-m

Design of vertical reinforcement:

Area of reinforcement: $A_s = \frac{\omega f_{cd} A_c}{f_{yd}}$

$\omega$is the reinforcement ratio from chart using v andμ values.$\mu = \frac{M_{sd}}{f_{cd}A_c h}$

Where h =depth of the cross section.

$$\mu = \frac{10780.65Kn_m}{\left(14.17 \times 10^3 \frac{Kn}{m^2}\right)(0.3m)(5m)(5m)} = 0.1014$$

Using, $v = 1.176$

$$\mu = 0.1014$$

Take $\frac{d'}{h} = 0.05$

From uni-axial chart number-6 the value of ωlies under the curve with$\omega = 0$, so provide minimum reinforcement.

Check for the limiting values:

For vertical reinforcement the code provides the following limiting values, as discussed in the previous section.

A_{min}=0.004 A_c=0.004(300mm) (5000mm)=6000mm^2

A_{max}=0.04A_c=0.04(300mm) (5000mm) =60,000mm^2

A_s=A_{min}=6000mm^2

Using Ø14:

a_s=$\frac{\pi d^2}{4} = \frac{\pi(14)^2}{4} = 153.93mm^2$

s=$\frac{ha_s}{A_s}$

Using two layers of bars.

A_s=$\frac{A_{s,total}}{2} = \frac{6000}{2} = 3000mm^2$

S=$\frac{(5000mm)(153.93mm)}{3000\,mm^2} = 256.56\ mm$

$S_{max} \leq \begin{cases} 2t \\ 300mm \end{cases}$ $t = b = 300mm$

S_{max}=300mm

Therefore provide Ø14 at $\frac{c}{c}$250mm.

Design of shear reinforcement:

- Check for the diagonal compression failure of concrete

Section resistance Vrd=$0.25\ f_{cd}\, b_w d \geq v_d$

Vrd= 0.25(14.17 mpa)(300mm)(4750mm)=5048.06 K_n>V_dO.K

Note here that if V_{rd} less than V_d(i.e, Vrd<Vd) the possible measures are:

Increase the grade of concrete:

Increase the cross-section (as it is barbell type shear wall i.e. fixed in the two edges it means increasing the thickness of the wall).

- Check the section capacity, V_c

For members subjected to significant axial compression: EBCS-2/1995 Section 4.5.3.2

$$V_c = 0.25\, f_{ctd} k_1 k_2 b_w d + V_{cn}$$

$$V_{cn} = 0.10 \frac{b_w d}{A_c} N_{sd}$$

$$f_{ctd} = 1.197\ \text{Mpa}$$

$$k_1 = 1.6 - d \geq 1, d \text{ in m}$$

d=h-d'

$$\text{Take } \frac{d'}{h} = 0.05$$

$$d' = 0.05h = 0.05 \times 5000 = 250\text{mm}$$

$$d = h - d' = 5000\text{mm} - 250\text{mm} = 4750\text{mm}$$

$$k_1 = 1.6 - 4.570 \geq 1$$

So take k_1 =1

$$k_2 = 1 + 50\rho \leq 2.0$$

$$\rho = \frac{A_s}{b_w d} = \frac{6000\,\text{mm}^2}{(300\text{mm})(4750\text{mm})} = 0.0042$$

$$k_2 = 1 + 50(0.0042) = 1.21 \leq 2.0.\text{O.K}$$

$$V_c = 0.25(1.197\ \text{Mpa})(1)(1.21)(300\text{mm})(4750\text{mm}) * 10^{-3} + 0.10 \frac{(300\text{mm})(4750\text{mm})}{(300\text{mm})(5000\text{mm})} * 2500\ \text{kN} = 753.42\ \text{kN}$$

$$V_c = 753.42\text{kN} < V_d = 960\ \text{kN}$$

- So, design for shear reinforcement
  EBCS provision for area of shear reinforcement (horizontal reinforcement), According to section 6.2.1.2 of EBCS-2

- Design for horizontal shear forces in the plane of the wall shall be in accordance with provisions for beams give on EBCS 2/1995 section 4.5.3

- Sections located closer to the base than a distance $\frac{b}{2}$ or, $\frac{L}{2}$ whichever is less, be designed for the shear at $\frac{b}{2}$. Or $\frac{L}{2}$

- The area of horizontal reinforcement shall not be less than one-half of the vertical reinforcement

- Spacing of shear reinforcement:

$S = \frac{A_v d f_{yd}}{V_s}$, $V_s = V_d - V_c$, EBCS-2/1995 Section 4.5.4(4)

$S_{max} \leq \begin{cases} 2t \\ 300mm \end{cases}, t = b$

The horizontal reinforcement shall enclose the vertical reinforcement. The horizontal bars shall enclose and be tied to the vertical bars so as to form rigid mat.

V_d=960 kN

(b/2)=150 mm< (L/2)

Position of V_c=515.98 kN

There fore $\frac{515.98\ kN}{x} = \frac{960\ kN}{4000mm}$, using the similarity of triangles, $x = 2149.92mm$

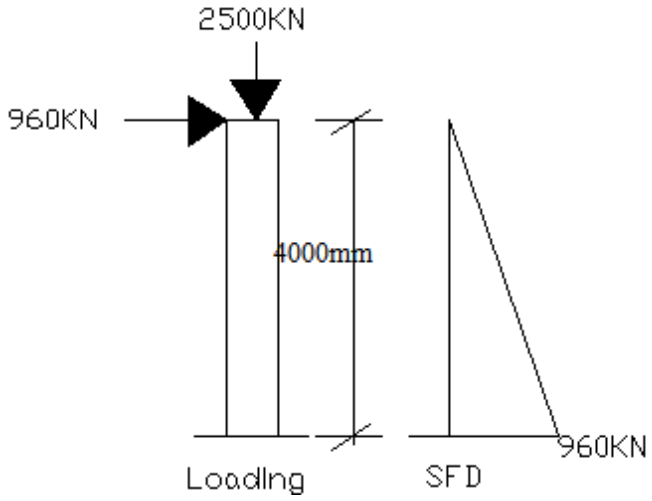

Fig 5: SFD of the Shear wall

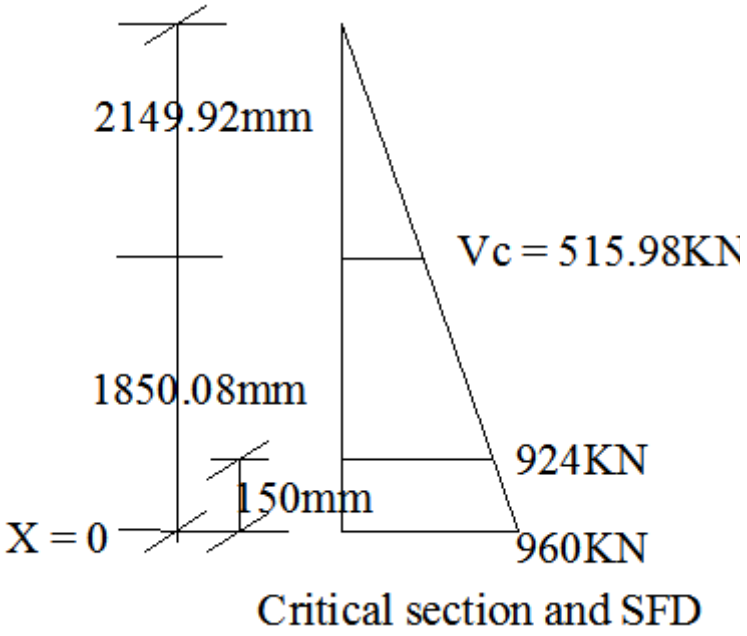

Fig 6: Critical Section and SFD of the Shear Wall

At the critical point (@ 150 mm from the base)

$$\frac{V_d}{(4000mm - 150mm)} = \frac{960\ KN}{4000mm}\ \text{using the similarity of triangewles.}$$

Therefore V_d=924kN.
Remember here that the critical section for column is at d distance from the face of the column.For region between x=0 and x=150mm, design for shear at x=150 mm,V_d=924 kN.

Using Ø8

$$a_s = \frac{\pi d^2}{4} = \frac{\pi(8)^2}{4} = 50.26\ mm^2$$

$$Smax = \begin{cases} 2t \\ 300\ mm \end{cases} \quad t = b = 300\ mm$$

Smax=300 mm

$$s = \frac{A_v d f_{yd}}{V_s}\ EBCS - 21995, section\ 4.5.4(4)$$

$V_s=V_d+Vc$= 924 kN-753.42 kN= 170.58 kN

$$S = \frac{(50.26\ mm)(4750\ mm)\left(360.87\frac{n}{mm^2}\right)}{170.58\times10^3\ N} = 505.06\ mm > s_{max} = 300\ mm, o.k$$

so provide Ø8 mm at 300 $mm\frac{c}{c}$

For region between x=150mm to x=(4000mm – 2149.92 mm)= 1850. 08 mm

V_d= 924 KN

Using Ø8mm,$\therefore a_s = 50.26\ mm^2$

$$Smax = \begin{cases} 2t \\ 300\ mm \end{cases} \quad t = b = 300mm$$

Smax =300 mm

$$S = \frac{A_v d f_{yd}}{V_s}\ EBCS - 2,1995, section 4.5.4(4)$$

Vs=Vd+Vc=924 KN-753.42 KN=170.58 KN

$$S = \frac{(50.26\ mm^2)(4750\ mm)\left(360.87\frac{N}{mm^2}\right)}{170.58\times10^3\ N} = 505.06\ mm > S_{max} = 300\ mm$$

So provide Ø8 mm at 300 $mm\frac{c}{c}$

For region between x=2149.92mm to x= 40`00mm, provide minimum shear reinforcement as Vd≤ V_c

$$S_{max}=\begin{cases} 2t \\ 300\ mm \end{cases} \quad t = b = 300mm$$

Smax =300 mm.

Reinforcement detailing:

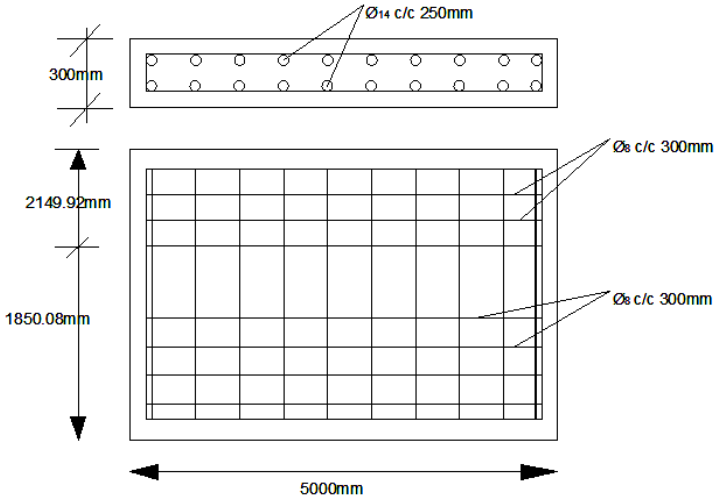

Fig 7: Reinforcement detailing of the reinforced concrete shear wall

IV. CONCLUSION

Even in today's high-tech computer-oriented world with all its sophisticated design capability, there still is a need to undertake approximate analysis of structures. First, it provides a basis for selecting preliminary member sizes because the design of a structure, no matter how simple or complex begins with a tentative selection of members. With the preliminary sizes, an analysis is made to determine if design criteria are met. If not, an analysis of the modified structure is made to improve its agreement with the requirements, and the process is continued until a design is obtained within the limits of acceptability. Starting the process with the best possible selection of member's results in a rapid convergence of the iterative process to the desired solution. It is almost mandatory for the structural engineer to compare several designs before choosing the one most likely to be the best from the points of view of structural economy and how well it minimizes the premium required by the mechanical, electrical, and curtain wall systems. Preliminary designs are therefore very useful in weeding out the weak solutions.

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Synthesis and Anticorrosion for Carbon Steel Of 4-Amino-3,5 Bis (4-Hydroxy-3-Methoxy)-1,2,4-Triazole in Hydrochloric Acid Solution.

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ABSTRACT : *4-amino -3,5bis (4-hydroxy-3-methoxy)-1,2,4-triazole (4-ABHMPT) was synthesized for the first time in the laboratory and his influence on the inhibition of corrosion of mild steel in 1N HCI was investigated by weight-loss and electrochemical impedance spectroscopy. The inhibition efficiency of this compound was found to vary with concentration and temperature . It is found that 4-ABHMPT is good inhibitor for corrosion of mild steel in 1N HCl. The maximum efficiency is about 98% for 4-ABHMPT at 300 mg.l^{-1} concentration. The adsorption of this compound on the steel surface for both acids was found to obey Lagmuir's adsorption isotherm. The values of activation energy and free energy of adsorption indicated chimisorption on mild steel surface.*

KEYWORD(S): *triazole, mild Steel, Corrosion inhibitors, HCl*

I. INTRODUCTION

Acid solutions are widely used for the removal of rust, scale and corrosion products. The corrosion of steel in acid solutions and its inhibition constitute a complex problem of process. Generally, employing organic inhibitors to protect metallic components in these hostile environments is highly cost-effective **[1-6]**. Most of the test inhibitors are organic compounds containing sulfur or nitrogen in their chemical structures. It was found that this kind of compounds is chemically adsorbed on the metal surface forming a barrier for mass and charge transfer and consequently decreasing the rate of corrosion **[7-17]**. Triazole compounds are of interest as corrosion inhibitors for steel in acidic media **[18-25]**. The present work includes the synthesis and the study of corrosion behaviour of mild steel in 1 N HCl solution and its control by using a new triazole : 4-amino-3,5 bis (4-hydroxy-3-methoxy)-1,2,4-triazole. The inhibitive efficiencies of various inhibitors were determined by weight loss and electrochemical impedance spectroscopy. The nature of the inhibitor adsorption process was also studied and discussed.

II. EXPERIMENTAL DETAIL

Characteristic of the molecule :4-amino-3,5bis(4-hydroxy-3-methoxy)-1,2,4-triazole (4-ABHMPT) was synthesized in our laboratory following the procedure reported in the literature**[26]** and characterized by its spectral data. It was well dissolved in aqueous hydrochloric acid solutions. The structure formula of this compound is given in Figure 1:

Figure.1: 4-amino-3,5 bis (4-hydroxy-3-methoxy)-1,2,4-triazole (4-ABHMPT)

Yield = 63%, m.p. = 266°C
^{1}H NMR (DMSO): 4,10 ppm (s,6H); 6,1 ppm (s,2H); 7,1 ppm (d ,2H); 7,7 ppm (d, 2H); 7,8 ppm (s ,2H); 9,7 ppm (s,2H).
^{13}C NMR (DMSO): 133 ppm, 116 ppm , 119 ppm , 122 ppm , 148 ppm , 148 ppm , 154 ppm .
IR(Kbr): 3400, 3350-3000 bande large: 1700; 1600; 1550; 1500; 1400; 1300.

The elementary analysis of the element is given in Table 1.

Table.1: Elementary analysis of the element

% C $_{cal}$	%C $_{found}$	% H $_{cal}$	%H $_{found}$	% N $_{cal}$	% N $_{fond}$
58.54	58,50	4.88	4.79	17,17	17,17

Carbon steel samples with the following composition: 0.18 per cent (C), 0.02 per cent (Si), 0.47 per cent (Mn), 0.01 per cent (P), 0.02 per cent (S) and the remainder iron, were used in the studies. The samples were polished with emery papers from grade 120 to 1200, washed with distilled water, degreased with ethanol and dried at room temperature prior to each experiment.In weight loss experiments, the cleaned rectangular carbon steel specimens of size 50×20×0.6 mm were weighed before and after immersion in 1M HCl for 24 hours at 25°C in the absence and presence of the inhibitor. The weight loss was determined in $mg.l^{-1}.hr^{-1}$.

Solution of 1 N HCl was prepared from an analytical reagent grade 37% HCl and bidistilled water and was used as corrosion media.

Impedance measurements : Electrochemical impedance spectroscopy tests were conducted using an electrochemical measurement system (Tacussel) which comprised a digital potentiostat model Z computer. The impedance measurements were performed at the free corrosion potential (E_{corr}) over a frequency range of 100 kHz to 10 mHz, with a signal amplitude perturbation of 10 mV. Nyquist plots were obtained from the results of these experiments. Values of the charge transfer resistance (R_t) were obtained from these plots by determining the difference in the values of impedance at low and high frequencies, as suggested by Tsuru et al. **[27]**. Values of the double-layer capacitance C_{dl} were calculated from the frequency at which the impedance imaginary component $-Z_i$ was maximum. The Inhibition efficiencies *IE%* per cent were calculated using the following equation:

$$IE(\%) = \left(\frac{R_0^{-1} - R_t^{-1}}{R_0^{-1}} \right) \qquad (1)$$

Where R_t and R_0 are the charge transfer resistance values without and with inhibitor, respectively.

The percentage inhibition (*IE* %) of mild steel was determined from weight loss as follows:

$$IE = \left(\frac{w_0 - w}{w_0} \right) \times 100 \qquad (2)$$

where w_0 and w are the corrosion rate of steel due to the dissolution in 1M HCl in the absence and the presence of definite concentrations of inhibitor, respectively.

III. RESULTS AND DISCUSSION

Weight loss measurements

Table 2 gives the values of percentage inhibition efficiency and corrosion rate obtained by weight-loss method with addition of different concentrations of 4-ABHMPT for 24 h of immersion time in 1N HCl at room temperature (25°C).

Table.2 Corrosion parameters obtained from weight loss data for carbon steel in 1N HCl (25°C) containing different concentrations of 4 ABHMPT

Concentration ($mg.L^{-1}$)	Corrosion rate ($mg.cm^{-2}.h^{-1}$)	Inhibition efficiency *IE(%)*
Blank	914	--
50	230	74.83
100	82	91.02
200	28	96.93
300	10	98.90

It can be observed that inhibition efficiency increased with increases in concentration for both the inhibitors. Inhibition efficiency of 4-ABHMPT was estimated to be better than 74.83 per cent in 1N HCl even at very low concentration (50 $mg.l^{-1}$), and the optimum concentration for maximum efficiency was found to be 300 $mg.l^{-1}$.

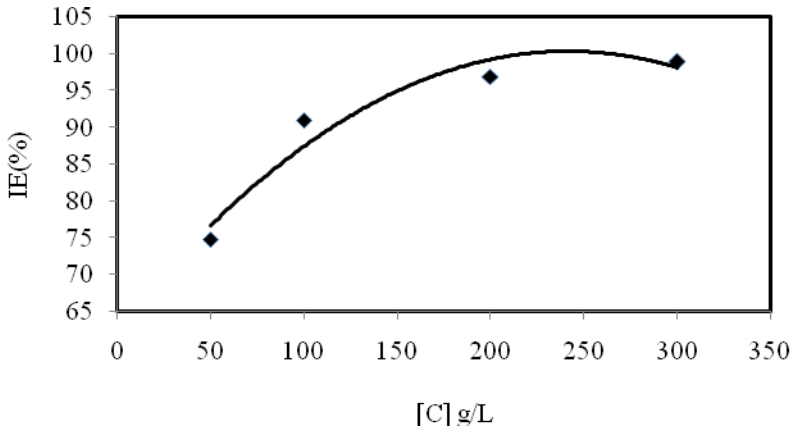

Figure.2: *Inhibition efficiency of 4-ABHMPT on mild steel in N HCl as a function of concentration*

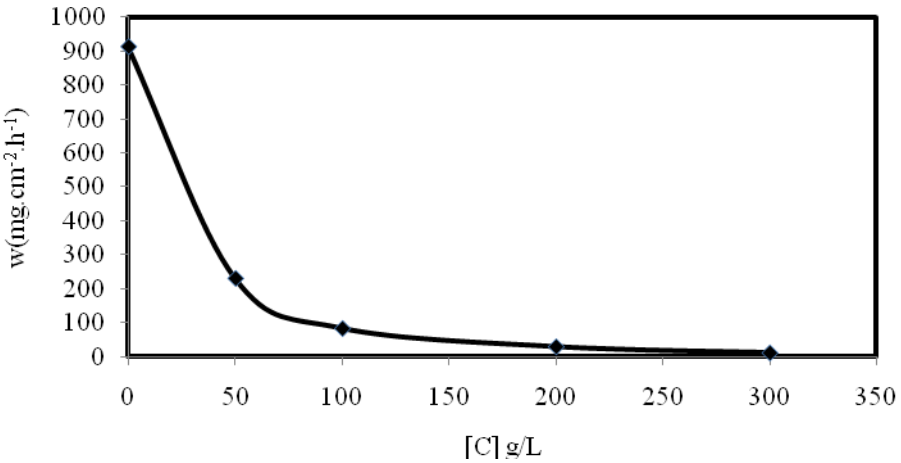

Figure.3: *Corrosion rate of mild steel in 1N HCl as a function of inhibitor concentration*

Temperature can influence the interaction between the carbon steel and acidic media without and with the inhibitor. Table.3 presents the corrosion rate and the inhibition efficiency for carbon steel in 1N HCl in the absence and presence of 300 mgl^{-1} of the inhibitor in the temperature range 25–55°C. The values of inhibition

efficiency of the inhibitor were very similar over the temperature range studied. The corrosion rate for carbon steel increased rapidly with temperature in the absence of the inhibitor. The result confirmed that this Triazole compound can act a corrosion inhibitor for carbon steel in the range of temperature studied.

Table.3 The influence of temperature on the corrosion parameters for mild steel in the absence and presence of 300 mg.l-1 4-ABHMPT from weight-loss measurements

Temperature (K)	Concentration of 4-ABHMPT ($mg.L^{-1}$)	Corrosion rate ($mg.cm^{-2}.h^{-1}$)	Inhibition efficiency *IE%*
298	0.0	914	-
	300	10	98.90
308	0.0	1812	-
	300	270	85.09
318	0.0	2275	-
	300	532	76.61
328	0.0	2985	-
	300	808	72.93

The corrosion can be regarded as an Arrhenius-type process. The values of activation energy *Ea* were calculated using the Arrhenius equation:

$$Ln(w) = A - \frac{Ea}{RT} \qquad (3)$$

Where *Ea* is the apparent activation energy for the corrosion process, A is the Arrhenius pre-exponential constant.

When the corrosion rate data obtained from the weight-loss measurements in Table 4 is used and its Ln(*w*) is plotted vs 1/T, straight lines are obtained and values of *Ea* are given as the slopes of the lines. The values of Ea for mild steel in 1N HCl, in the absence and presence of 300 mg 4-ABHMPT, are then obtained.

Table.4 *variation of the Ln(w) in the presence and absence of the inhibitor*

T(K)	1000 /T	Ln (w_0)	Ln (*w*)
298	3,35	6,82	2,3
308	3,25	7,5	5,6
318	3,14	7,73	6,28
328	3,05	8	6,69

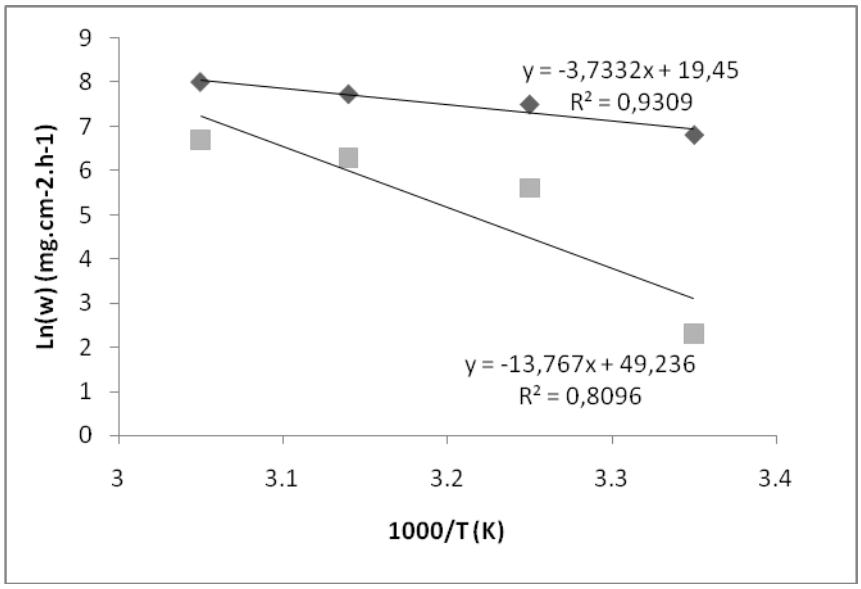

Figure.4: *Ln(w) vs 1/T for mild steel in 1N HCl in the absence (bleu) and in the presence (rouge) of 300 mg of 4-ABHMPT*

Values of the *Ea* in presence and absence of the inhibitor are 31 and 114 kJ.mol^{-1}, respectively. The decrease in apparent free energy of activation in the presence of the triazole compound may be attributed to the chemisorptions of the inhibitor on mild steel surface, and the corrosion process corresponds to a different mechanism of steel dissolution in the presence of the inhibitor **[28]**.

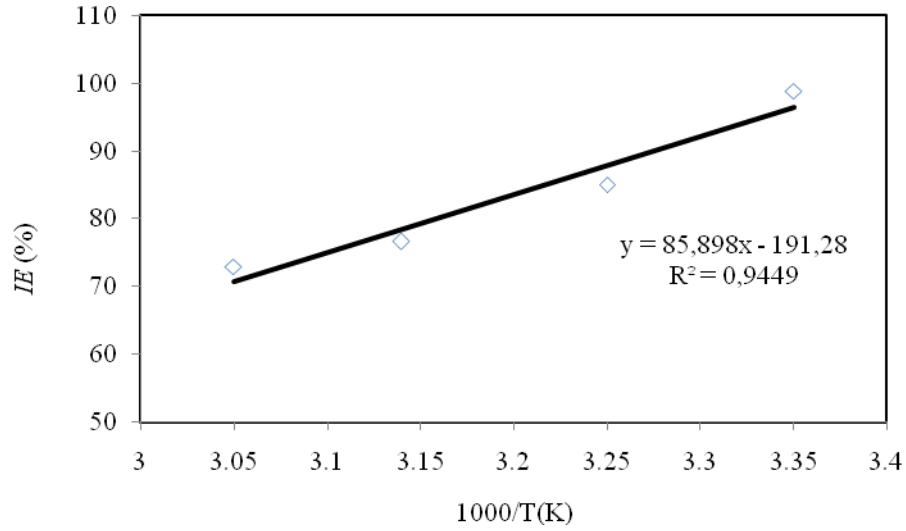

***Figure.5**: Inhibition efficiency of 300 mg.L^{-1} of 4-ABHMPT on mild steel in 1N HCl as a function of temperature.*

IV. ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

Impedance diagrams obtained for frequencies ranging from 10kHz to 20 mHz at open circuit potential for carbon steel in 1N HCl in the absence and in the presence of various concentrations of 4-ABHMPT are shown in Figure 2. The diagrams are not perfect semicircles. The distortion has been attributed to frequency dispersion **[29]**.The fact that impedance diagrams have an approximately semicircular appearance shows that the corrosion of steel is controlled by a charge transfer process. Table.5 gives the

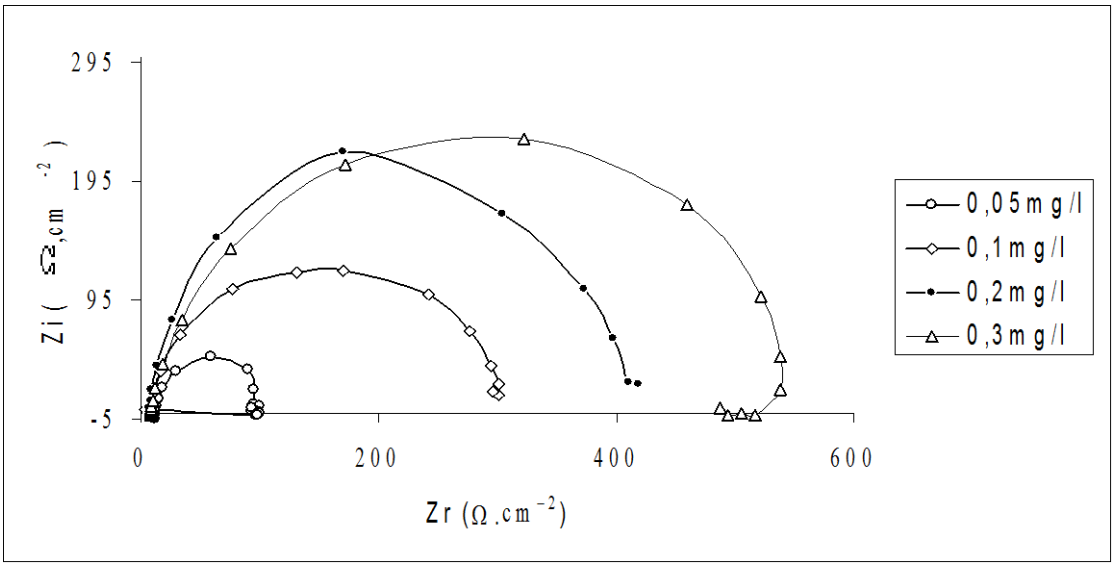

Figure.6: Nyquist diagrams of mild steel in 1M HCl without and with different concentrations of 4-ABHMPT

Values of the charge transfer resistance R_t, double layer capacitance C_{dl}, and inhibition efficiency obtained from the above plots. It could be seen from Table V that the charge-transfer resistances, R_t,, increase with increasing concentration of 4-ABHMPT and the inhibiting power is higher. A large charge-transfer resistance is associated with a slower corroding system **[30]** Furthermore, a better protection provided by an

inhibitor is associated with a decrease in capacitance of the metal **[31]**. The decrease in Cdl, which results from a decrease in local dielectric constant and/or an increase in the thickness of the electrical double layer, suggests that the triazole act by adsorption on the metal/solution interface [32]. As could be seen from Table V Cdl is decreased with increasing triazole concentration. The greatest inhibition was observed at concentration of 300 mg.l^{-1}. The impedance study also confirmed the inhibiting character of 4-ABHMPT obtained with weight loss measurements.

Adsorption isotherms

The results obtained with different concentrations are summarized in table 5.

Table.5 *Impedance parameters for corrosion of mild steel in 1 N HCl with different concentrations of 4-ABHMPT.*

4-ABHMPT(mg/l)	R_t (Ωcm^{-2})	C_{dl}(μFcm^{-2})	*IE*(%)	θ
Blank	16.31	517.14	--	--
50	100.86	49.71	83.83	0.90
100	302.29	44.47	94.61	0.91
200	410.16	40.26	96.04	0.92
300	550.00	22.40	97.06	0.96

Plots of R_t and C_{dl} against the concentration of 4-ABHMPT are shown in Figure.6. The figures.6 indicating that higher the concentration of inhibitor, the higher the charge transfer resistance and more the double layer capacitance decreases, up to a concentration of 300 mg. l^{-1}, where it is equal to 550 R_t (Ωcm^{-2}) and C_{dl} is equal to 22.40 (μFcm^{-2}) .

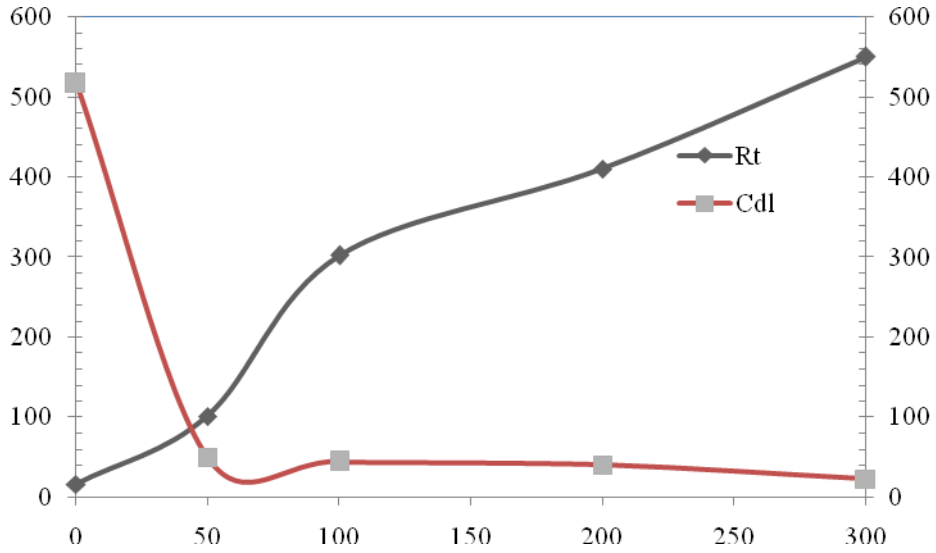

Figure.7: The double layer capacitance and the charge transfer resistance for mild steel in 1N HCl containing different concentrations of 4-ABHMPT

The adsorption isotherm : Surface coverage (θ) values have been obtained from the values of inhibition efficiency for different concentrations of 4-ABHMPT. It can be seen from Figure 8 that a plot of log C vs θ of the compound gives a straight line for both the acids. This observation clearly brings out the fact that the adsorption of 4-ABHMPT on the metal surface from both the acids obeys Lagmuir's adsorption.
In order to obtain the adsorption isotherm, the degree of surface coverage (θ) for the various concentrations of the inhibitor has been calculated using the following equation:

$$\theta = \frac{C_{dl^\circ} - C_{dl_{inh}}}{C_{dl^\circ}} \quad (4)$$

where C_{dl° and $C_{dl(inh)}$ are the double layer capacitance in absence and presence of the inhibior, respectively.

The values of θ were tested graphically for fitting a suitable adsorption isotherm. The plot of Cinh/θ versus yields a straight line with slope equal the unity as shown in Fig. VII. The experimental results are in good agreement with the Langmuir adsorption isotherm, which is represented by the following equation:

$$\frac{C_{inh}}{\theta} = \frac{1}{K_{ads}} + C_{inh} \qquad (5)$$

The mechanism of the inhibition of corrosion of carbon steel in 1N HCl may be explained on the basis of adsorption. In aqueous acidic solutions, the investigated triazole can exist as cationic species. These cations can adsorb on the cathodic sites of the carbon steel surface and cause a decrease in the rate of evolution of hydrogen. The results of the present work indicate that triazole compounds adsorb on the metal surface through a process of chemisorption. The inhibitor film could prevent the attack of Cl^- ions, thereby retaining the M-O-M and M-O-H…O-M bonds.The adsorption of the protonated form of the triazole onto the iron surface occurs by establishing "donor/acceptor" interactions between the π electrons of the heterocyclic compound and the vacant "d "orbitals of iron surface atoms, which involves displacement of water molecules from the metal surface and the sharing of electrons between the nitrogen atoms and the metal surface.
The adsorption of organic substance (triazole in this case) at the metal/solution interface may be written according to the following displacement reaction [33]:

$$Surfactant\ (soluble) + nH_2O \rightarrow surfactant + nH_2O \qquad (6)$$

Where n is the number of water molecules removed from the metal surface for each molecule of inhibitor adsorbed.

Clearly, the value of n depends on the cross-section area of the triazole molecule. Adsorption of the triazole molecule occurs because the interaction energy between the inhibitor and the metal surface is higher than the interaction energy between water molecules and the metal surface **[23]**.

The compound 4-ABHMPT has an additional electron releasing group ($-OCH_3$), which probably may also be attached there by accounting for the observed high *IE*.

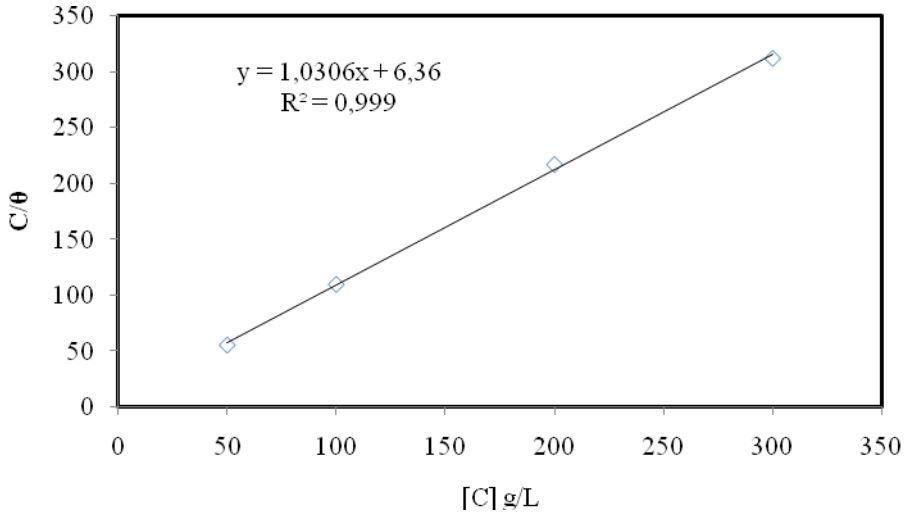

Figure.8: *Langmuir adsorption plots for mild steel in 1N HCl containing different concentrations of 4-ABHMPT: (a) the charge transfer resistance, (b) the double layer capacitance.*

V. CONCLUSION

4-ABHMPT behaves as an effective inhibitor for carbon steel corrosion in hydrochloric acid media. The inhibition efficiency of the inhibitor increases with the inhibitor concentration, but is temperature-independent. The adsorption of the inhibitor compound on carbon steel surface obeys Langmuir isotherm.

The results of (EIS) measurements indicated that, as the concentration of the inhibitor increases, the charge transfer resistance (*R*t) is increased, while the double layed capacitance is decreased. The inhibition is due o the adsorption of the inhibitor molecules on mild steel surface and blocking is active sites.

The results obtained from different experimental studies are in good agreement.

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Recuperation of data node: An alternative way to ensure the data recovery in Hadoop architecture.

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ABSTRACT: *Hadoop is a software framework that supports data intensive distributed application. Hadoop creates clusters of machine and coordinates the work among them. It include two major component, HDFS (Hadoop Distributed File System) and MapReduce. HDFS is designed to store large amount of data reliably and provide high availability of data to user application running at client. It creates multiple data blocks and store each of the block redundantly across the pool of servers to enable reliable, extreme rapid computation. MapReduce is software framework for the analyzing and transforming a very large data set in to desired output. This paper focus on how the data can be recovered by a variation in the architecture ensuring the continuation of computing if the DataNode fails.*

KEYWORDS: *Hadoop, HDFS, clustering*

I. INTRODUCTION

Hadoop distribute and parallelize data processing across many nodes in a compute cluster, speeding up large computations and hiding I/O latency through increased concurrency. It is well suited for large data processing like searching and indexing in huge data set. Hadoop includes Hadoop Distributed File System (HDFS) and MapReduce. It is not possible for storing large amount of data on a single node, therefore Hadoop use a new file system called HDFS which split data into many smaller parts and distribute each part redundantly across multiple nodes. MapReduce is a software framework for the analysis and transformation of very large data sets. Hadoop uses MapReduce function for distributed computation. MapReduce programs are inherently parallel. Hadoop take advantage of data distribution by pushing the work involved in analysis to many different servers. Each server runs the analysis on its own block from the file. Results are combined in to single result after analyzing each piece. MapReduce framework takes care of scheduling tasks, monitoring them and re-executes the failed tasks [1].

This paper gives an overview of an alternative way to recuperate the DataNode loss in the hadoop architecture.

II. HADOOP DISTRIBUTED FILE SYSTEM (HDFS)

HDFS is a distributed file system designed to run on commodity hardware. HDFS is highly fault tolerant and is designed to be deployed on low cost hardware. HDFS is suitable for applications that have large dataset.

HDFS maintain the metadata in a dedicated server called NameNode and the application data are kept in separated nodes called DataNode. These server nodes are fully connected and they communicate using TCP based. protocols. In HDFS the file content are replicated on multiple DataNodes for reliability.

2.1 NameNodes

HDFS name space is a hierarchy of files and directories. Files and directories are represented on the NameNode using inodes which record attributes like permissions modification and access time, namespace and disk space quotas. The file content is split into blocks (typically 128MB) each block of file is independently replicated at multiple DataNodes. NameNode maintains the mapping of file blocks to DataNodes. An HDFS client waiting to read a file first contact the NameNode for the locations of data blocks comprising the file and

then reads block content from the DataNode closest to the client. When writing the data, the client requests the NameNodes to nominate a set of DataNodes to host the block replicas.

2.2 DataNodes

Each data block is represented by two files in the host native file system, one file contains the data itself and the other contains block‟s metadata. Handshake is performed between all DataNodes and the NameNode at startup. During handshake, the namespace ID and software version of DataNode is verified with the NameNode. If it does not match with that of NameNode, then that DataNode will automatically shuts down. Namespace ID is assigned to the file system instance when it is formatted. A newly initialized DataNode without any namespace ID can join the cluster and the will receive the cluster‟s namespace ID. Each DataNode persistently store its unique storage ID, which help to recognize it after restarting it with a different IP address or port. Each DataNode send block report to the NameNode to identify the block replicas in its possession. First block report is send during DataNode registration and the subsequent block reports are sent at every hour. This helps the NameNode to keep an up-to-date view of where block replicas are located on the cluster.

Each DataNode send heartbeat to NameNode to confirm that it is operating and its block replicas are available. Default heartbeat interval is 3 seconds and if no heartbeat signal is received at NameNode in 10 minutes, the NameNode will mark the DataNode as unavailable. NameNode schedules creation of new replica of those blocks on another DataNode. NameNode use replies to the heartbeat to send instruction to DataNodes [1].

2.3 CopyNode

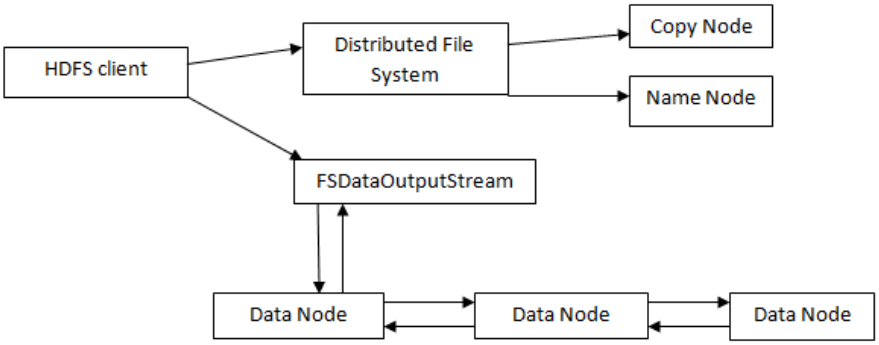
Copy node is a space in the hadoop architecture where the data of the current data node is stored. During handshake, the namespace ID and software version of DataNode is verified with the NameNode. Namespace ID is assigned to the file system instance when it is formatted. Copy node is primarily a defensive mechanism when the write operation fails on the data node for any reason.

III. ANATOMY OF FILE WRITE

Client creates the file on DistributedFileSystem (step 1). DistributedFileSystem makes an RPC call to the copynode to create a new file in the filesystem's namespace, with no blocks associated with it (step 2). DistributedFileSystem makes an RPC call to the namenode to create a new file in the filesystem's namespace, with no blocks associated with it (step 3).

The namenode performs various checks to make sure the file doesn't already exist, and that the client has the right permissions to create the file. If these checks pass, the namenode makes a record of the new file; otherwise, file creation fails and the client is thrown an IOException. The DistributedFileSystem returns an FSDataOutputStream for the client to start writing data to. Just as in the read case, FSDataOutputStream wraps a DFSOutputStream, which handles communication with the datanodes and namenode.As the client writes data (step 4), DFSOutputStream splits it into packets, which it writes
to an internal queue, called the *data queue*.

The data queue is consumed by the Data Streamer, whose responsibility it is to ask the namenode to allocate new blocks by picking a list of suitable datanodes to store the replicas. The list of datanodes forms a pipeline—we'll assume the replication level is three, so there are three nodes in the pipeline. The DataStreamer streams the packets to the first datanode in the pipeline, which stores the packet and forwards it to the second datanode in the pipeline. Similarly, the second datanode stores the packet and forwards it to the third (and last) datanode in the pipeline (step 5). DFSOutputStream also maintains an internal queue of packets that are waiting to be acknowledged by datanodes, called the *ack queue*. A packet is removed from the ack queue only when it has been acknowledged by all the datanodes in the pipeline (step 6)



If a datanode fails while data is being written to it, then the following actions are taken, which are transparent to the client writing the data. First the pipeline is closed, and any packets in the ack queue are added to the front of the data queue. Since the current data is already present in the copy node, the data is copied into all the three data nodes. As long as dfs.replication.min replicas (default one) are written, the write will succeed, and the block will be asynchronously replicated across the cluster until its target replication. Factor is reached (dfs.replication, which defaults to three). When the client has finished writing data, it calls close () on the stream (step 7). This action flushes all the remaining packets to the datanode pipeline and waits for acknowledgments before contacting the namenode to signal that the file is complete (step8). The namenode already knows which blocks the file is made up of (via DataStreamer asking for block allocations), so it only has to wait for blocks to be minimally replicated before returning successfully [2].

IV. CONCLUSION

Though it is unlikely, that multiple datanodes fail while a block is being written, it should be a defensive practice to not leave that to sheer chance. The change in the hadoop architecture ensures continual processing without a sudden breakdown.

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Comparison of Different Classification Techniques Using WEKA for Hematological Data

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ABSTRAC : *Medical professionals need a reliable prediction methodology to diagnose hematological data comments. There are large quantities of information about patients and their medical conditions. Generally, data mining (sometimes called data or knowledge discovery) is the process of analyzing data from different perspectives and summarizing it into useful information. Data mining software is one of a number of analytical tools for analyzing data. It allows users to analyze data from many different dimensions or angles, categorize it, and summarize the relationships identified. Weka is a data mining tools. It contains many machine leaning algorithms. It provides the facility to classify our data through various algorithms. Classification is an important data mining technique with broad applications. It classifies data of various kinds. Classification is used in every field of our life. Classification is used to classify each item in a set of data into one of predefined set of classes or groups. In this paper we are studying the various Classification algorithms. The thesis main aims to show the comparison of different classification algorithms using Waikato Environment for Knowledge Analysis or in short, WEKA and find out which algorithm is most suitable for user working on hematological data. To use propose model, new Doctor or patients can predict hematological data Comment also developed a mobile App that can easily diagnosis hematological data comments. The best algorithm based on the hematological data is J48 classifier with an accuracy of 97.16% and the total time taken to build the model is at 0.03 seconds. Naïve Bayes classifier has the lowest average error at 29.71% compared to others.*

Keywords *-Hematological data, Data Mining, J48 Decision tree, Multilayer Perception, Naïve Bayes.*

I. INTRODUCTION

Data mining technique is a process of discovering pattern of data. The patterns discovered must be meaningful in that they lead to some advantage. The overall goal of the data mining process is to extract information from a data set and transform it into an understandable data in order to aid user decision making [9]. Data mining is being used in several applications like banking, insurance, hospital and Health informatics. In case of health informatics, Data mining plays a vital role in helping physicians to identify effective treatments, and Patients to receive better and more affordable health services. In hematology laboratory, it has become a powerful tool in managing uncountable laboratory information in order to seek knowledge that is underlying or within any given information.

Comparison of Different Classification Techniques Using WEKA for Hematological Data Comment is a challenging and interesting task in medical research area. To find out which classification algorithms is batter it is very difficult to compare different classification algorithms in different dataset. Our dissertation concerns with to make a mobile App, which is capable to Diagnose Hematological data comments. With this purpose to perform a better approach, we divide this problem of Hematology Data comments into three phases: Data Collection, Classification algorithm, and developed mobile App. We proceed in the following ways to achieve our purpose successfully.

- We are going to collect hematological data from oracle 10g database.
- We are going to apply hematological data in WEKA then find three classification algorithms performance.

- Finally developed a mobile App.

We studied various journals and articles regarding performance evaluation of Data Mining algorithms on various different tools, some of them are described here.

- There are related works using data mining techniques to diagnose several types of diseases and phenomena, such as Automated Diagnosis of Thalassemia Based on Data Mining Classifiers, etc. And many other tried to find their own formula. This paper presents an investigation for thalassemia existence by using data mining classifiers depending on CBC. They do that but they say MCV is the main feature. They should need use Hemoglobin is the main feature to classified thalassemia, [11].
- K.Rajesh et al [14] in their paper "Application of Data Mining Methods and Techniques for Diabetes Diagnosis." they provide a comparative analysis of different algorithms. This project aims for mining the relationship in diabetes data for efficient classification. But they need proposed a model that can diagnose diabetes dataset.
- Satish Kumar David et al [15] in his research paper "Comparative Analysis of Data Mining Tools and Classification Techniques using WEKA in Medical Bioinformatics." Studied the performance of Tree Random Forest, J48 decision tree, Bayes Naïve Bayes and Lazy.IBK. In this paper, they compared algorithms based on their accuracy, learning time and error rate. They observed that there is a direct relationship between execution time in building the tree model and the volume of data records, while there is also an indirect relationship between execution time in building the model and the attribute size of the data sets. Through experiment, they conclude that Bayesian algorithms have better classification accuracy over and above compared algorithms.
- Salvitha et al [3] in their article "Evaluating Performance of Data Mining Classification Algorithm in Weka". They provide performance of different dataset use data mining classification. The main aim of this paper judge the performance of different data mining classification algorithms on various datasets.
- Nookala et al [6] in their article "Performance Analysis and Evaluation of Different Data Mining Algorithms used for Cancer Classification." In this study, they have made a comprehensive comparative analysis of 14 different classification algorithms and their performance has been evaluated by using 3 different cancer data sets. The results indicate that none of the classifiers outperformed all others in terms of the accuracy when applied on all the 3 data sets. Most of the algorithms performed better as the size of the data set is increased. They recommend the users not to stick to a particular classification method and should evaluate different classification algorithms and select the better algorithm.
- Vaithiyanathan et al [1] in their paper "comparison of different classification techniques using different datasets". They used three dataset from benchmark data set (UCI) and they used four classifier algorithms J48, Multilayer Perceptron, Bayes Net, and Naïve Bayes Update. This work has been carried out to make a performance evaluation above algorithms.
- Tiwari et al [7] in their research paper "Performance analysis of Data mining algorithms in Weka". The aim of their paper is to judge the accuracy of different data mining algorithms on various data sets.
- Bin Othman et al [10] "Comparison of different classification techniques using WEKA for breast cancer". In this paper they present the comparison of different classification techniques using Waikato Environment for Knowledge Analysis or in short, WEKA. The aim of their paper is to investigate the performance of different classification or clustering methods for a set of large data. The algorithm or methods tested are Bayes Network, Radial Basis Function, Pruned Tree, Single Conjunctive Rule Learner and Nearest Neighbors Algorithm. The best algorithm based on the breast cancer data is Bayes network classifier with an accuracy of 89.71% and the total time taken to build the model is at 0.19 seconds. Bayes network classifier has the lowest average error at 0.2140 compared to others.
- All the previous works tried to makes a model to diagnosis diesis, and most of them just try to use one data mining technique they consider it the best one without any comparison with the other techniques in the domain. In this study, I will used more than one classifier to get most significance one, and make a model that can easily diagnosis hematological data comments.

The main contributions of the thesis are summarized follow:

- J48 based on decision tree algorithm has been achieved to classify different types of hematological data comment.

- Naïve Bayes algorithm has been obtained for high probability of hematological data comment.

- Multilayer perceptron algorithm has been obtained mathematical or computational model for information processing based on a connectionist approach.
- A comparison with different classification techniques has made with optimal features to show which method is appropriate for hematological data.

II. MATERIAL AND METHODS

We have used the popular, open-source data mining tool Weka (version 3.7.11) for this analysis. Two different data sets have been used and the performance of a comprehensive set of classification algorithms (classifiers) has been analyzed. The analysis has been performed on a TOSHIBA Windows 7 Enterprise system with Intel® Core ™ i5 CPU, 2.30 GHz Processor and 3.00 GB RAM. The data sets have been chosen such that they differ in size, mainly in terms of the number of attributes.

The hematological parameter are composed of White blood cell count (WBC), Red blood cell count (RBC), Hemoglobin (Hb), Hematocrit (Hct), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC), Platelet count (PLT), Neutrophil count (NEU), Lymphocyte (LYMP), Monocyte (MONO), Eosinophil (EO), and Basophil (BASO) (SysMex 1000i Sysmex corporation, Kobe, Japan). Hematological data was manually evaluated by medical technologist who has a license certification from the State medical Faculty of Bangladesh. Collected data are assigned to Several labels: Suggestive of anaemia of chronic disorder, Eosinophilia, Microcytic hypochromic anaemia, Normocytic anaemia, Neutrophil leucocytosis, Neutrophilia, Non-specific findings, High ESR.

2.1 Dataset and Preprocessing

The experiment1 dataset consists of 600 samples and experiment2 dataset consists of 298 samples. Its attributes represents the CBC features as in Table 1, some features; such as the sex, age, and some others features which are dropped due the privacy of the blood sample's owner, and finally it contain diagnoses attribute which represent the target label of the sample, it has several labels: Suggestive of anaemia of chronic disorder, Eosinophilia, Microcytic hypochromic anaemia, Normocytic anaemia, Neutrophil leucocytosis, Neutrophilia, Non-specific findings, High ESR, and Other which represented any other hematological data comments.

Table 1: CBC Test Features

Shortcut	Term	Male Normal Value	Female Normal Value
WBC (cmm)	White Blood Cell	4000-11000	
RBC (million/cmm)	Red Blood cell	5.0±0.5	4.3±0.5
HB(g/dl)	Hemoglobin	15.0±2.0	13.5±1.5
HCT(l/l)	Hematocrit	0.45±0.05	0.41±0.05
MCV(ft)	Mean Cellular Volume	92±9	
MCH(pg)	Mean Cellular Hemoglobin	29.5±2.5	
MCHC(g/dl)	Mean Cellular Hemoglobin Concentration	33.0±1.5	
PLT(/Cmm)	Platelet Count	150000-400000	
NEU	Neutrophils(%)	40-75	
LYMP	Lymphocytes(%)	20-40	
MONO	Monocytes(%)	2-10	
EO	Eosinophils(%)	2-6	
BO	Basophils(%)	<1.0	

In the preprocessing of the dataset we eliminate useless attributes, refill the missing values and remove/refill the outlier values on the outlier samples. Table 2 represent the dataset attributes which we used in our investigation.

Table 2: Dataset Attributes

Attribute	Data type	Attribute role
SEX	Binomial	Regular
WBC	Integer	Regular
RBC	Integer	Regular
HB	Integer	Regular
HCT	Integer	Regular
MCV	Integer	Regular
MCH	Integer	Regular
MCHC	Integer	Regular
PLT	Integer	Regular
NEU	Integer	Regular
LYMP	Integer	Regular
MONO	Integer	Regular
EO	Integer	Regular
BO	Integer	Regular
Hematological Comments	Nominal	Label

2.2 Classification Methods

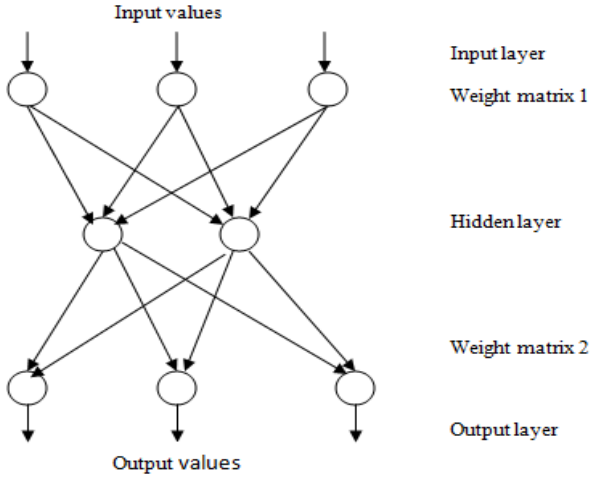
Three candidate classifiers are considered in this study: Decision Tree (J48), Naïve Bayes, and Neural Network (Multilayer Perceptron)

2.2.1 J48 Algorithm

J48 algorithm is called as optimized implementation of the C4.5 or improved version of the C4.5. The output given by J48 is the Decision tree. A Decision tree is same as that of the tree structure having different nodes, such as root node, intermediate nodes and leaf node. Each node in the tree contains a decision and that decision leads to our result as name is decision tree. Decision tree divide the input space of a data set into mutually exclusive areas, where each area having a label, a value or an action to describe or elaborate its data points. Splitting criterion is used in decision tree to calculate which attribute is the best to split that portion tree of the training data that reaches a particular node [1].

2.2.2 Multilayer Perceptron

The single-layer perceptron can only classify linearly separable problems. For non-separable problems it is necessary to use more layers. A Multilayer (feedforward) network has one or more hidden layers whose neurons are called hidden neurons. The Fig.1 illustrates a multilayer network with one input layer, one hidden layer and one output layer.



Figurer 1: multilayer perceptron

2.2.3 Naive Bayes

Naive Bayes implements the probabilistic Naïve Bayes classifier. Naïve Bayes Simple uses the normal distribution to model numeric attributes. Naïve Bayes can use kernel density estimators, which develop performance if the normality assumption if grossly correct; it can also handle numeric attributes using supervised discretization. Naïve Bayes Updateable is an incremental version that processes one request at a time. It can use a kernel estimator but not discretization [13].

III. RESULTS AND DISCUSSION

In this investigation, the experiment using the data mining classifiers will be divided into two parts: the experiment with full and reduced features. The results from these two parts and a detailed classification accuracy analysis emphasizing on the classification errors will be presented in following Sections. Three experiments were conducted in each type: the first one is to measure the performance of the decision tree classifier; the second one is to measure the performance of the naïve bayes classifier, the third one to measure the performance of the neural network. The feed-forward back-propagation neural network classifier was adjusted with 500 training cycles, learning rate 0.3, and momentum 0.2.

3.1 Experiments with full features

In these experiments we used the whole records attributes of each sample. The decision tree classifier gives a result with general accuracy of 97.16%, the naïve bayes classifier gives a result with general accuracy of 70.28%, and finally the neural network classifier gives a result with general accuracy of 86.55% as shown in Fig.2,Table3.

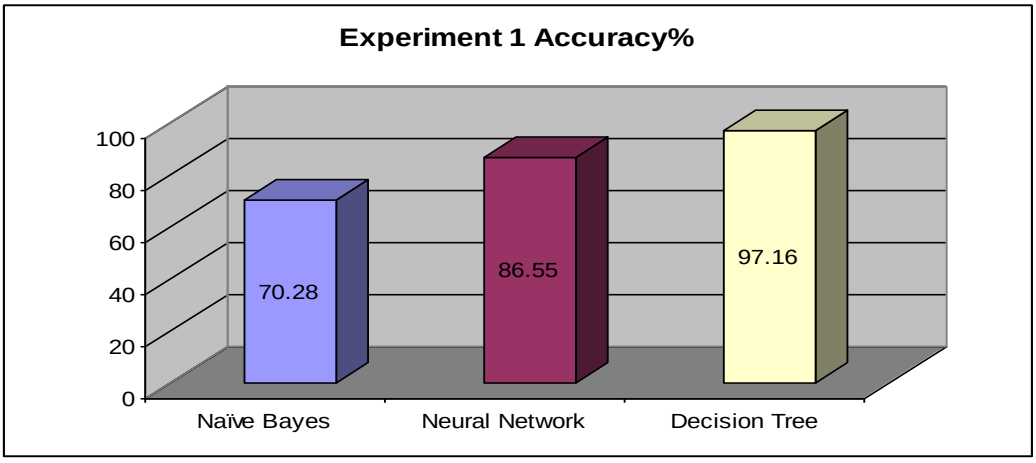


Figure 2: experiment 1 classifiers accuracy values

Table 3: Simulation Result of Each Algorithm for Exprement1

Algorithm (Total instances,425)	Correctly Classified Instances %(Value)	Incorrectly Classified Instances %(Value)	Time Taken (seconds)	Kappa statistic
J48 Decision tree	97.16 %(412)	2.83(12)	0.03	0.9648
Multilayer Perception	86.5566 %(367)	13.4434 %(57)	2.29	0.8346
Naïve Bayes	70.28 %(298)	29.71 %(126)	0.03	0.6329

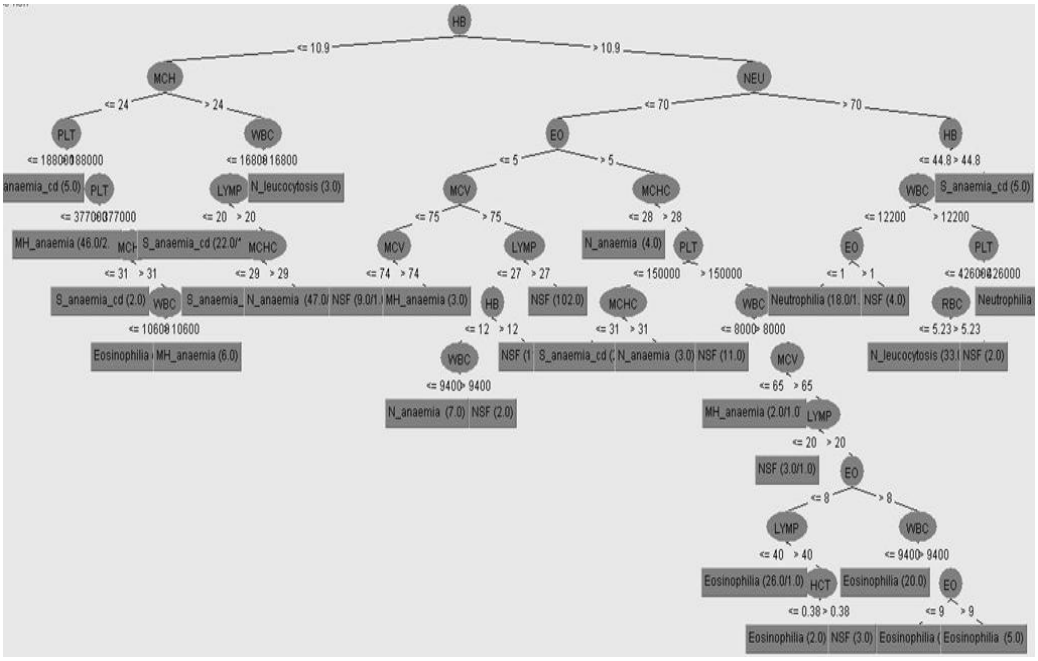


Figure 3: decision tree form experiment 1

3.2 Experiment with reduced features

In our experiments we used the whole record's attributes of each sample as in Table 4.The Decision Tree classifier gives a result with general accuracy: 94.27%, while the Naïve Bayes classifier gives a result with general accuracy: 70.03% and the Neural Network classifier give a result with general accuracy: 78.45% as shown in Fig.4, Table 4.

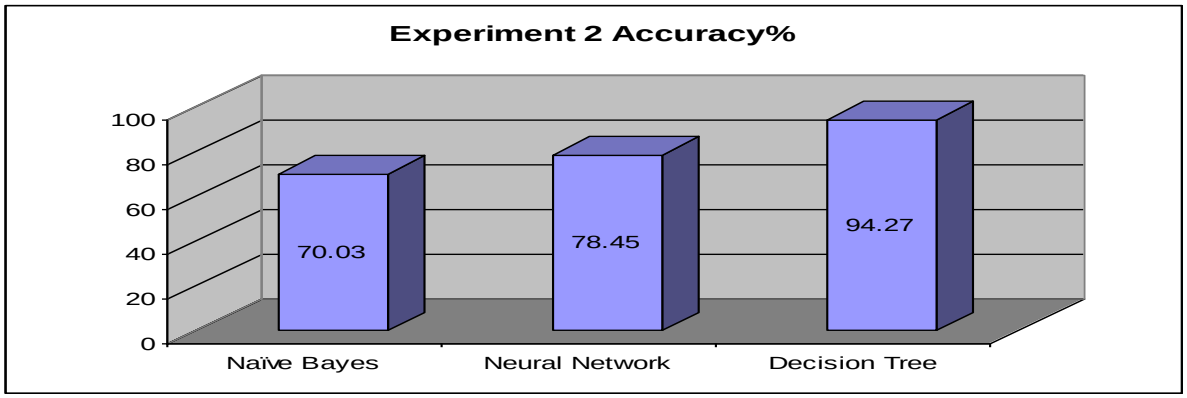


Figure 4: experiment 2 classifiers accuracy values

Table 4: Simulation Result of Each Algorithm for Exprement2

Algorithm (Total instances,298)	Correctly Classified Instances %(Value)	Incorrectly Classified Instances %(Value)	Time Taken (seconds)	Kappa statistic
J48 Decision tree	94.2761 %(280)	5.7239 %(17)	0.03	0.9258
Multilayer Perception	78.4512 %(233)	21.5488 %(64)	1.76	0.7137
Naïve Bayes	70.0337 %(208)	29.9663 %(89)	0.01	0.5981

Table 5: Comparison on Various Datasets Depend Accuracy and Classifiers.

Name of the classifier	Experiment 1	Experiment 2
J48 Decision tree	97.16	94.2761
Multilayer Perception	86.5566	78.4512
Naïve Bayes	70.28	70.0337

Based on the above Fig.2, 4 and Table 5, we can clearly see that the highest accuracy is 97.16% and the lowest accuracy is 70.03%. We can say that J48 Decision tree is batter.

IV. CONCLUSION

As a conclusion, we have met our objective which is to evaluate and investigate three selected classification algorithms based on Weka. The best algorithm based on the hematological data is J48 classifier with an accuracy of 97.16% and the total time taken to build the model is at 0.03 seconds. Naïve Bayes classifier has the lowest average error at 29.71% compared to others. These results suggest that among the machine learning algorithm tested, Naïve Bayes classifier has the potential to significantly improve the conventional classification methods for use in medical or in general, bioinformatics field.

We would like to develop web based software for performance evaluation of various classifiers where the users can just submit their data set and evaluate the results.

V. ACKNOWLEDGEMENTS

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Field Study of Drilling Bits Performance Optimization Using a Computer Model.

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ABSTRACT: *One of the major problems facing drilling operations is the performance of the drilling Bits. The ability of the Bit to crush the rock and the removal of the crushed rock from the wellbore effectively. It is necessary to understand the fundamental difference in Bit design for different rock textures because many variables tend to affect Bit optimization, particularly the type of formations, economics and Bit selection. However, the cost of drilling a well has a considerable effect on the selection and the design of a particular Bit, therefore this paper focuses on the development of a model that will predict future Bit performance and optimization for actual well design and construction. The variables to optimize Bit performance provide means of handling cost estimation hence the model becomes more realistic and dynamic in its application. The input variables and control factors for this model are stretched to minimize cost and maximize performance. The cost per foot and the break even calculations were done using data from the reference well X14 and also the evaluation well X35 from a field-X in the Niger Delta region. A Visual Basic dot Net program model was developed, tested and validated with the real field data to know its accuracy. The model interface shows the detailed application of the Bits in validating the data to provide the equivalent results for the five different Bits. Each set of the Bit record was ran separately on the software and the results for each application developed for comparison. In the software, data application were grouped into two distinct methods namely; rentals method and historical method. Under the rentals method, data were uploaded into the software and ran to generate results while the historical method was basically used for model prediction. The breakeven analysis provided a technique for calculating the performance required for an alternative Bit type to match the cost per foot of the current Bit. Based on the model results , Hughes Tungsten Carbide (HTC) Bit and Security Bit(SEC) used to drill well X14 and X35 were well optimized and should be encouraged in drilling wells within the area.*

I. INTRODUCTION

The increasing demand for fossil fuel has intensified the search for hydrocarbon reservoirs. The world has to move on the daily energy derived from processing of the content of the reservoir. This search has lead to high cost of drilling oil and gas wells. The drilling Bit performance optimization depends on the type of formation, drilling fluids, pore pressure and engineering variables but with a direct relationship with the drilling cost per footage. The drilling industry has seen tremendous improvements in drill Bit development and manufacturing and technological advancement is being made by Bit manufacturers in order to meet the continuously changing and more demanding needs of the operators. However, the evaluation of drilling Bit performance plays an important role in the oil and gas drilling operation.

II. CASE STUDY DEVELOPMENT OF FIELD -X

A case study of the Bits was from the offset well X14 in field- X used to evaluate well X35 that was subsequently drilled. The offset well X14 and the evaluation well X35 were drilled 5 kilometers apart both with formation intervals of interest as basically alternating shale and sharp sand, sandstone and silt stone. The field-X Bit records are as shown in tables (1-5), which were ran on trials in the different intervals to see their performances. The cost per foot calculation were used to analyze the performance of the Bits for the wells while the breakeven method were used to analyze the Bits on trial in order to know the performance of each of

the Bit. In analyzing the Bits used to drill well X14. Four SEC Bits drilled from 6214-7789 ft for a footage of 1895ft in 65 hours with an average cost per foot drilled of $ 49.43/ft. Three HTC Bits drilled well X14 from 3124ft to 5167ft for a footage of 3094ft in 48 hours with an average cost per foot of $19.09/ft. The REED Bit made a footage of 99ft in 19 hours with an average cost per foot of $42.32/ft. The SEC Bit drilled well X35 from 8607- 10057ft for a footage of 2050ft in 41 hours with an average cost per foot of $32.98/ft. While the HTC Bit drilled well X35 from 5031-8007ft for a footage of 3716ft in 48 hourrs with an average cost per foot $17.31/ft. From the analysis, the SEC Bit and the HTC Bit in well X35 drilled more footage with less time in the well than that of the HTC Bit and SEC bit in well X14.

Table 1: SEC. Bits Record for the Interval in Well X14.

BIT NO	TYPES/ MAKE	BIT COST ($)	FOOTAGE DRILLED (FT)	ROTATION TIME (HOUR)	FOOT /HOUR (FT)	TRIP TIME (HOUR)	BIT SIZE (INCHES)
7	SEC	3560	335	12	27.9	6.2	12 ¼
8	SEC	3560	670	21	31.9	6.8	12 ¼
9.	SEC	3560	428	16.5	28.0	7.3	12 ¼
10.	SEC	3560	428	15.5	27.6	7.7	12 ¼
AVERAGE		**3560**	**465.25**	**16.25**	**28.85**	**7**	**12 ¼**

Table 2: HTC. Bits Records for the Interval in Well X14

BIT NO	TYPES/ MAKE	BIT COST ($)	FOOTAGE DRILLED (FT)	ROTATION TIME (HOUR)	FOOT /HOUR (FT)	TRIP TIME (HOUR)	BIT SIZE (INCHES)
3	HTC	2803	1051	18.5	56.8	3.1	12 ¼
4	HTC	2803	1438	11.5	125	4.5	12 ¼
5	HTC	2803	605	18	33.8	5.1	12 ¼
3	HTC	2803	1051	18.5	56.8	3.1	12 ¼
AVERAGE		**2803**	**1031.3**	**16**	**71.8**	**4.2**	

Table 3: REED Bit Record for the Interval in Well 14

BIT NO	TYPES/ MAKE	BIT COST ($)	FOOTAGE DRILLED (FT)	ROTATION TIME (HOUR)	FOOT /HOUR (FT)	TRIP TIME (HOUR)	BIT SIZE (INCHES)
14	REED	16,900	996	19	52.4	11.2	12 ¼
AVERAGE		**16,900**	**996**	**19**	**52.4**	**11.2**	**12 ¼**

Table 4: SEC BITS Record for the Interval in Well X35

BIT NO	TYPES/ MAKE	BIT COST ($)	FOOTAGE DRILLED (FT)	ROTATION TIME (HOUR)	FOOT /HOUR (FT)	TRIP TIME (HOUR)	BIT SIZE (INCHES)
7	SEC	3560	600	18.75	32	8.6	12 ¼
8	SEC	3560	505	11.75	43	9.1	12 ¼
9.	SEC	3560	945	10.5	90	10.0	12 ¼
AVERAGE		**3560**	**683.3**	**13.5**	**55**	**9.2**	

Table .5: HTC BITS Record for the Interval in Well X35.

BIT NO	TYPES/ MAKE	BIT COST ($)	FOOTAGE DRILLED (FT)	ROTATION TIME (HOUR)	FOOT /HOUR (FT)	TRIP TIME (HOUR)	BIT SIZE (INCHES)
4	HTC	2803	740	10	74	5.0	12 ¼
5	HTC	2803	956	9.75	98	5.9	12 ¼
6	HTC	2803	2020	28.25	52.8	8.0	12 ¼
AVERAGE		**2803**	**1238.6**	**16**	**74.93**	**6.3**	

DISCUSSION

Predicting the behaviour of drill Bits in an unfamiliar environment is done using the drilling data acquired from the vicinity but if already known conditions and terms remain the same, then predicting well cost becomes very easy. However, it is customary to always use certain level of safety factors to account for downtime losses due to tool failures and other unforeseen hole problems rather than solely rely on the data obtained from the previous well.

Well 14: (BIT TYPE SEC and HTC)

In table 8, Bit number 7 has the highest overall cost value of 27,136.24US Dollar while Bit number 8 has the least overall cost of 18,961.69US Dollar. Therefore, if all other factors are kept constant, Bit number 8 being the Bit with the lowest cost value may be recommended for this operation. From table 7,Bit number 5 has the highest overall cost value of 36,494.52US Dollar while Bit number 4 has the least overall cost of 11,607.23 US Dollar.

Well 35: (BIT TYPE SEC and HTC)

In table 9,Bit number 9 has the highest overall cost value of 77,772.12US Dollar while Bit number 7 has the least overall cost of 13,015. 21US Dollar. Table.10 , Bit number 4 has the highest overall cost value of 41,632.69US Dollar while Bit number 5 has the least overall cost of 31,863.71US Dollar.

Generally from the results and the cost per foot analysis, a total saving of 114,622.12US Dollar was experienced in well X35 when compared with well X14 Bit records. The X14 Bit records showed a total of 14 Bits, in 220.25 hours while the X35 well Bit records showed a total of 9 Bits with a drilling time of 160.25 hours. Thus this is a cost and time saving for the evaluation well X35. Hence it can be deduced that Bit performance evaluation and optimization enhanced the minimum cost of the well and also lots of time saving.

SOFTWARE DESIGN AND RESULTS

TABLE 6: Bit Input Data and optimization Results X14 (BIT TYPE SEC)

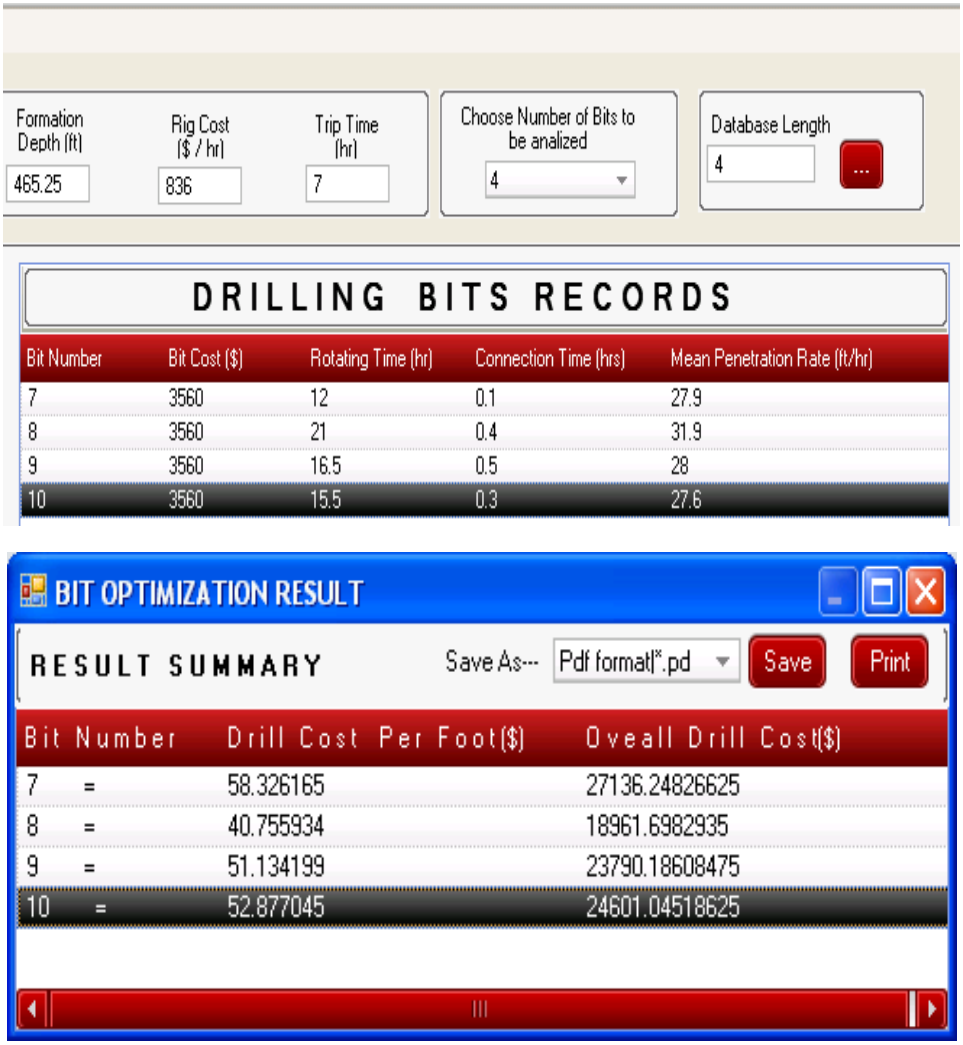
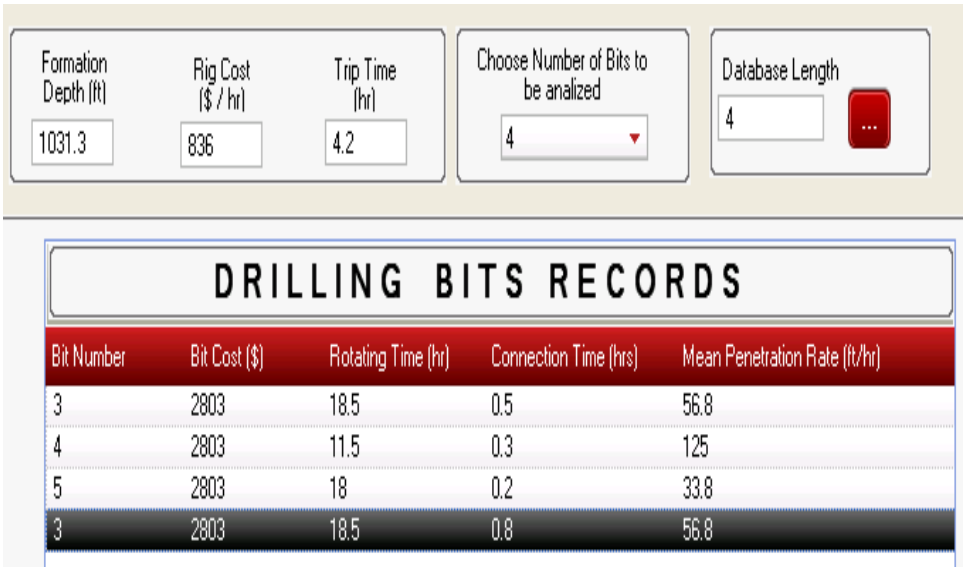


TABLE 7: Bit Input Data and optimization Results X14 (BIT TYPE HTCC)



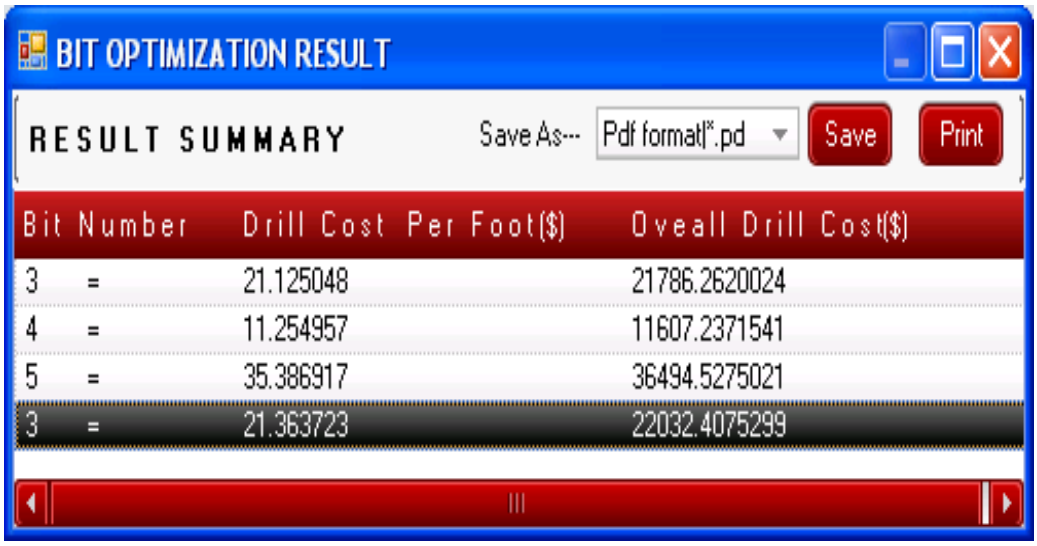


TABLE 8: Bit Input Data and optimization Results X14B (BIT TYPE HTC)

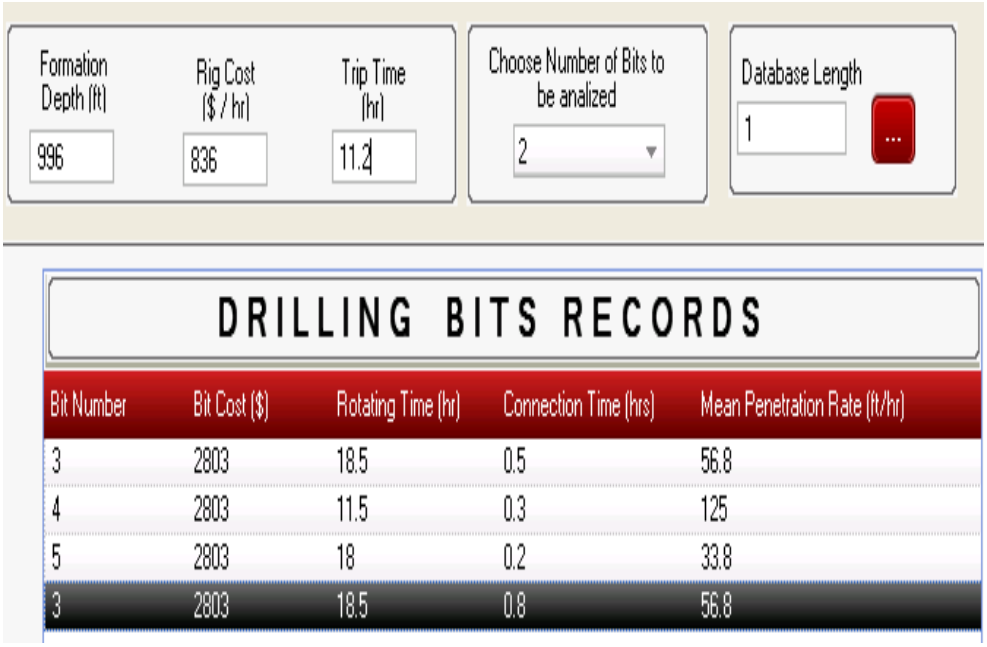


TABLE 9: Bit Input Data and optimization Results X35 (BIT TYPE SEC)

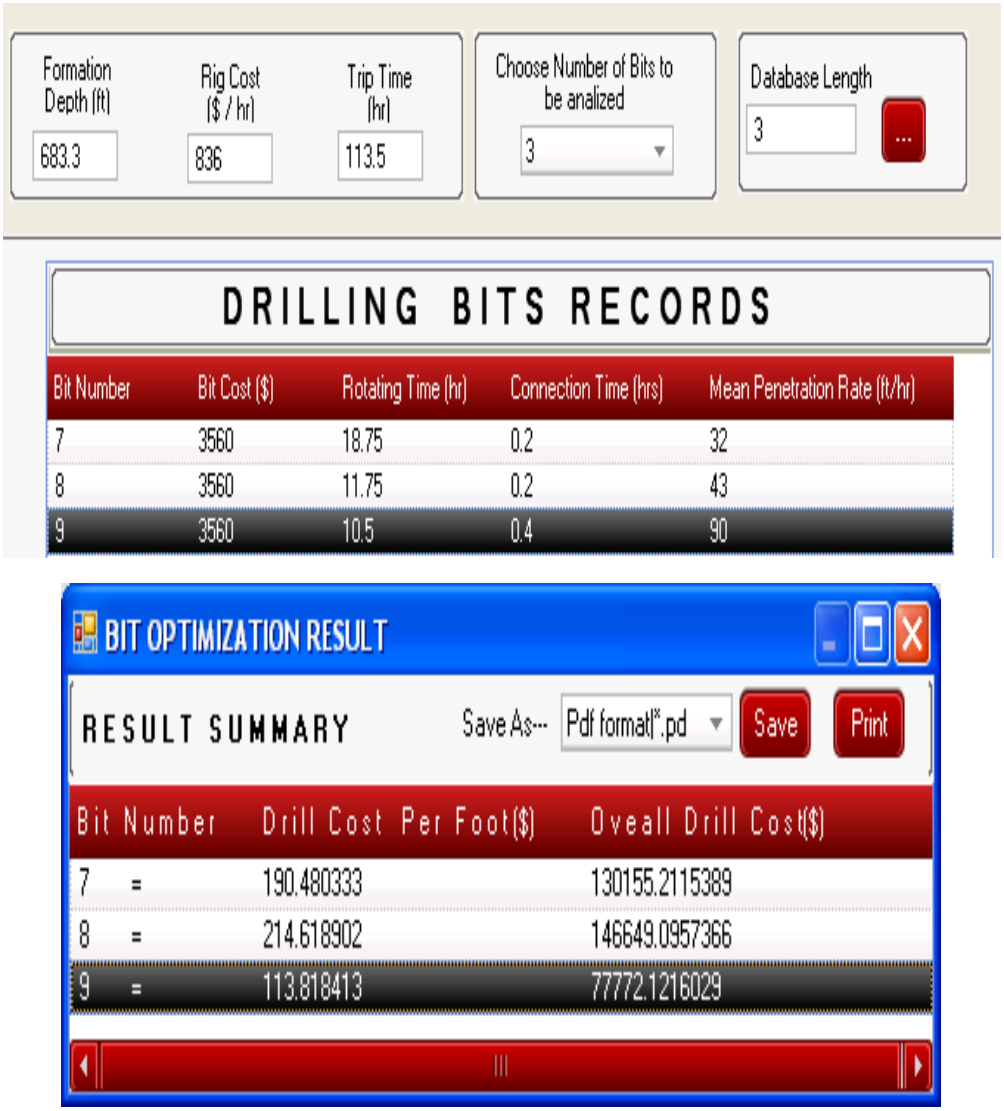
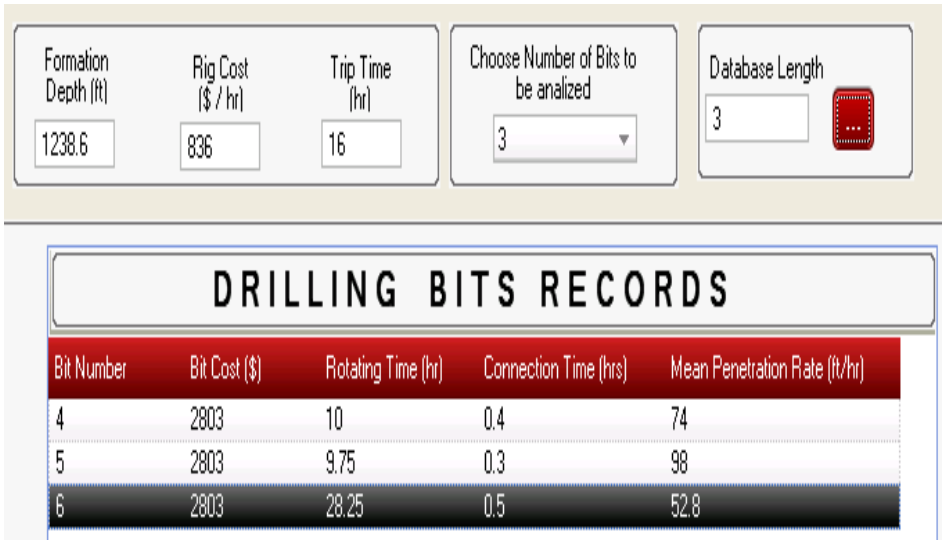


TABLE 10: Bit Input Data and optimization Results X35 (BIT TYPE HTC)



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APPENDIX

TABLE 11: The Input And Output Variable Of The Sensitivity Analysis Of Well X14 Bit Type Reed

	Bit Cost	Rig Cost	Rotation time	Trip Time	Depth
Distribution	Uniform	Uniform	Uniform	Uniform	Uniform
Min	16900	836	19	7	465.25
Max	16900	836	19	7	465.25
Name	16900	836	19	7	465.25
	OUTPUT	VARIABLES			
Cost Per Foot	83.04352499				
Overall Cost	38636				

TABLE 12: The Input And Output Variable Of The Sensitivity Analysis Of Well 35 Bit Type Sec

	INPUT VARIABLES				
	Bit Cost	Rig Cost	Rotation time	Trip Time	Depth
Distribution	Normal	Uniform	Normal	Uniform	Uniform
Mean/Min	3560	836	13.66667	13.5	683.3
STD/Max	0	836	4.446441	13.5	683.3
Name	3560	836	13.66667	13.5	683.3
	OUTPUT	VARIABLES			
Cost Per Foot	38.44772916				
Overall Cost	26271.33333				

TABLE 13: The Input And Output Variable Of The Sensitivity Analysis Of Well 35 Bit Type Htc

	INPUT VARIABLES				
	Bit Cost	Rig Cost	Rotation time	Trip Time	Depth
Distribution	Normal	Uniform	Normal	Uniform	Uniform
Mean/Min	2803	836	28.25	6.3	1017.55
STD/Max	0	836	10.60955	6.3	1017.55
Name	2803	836	28.25	6.3	1017.55
	OUTPUT VARIABLES				
Cost Per Foot	31.14028795				
Overall Cost	31686.8				

TABLE 14: The Input And Output Variable Of The Sensitivity Analysis Of Well 14 Bit Type Sec

	INPUT VARIABLES				
	Bit Cost	Rig Cost	Rotation time	Trip Time	Depth
Distribution	Normal	Uniform	Normal	Uniform	Uniform
Mean/Min	3560	836	16.25	16.25	465.25
STD/Max	0	836	3.708099244	16.25	465.25
Name	3560	836	16.25	16.25	465.25
	OUTPUT VARIABLES				
Cost Per Foot	66.05051048				
Overall Cost	30730				

TABLE 15: The Input And Output Variable Of The Sensitivity Analysis Of Well 14 Bit Type Htc

	INPUT VARIABLES				
	Bit Cost	Rig Cost	Rotation time	Trip Time	Depth
Distribution	Normal	Uniform	Normal	Uniform	Uniform
Mean/Min	2803	836	16.625	16	1031.1
STD/Max	0	836	3.424787	16	1031.1
Name	2803	836	16.625	16	1031.1
	OUTPUT VARIABLES				
Cost Per Foot	29.17030356				
Overall Cost	30077.5				

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Influence Of Thermal Radiation On Magnetohydrodynamic (Mhd) Boundary Layer Flow Of A Viscous Fluid Over An Exponentially Stretching Sheet

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ABSTRACT: *Radiation on magnetohydrodynamic (MHD) boundary layer flow of a viscous fluid over an exponentially stretching sheet was considered together with it's effects. The new technique of homotopy analysis method (nHAM) was used to obtain the convergent series expressions for velocity and temperature, where the governig system of partial differential equations has been transformed into ordinary differential equations. The interpretation to these expressions is shown physically through graphs. We observed that the effects of Prandtl and Magnetic number acts in opposite to each other on the temperature.*

KEYWORDS: *Boundary-layer; heat transfer; MHD; radiation; stretching sheet*

I. INTRODUCTION

In many engineering processes today incompressible boundary layer flow due to an exponentially stretching sheet is useful in a good number of applications. Such applications includes the industrial manufacturing in the aerodynamic extrusion of plastic sheets, hot rolling, the boundary layer along a liquid film condensation process, cooling process of metal plate in a bath and in the polymer industries. It is seen that kinematics of stretching with both the simultaneous heating or cooling during this processes has great influence on the quality of the end products(Magyari and Keller, (1999)). The work of Sakiadis, (1961) was able to look into the stretching flow problem where from there Crane, (1970) became the first to study the boundary layer flow caused by a stretching sheet which accelerates with a velocity varying linearly with the distance from a fixed point. Carragher and Crane, (1982) investigated the heat transfer area under this problem, with the conditions that the temperature difference between the surface and the ambient fluid is proportional to a power of the distance from a fixed point. The steady boundary layer on an exponentially stretching continuous surface with an exponential temperature distribution was also discussed by Magyari, et al. (1999) . Effect of viscous dissipation on the mixed convection heat transfer from an exponentially stretching surface was studied by Partha, et al. (2005) . Sajid and Hayat, (2008) in recent time considered the radiation effects on the flow over an exponentially stretching sheet, where the problem was solved analytically using the homotopy analysis method. To deal with the problems such as cooling of nuclear reactors by liquid sodium and induction flow meter, which depends on the potential difference in the fluid in the direction perpendicular to the motion and to the magnetic field(Ganesan and Palani, (2004)), MHD has important applications. Various processes in engineering areas occur at high temperature where radiation heat transfer becomes of great importance in the design of partinent equipments(seddeek, (2002)). Anuar, (2011) studied the MHD boundary layer flow on an exponentially stretching sheet taking the velocity gradient in the energy equation to be zero. The motivation to this present work is the variation of velocity gradient on the problem of MHD boundary layer flow over an exponentially stretching sheet in the presence of radiation where the velociy gradient in the energy equation not zero, which has not been studied.

II. PROBLEM FORMULATION

Consider the two-dimensional flow of an incompressible, steady viscous fluid bounded by a stretching sheet and conducted ellectrically which is placed in a fluid of uniform temperature T_∞, given in Fig 1. with magnetic field B(x) applied normal to the sheet and the induced magnetic field neglected,which is justified for MHD flow at small magnetic Raynold number.Under the usual boundary layer approximations,the flow and heat transfer with the radiation effects are governed by the following equations:

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0 \tag{1}$$

$$u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=\nu\frac{\partial^2 u}{\partial y^2}-\frac{\sigma B_o^2 u}{\rho} \tag{2}$$

$$u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}=\frac{\kappa}{\rho C_p}\frac{\partial^2 T}{\partial y^2}+\frac{\mu}{\rho C_p}(\frac{\partial u}{\partial y})^2-\frac{1}{\rho C_p}\frac{\partial q_r}{\partial y} \tag{3}$$

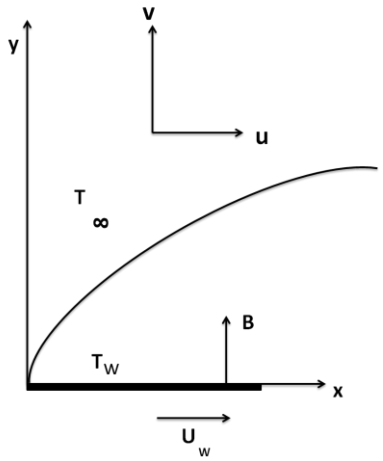


Fig 1: physical Model and Coordinate System

where u and v are the velocities in the x- and y-directions respectively, ρ is the fluid density, ν the kinematic viscosity, μ is the dynamic viscosity, κ the thermal conductivity, C_p the specific heat,T the fluid temperature in the boundary layer and q_r is the radiation heat flux.The boundary conditions are given by:

$$\left.\begin{aligned} u=U_w=U_\circ exp(\frac{x}{l}),\ v=0,\\ T=T_w=T_\infty+T_\circ exp(\frac{x}{2l})\ \ at\ \ y=0,\\ u\to 0, T\to T_\infty\ \ as\ \ y\to\infty \end{aligned}\right\} \tag{4}$$

where $U_\circ$ is the reference velocity, $T_\circ$ and T_∞ are respectively the temperature at and far from the plate and L the reference length. Understanding fluid radiation is devoted to the derivation of reasonable simplifications(Aboeldahab and El Gendy(2002)).One of these simplifications was made by Cogley, et al. (1968) who assumed that the fluid does not absorb it's own radiation,but,it only absorbs radiation emitted by the boundaries.Hence,the problem can be simplified by using the Rosseland approximation (Rosseland 1936 ;Siegel and Howell 1992 ;Sparrow and Cess 1978)which simplifies the radiation heat flux as:

$$q_r = -\frac{4\sigma^*}{3\kappa^*}\frac{\partial T^4}{\partial y} \qquad (5)$$

where σ^* and κ^* are the Stefan-Boltzmann constant and the mean absorption coefficient respectively.This approximation is valid at points optically far from the boundary surface and it is good only for intensive absorption which is far for an optically thick boundary layer(Bataller 2008 ;Siegel and Howell 1992 ;Sparrow and Cess 1978). Assumed that the temperature differences within the flow such that the term T^4 may be expressed as a linear function of temperature.Expanding T^4 in a Taylor series about T_∞ and neglecting higher order terms gives:

$$T^4 \approx 4T_\infty^3 T - 3T_\infty^4 \qquad (6)$$

Using Equations (5) and (6), Equation (3) reduces to:

$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \frac{k}{\rho C_p}\frac{\partial^2 T}{\partial y^2} + \frac{\mu}{\rho C_p}(\frac{\partial u}{\partial y})^2 + \frac{16T_\infty^3\sigma^*}{\rho C_p 3k^*}\frac{\partial^2 T}{\partial y^2} \qquad (7)$$

To get the similarity solutions, we assumed that the magnetic field $B(x)$ is of the form:

$$B = B_\circ exp(\frac{x}{2L}) \qquad (8)$$

where $B_\circ$ is the constant magnetic field.

Equation (1) is satisfied by introducing a stream function ψ such that:

$$u = \frac{\partial \psi}{\partial y} \ and \ \ v = -\frac{\partial \psi}{\partial x} \qquad (9)$$

Equation (2) and Equation (3) are transformed into the corresponding ordinary differential equations by the following transformation(Sajid and Hayat 2008):

$$\left.\begin{aligned} u = U_\circ exp(\frac{x}{L}) f'(\eta),\ v = -(\frac{\nu U_\circ}{2L})^{\frac{1}{2}} exp(\frac{x}{2L})(f(\eta) + \eta f'(\eta)) \\ T = T_\infty + T_\circ exp(\frac{x}{2L})\theta(\eta),\ \eta = (\frac{U_\circ}{2\nu L})^{\frac{1}{2}} exp(\frac{x}{2L}) y \end{aligned}\right\} \qquad (10)$$

where η is the similarity variable, $f(\eta)$ is the dimensionless stream function, $\theta(\eta)$ is the dimensionless temperature and prime denotes differentiation with respect to η. The transformed ordinary differential equations are:

$$f''' + ff'' - 2f'^2 - Mf' = 0 \qquad (11)$$

$$[1+\frac{4K}{3}]\theta''(\eta)+P_r[\theta'(\eta)f(\eta)-\theta(\eta)f'(\eta)+Ef''^2(\eta)]=0 \quad (12)$$

Where $M=\frac{2\sigma B_\circ^2 L}{\rho U_\circ}$, $K=\frac{4\sigma^* T_\infty^3}{kk^*}$, $P_r=\frac{\mu C_p}{k}$ and $E=\frac{U_\circ^2}{T_\circ C_p}$ are repectively the Magnetic, Radiation, Prandtl and Eckert parameter respectively.

The transformed boundary conditions are:

$$\left.\begin{array}{c} f(0)=0,\ f'(0)=1,\ \theta(0)=1 \\ f'(\eta)\to 0,\ \theta(\eta)\to 0\ as\ \eta\to\infty \end{array}\right\} \quad (13)$$

nHAM SOLUTION

In order to solve Equations (11)-(13) using nHAM, assume that $f''(0)=\alpha$ and $\theta'(0)=\beta$, we construct system of differential equations, as follows:

(14)

$$f'(\eta)=v$$

$$v'(\eta)=w$$

$$w'(\eta)=2f'^2-ff''+Mf'$$

}

with intial approximations

$$f_\circ(\eta)=0, v_\circ(\eta)=1, w_\circ(\eta)=\alpha \quad (15)$$

the auxiliary linear operators are

$Lf(\eta)=\frac{\partial f}{\partial\eta}, Lv(\eta)=\frac{\partial v}{\partial\eta}, Lw(\eta)=\frac{\partial w}{\partial\eta}$,where L is an auxiliary linear operator.

and

(16)

$$\theta'(\eta)=C$$

$$C'(\eta)=-\frac{P_r}{1+\frac{4K}{3}}[f\theta'-f'\theta+Ef''^2]$$

}

using initial approximations

$$\theta_\circ(\eta)=1,\ C_\circ(\eta)=\beta \quad (17)\backslash$$

and the auxiliary linear operators are

$$L\theta(\eta) = \frac{\partial \theta}{\partial \eta},\ LC(\eta) = \frac{\partial C}{\partial \eta} \tag{18}$$

we then have

(19)

$$f_1(\eta) = \hbar_1 \int_0^\eta [-v_\circ(\eta)] d\eta$$

$$v_1(\eta) = \hbar_1 \int_0^\eta [-w_\circ(\eta)] d\eta$$

$$w_1(\eta) = \hbar_1 \int_0^\eta [-Mv_\circ - 2v_\circ^2 + f_\circ w_\circ] d\eta$$

$$\}$$

and

(20)

$$\theta_1(\eta) = \hbar_2 \int_0^\eta [-C_\circ(\eta)] d\eta$$

$$C_1(\eta) = \frac{P_r \hbar_2}{1 + \frac{4K}{3}} \int_0^\eta [f_\circ C_\circ - f_\circ' \theta_\circ + E f_\circ''^2]$$

$$\}$$

For $m \geq 2$,

(21)

$$f_m(\eta) = (1+\hbar_1) f_{m-1}(\eta) + \hbar_1 \int_0^\eta [-v_{m-1}(\eta)] d\eta$$

$$v_m(\eta) = (1+\hbar_1) v_{m-1}(\eta) + \hbar_1 \int_0^\eta [-w_{m-1}(\eta)] d\eta$$

$$w_m(\eta) = (1+\hbar_1) w_{m-1}(\eta) + \hbar_1 \int_0^\eta [-M f'_{m-1} + \sum_{i=0}^{m-1} (-2 f'_{m-1-i} f_i' + f_{m-1-i} f_i'')] d\eta$$

$$\}$$

and

(22)

$$\theta_m(\eta) = (1+\hbar_2) \theta_{m-1}(\eta) + \hbar_2 \int_0^\eta [-C_{m-1}(\eta)] d\eta$$

$$C_m(\eta) = (1+\hbar_2)C_{m-1}(\eta) + \frac{P_r\hbar_2}{1+\frac{4K}{3}}\int_0^{\eta}\sum_{i=0}^{m-1}[\, f_{m-1-i}\theta_i' - f_{m-1-i}'\theta_i + Ef_{m-1-i}''\, f_i']d\eta$$

}

The systems of Eqs. (19) - (22) have been solved using symbolic computation software MAPLE. It is found that

(23)

$$f_1(\eta) = -\hbar_1\eta$$

$$v_1(\eta) = -\hbar_1\alpha\eta$$

$$w_1(\eta) = \hbar_1(-2\eta - M\eta)$$

}

(24)

$$f_2(\eta) = -(1+\hbar_1)\hbar_1\eta + \frac{1}{2}\hbar_1^2\alpha\eta^2$$

$$v_2(\eta) = -(1+\hbar_1)\hbar_1\alpha\eta - \frac{1}{2}\hbar_1^2(-2-M)\eta^2$$

$$w_2(\eta) = (1+\hbar_1)\hbar_1(-2\eta - M\eta) + \frac{1}{2}(M\hbar_1\alpha + 3\hbar_1\alpha)\eta^2$$

}

and

(25)

$$\theta_1(\eta) = -\hbar_2\ \beta\eta$$

$$C_1(\eta) = -\frac{P_r\hbar_2\eta}{1+\frac{4K}{3}}$$

}

(26)

$$\theta_2(\eta) = -(1+\hbar_2)\hbar_2\eta\ \beta + \frac{1}{2}\frac{\hbar_2^2 P_r\eta^2}{1+\frac{4K}{3}}$$

$$C_2(\eta) = -\frac{(1+\hbar_2)P_r\hbar_2\eta}{1+\frac{4K}{3}} + \frac{0.50P_r\hbar_2(0.70\ \beta+\hbar_2\ \beta)\eta^2}{1+\frac{4K}{3}}$$

}

$f_m(\eta,\alpha;\hbar_1)(m=3,4,5,...)$ and $\theta_2(\eta,\beta;\hbar_2)(m=3,4,5,...)$ can be calculated similarly.Then the series solution expressions by nHAM can be written in the form

(27)

$$F_Q(\eta,\alpha,\hbar_1) = \sum_{m=0}^{Q} f_m(\eta,\alpha,\hbar_1)$$

(28)

$$\theta_N(\eta,\beta,\hbar_2) = \sum_{m=0}^{N} \theta_m(\eta,\beta,\hbar_2)$$

we note that analytic expressions (27) and (28) cantains two auxiliary parameters $\hbar_1$, and $\hbar_2$ as suggested by Liao (1992) and (2003)one can choose the values of $\hbar_1$ and $\hbar_2$ properly for $\hbar$-curves which ensure the convergence of the series solutions.Using the boundary condition $f' \to 0\ as\ \eta \to \infty$ and $\theta \to 0\ as\ \eta \to \infty$ we get $\alpha = 0\ for\ M = 0$ and also $\beta = 0\ for\ K = 0, M = 0, P_r = 0, E = 0$.

fig 2: The $\hbar_1$ curve

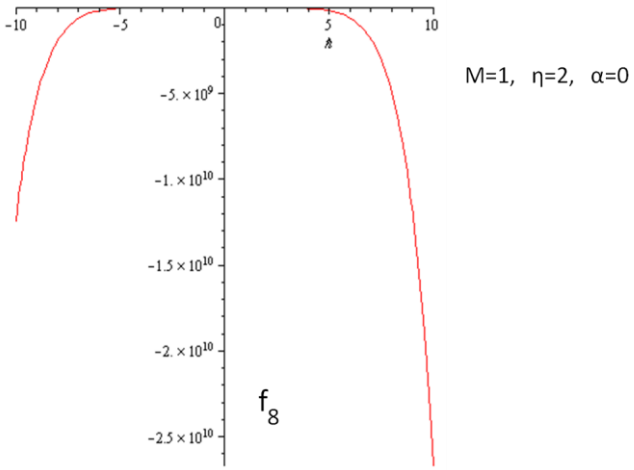
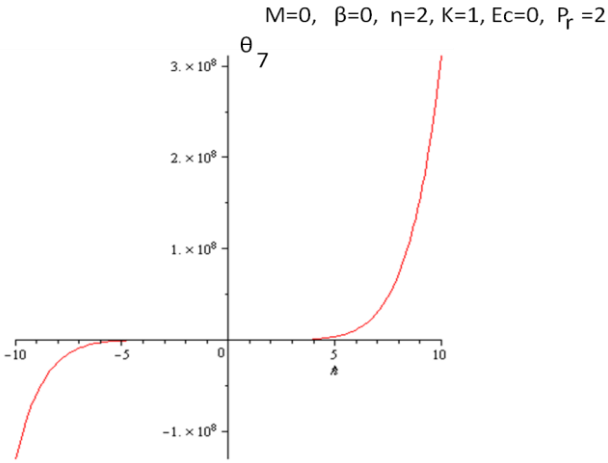


fig 3: The $\hbar_2$ curve



In figs. 2 and 3 the $\hbar$-curves are shown for the range of admissible values of $\hbar_1$ and $\hbar_2$. Figs. 2 and 3 clearly indicate that the ranges for the admissible values of $\hbar_1$ and $\hbar_2$ are $[-5.6,4.2]$ and $[-5.1,3.1]$.Our calculations show that the series solution (27) and (28) converge in the whole region of η, when $\hbar_1 = -0.7, \hbar_2 = -1$.

III. RESULTS AND DISCUSSION

The system of ordinary differential equations (11) - (13) whigh have been solved numerically using nHAM as described by Hassan and El-tawil (2012) .This method has been used to solve several boundary layer problems,we show the graphical results of velocity and temperature.Attention has been focused to the variations of P_r, M, E *and* K. For this purpose Figs. $4-8$ have been displayed. Fig. 4 shows the effect of magnetic number on velocity $f'(\eta)$. Figs. $5-8$ elucidate the influence of Radiation number K, Magnetic number M, Prandtl number P_r and Eckert number E on the temperature $\theta(\eta)$. From the present study, the main findings can be summarized as follows:

• Increase in magnetic parameter M have accelerating effect on velocity of the flow field.

• Increase in radiation parameter K ,magnetic parameter M and Eckert number Ec retard the magnitude of temperature of the flow field and the thickness of thermal boundary layer.

• Increase in the prandtl number P_r shows that there is a rise in the magnitude of temperature of the flow field and the thickness of thermal boundary layer.

fig 4: The Effect of Magnetic Parameter, M on Velocity, f' for $\alpha = 0, \hbar = -0.7$

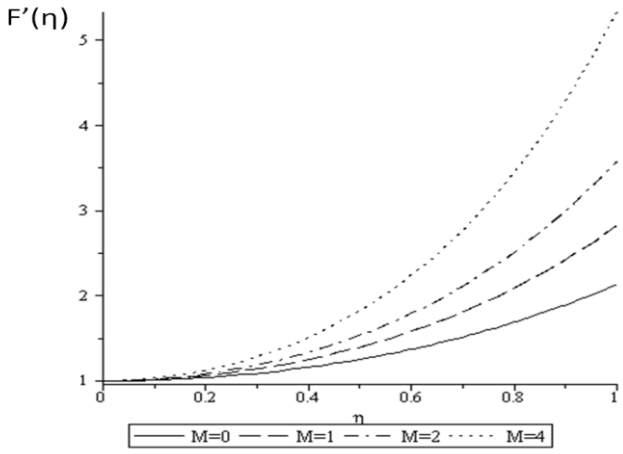


fig 5: The Effect of Radiation Parameter, K on Temperature, θ for $P_r = 1, Ec = 0.2, M = 1$

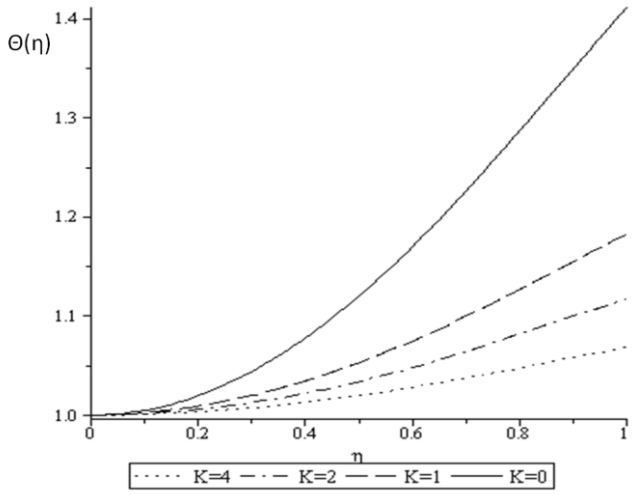


fig 6: The Effect of Magnetic parameter , M on Temperature, θ for $P_r = 1, Ec = 0.2, K = 1$

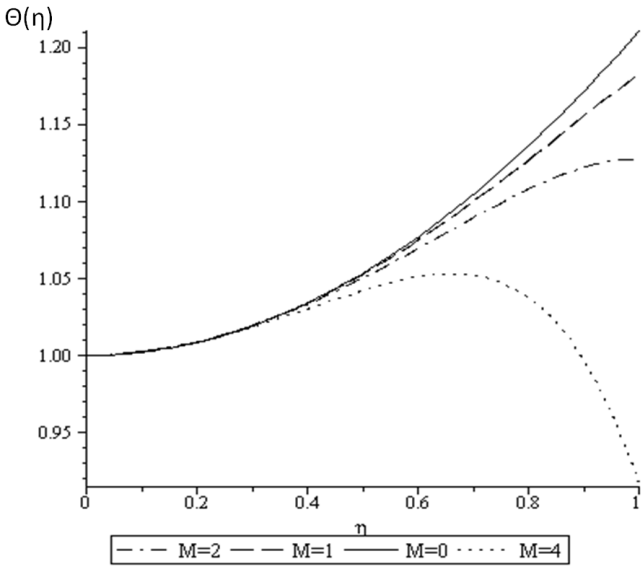


fig 7: The Effect of Prandtl Number, P_r on Temperature, θ for $K = 1, Ec = 0.2, M = 1$

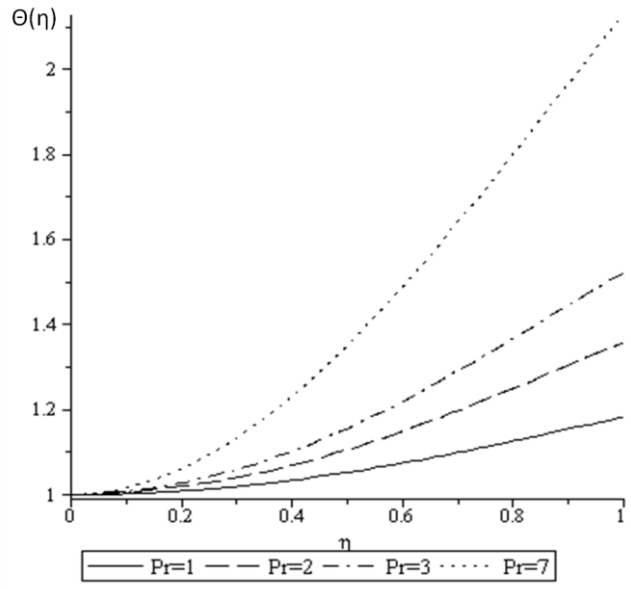
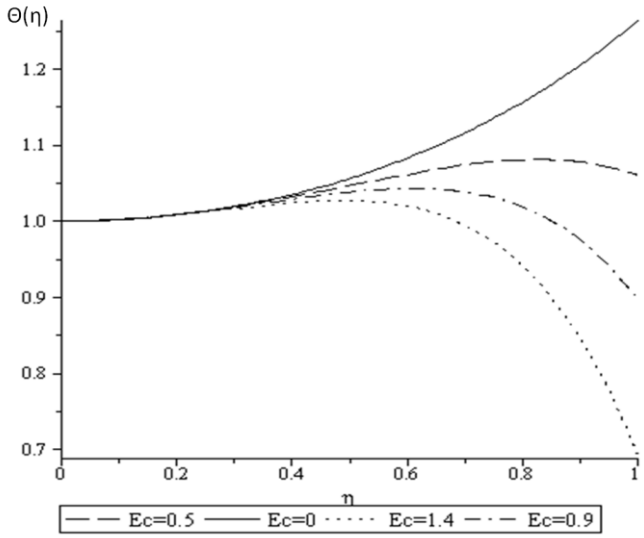


fig 8: The Effect of Eckert Number, Ec on Temperature, θ for $K = 1, P_r = 1, M = 1$



IV. CONCLUSIONS

Radiation on steady MHD boundary layer flow over an exponentially stretching sheet was investigated and it's effects observed. The similarity transformations are used to reduce the partial differential equations into ordinary differential equations. Analytical solutions for the velocity and temperature distributions are obtained using a nHAM. It was found that the heat rate increases with prandtl number P_r, but decreases with both magnetic parameter M and radiation parameter K. Thus Magnetic and Radiation parameter brought about cooling effect on the sheet, because the higher the increase in the parameter reduces the heat rate.

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Should Public Buildings Be Exclusive? A Study of Selected Institutional Buildings in Minna, Niger State.

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ABSTRACT: Some individuals are born with a deformity also known as disability whereas others may become permanently or temporarily disabled over the course of their lives. Buildings should not be made to judge who comes in and goes out of its spaces. A good design must be accessible to all individuals, especially when discussing public buildings. An educational building is a public building and "education for all" is a common dictum that refers to all individuals irrespective of current status. Disabled individuals especially those in wheelchairs have special needs and requirements however, most Institutional buildings do not portray this equality with regards to their design; instead these designs ostracize individuals with disabilities. A survey was carried out on the existing special educational facility and forty four (44) randomly selected institutions of learning located in Minna, the capital of Niger State. They were further categorised based on funding; Federal, state or privately funded institutions. The survey showed that individuals with physical disabilities in Minna were not attending the special educational school and even if they were, facilities were not put in place to accommodate them also, despite the support by the Nigerian government on the equalisation of opportunities for people with disabilities, the public educational system have yet to factor in or retrofit designs to suit disabled individuals in their designs. This paper further highlighted these abnormalities in design and probable causes and concluded by recommending possible solutions.

KEY WORDS: *Accessible, Design, Disabilities, Functionality, Institutional Buildings*

I. INTRODUCTION

Disability is a common phenomenon worldwide. According to the World health Organisation (W.H.O), about 500 million people are living with disability and 75% of that number is living in developing countries. (Mickailakis, 1997; Lang and Upah, 2008) in Amusat (2009). Although there are no credible statistical data about disability in the country, the W.H.O estimates that 19 million or about 20% of the Nigerian population are disabled (Lang and Upah, 2008). According to Bamidele (2010) the Nigerians with disability act defined a disabled person as one who has received preliminary or permanent certificate of disability to have condition which is expected to continue permanently or for a considerable length of time which can reasonably be expected to limit the persons functional ability substantially, but not limited to seeing, hearing, thinking, ambulating, climbing, descending, lifting, grasping, rising, any related function or limitation due to weakness or significantly decreased endurance so that he cannot perform his everyday routine, living and working without significant hardship and vulnerability to everyday obstacles and hazards.

The Nigerian government supported the United Nations standard rules on the equalization of opportunities for people with disability. The disability act of 1993 was promulgated to enhance the social and societal positions of people living with disability. Nigerians living with disability are said to be no better off when compared with others living in other parts of the developing world, in terms of the challenges they face- they are poor, marginalised and excluded (Lang and Upah, 2008). The promulgations of these laws was so that there can be a change in how we as Nigerians see ourselves; but unfortunately, Nigerians with disabilities are still faced with these challenges. A portion of the disability act stipulates what may be referred to as positive discrimination in favour of the disabled persons as section 6(2) of the act requires all employers of labour to reserve for the disabled not less than 10 % of the workforce (Bamidele, 2010), unfortunately, this also does not happen as most employers of labour view the disabled as the proverbial chink in the chain - a weakness that will

affect total work output. In recent years, the debate about inclusive education has moved from high-income countries like the United States and Canada to low-income countries like Nigeria, where an official policy of educating children and youth with disabilities alongside their peers without disabilities in ordinary schools has been adopted (National policy on education, 2008). The inclusion of children with disabilities in general education where they can learn in natural stimulating settings which may further lead to general acceptance and appreciation of differences has received growing recognition. This has led to a continuous debate amongst policy makers at all levels, parents and people with disability in Nigeria regarding the efficacy of inclusion and the inevitable restructuring of the general education that will need to occur to make learning meaningful in an inclusive environment.

II. SPECIAL EDUCATION

The term special education is referred to when discussing education for disabled individuals, whether it is for the blind, deaf, dumb, autistic or even physical disability. These students need special conditions and requirements for learning. Therefore, it is assumed that all necessary facilities have been put in place to aid and ease education for these set of individuals. Under ideal situations this would involve proper planning, design and construction of necessary facilities and structures to embrace these individuals in order to promote a proper learning environment. An initial visit was then made during the preliminary stages of the research to the facility for special education located in Minna, Niger state. The results are tabulated in TABLE I below.

TABLE 1. SCHOOL FOR SPECIAL EDUCATION MINNA, NIGER STATE

STUDENT CAN HEAR BUT CAN'T SPEAK	CAN HEAR AND SPEAK BUT NO CLARITY IN THE WORDS	PHYSICALLY DISABLED	TOTAL NO. OF STUDENTS
312	35	0	347

Source: Authors Field Work

Note: The author used language used by proprietor in describing students' disabilities since no medical professional was available to clearly diagnose student's conditions

The results showed that there were no physically disabled students in the institution and even if there were, they would be impeded by physical barriers. This can be seen from on site photographs clearly shown below.

PLATE(a) Shows the entrance to the special school

PLATE (b) Showing one of three (3) stairs (access) to the corridor that leads to the classrooms and threshold of doors

Plate (c) and (d) showing the conditions of the schools central terrain and office and classroom blocks

III. INCLUSIVE EDUCATION

Inclusive education can be interpreted as the philosophy and practice for educating students with disabilities in general education setting (Bryant, smith & Bryant, 2001; Lipsky & Gartner, 1997;Rodgers, 1993; Salend, 2001). The principles are simple; a sort of symbiotic relationship whereby children with disabilities benefit from learning in a regular classroom, while their peers without disabilities gain from being exposed to children with different characters, talents and temperaments. There are obvious benefits to the inclusive education paradigm i.e. children are more likely to learn social skills in an environment that approximates to normal conditions of growth and development (Ajuwon, 2008).

According to Mitchell & Brown (1991), children during their formative years develop language more effectively if they are with children who speak normally and appropriately. Often, it is fulfilling that where school environments can be made physically accessible, children and youth with physical disabilities can function more effectively than would otherwise be the case. It is also apparent that such modifications to the environment often enable others who do not have disabilities to access their environment even more readily (Ferguson, 1996). In recent years, the principle of universal design (Centre for Universal Design, 1997; Waksler, 1996), has evolved to describe physical, curricular and pedagogical changes that must be put in place to benefit people of all learning styles without adaptation or retrofitting. Failing to accommodate the environmental and accessibility needs of persons with disabilities in the society will inevitably inhibit their participation in educational, social, recreational and economic activities (Steinfeld, Duncan, & Cardell, 1977 in Ajuwon, 2008). Therefore, architects, product designers, engineers and environmental design researchers should use their best judgment in early programming and design decisions (Ajuwon, 2008).

To further promote their involvement in the scheme, the Federal government of Nigeria launched the Universal basic Education (U.B.E) scheme in 1999, and in 2004 the law was enacted. Thus the compulsory free Universal Basic Education act 2004, which provides the legal frame work within which the Federal government supports the state's towards achieving an uninterrupted nine (9) year compulsory universal basic education for all children in primary and junior secondary levels throughout the country. The scheme also developed blocks of classrooms for children all around the country.

AIM OF STUDY

This paper sets out to assess selected institutions of learning - primary and secondary with a singular view to determine if their buildings designed prior to the enactment of the laws have been retrofitted in conformity with the enactment of the disability act and/or if recent construction are carried out with the disabled in view. According to the British Department for International Development (DFID) report, disabled people in Nigeria encounter a plethora of attitudinal, institutional and environmental barriers that impede and militate against their active social inclusion within contemporary society. These barriers are summarized in the **Table II** below.

TABLE 2. BARRIERS TO THE SOCIAL INCLUSION OF DISABLED PEOPLE IN NIGERIA

ENVIRONMENTAL	INSTITUTIONAL	ATTITUDINAL
Inaccessible public buildings Inaccessible transport system; Lack of access to computers & the internet Poor lighting Lack of accessible information,	Lack of disability legislation; Lack of robust and reliable disability statistics No social protection; Inadequate provision of medical and rehabilitation services; Lack of access to micro-finance and banking services Inaccessibility to mainstream public services, (especially education)	The cause of impairment often attributed to a "curse"; Disability issues are predominantly perceived in terms of charity/welfare – not in terms of human rights Lack of understanding of disability issues by the general public

Source: DFID report; April 2008.

Table 1 highlights "*inaccessible public buildings*" as one of the environmental barriers affecting the inclusion of disabled children and youth into the educational system. Hence, this forms the basis for this paper.

IV. RESEARCH METHOD

The primary data for the research were obtained in field surveys conducted in 45 randomly selected educational institutions in Minna, capital of Niger State, Nigeria. Tertiary Institutions were exempted from the study. Questionnaires were also used to get relevant information for analysis. The Schools were divided into categories; Federal, State or privately owned Institutions. The view was to determine how the introduction of the disability law changed the designs and construction of schools to suit physically disabled individuals and if institutions are retrofitting their buildings to make them disabled friendly?

The focus was on physical barriers that would affect the inclusion of disabled into the institutions; things like threshold heights, elevated levels, stairs, corridor width and conveniences. These constituted primary data and were presented using simple photograph pictures.

V. RESULTS AND DISCUSSIONS

50 Questionnaires were distributed, out of which 45 were answered, returned and analysed. The table 3 – 5 present the data obtained from the field survey. The questions are analysed and discussed making reference to the tables concerned.

TABLE 3. FEDERAL INSTITUTIONS

	S/N	School	Year Of Eatablishment	Number Of Students Enrolled	Number Of Physical Disabled Students	Number Of Staff	Number Of Physically Disabled Staff
Federal	1	Police Secondary School, Western Bypass, Minna	1992	1500	0	220	0
	2	Federal Government Staff College, Dutsen Kura, Minna	2003	700	3	58	0
	3	Federal University Staff School, Bosso;Minna	1987	656	0	36	0
		Total		**2856**	**3**	**314**	**0**
		%		**0.11%**	**0%**		

Source: Author's Field Work, 2012

The numbers of federally funded secondary schools in the state are few; however these do not represent the total number within the state capital but only represent the ones that granted the researcher access. They maintained a strict selection process for admitting students and sources revealed that physical disabilities were major criteria for student admissions. One of the three institutions visited showed recent modifications (introduction of ramps) which is likely the reason there are few physically disabled students there.

TABLE 4. STATE INSTITUTIONS

	S/N	School	Year Of Eatablishment	Number Of Students Enrolled	Number Of Physical Disabled Students	Number Of Staff	Number Of Physically Disabled Staff
State	**1**	**Niger State School For Special Education**	**1983**	**365**	**0**	**93**	**0**
	2	Government Day Junior Secondary School, Bosso Rd, Minna	1964	959	3	377	2
	3	Gidan Kwano Primary School, Gidan Kwano, Minna	1976	648	1	19	0
	4	Shango Primary School, Shango, Minna	1976	700	10	93	1
	5	Government Day Junior Secondary School, Bosso Rd, Minna	1979	1250	1	120	0
	6	Dutsen Kura Primary School, Minna	1989	825	3	107	0
	7	Bosso Secondary School, Bosso Estate	-	738	0	92	0
	8	Hill-Top-Model School, Maitumbi Minna	1985	6450	0	154	0
	9	Government Day Junior Secondary School, Barkin Sale, Minna	2007	3800	36	85	0
	10	Zarumai Model School, Taibi Quarters Bosso	1976	3885	4	121	0
	11	Government Girl's Day Secondary, School, (A) Old Airport Rd	-	390	0	42	0
	12	Government Girl's Day Secondary, School, (B)Old Airport Rd	-	277	0	21	0
		Total		**20287**	**58**	**1324**	**3**
		%		**0.30%**		**0.23%**	

Source: Author's Field Work, 2012

The selection process for admitting students here is less strict and the state has literally tried to adopt the free for all education in conformity with the disability act and that's why the table shows more individuals (although still few) are being admitted. However, structures were not built to accommodate these groups of individuals and haven't been retrofitted in response to them. The research revealed that students with physical deformities especially those that cannot walk are carried over stairs and into classrooms.

TABLE 5. PRIVATE INSTITUTIONS

	S/N	School	Year Of Eatabl Ishment	Number Of Students Enrolled	Number Of Physical Disabled Students	Numbe r Of Staff	Number Of Physically Disabled Staff
Private	1	Niger Baptist School, Minna	1911	957	0	24	0
	2	Mawo International Schools, Minna	1989	960	0	67	0
	3	Rhema Model Nurs& Primary School, Tunga	1996	162	0	11	0
	4	Abu-Turab Islamic Schools, Bosso, Minna	1994	340	0	35	0
	5	Abu-Turab Islamic Schools, Bosso, Minna	2003	628	1	36	0
	6	Onward Primary School, Gidan Mangoro, Minna	2004	50	0	6	0
	7	Onward Primary School, Tudun Fulani, Minna	2009	175	0	13	0
	8	Umar Nursery And Primary School, Tudun Fulani	2005	375	2	11	1
	9	Fountain Height Montessori School, Tunga, Minna	2006	185	0	16	0
	10	Prevail International School, Gidan Kwano, Minna	2006	120	0	10	0
	11	Salam Goodwill Int'l School, Minna	2008	152	1	16	0
	12	Kowa Schools, Kpakungu, Minna	2010	2300	0	60	0
	13	Bilal Bin Rabah Islamic Nursery/Prim School	2011	357	0	30	0
	14	Faruk Bahago Int'l School, Dutsen Kura Gwari, Minna	2004	285	6	36	0
	15	Himma International College	1989	600	2	110	0
	16	St. Clement Sec. School Gbaiko	2005	400	0	50	1
	17	Kings And Queens International School	2006	284	0	21	0
	18	Hasha Model School, Bosso	1996	580	4	105	0
	19	Galaxy International School, Eastern Bypass	2007	2470	0	47	0
	20	Dr Yahaya Primary School, Bosso	1950	4024	2	112	2
	21	Kingdom Heritage Model School	2009	252	0	26	0
	22	Harmony School, London Street, Dutsen Kure	2004	634	2	32	0
	23	Brighter Schools, Minna	-	390	0	42	0
	24	Gbatara International Science Academy, Bosso; Minna	2007	277	0	21	0
	25	New Horizons School	1984	304	0	36	0
	26	Unmi Nursery And Prim School	1985	385	0	38	0
	27	Jamat Islamic Primary School	2005	155	0	12	0
	28	Aziziyyah Model Academy	2006	58	3	11	1
	29	Ar-Rayyan Academy	2003	96	0	13	0
	30	Amina International School	2008	1242	0	42	0
		Total		**19197**	**23**	**1089**	**4**
		%		**0.12%**		**0.37%**	

Source: Author's Field Work, 2012

One would expect that these type of institutions would at least put design considerations and construction to meet the peculiar needs of disabled individuals, but even here there are considerable lapses and it is sad to admit but the institution of learning is gradually turning into a profit making venture with "few" or "no" consideration for disabilities. On a good note, some few private institutions seen in table 5, made peripheral provisions for children with disabilities with the introduction of ramps, increased door widths in order to accommodate wheel chairs, and elimination of door thresholds.

The tabulated data represented above for all three (3) types of institutions are succinct. The numbers of physically disabled students and staff are minuscule when compared to the number of admitted students and appointed staff. The reasons for these small numbers can be explained by a number of factors that can be explained in Table 2 but precisely, these institutions were not designed to factor in disabled individuals from their design stages and have not been retrofitted during their use to cater for these groups of individuals. The plates below will clearly provide vivid images of the barriers these few disabled individuals face, in the institutions tabulated above.

(A) E.T.F project for staff school (f.u.t) minna: The class rooms have no access to wheel chair users

(B) Bosso Primary School; all classrooms are accessed by stairs

(A)Stairs Along Corridors And To Classrooms F.G.C) Minna

(B) F.G.C Minna: door width to offices Are too small and threshold Presence In Doorways Prohibits Easy access To Disabled Users

BOSSO PRIMARY SCHOOL

(B) TUDUNWADA PRIMARY SCHOOL

Inaccessible Toilet Facilities For Wheelchair Users' In (A) AND (B)

(A) F.G.C minna:toilets cannot be accessed by wheel chair user

(b) F.U.T staff school (staff toilet)no consideration for door swing (Problem for wheel chair users)

VI. CONCLUSIONS

The study revealed that architectural designs, especially those of educational institutions in Minna, Niger state, do not factor in disabled individuals despite the enactment of the disability act by the country. These randomly selected institutions depict the trend of institutional designs in Minna. This can be a contributory reason why a large number of disabled children can be seen roaming the streets. These individuals have been given free education, jobs, even financial assistance but cannot access the buildings due to design barriers. It has to be pointed out that the disabled people account for a recognisable size of the population and deserve the right to access and use buildings comfortably. In order to stop the designs and construction of buildings that are not disabled friendly, the government, professional regulatory bodies and the civil society, should embark on vigorous sensitisation and education for all stakeholders in the building industry on the need to adhere to the dictates of the disability Act especially with regards to buildings. The government (legislative) and civil society should create and pass laws to back its implementation and enforcement in the building Industry.

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Analyzing and studying the role of Zabol city in regional development

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ABSTRACT: *In regional planning the aim is to make optimal use of resources for developing the regions. One of the most crucial issues in regional development is recognizing the spatial and economic structure of the region. In studying the economic structure of the regions, middle cities have an essential role after first class cities. Nowadays, in most developing countries the planners' tendency toward spatial decentralization, reducing regional inequalities, etc. has led to adopting different urbanizing strategies. In this regard, the present research aims at analyzing and studying the role of Zabol city in regional development. This research adopts a descriptive-analytical approach based on library resources and field study and in order to analyze the data the AHP model is used. The results show that indicator C (reducing regional inequalities) with a weighted mean of 0.391 stands the first and indicator D (accommodating the population in the region) is placed the fourth with a weighted mean of 0.191.*

KEY WORDS: *regional development, balance, Sistan, Zabol city*

I. INTRODUCTION

The aim of regional studies is to regulate the relationship between human, space and activity or the suitable and moderate arrangement of human and his activities over the land (Ziari and Fallah Madvari, 2006). One essential problem of the third world countries including ours is the intense concentration of population and facilities in big cities and creation of urban primacy system and elimination of the dominant system of urban hierarchy. This phenomenon occurs due to lack of balance in distributing various facilities over the land and not paying any attention to the capabilities of small and medium cities. The urban system is the spatial realization of a country's political economy and land management. Studying the urban system reveals the way of diffusion and the balance of urban population. The urban system in Iran has turned from the traditional galactic pattern before 1922 to chain pattern due to the concentration of services and facilities in big cities. While this pattern has broken off the logical relations between small, medium and big cities, it also caused disturbance in Iran's urban system (Taghvaei, 2010. 55). Urban centers in each country can be categorized following the geographical conditions and affected by economic, social and political issues in terms of quality and quantity or in other words in terms of population and role and function (Rakhshaninasab, 2008, 26). Studying urban hierarchy as a factor to recognize the spatial order of the cities and equal distribution of facilities and services among urban centers, especially small and medium cities, has always been crucially important. Urban hierarchy is the best form of organizing the space (ibid). The urban network in developed industrial countries is galactic due to functions and activities in different cities' hierarchy and relative homogeneity of socio-economic and spatial facilities, whereas in developing countries the medium and small cities have lost their importance due to infrastructures and facilities being concentrated in big cities and this has led to forming a chained urban network. During recent years, the population and urban centers of Iran have experienced a considerable spatial change (Rakhshaninasab, 2008, 28). Disturbing regional balance is regarded as a main obstacle against national development. This trend as well as expansion of urbanism and an increase in the number of cities due to not

complying with the exogenous development have most affected the settlement pattern and formation of urban system in Iran which led to an inefficient and inconsistent urban system.
In southeastern Iran, except for Zahedan that grew very rapidly, other cities have not experienced much development; on the other hand, most investments poured into this city. Meanwhile, Zabol city in Sistan region have been able to play a crucial role in eliminating inequalities by attracting people and striking balance in the region. Thus, the present research aims at analyzing and studying role of Zabol city in regional development.

Theoretical background

Urban system: refers to a number of interdependent cities that create the structure of a system of urban settlements in an area, region, country and the world. The urban system is not merely limited to a spatial collection of urban habitats and contains the currents and communications between these habitats. These currents include: population, capital, production factors, information and innovation (Azimi, 2002, 53).
What is known as urban system is totally different in developed and developing countries. With the advent of the industrial revolution in European countries, the population of these countries were greatly redistributed which could be regarded as a cause for a deviation of European urban system since many of today's big cities developed from small towns to higher ranks of the hierarchy. The industrial revolution also has had another great impact through increasing inequality in sizes of cities all through Europe. However, it should be noted that urban hierarchy in Europe has not been much disturbed as a result of industrial revolution in general. But, later consistent growth of the infrastructure and public welfare with the sizes of these cities led to balance in the urban system (Farhudy et.al, 2009, 57).

It should be noted that "most urban system theories in the past emphasized the elements of distance and space geometry, whereas information technology developments on the one hand, and the new social organization in the future post modern world on the other, led the "spatial organization of the society" to be replaced with "the social organization of the space" in the new urban geography in which political, economic and cultural elements gained more importance than elements such as "geometry and distance". Therefore, in the process of globalization or compression of time and place, at the same time that urban hierarchical system deteriorated in favor of big cities and contraction of urban network and closeness of small and big cities to each other in terms of time and place, we should expect the urban system as an open system to adapt itself to external qualitative and quantitative changes more rapidly (the necessity of understanding and planning); otherwise, functional and physical disruption would be the price that the elements of urban system have to pay" (Azimi, 2002, 130-131).

The regional sciences scholars have tried to elaborate on this issue by proposing theories, schools of thought and various models quantitatively or descriptively to discuss and institutionalize urban system, the optimal size of the city and concentration of the population and human functions as spatial hierarchy. In this regard, theories such as central place, growth pole, center-periphery, euferd theory and scholars such as Christaller, Lösch, Friedman, Isard, Perrot & Misra, Hilhorst's spatial development model can be mentioned (Ziari & Fallah Madvaari, 2006).

Balance and equilibrium in urban system and balanced development of population and activities in the region have always been a main concern of urban and regional planners and managers. After World Wars the first and the second and due to relative political stability throughout the world, the activities and plans for development began in countries. The early development theories focused on the concept of economic growth and some theories proposed in this regard. The theory of growth pole emphasizing the role of pioneer section in development economy and aiming at leaking the effects of development from the centers of growth was placed at top of countries' development plans. However, implementing this policy quickly led to negative effects on greater concentration of growth centers and instead of leaking the results of development, it caused metropolises to appear as indispensible economic and social powers whose negative effects on the urban and regional system of provinces and countries are still evident today.

Development and sustainable development

Ever since humans came into existence, development has been their concern and has evolved in line with his spiritual and material progress. There are extensive discussions and comprehensive literature about the human's thoughts on development and growth and their environmental effects the most recent of which are the sustainable development issues. In geography, like any other science that deals with human and his natural environment, these concepts have philosophical and theoretical foundations.

Development is an idea and practice that was created in the beginning of the nineteenth century. This concept is different from the idea of progress. Following the dissatisfaction with progress in the age of Western thoughts of mercantilists, positivists, idealists, the accompaniment of the development theory with early capitalism based on guardianship concept has strongly empowered the theory of development and guardianship is an intention that leads to expansion of other's potentials (Cowen & Shenton, 1996, 1).

Sustainable development means the human being's movement along the human-environment axis and it considers development of economic facilities according to environmental considerations and social justice. Sustainable development was proposed after troubles posed by mere economic development after World War II where irregular development caused class differences and several environmental problems and development did not take social and environmental dimension into account. This concept is rooted in an ecological principle. Based on this principle, in an environment if exploitation is done to the extent of natural potential of ecological processing, the main capital (ecologic resources) remains constant and our use of that environment is always sustainable to the extent of that generative power. The extent of human exploitation in that given environment which suits the environment's potentials has the maximum efficiency because it is the same as the whole generation (Makhdum, 1999, 54).

In sustainable development the focus is on human beings and, consistent with the nature, they deserve a healthy and constructive life. In this trend, the principle of creating balance between economic, social and ecologic demands of each generation with regard to future generations' share of the earth's limited resources is the focus of urban policymaking and arrangement of settlements (Emakchi, 2004, 1). Thus, the concept of sustainable development gives an extensive meaning which contains all aspects of humans' lives in which policies in economic, commercial, technology, natural resources, education, health and industry, etc. are designed and planned in a way that sustains economic-social and environmental development (Movahhed, 2000, 4).

Urban development may include balanced and consistent expansion of the area allocated to residential buildings in a city with areas required for other applications as well as the required facilities in a standard manner; in other words, in urban development equality and balance between the quantity and quality of what is established on the one hand, and number and size of urban population should be emphasized. Attention to urban environment and taking the civilians' welfare and comfort into account as well as preserving the beauty of the city are among the aims of urban planning. Based on what was said, a sustainable city is a city that has such an economy which not only does not have the least negative impact on the environment (Bahraini, 1997, 23), but also focuses on physical aspects of the city, i.e., its future optimal development and act consistently in terms of function and plans for citizens' participation.

Focusing on physical development of the cities is considered as a key factor in planned growth of them. In our country, as long as the pattern of development for the cities has been organic and endogenous and local factors determined urban growth, the urban lands sufficed traditional urban applications and organized the city according to its economic, social and security conditions. But, today due to exogenous groups' interference and people flooding into these cities, physical development is regarded as a key factor in urban planning. Moreover, although urban areas comprise 4 percent of the lands on earth, their irregular development could cause vast changes in the environmental conditions of other applications. The irregular urban development affects cities and their surroundings negatively; these effects include nonconformity of natural perspectives and loosing farm lands. Despite that scientific findings have proven that this pattern is not effective for urban development, it is still the dominant pattern in urban development (Batisani & Yarnal, 2008, 2).

Based on the proposed definition, it can be seen that sustainable development is based on three principles:

1. Ecological stability: this principle emphasizes development besides preserving essential environmental activities, biological species variety and the nature.
2. Socio-cultural stability: this principle focuses on people's rule over their destiny in the course of development.
3. Economic stability: this principle emphasizes optimal deployment of resources and their suitable management such that future generations would not face problems (Hashemi & Sabouri, 2010).

Review of literature

Jaajarmi & Gheibi (2011) in a study titled "investigating and analyzing developments in Tehran's urban system during the years 1976-2006" found that Tehran's urban system has two main characteristics: the first is rapid growth in its population and its transformation into a local-national metropolis which contains 64 percent of urban population of Tehran province. This process, in turn, has been followed by the "Macrosephaly" or "Primate City" phenomenon. The second characteristic is increase in urban population in general and their tendency to ascend to higher ranks. Overall, what is most evident in the curves is kurtosis during the years 1976-2006 which is due to population increase and shows the superiority of Tehran in the national and local urban system.

Lotfi et.al, in a study titled "investigating the development of Primate City and the urban system in Zagros region (1976-2006) concluded that there is no Primate City in Zagros region despite increase in the number and size of the cities in all provinces and there is balance in most census rounds in urban network.
In a study titled "the balanced urban system and its role in balanced development of the regions of Ardabil province", Nazmfar & Khodaei (2012) found that because of primate city Ardabil, the urban hierarchy of the province did not follow the rank-size rule. In fact, having vast and various functions, Ardabil city has always enjoyed a distinct regional situation and caused irregularity of urban system in the province by attracting population of the surrounding areas.

Methodology

This is an applied-developmental study which uses a descriptive-analytical methodology. The theoretical parts of this study are written using library, internal and external resources and to analyze the data the AHP model is applied.

Introducing the area under study

Zabol County with an area of 15,197 square kilometers is located Northwest of Sistan & Baluchestan province and the distance between the center of the County and the center of the province is 213 kilometers. This County contains 6 towns and 5 districts, 17 rural districts, and 932 populated villages. According to the 2011 census the population of Zabol and its surrounding villages amounts to 259356.

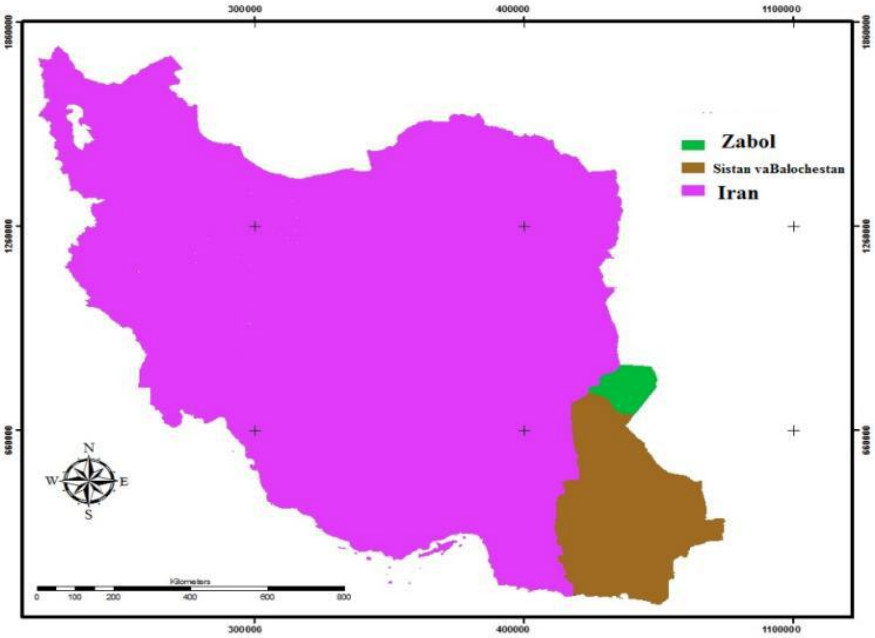

Figure (1). The location of Zabol city in the country, province, and the county, Source: findings of the research

Discussion and conclusion

Analysis and prioritizing indicators of the role of Zabol city in regional development using AHP model

First the issue under study is transformed into a hierarchical structure including a three-level hierarchy i.e., aim, criteria and the options (table 1)

Table (1). Indicators of the role of Zabol city in regional development

Indicator	criterion
A	Creating services and facilities for the surrounding areas
B	The spatial-economic development of the region
C	Reducing regional inequalities
D	Accommodation of the population in the region

Source: findings of the research

In order to determine the binary comparison matrix of the indicators (A=aij) and their significance, experts' opinion was applied.

Table 2, binary matrix of the indicators

Indicators	A	B	C	D
A	1	1.3	1.3	2
B	3	1	1.7	1.2
C	5	3	1	3
D	2	1.2	1.3	1
∑	10	6.5	5.3	7.2

Source: findings of the research

Binary matrix of the indicators is obtained as follows:
It should be noted that in order to fill this matrix, a 1 to 9 scale is used to determine the relative significance of each element compared to the others.

Table 3. The 9 digit Saati scale for binary comparison of the options

Numerical value	Preferences (oral judgment)
9	Extremely preferred
7	Very strongly preferred
5	Strongly preferred
3	Moderately preferred
1	Equally preferred
2,4,6,8	In between preferences

source: findings of the study

After creating binary comparison matrices for the indicators, we normalize their values. To do this, the value of each matrix is divided to the sum of the corresponding column.

Table 4 normalized matrix of binary comparisons of indicators and relative weights

Indicators	A	B	C	D
A	0.1	0.2	0.245	0.277
B	0.3	0.153	0.320	0.166
C	0.5	0.461	0.188	0.416
D	0.2	0.184	0.245	0.138

source: findings of the research

The principle of logical compatibility of the judgments
Now these steps are taken for all options (a, b, c, etc.). In this step the rate of I.R should be calculated in order to decide whether there is agreement between the binary comparisons. Here we only calculate the compatibity rate for binary comparisons of the indicators; a similar operation should be performed for the options in each indicators view. The (I.R) is obtained from the following relation:
The I.R is extracted from the following table (5)

Table 5. The standard table of calculating the I.R

N	1	2	3	4	5	6	7	8	9	10
I..I..R	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.45

Source: findings of the research

Therefore, according to the calculations of the expert choice software, the I.R is 0.069 in the present study. Since *IR* =0.069 is less than 0.1, therefore there is an acceptable compatibility.

A (L: 0.205) B (L: 0.234) C (L: 0.391) D (L: 0.191)

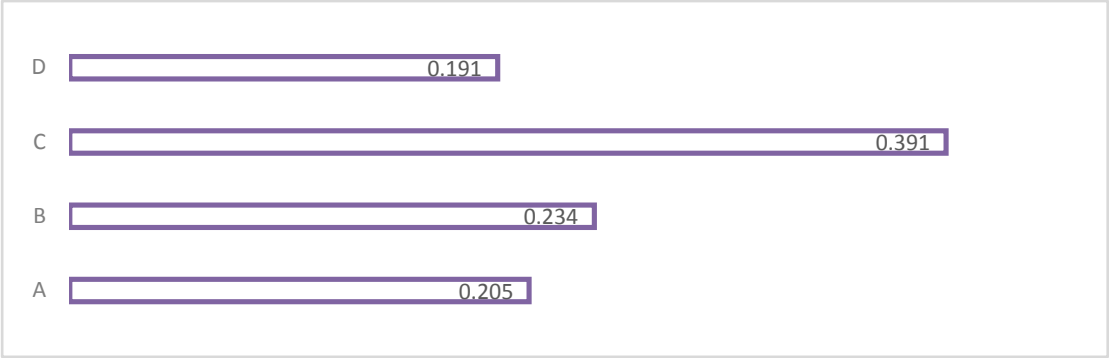

Figure (2). Results obtained from hierarchical analysis using expert choice; source: findings of the study

The results obtained from prioritizing the indicators of the role of Zabol city in regional development is as follows: C >B >A >D, in which indicator C (reducing regional inequalities) with a weighted mean of 0.391 ranks first, indicator B (spatial-economic development of the region) with a mean of 0.234 stands the second, indicator A (services for the surrounding areas) with a mean of 0.205 takes the third place, and indicator D (habituating the population in the region) with a weighted mean of 0.191 is placed fourth.

Table 6. Final ranking of the indicators of the role of Zabol city in regional development AHP model

indicator	Criteria	Mean	Rank
A	services for the surrounding areas	0.205	3
B	spatial-economic development of the region	0.234	2
C	reducing regional inequalities	0.391	1
D	Accommodating the population in the region	0.191	4

Source: findings of the research

CONCLUSION:

In views specifying the process of regional development, the issue of balance in development and balanced arrangement of activities in the space is crucially important. One of the basic issues of decentralization is the need to take middle parts of the hierarchy of habitats into account. In this regard, middle cities require more attention. In developing countries like Iran, the irregular growth of metro polises and concentration of all facilities in these spots leads to imbalanced growth of the population. This in turn is the source of many problems and creates several incongruencies such as population growth and increase in the number of big cities against middle and small cities and villages. Therefore, the solution to balanced development is paying attention to middle and small cities which could have an effective role in distributing regional facilities and development. The policy of middle cities has always attracted attention of planners and researchers. Middle cities play the role of transmission and enhancing regional development, a role that enables each city to have their particular function in applying potentials of development and movement of regional-urban network. In this regard, the aim of the present study is to investigate and analyze the role of Zabol city in regional development. It makes use of a descriptive-analytical methodology based on library resources and field studies and the AHP model to analyze the data. The results show that indicator C (reducing regional inequalities) with a weighted mean of 0.391 ranks the first and indicator D (habituating the population in the region) with a weighted mean of 0.191 ranks fourth.

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Evaluation and analysis of the role of urban planners and managers in sustainable urban development (Case study: The cities in Sistan region)

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ABSTRACT: *Cities have different structures and functions as the centers of dwellings. The formation of skeletal elements in multiple cities is conducted by political and social players of country but it does need some contexts and background to administrate the city and meet expectations of citizen's need which depended on them to be able to give a reasonable answer to them. City and urban management are concepts which are very close to each other. Establishing the necessary conditions and backgrounds for urban holistic development will not provided without full interaction between elements of urban management, including urban planners, city managers, citizens, institutions and the city administration, council and private sector. So the goal of this paper is the evaluation and analysis of the role of urban planners and managers in sustainable urban development (Case Study: Cities in Sistan region). The research method is descriptive-analytic and is based on library studies. The results of multi-criteria classification of Electre-TRI show that based on the studied criteria, Zabol is in first place and the city of Dost Mohammad is in the second place and finally the city of Zahak is in the last place.*

KEY WORDS: *Urban management, urban planning, sustainable development, Sistan*

I. INTRODUCTION

The city is the economic and social phenomenon basically which has been shaped and developed by the influence of various factors and forces. People aggregate together in a limited and dense area to live and work and communicate and create the city gradually. So cities like living creatures, is always becomes larger physically and more complicated structurally. The increasing value and importance of the role of citizens in administrating a democratic system of governance and society has attended the idea of public participation in affairs of society. According to the movements of democracy and democratic governance of societies, the right of people to their fate is accepted by popularity and their lack of participation has led to the creation of large losses (Habibi, 2002, 12).

It is certain that strategy is not enough by itself but, it is the implementation and monitoring of strategies that drive the organization. Experience has shown that it has not been because of weakness of the strategy that most organizations have failed, but it has been due to not implementing or weak implementing of strategies. If strategies been designed correctly but not appropriate to the processes and activities of the organization then, the operational managers and in another words, the executive bodies will be away from each other and as a result, divergence between the performance and strategies will occur. Establishing of a performance evaluation system will minimize the risk of this divergence and prevent from the waste of time and resources of organization (Alavimatin and et al, 2009, 191).

But nowadays, the roles of managers in urban management have changed in the world fundamentally. Cities are

managed to provide welfare and comfort of their residents. Urban management has large structures and has an important role in the success of the programs and projects of urban development and the needs of the flow of traffic in the city, public welfare, housing, land use, recreation, culture, economy, infrastructure and etc (Shaia, 2003: 47).

The purpose of the role of managers in urban management is improving of the working and living conditions of the population living in a different socio-economic strata and groups and protect the rights of citizens, to encourage sustainable economic and social development and protection of environments (Saedinia, 2000:46). Urban management must plan for the city, organize the urban activities, and monitor conducted activities and even create motivation for optimal performance of affairs. Performances of such cases are returned to knowledge of principles of management, planning, communication, motivation, organization, leadership and control (Saedinia, 2000: 20).

Today, the managers know the measuring of the performance of their organization as an inevitable fact to achieve its strategic goals. They believe that their improvement and the growth of their performance depend on performance measurement system which controls all components of the organization and shows the deviation of the component from those that are in line with the strategy. Performance management is an approach that it will be possible to achieve many of these objectives by using it. Performance management is a process based on a series of activities and is built in such a way that through continuous improvement of people and groups will lead the organization to organizational effectiveness and Improvement of strategic focusing.

In our country, after two decades of interruption, in October of 1998, the people had the chance to participate in free elections for the election of members of city councils, town and village for the first time. Welcoming millions of Iranians of this historic event is a sign of their long-standing interest in participation in politics and public services and it is hoped that the council elected by the people with knowledge about their heavy duty, will try to improve the economic and social wellbeing of the local community and the development of towns and villages. Sustainable development model as the common modeling approach of development, knows the development as the world modernization according to Western demands and ways (Baker, 2006, 1). From 1980s onwards the concept of sustainable development has been as a fundamental concept in the World Conservation Strategy of the United Nations and in Report of Brantland, the report of Brandland (1983) defines the sustainable development as a development which meets the needs of present generation without compromising those of future generations (WCED, 1987, 43). It contains 2 original concepts. A) Needs, especially the basic needs of poor people who need to be given higher priority. B) Restrictions, restrictions are to protect environmental resources for future generations in the frame of use of adaptive technology (Purvis & Grainger, 2004, 6). Sustainable city should be planned in a way that by the efficient utilization of resources provides fair choice and benefit from the environment for residents; it is the approach of the development of sustainable city that leads the urban planning process to this direction.

The history of the research

In 2009, Alavimatin and et al did a research entitled, performance Evaluation of Islamic council of Tabriz and its role in the implementation of municipal projects (case study: reconstructive projects of Tabriz Municipality), and concluded that based on Article VII of the Constitution, Islamic councils should have continuous monitoring on the performance of municipalities and on reconstructive projects.

In 2007, Azarbaijani and Dariai did a research entitled, impact of city councils on the effectiveness of municipalities (case study: Islamic council and Municipality of city of Abada), and concluded that in the prospective of employees, there is no significant difference in the effectiveness of the municipality before and after the establishment of the Council, however the elected mayor by council have been weaker than before ones. In prospective of citizens, there is a meaningful difference in the effectiveness of the municipality before and after the forming of the council while there is not a meaningful difference in electing of mayor.

In July of 2002, Habibi has done a research at faculty of law and political science at Tehran University entitled, the performance of the first Islamic council of Tehran, the main hypothesis of this thesis is that the most important element for electing members of the City Council of Tehran is political affiliation and orientation not the experience and administrative efficiency. And if the council neglect this important, it will lead to the ultimate failure of the Council.

In 2012, Ziari and et al have done a research entitled, Study and identify fiscal resources and presenting of ways to improve the sustainability of resources and income of municipalities, the municipality of the city of Mahabad, and concluded that Municipality of Mahabad faces to some problems in many aspects that its origin goes back to the lack of mechanisms and strategies for sustainable income. Finally, due to problems in the municipality, some strategies have been suggested for sustainable income of the municipality.

In 1967, Zahedi has done a research to get a master's degree with guidance of Niamey, at Faculty of Business Administration and Management in Tehran University entitled, Tehran City Council and its role in municipal affairs. In this study, the researcher has stated duties of the City Council and its relationship with the municipality and related problems.

Theories

City

Although still in the Third World people live in rural areas, but city was the center of the many developments that have occurred in colonial period and especially after it (Smith, 2000). According to ecology, the existence of cities belongs to the second food production. In this period of time rich cities are growing in number in rich areas. Urban communities are growth and more facilitate. So production is increased in the cities. Transactions occur between the cities, life is more extensive and comfort coupled with the vast social network. Then the man went into the field of urban communities and creates new areas of a Word. Devices may be replaced by a machine instead of simple tools and period of machinery in production begins. Cities become a closed Center and habitats of community elders and social organizations are transmitted to the cities from the villages. City Especially big city is an unquiet community that large groups gathered in mass, and because of a variety of complex social organizations, especially official organizations they are cooperating together. City dwellers usually have an official or private relation with each other. Among city dwellers, there are fundamental differences in terms of jobs and expertise. Despite cities have in common about qualities but they are not all of one type, many cities by the time spent, have been named in terms of certain specialties. So cities can be divided into different groups such as trade center city, industrial city, cultural city, realigned city, political city, cultural city, sportive city and so on (Romory, 2008, 9).

Urban management system

Urban management is as a system. To understanding of urban management, it can be likened to a system. Urban management like all systems is included of departments and affiliate agency or organizations, which have mutual relations together in form of unique structure. This relationship may be weak or strong.

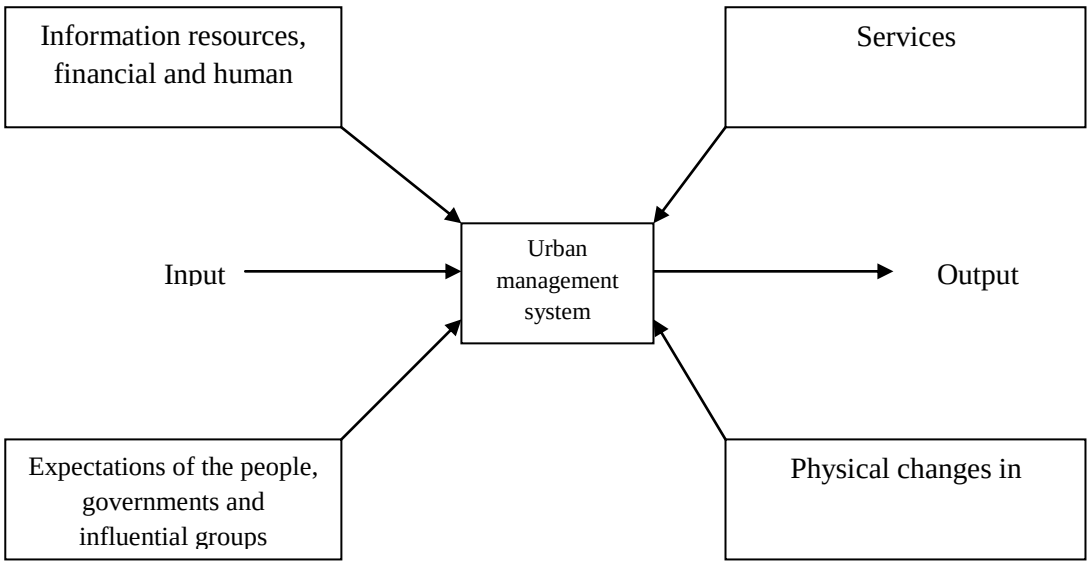

Figure (1): Input and output in an urban system, Source: S. Ahmadnia, p 29

Since there are large number of individuals, hierarchical and accurate division structure of labor; urban management system in the term of systems classification is in the social systems category. The important part of this system is financial sector which is the most important issues of urban management system.

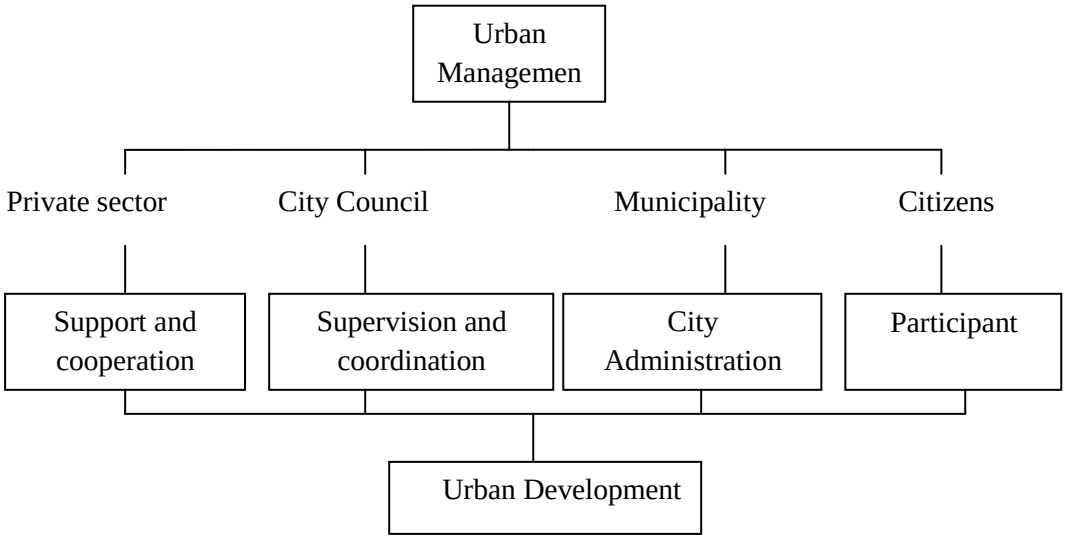

Figure (2): The Role of Urban Management

The concept of the development and sustainable development

Development is an idea that emerged from the early of nineteenth century. This concept is different from the idea of progress. Accompanying of development theory with first capitalism based on Mandate idea (Act instead of other), a strong force for creating the idea of development was created following dissatisfaction with the progress taking place in Western thought era of positivists, idealism and critical ideas. Mandate is stated as an intention which is to develop the sources of others by using of powerful factors (Cowen & Shenton, 1996, 1).

In sustainable development, the human is focused and humans deserve a life coupled with health and construction in harmony with nature. In this orientation, the balance principle between the demands of economic, social and ecological of each generation according to the share of the earth's limited resources are urban policies and urban settlements layout (Amakchi, 2004: 1). So the concept of sustainable development has an extended meaning which covers all aspects of human life, and policies on economic, trade, technology, natural resources, education, health and industry and etc have designed and planned in such a way that continue the socio-economic development and environmental development (Moahed, 2000, 4).

Area of study

Sistan region with an area of 15,197 sq km in the geographic range between 30 ° C and 5 minutes to 31 degrees 28 minutes latitude and 60 degrees 15 minutes to 61 degrees 50 minutes longitude in southeastern Iran and the northern part of the province and Balochistan by about one eighth of the total area allocated to the province. Average annual rainfall in the region 6/59 mm, mean annual temperature of 22 ° C and the average annual relative humidity is 38 Drsdmy. One of the hallmarks of the region, which winds 120 days in the mountains between Afghanistan and plain air pressure, occurs. The wind almost from early June starting at about 4 months of the year continues in Zabol plain and almost September (late August) is terminated.

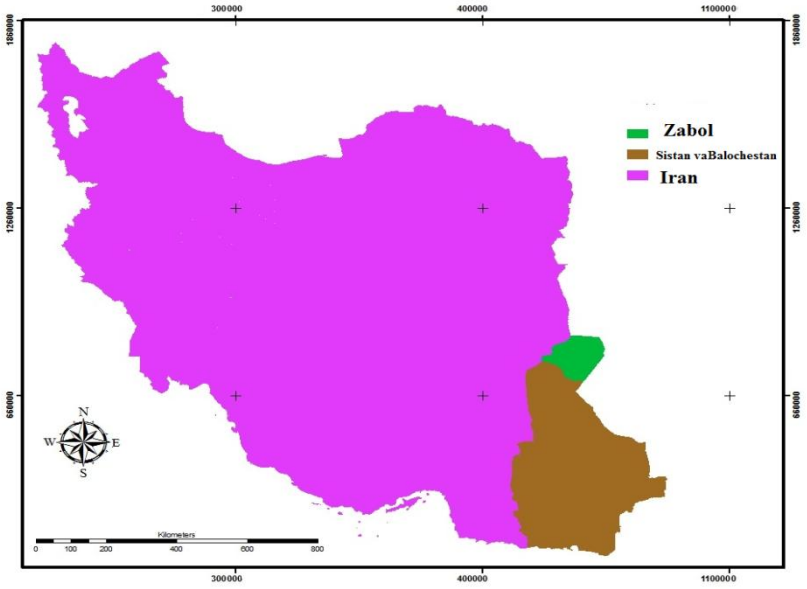

Figure (3): position in the region, Sistan-Baluchistan province Source: search results

Discussion and Conclusion

Using of ELECTRE model for evaluation and analysis of the role of urban planners and managers in sustainable urban development (Case Study: Cities in Sistan region).

Sustainability criteria are:

* Social dimensions
* Economic dimensions
* Cultural dimensions
* Environmental dimensions

In this model it is assumed that desirability of each index is steadily increasing or decreasing. The problem solving with this method involves the following 7 steps which we will refer to this process in the next section. Table 1 shows the Matrix of evaluation and decision-making criteria, evaluated by ELECTRE model in cities of the province of Sistan.

Table (1): Matrix of evaluation and decision making the criteria used

Environmental dimensions	Cultural dimensions	Economic dimensions	Social dimensions	Indicators Cities
average	Low	Low	Low	Zahak
much	average	average	average	Zabol
average	average	Low	Low	Dost Mohammad

Source: search results

Our criteria, all 4 of the criteria are qualitative. Qualitative criteria are: very low, low, medium, high, very high, and were considered as the "positive" then we use the scale of The "distance scale dipole" for converting qualitative indices to quantitative indices and placing them in the evaluation and decision-making matrix which follows as :

Table (2): Conversion of quantitative indicators to qualitative

1	2	3	4	5	6	7	8	9	10
Very Low		Low		average		much		very much	

Source: search results

Based on these scales, qualitative criteria were measured and converted into quantitative criteria which the results are reflected in Table (3).

Table (3): evaluation and decision-making matrix

Environmental dimensions	Cultural dimensions	Economic dimensions	Social dimensions	Indicators Cities
5	3	3	3	Zahak
7	5	5	5	Zabol
5	5	3	3	Dost Mohammad

Source: search results

After obtaining the table of the matrix of decision making, table 3, the steps of ELECTRE method were performed as follows:

First step: Not scaling of the matrix of decision (N)

There are different ways to not scaling of the matrix of decision that one of those ways is not scaling of the norms.

In this type of not scaling, we divide each element of the matrix of decision making by the square sum of each column in this way, all the columns of the matrix will have a similar unit and we will be able to compare them easily.

Equation (1)

$$n_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{n} a^{2}{}_{ij}}}$$

Second step: Gaining of the balanced not scaling matrix (V)

For this purpose, we use the method of Entropy, by using this method we can obtain the weight of indices as equation (2) and table (5):

Table (5): obtain the matrix (V)

C4	C3	C2	C1	Indicators Cities
0.009	0.04	0.08	0.01	A1
0.01	0.04	0.04	0.05	A2
0.03	0.07	0.01	0.08	A3

Source: search results

Equation (2)

$$P_{ij} = \frac{aij}{\sum_{i=1}^{n} a_{ij}}$$

Table (6): continue with the second step: the obtain the matrix (V)

C4	C3	C2	C1	Indicators Cities
0.50	0.23	0.23	0.23	Ej
0.63	0.50	0.50	0.50	Dj
0.50	0.50	0.23	0.23	Wj

Source: search results

To obtain the value of k from equation (3) is used:

Equation (3)

$$k = \frac{1}{\ln(m)} = \frac{1}{\ln 3} = 0/89$$

Equation (4)

$$d_j = 1 - E_j$$

$$w_j = \frac{d_j}{\sum_{j=1}^{n} dj}$$

Equation (5)

Now it is possible to obtain the balanced not scaling matrix, for this purpose the not scaling matrix will be multiplied to quadratic matrix (wn*n) which the diagonal elements of the weights of indices and other elements is zero. This matrix is called the balanced not scaling matrix (V) that will be obtained by using the following equation:

Equation (6)

$$V = N \times w_{n \times n}$$

Third Step to seventh step: setting of coordinated and uncoordinated complex

At this stage, all options will be evaluated with respect to all indices and the matrixes of coordinated and uncoordinated will be formed. Coordinated complex concludes all indices which in them an option is better than other option. For finding this utility, the type of indices should be noticed in having both positive and negative aspects.

This matrix can be calculated by the following equation:

Equation (7)

$$I_{kl} = \sum w_j, j \in S_{kl}$$

The index of S_{KL} represents the relative importance of S_K to S_K. This measure is a numerical value between zero and one and the greater this value, the more preferable the S_K to S_L and vice verse.

The next step is to determine the uncoordinated matrix based on the matrix of V and is obtained by using the following formula:

Equation (8)

$$NI_{ki} = \frac{\max \left| v_{kj-} v_{ij} \right|, j \in D_{ki}}{\max \left| v_{kj-} v_{ij} \right|, j \in \sum A}$$

This criterion measures the lack of acceptance of the complex of (K) and (I) to inconsistency in the indices.

Then for creating an effective matrix of H, you need to determine a threshold first and if each element of matrix of (i) is greater than or equal to it, the amount of that component will be one, otherwise it would be zero.

According to the obtained threshold, larger values than it, will take the number one in the effective matrix and the smaller value than it will take the number Zero. By combining of the effective coordinated matrix with the effective uncoordinated matrix, the general matrix will be obtained and according to the obtained matrix, prioritizing of options is as follows:

Table (7): determining the priority based on parameters the studied cities in Sistan region

Rank	Environmental dimensions	Cultural dimensions	Economic dimensions	Social dimensions	Indicators Cities
3	3	3	2	3	Zahak
1	1	1	1	1	Zabol
2	2	2	2	2	Dost Mohammad

Source: search results

The results of multi-criteria classification of Electre-TRI in determining the importance of the role of managers and urban planners in sustainable urban development based on a set of parameters of sustainable urban development such as: (Social, economic, cultural aspects, and environmental aspects) shows that the city of Zabol is in the first place and the city of Dost Mohammad is in the second place and finally the city of Zahak is in the third place based on the studied criteria.

CONCLUSION

Today, the urban management has been developed. Cities are managed for more welfare for citizens. Urban management has an important role in the success of the programs and projects of urban development. This will be more important especially in relation to sustainable development. The goal of urban management is improving the working and living conditions of the population living in a social and economic strata and different groups and protection of citizens' rights, to promote sustainable economic and social development and protection of environments. Urban management should plan for the city, organize the urban activities and monitor on the carried activities and create motivation for doing optimal affairs.

So the goal of this paper is the evaluation and analysis of the role of urban planners and managers in sustainable urban development (Case Study: Cities in Sistan region). The research method is descriptive-analytic and is based on library studies. The results of multi-criteria classification of Electre- TRI show that based on the studied criteria, Zabol is in first place and the city of Dost Mohammad is in the second place and finally the city of Zahak is in the last place.

Suggestions

- Officials involved in municipal affairs must attract the consent and participation of the people and use their ideas for improvement and more effective use of their program goals.
- Honesty, transparency and flexibility are the winning factor for managers and urban planners
- The urban planning of the city council and managers should be offered to the people openly and honestly. This provides increased trust of citizens
- Reasonable grounds for making people familiar with the laws and regulations of the city

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Instantaneous GSM Signal Strength Variation with Weather and Environmental Factors

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ABSTRACT: *Spatial and temporal changes that transmitted radio signals may go through are attributed to variations in the atmospheric conditions as well as other environmental factors. This work evaluates and establishes some atmospheric and environmental variables that have a dominating impact on temporal signal strength fluctuations that are experienced even on a fixed location. The average refractivity gradient dN/dh computed from hourly measurement taken at a fixed location for seven days was -61.3 N/km and so the average propagation conditions correspond to the normal mode, although super refraction was to be expected at about 10 am and 8 pm. On the overall, the variation in dN/dh does not actually explain the temporal variations in the received signal Pr, since the correlation between the variables is as low as 0.091. Among the environmental factors investigated for their effect on signal strength fluctuations, receiver location has a dominating impact.*

KEYWORDS: *Radio Signals, Weather, Refractivity, Environment*

I. INTRODUCTION

Recent studies have however shown that the transmitted radio signals may go through spatial and temporal changes due to variations in the atmospheric conditions as well as other environmental factors [9]. These conditions vary with changes in height, geographical location, and even with changes in time of the day as well as seasons of the year.

Virtually all weather phenomena take place in the troposphere which is the portion of the Earth's atmosphere that extends from the surface of the Earth to a height of about 6 km at the Poles and 18 km at the equator. The temperature in this region decreases rapidly with altitude, clouds form, and there may be much turbulence because of variations in temperature, density, and pressure.

These fluctuations in the atmospheric parameters like temperature, pressure and humidity in the troposphere are said to cause the refractive index of the air in this layer to vary from one point to another [14]. This study evaluates the correlation between instantaneous or temporal signal strength fluctuation and the associated refractivity gradient based on hourly data of the atmospheric parameters obtained from Nigerian Meteorological Centre, Bauchi station and the simultaneous hourly GSM Signal Strength measured at a fixed location.

II. RELATED STUDIES

Influence of atmospheric refraction on the propagation of electromagnetic waves has been studied by several researchers and it has been shown that the inhomogeneous spatial distribution of the refractive index result in multipath fading and interference, and these impair radio communication, navigation and radar systems [13]. It has also been shown that seasonal variation of refractivity gradient could cause microwave systems unavailability [22].

This variation of atmospheric refractivity in space and time as a result of some physical processes are often difficult to describe in a deterministic way and have to be considered as a random variable. Current research on the effect of refractivity is based on experimental measurements in some case [1, 3, 5, 7] and in other cases they are based on computational methods which are used to simulate the refractivity effects [20]. Such have been carried out for different propagation environments [6, 9, 14, 15, 21].

Statistical distributions of the refractive index modulus, its vertical gradient, and the diurnal and seasonal variations have been investigated and characterized for different regions and climates using measured local meteorological data [5, 8, 17, 19, 22]. The results of these works show that the local climate has an appreciable influence on the radio refractivity and hence on the transmitted radio signals. The result of [4] actually showed that the diurnal refractivity variation is basically a function of local meteorology, while seasonal variation follows the climatic condition.

In a related development, [16] evaluated the refractivity gradient for Bauchi based on a five year meteorogical data obtained between 1995 and 1999. A second order polynomial expression developed from the data of [17] was used to obtain the gradient. The foregoing show the possibility of higher path loss between January and March, and conditions conducive for ducting may exist between May and October. Also, the presence of the anomalous propagation discovered by [14], during their measurement campaign led to further studies and analysis to correlate weather conditions with the temporal variations in the received signal of a live VHF network. The abnormal conditions in the upper atmospheric layers were used to explain the observed variations in the received signal strength.

These related works only attempted to correlate the observed seasonal refractivity profiles with actual signal strength from a live network operating at VHF bands and not the instantaneous and temporal fluctuations. This work investigated the extent to which variation in refractivity and its gradient affect the temporary signal strength variations at fixed locations in Nigeria among others. Although other parameters like equivalent gradient and the potential refractive index have also been proposed for predicting or interpreting radio data, surface refractivity is more commonly used because of the relative ease in obtaining its related surface parameters namely; temperature, pressure and relative humidity from many widely separated stations [4].

III. MATERIALS AND METHODS

An experiment focusing on refractivity related effects was carried out by, first, taking the hourly measurement of signal strength at a fixed location (Plate I) on a live GSM network operating in the 900 MHz band and the fluctuations were observed. Secondly, data of tropospheric variables - temperature, pressure, and relative humidity were simultaneously obtained from Bauchi meteorological centre. The meteorological data available was only for the surface weather parameters, and were used to calculate vapor pressure, radio refractivity, and refractivity gradient, and Effective Earth Radius Factor.

Plate I: Digital Map of a Fixed Location in Bauchi, Nigeria, Downloaded from Google Maps website.

3.1 Refractive index in the troposphere

The refractive index of the troposphere is a function of pressure, temperature and water vapour content. The value of refractive index, n, approximately equals to one (varying between 1.000250 and 1.000400) at or near the Earth's surface and changes in this value is very small in time and in space. The concept of refractivity N was thus developed in practice for easy handling of figures and to make those changes more noticeable [10]:

$$N = (n-1)\times 10^6 \tag{1}$$

From Equation (1), it is easily deduced that a typical range of N will be between 250 and 400 N units. Radio refractivity N is given in equation (2) as:

$$N(P,T,e) = N_{dry} + N_{wet}$$

$$= \frac{77.6P}{T} + 3.732\times 10^5 \frac{e}{T^2} \tag{2}$$

where P is atmospheric pressure (hPa), e the water vapor pressure (hPa), and T is the absolute temperature (K). Equation (2) may be used for all radio frequencies up to 100 GHz with error less than 0.5% [10].

The water vapor pressure e is given by equation (3),

$$e = \frac{H_R e_s}{100} \tag{3}$$

where H_R is the relative humidity, and e_s saturation vapor pressure (hPa) at a given temperature, t (^{0}C) is given by equation (4):

$$e_s = a\times \exp\left(\frac{bt}{(t+c)}\right) \tag{4}$$

where a = 6.1121 hPa, b = 17.502 and c = 240.97 °C above liquid water and above ice a = 6.1115 hPa, b = 22.452 and c = 272.55 °C. In this work, the values above liquid water were used.

From equation (2), the refractivity N varies inversely with temperature T and is strongly dependent on water vapour pressure e. N also decrease exponentially in the troposphere with height [6, 10]

$$N = N_s \times \exp\left[\frac{-h}{H}\right] \tag{5}$$

where N is the refractivity at the height h (km) above the level where the refractivity is N_s while H is the applicable scale height. [10] suggested that at average mid-latitude, N_s and H are 315 and 7.35 km respectively. Hence, N as a function of height $N(h)$ is given in equation (6):

$$N = 315e^{-0.136h} \tag{6}$$

However, the results of the work of [3] showed that the model using the scale height of 7.35 km and 7 km as recommended for global environment [10] and tropical environment [12] respectively gave reasonably accurate results for the refractivity at the altitude of 50m and 200m for seven out of the twelve months of the year. Although the scale height of 7 km gave a better result at 50 m altitude while 7.35 km scale height gave a better performance at 200 m.

3.2 The refractivity gradient

From equation (5) the refractivity gradient is given by equation (7);

$$\frac{dN}{dh} = \frac{-N_s}{H} \exp \frac{-h}{H} \quad (7)$$

For a standard atmosphere, the refractivity gradient is -39 N units/km. According to [12], when h < 1 km, refractivity gradient is well approximated by its value in a standard atmosphere. However, a study like the one by [17] which was within the first 100 m provides a good chart and was used in this work.

Generally, the value of dN/dh determines the ray path or the curvature of the radiowave. For $-40\ {}^{N}/_{km} \leq {}^{dN}/_{dh} \leq 0\ {}^{N}/_{km}$, the phenomenon known as sub-refraction in which the bending of the rays is less than normal occurs. This shortens the radio horizon and reduces the clearance over obstacles along the path and may lead to increased path loss, and possibly even an outage.

Normal mode of propagation is obtained when dN/dh lies between -75 and -40. If the gradient is between –75 to –156 N/km, super-refraction occur in which the ray path will increase, hence extending the radio horizon.

Below −157 N/km, the ray path deviates towards the Earth's surface, and a phenomenon known as ducting occurs [12]. Ducting is sometimes considered as beneficial if longer-range propagation is desirable. The downside is that the receiving antenna has to be within the height limits of the ducts, else, signal losses increases dramatically [6].

3.3 Effective earth radius factor (k)

The effective earth radius factor k can also be used to characterise refractive conditions as normal refraction, sub-refraction, super-refraction and ducting respectively. Thus, in equation (8), k, is expressed in terms of refractivity gradient [2,14]:

$$k = \left[1 + \left(\frac{dN}{dh}\right)/157\right]^{-1} \quad (8)$$

Near the earth's surface, k = 4/3 [12] and is referred to as normal refraction or standard atmosphere. Under this condition, radio signals travel on a straight line path along the earth's surface and go out to space unobstructed.

For $0 < k < 4/3$, sub-refraction occurs, under this condition, radio waves propagate away from the earth's surface. When $4/3 < k < \infty$, super-refraction occurs and radio waves propagate towards the earth's surface thus extending the radio horizon and lastly, for $0 > k > -\infty$, result in ducting and the waves bend downwards with a curvature greater than that of the earth. These conditions are illustrated in Figure 1.

Figure 8: R

Fig

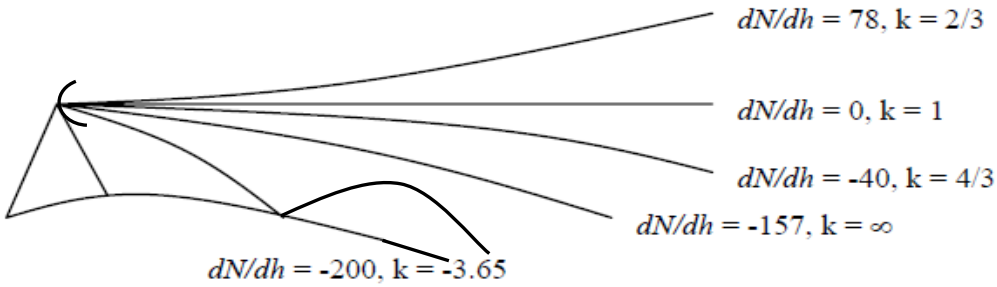


Figure 1:Ray Path for different values of dN/dh and k.

Correlation Coefficient: The correlation coefficient given in equation (9), is a measure of the extent to which two measurement say X and Y vary together. Correlation analysis examines each pair of measurement to determine whether the two tend to move together. The correlation coefficient can assume any value between -1 and +1. Positive correlation is obtained when large values of one variable tend to be associated with large values

of the other. Negative correlation results when small values of one variable tend to be associated with large values of the other and a correlation near 0(zero) is obtained when values of both variables tend to be unrelated.

$$Correl(X,Y) = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}} \quad (9)$$

IV. RESULTS AND DISCUSSION

The subsections under this heading describe the result of temporal signal strength variation with environmental factors, time of the day and weather.

4.1 Signal strength variation with environmental factors

Result of [18], shows that signal strength Pr, is strongly correlated with radial distance from the entire four base stations investigated irrespective of the frequency of operation. However, the same result suggests the need to further investigate the potential environmental factors —such as location, weather, time of day, etc that have a dominating impact on the received signal strength. Effects of these environmental factors on the measured signal strength have been investigated herein. As shown in Figure 2, each line indicates a different experiment that was performed at different times on the same route.

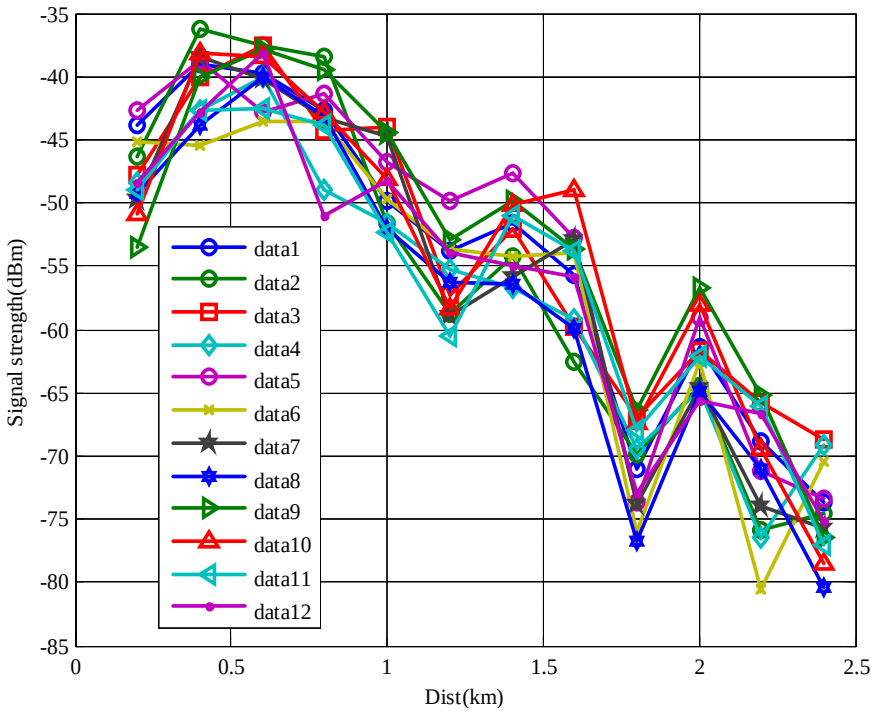
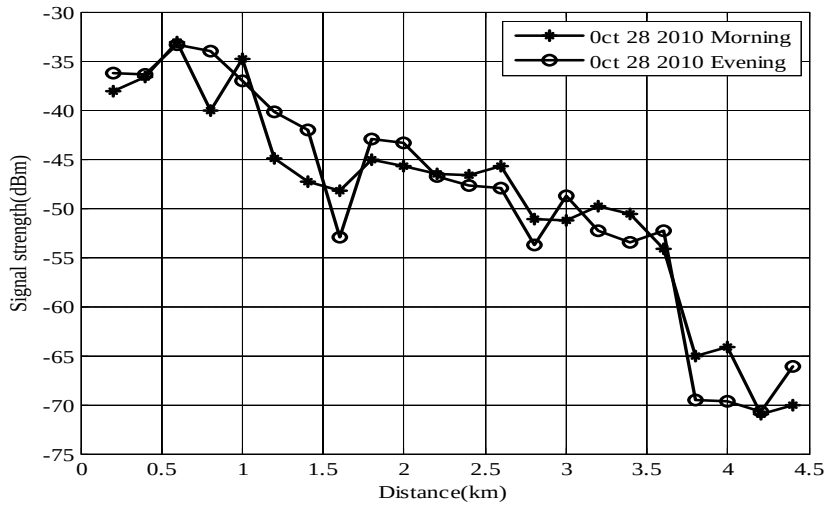


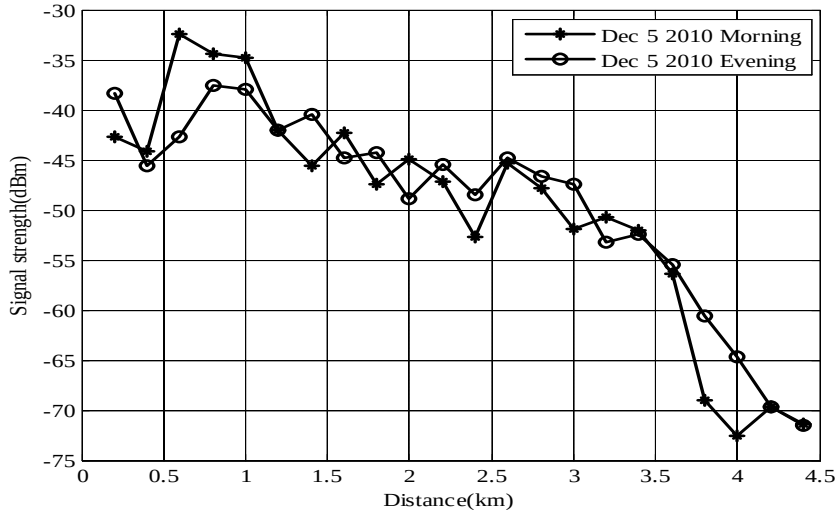
Figure 2: Signal Strength Measured at Different Times across Different Locations

4.2 Diurnal variation of signal strength

To evaluate the variation with time of the day, signal strength was measured over the same route at two different times: morning (8 to10 am) and evening (4 to 6 pm). Figure 3 (a) and (b) shows a sample of such measurement conducted on October 28, 2010 and Dec 5, 2010 respectively. The statistics of the differences observed between the morning and evening measurements are presented in Table I.



(a)



(b)

Figure 3: Signal Strength Variation along a Specified Path at Different Times of Same Day.

Table I: Statistics of Morning and Evening Samples

	0ct 28 2010		Dec 5 2010	
	Morning	**Evening**	**Morning**	**Evening**
Min	-71.00	-70.75	-72.55	-71.50
Max	-33.05	-33.40	-32.45	-37.60
Mean	-49.10	-48.98	-49.89	-49.24
Median	-47.03	-47.80	-47.35	-46.13
Mode	-71.00	-52.25	-72.55	-44.85
Std	10.54	11.62	11.63	9.76
Range	37.95	37.35	40.10	33.90

4.3 Signal strength variation with weather

To determine signal strength variation with weather, hourly signal strength was measured at a selected field point for seven days. Figure 4 shows measurement of Day 4 and Day 6 that present significant 0.65 correlation coefficient value, signal strength of other days is strongly uncorrelated. Using equations (2) to (4), refractivity *N*, was computed and since the Bauchi meteorological data was taken at a fixed height of 609.3 m, refractivity gradient *dN/dh*, was computed using the regression formula deduced by [16] from the work of [17]. A plot of the refractivity gradient, as is often used in literature to explain the weather effect on the radio signal is shown in Figure 5.

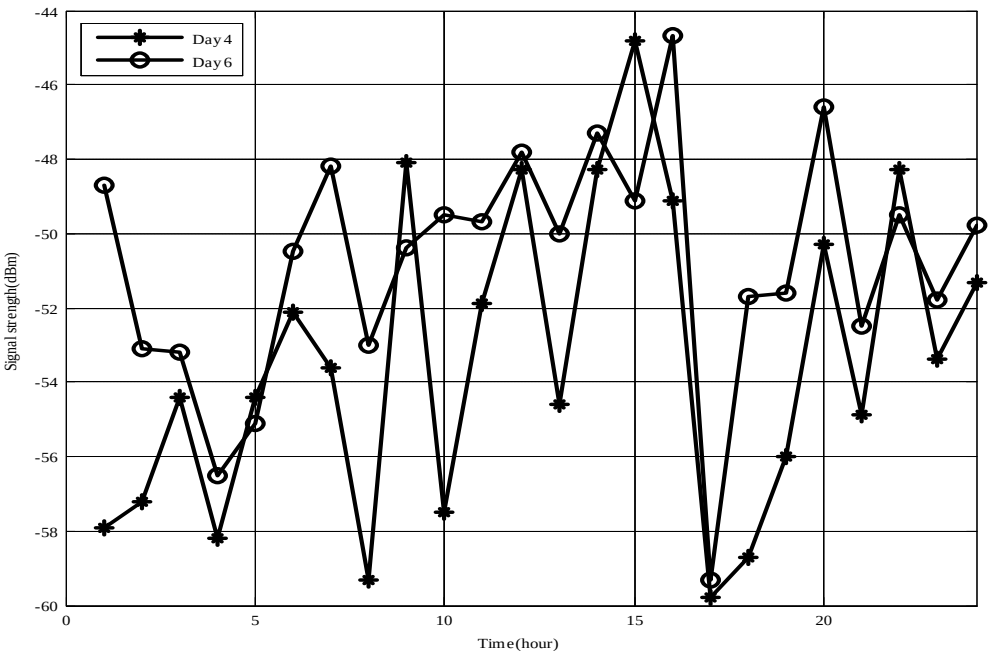


Figure 19: Signal Strength Measures in Day4 and Day6 with Strongest Correlation

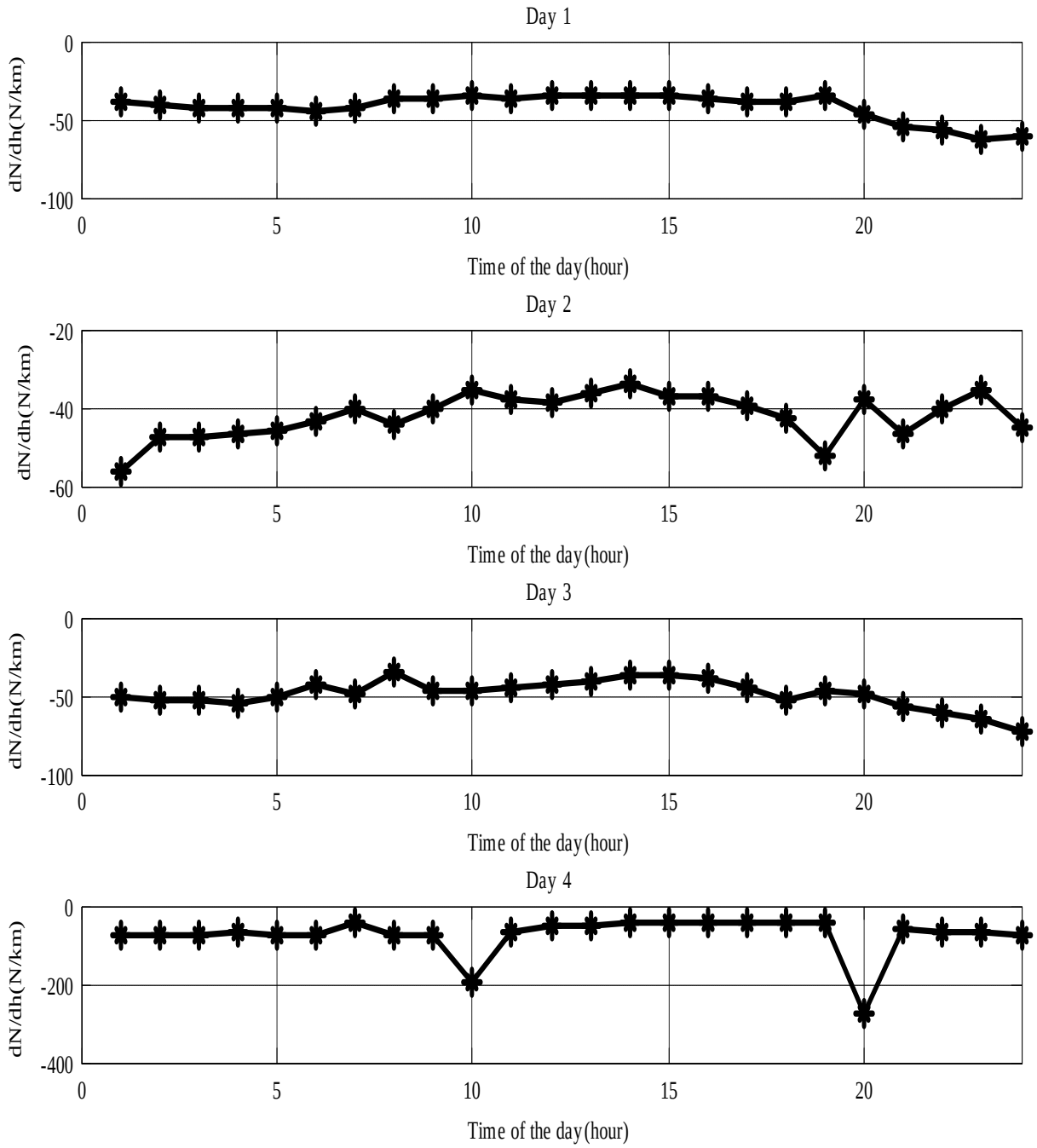


Figure 5 (a): Diurnal Variation of Refractivity Gradient for Days 1 to 4

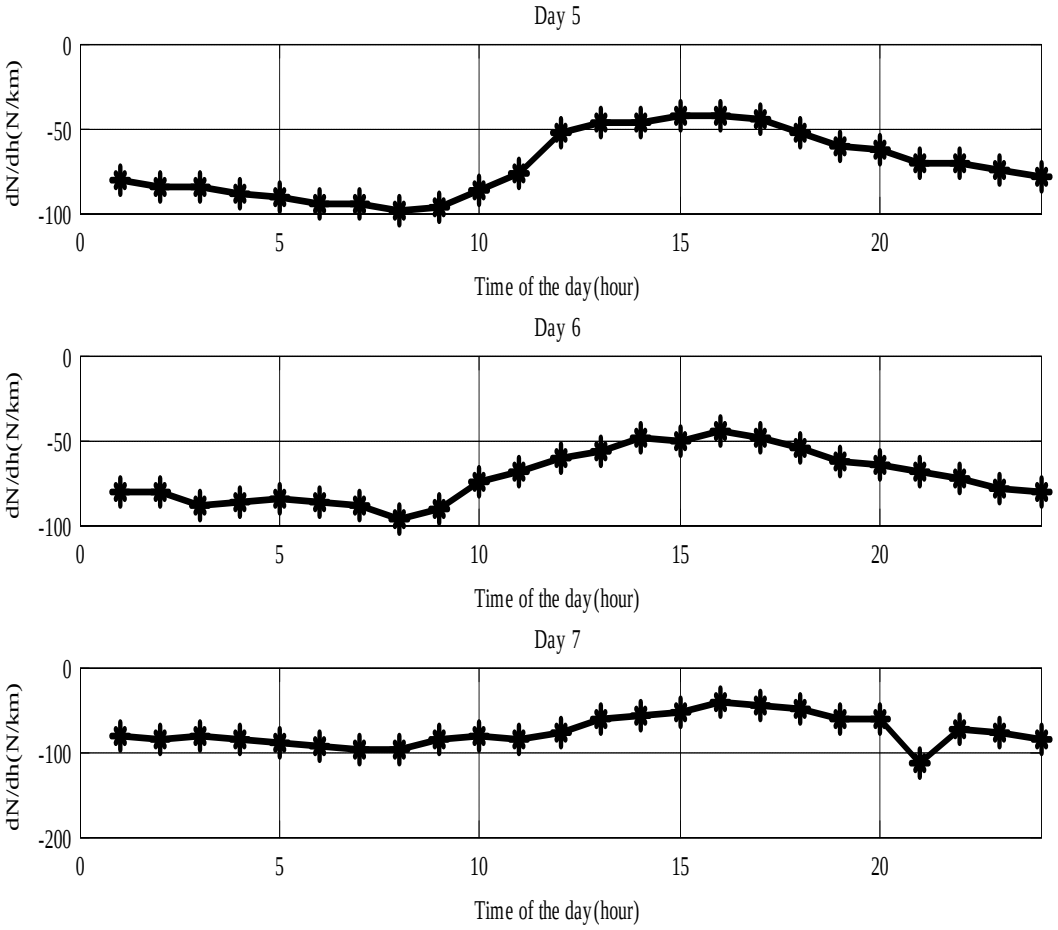


Figure 5b): Diurnal Variation of Refractivity Gradient for Days 5 to 7

Figure 6 shows refractivity gradient *dN/dh*, plots for the three days with strongest correlation and the overall average *dN/dh* values is plotted on Figure 7. Plotting the normalized *dN/dh* values against normalized signal strength measures on Figure 8 present a basis for comparing the simultaneous variation of the two quantities.

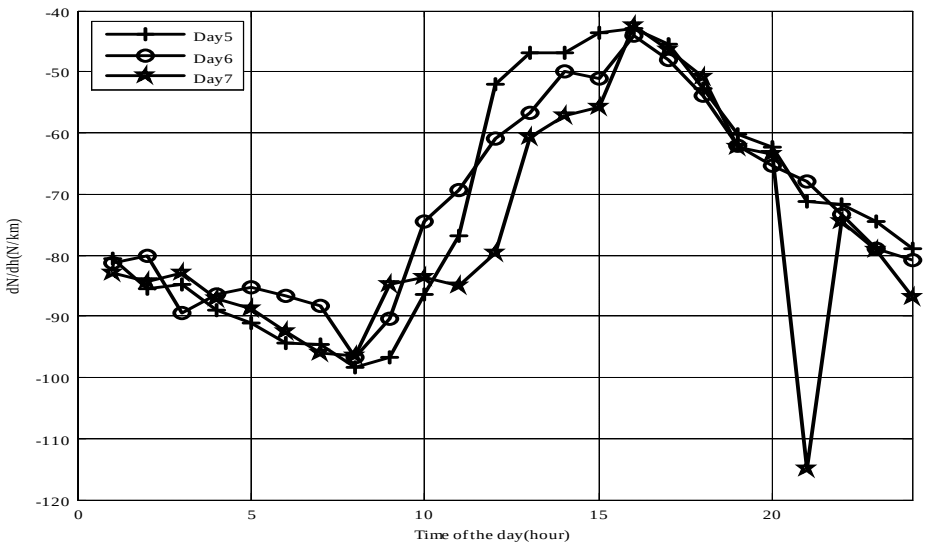


Figure 6: dN/dh Values of Day5, Day6 and Day7 with Strongest Correlation

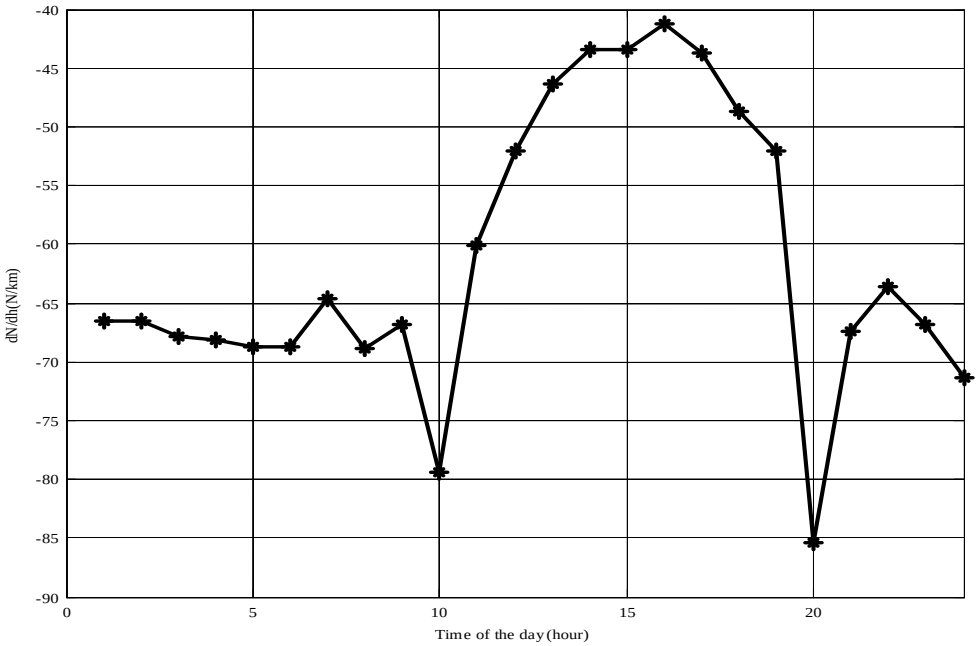


Figure 7: Average dN/dh Values for the Entire Measurement

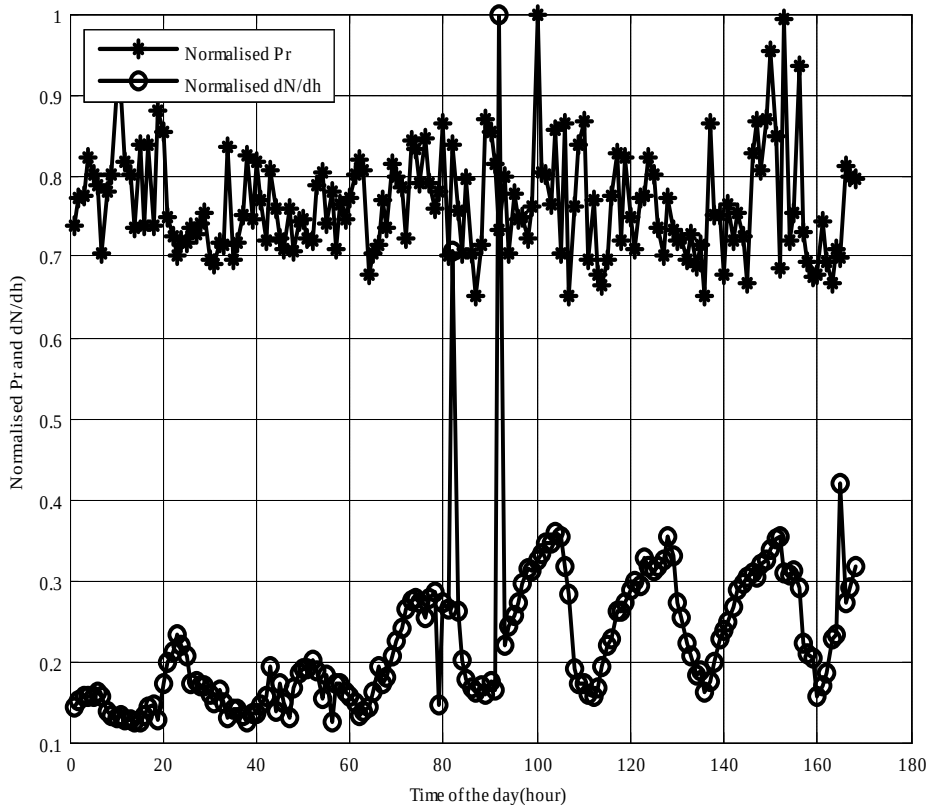


Figure 8: Normalised Pr and dN/dh Values for the Entire Measurement

Table II: Daily Correlation between *Pr* and the weather parameters

	Parameter			
Day	**T(K)**	**R. H(%)**	**P(hPa)**	***dN/dh***
1	-0.33	0.53	-0.25	-0.54
2	-0.46	0.46	0.26	-0.29
3	-0.03	0.15	-0.10	-0.15
4	0.32	-0.20	0.04	0.01
5	0.29	-0.30	-0.34	0.26
6	0.26	-0.27	-0.05	0.26
7	0.50	-0.50	-0.45	0.41

V. CONCLUSION

During the measurement campaign, potential environmental factors that may have a dominating impact on the received signal strength were investigated and it was observed that signal strength is strongly correlated with locations among other factors across the different times of measurement. The result presented in Figure 2 shows that the quality of signal varies significantly among different locations, but remains similar across the different times for the same location. Statistics of comparing morning and evening samples presented in Table I and the plot in Figure 3 suggests no distinct pattern for signal strength fluctuation with time of the day. Although the seven day hourly measurements at a fixed location indicates the range of signal strength fluctuation to be 24 dBm, only measurement of Day 4 and Day 6 are significantly correlated with 0.65 correlation coefficient value across the hours of the day as presented in Figure 4.

Refractivity gradient plots shown in Figure 5 presents no clear regular daily pattern in the first four days of the measurement, however, it was observed that the gradient shows a fall in the early morning hours to the minimal value at about 8 am and a rise to the peak value at about 4 pm and then starts to fall again in the evenings during the last three days of the measurement as shown in Figure 6. From Figure 7, it was observed that refractivity gradient values on the average, shows a decline in the early morning hours to the minimum value of -79.4 N/km at about 10 am and then begins to rise to a peak value of -41.2 N/km at about 4 pm. For the seven days hourly measurement, average refractivity gradient was -61.3 N/km and so the average propagation conditions correspond to the normal mode, although super refraction was to be expected at about 10 am and 8 pm. Figure 8 however shows that the variation in *dN/dh* does not actually explain the temporal variations in the received signal *Pr,* since the correlation between the variables is as low as 0.091.

From Table II, *Pr* shows a fair positive correlation with relative humidity, having a value of 0.53 and 0.46 on days 1 and 2 respectively. Negative correlation coefficient of -0.54 and -0.46 were obtained when *Pr* was compared with *dN/dh* and temperature respectively in the first two days. Days 3 to 6 show relatively low correlation between *Pr* and every weather parameter. On Day 7, fair positive correlations of 0.50 and 0.41 with temperature and *dN/dh* respectively were observed as well as negative correlations of-0.50 and -0.45 with relative humidity and pressure respectively. These results however suggest location as having a dominating impact on the received signal strength among other environmental factors such as weather and time of the day. This conforms to results of [11] where the effect of environmental factors on link quality for on-board communications were studied.

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Impact of urban population on the environment of the city of Brazzaville

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***ABSTRACT**: Urbanization is the development of a city. It is a major phenomenon that has gained momentum in recent years and almost all key cities of the world in general and Africa in particular. Brazzaville, the political capital of the Republic of Congo and the seat of central power has not remained untouched by this phenomenon of urbanization. The increase in the population of Brazzaville predicts a rise in demand for goods and services at all levels including environmental pressures from human activities. The growth of urban population feels the pressure that it exerts on the environment that goes with multiple consequences. Brazzaville is a city in the developing world where population growth in recent years and the spatial extensions have hardly allowed the establishment of a specific framework to fight against environmental problems. This requires the implementation of an appropriate urban governance to fight against environmental pressures.*

KEYWORDS; *Impact, urban population, environment, city, Brazzaville*

I. INTRODUCTION

Urbanization is a phenomenon that affects all countries in the world with a population growth and the proliferation of cities. This is a phenomenon which deflects the inevitable and affects all cities of Africa south of the Sahara. This phenomenon of urbanization that continues to preoccupy African States has particularities and continues exponentially. It reached an alarming stage leading to a spatial growth and defies all predictions made in terms of urbanization and land use. The surrounding villages are swallowed up and disappear in favor of suburbs that are born haphazardly. Brazzaville, one of the cities of Africa in recent years knows very rapid population growth due to the influence and its many functions it performs. These functions are political as well as administrative and social, as it is the first city in the Republic of Congo and the seat of the central government. In tropical countries, urbanization continues and has taken a rapid pace (Vennetier, 1967) .The city of Brazzaville is in contrast with a dynamic socio-spatial recomposition (Ziavoula, 2006) .The population growth has major impact on the environment of the city of Brazzaville. This impressive urbanization has its roots in the rural exodus (Vennetier, 1990) .This article proposes to study the environmental problems of the city of Brazzaville, when we know that these are the result of the growth of the urban population. This article first examines urban growth, then the environmental problems (pollution, global warming climatic, transport, waste, noise ... ..) and finally proposes ways or approaches to fight against environmental pressures. These are the main objectives of this work.

II. STUDY AREA

Brazzaville is the political capital of the Republic of Congo, and the first settlement of the country .It is located on the right bank of the Congo River. Brazzaville was administratively divided into 7 districts until 2011 are; Makélékélé, Bacongo, Poto Poto, Ouenzé, Talangai, Moungali, Mfilou and as shown in this figure **(Fig. 1).**

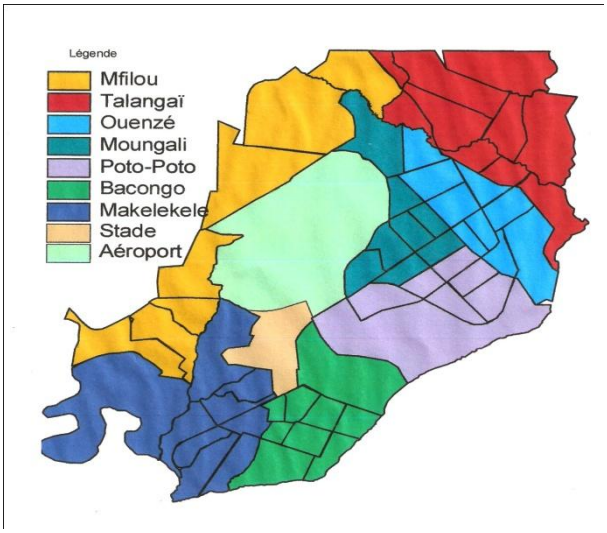

Fig 1; Districts and Neighborhoods of Brazzaville

But due to the spatial growth of the city, two other districts were born .This is singularly Djiri and Madibou (2011) City with multiple functions, Brazzaville annually attracts many new citizens who come from everywhere. It is located in the department of pool. It is bounded north and south by the department of the pool, to the east by the Congo River and to the west by the department of pool. The geographical coordinates of the city of Brazzaville; 4 degrees south latitude 16, longitude 15degrés16 is. His current area of 263.9 km ^{2} and a population of 1. 373.382 inhabitants (CNSEE 2007) or a density of 5204hab / km2.

III. THE REVIEW OF THE LITERATURE

The research literature on the impact of the urban population on the environment of the city of Brazzaville part of the urban crisis and environmental problems facing cities around the world in general and the cities of the Third world in particular. In the current context of the evolution of the urban population of Africa south of the Sahara in general, and particularly Brazzaville important reforms should be considered to meet the needs of the population and save the hazards environment. Mutations in the world today; these authors (Ziavoula 2006; Dorrier Apprill 2006a) speak of the urban environment of Brazzaville, particularly waste management districts and streets of the capital city are still littered with rubbish. Environmental problems are caused by the rapid growth of urban population (Balkiabiya, 2008) .The urban growth in a city raises the very important environmental problems. These include access to water problems, electricity and basic services like transport, hospitals, and training (Dorrier Appril, 2006b Allessembaye, Louembe, 2000). In the extension of Rio, was posted an institutional interest of donors to the environmental management of cities (Dorrier Apprill, 2002). The environmental management becomes increasingly crucial to the extent that it raises many concerns about the extent. Environment of urban damage is an immediately sensitive social reality. In everyday life and in everyday language, the concept of urban environment refers to a multiplicity of factors perceived as a problem in the city; pollution of air, water quality, sanitation, transport conditions, noise, landscape degradation, preservation of green space, deteriorating living conditions. (Metzger, 1994)

Management of African cities in general, and in particular Brazzaville continues to cause huge problems when we know that for a long time, keep out of the cities popular mass colonization aimed. The increase in urban population thereby causes a degradation of the urban environment of the city of Brazzaville (Nzoussi, 2014).

IV. THE EVOLUTION OF THE POPULATION OF BRAZZAVILLE

Worldwide, the urban population believes exponentially. African cities are experiencing annual population growth above 4%, compared to Asian or Latin American cities where urban growth appears to be low (Moustier and Falla, 2004) The limits of urban growth and social and environmental price (....) are still not taken into account (Miras, 2010).

The increase in the population of Brazzaville is staggering. The causes of this growth are to be found in rural-urban migration and external migration due mainly to the influx of Congolese from the other side (Congo-Kinshassa) who are in search of for better and sometimes cross the Congo river to swim and at the peril of their lives living .This event has taken an alarming pace. That is why there is need to put an end to this migratory soaring, the government of Brazzaville triggered operation called the 'slap of seniors' following what the more than 400,000 undocumented were deported and expelled. It should be noted that the evolution of the urban population of the city of Brazzaville is explained not only by rural-urban migration but also by structural

adjustment policies that have strengthened the disengagement of the state in rural areas (Pripode, 2005) .The two Figure **(02)** shows the evolution of the population of Brazzaville from 1900 to 2005.

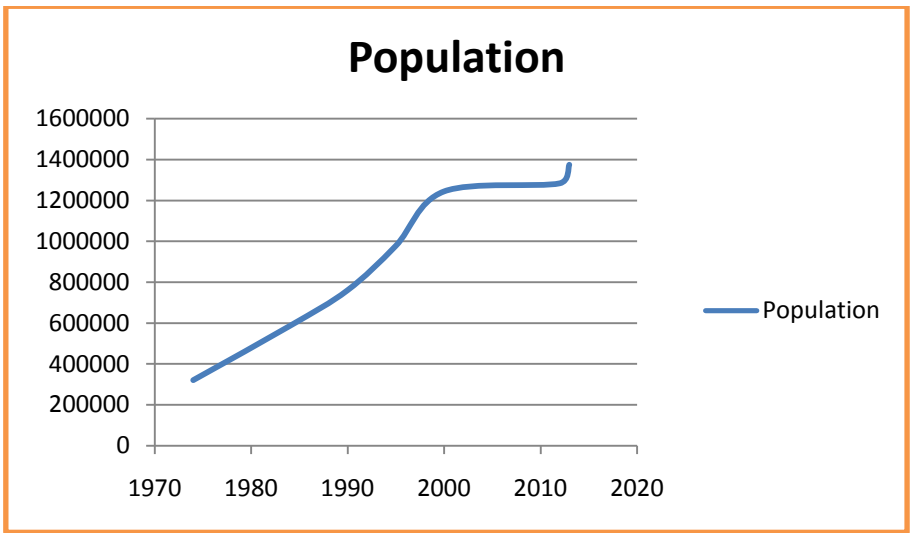

Fig. 2; Evolution of the digital population of Brazzaville from 1974 to 2013 (NCSEC)

This figure shows the evolution of the population of the city of Brazzaville from 1974 to 2013. In fact, when looking at the figure, it is clear that the population of Brazzaville has evolved considerably over the years. She reached over a million people in the year 2000. But in recent years; natural increase is accelerated as it was during the 1980s.

4.1 On cityscape Brazzaville

Tropical African cities have a particular morphology. Colonization and urbanization have totally changed the morphology of African cities. From 1950 to 1990, for example, the urban population in Africa south of the Sahara has increased up to threefold (Bocquier, 1999).

In fact, when talking about the urban landscape of the city of Brazzaville, reference is made to transport, housing, spatial planning, sanitation, energy...

Like most colonial cities, Brazzaville is a dual city. On one side is the city center, the seat of aristocrats and all urban structures. It is also the core of the city i.e. the place where the city took its origins. The central areas which are the intermediary between the city center and the suburbs. Mention may be made to Bacongo born in 1909, Poto-Poto (1911), Ouenzé, Moungali, Diata ... Finally come the suburbs born and extend a disproportionate manner with all the evils associated with urbanization. The city has gradually equipped structures and infrastructures (airport, schools. Roads, hospitals, universities.. .) before and after independence in 1960. Some countries have been destroyed during the unfortunate events 1997.But, everything was renovated and rebuilt. Clearly, the urban landscape of Brazzaville bears the mark of a colonial past with a city center wearing urban amenities, and the peripheral devices equipped with infrastructure and viable neighborhoods structures.

4.2 The special districts and the distribution of population

The sex and age class brings up the differences between the boroughs. According to the districts, the percentages of women in Makélékélé 51%, Bacongo 46% to in Poto-Poto Moungali 45% to 49% to 48% and Ouenzé Talangai 50% (Balkiabiya, 2008) .Has Moungali, Poto-Poto Bacongo and the proportion is less than 5 years. It is in these districts that there is a relatively old population. In 1985 for example, the sex ratio of Bacongo and Makélékélé was around 100, and that of Moungali Ouenzé was 102, Poto-Poto 96.

Regarding the distribution of the population, it should be noted that during the general census of population and housing (GPHS), the city of Brazzaville were 585,812 inhabitants, 2,934,343 men, a percentage of 51% .The sex ratio was 100.30 in 1984. We observe the balance between the sexes. In 2002, the sex ratio was 99.6%.

The city of Brazzaville was built in the southern part of the country. The population is unevenly distributed, as the southern suburbs are home to over population, compared to the northern parts of the city where there are some sparsely populated areas. With explosions camp M'Pila in 2012 (explosion of a munitions depot on a perimeter of 5km^2), the configuration of the city, in the northern part had changed completely. The

spatial extension these days seems to be for the people of the northern districts. But to acquire an area of land to construct in such a city still poses many problems. The recent report of the World Bank in 2014 indicates that the Congo has 50% of the urban poor against 75% in rural areas. It is ranked 136th out of the 182 HDI (Human Development Indicator), UNDP (United Nations Development Program) (Nzoussi, 2014c) .As in most country towns in developmental urban population Brazzaville is in favor of women, who represent 51% of the total population against 49%.

In short, rapid population growth in recent years continues to pose significant problems for the urban environment of the city of Brazzaville.

V. ENVIRONMENTAL PROBLEMS.

The environment has the great merit of force to apprehend reality to raise issues in a comprehensive manner (Pourtier, 1992) .The city of Brazzaville is facing serious environmental problems that concern both the public authorities and the population. These are;

5.1 Water

In most cities in sub-Saharan Africa, generally in Brazzaville, the water problem is still acute. Although drained by numerous rivers (the Tsiemé, the Cooler, Madoukou, M'filou ...) and rivers including Djoué and especially the Congo River, the most powerful river in the world after the Amazon by its flow rate 40milles m3 of water / s, the city of Brazzaville suffers from a glaring shortage of water. This can be seen much more in outlying areas that grow in a disproportionate manner and lack most of the urban amenities and viable. This is especially true because the suburbs are marginalized and there is the lack of infrastructure (Dureaud et al, 2000) .Although being a key natural resource for life and survival, water is still scarce in Brazzaville. Forcing people to wake up very early to have recourse to wells and boreholes. Some people have developed good faith drilling around their plots for lucrative reasons 150cfa by means of 25-liter bottle is $ 0.3. As shown in the figure below **(Fig 3).**

Figure 3; Crowds of people around a borehole** in **Brazzaville

In the city of Brazzaville management and distribution of drinking water was given to the NWDC (National Water Distribution Company) created 1967.This one is faced with many problems related to the obsolescence of its network and financial resources. Water supply is provided from two stations; the first is located in the existing Djoué since 1954 before the creation of the NWDC, and the second Djiri created 1986.These two resorts offer a capacity of 150,000 m3 of water. In 1990, a population of 760,300 inhabitants, only 44,600 people had a subscription to the NWDC, so supplied, and 60,183 in 2004 (Balkiabiya ,2008) .The water problem is felt more and more especially with the extension the city has resulted in the birth of two new districts. The following (Figure 4) represents the number of subscribers NWDC 1990 to 2004.

Figure 4 Evolution of the number of Subscribers to the national water distribution company in Brazzaville

This figure shows the evolution of the number of subscribers NWDC 1990 2004.He to note that the number of customers grows at the same rate as the population of the city, and 2004 serves as an example. Although having mixed performance due to the above factors, said company strives to increase strategies to meet the needs of its customers.

5.2 Electricity

The increase in population is also accompanied by the increase and improvement of infrastructural facilities, goods and services. This is quite the opposite in the cities of tropical Africa and particularly in Brazzaville. The electrical network in Congo Brazzaville in general and in Brazzaville particular is old and date of colonization. Then it is defective and no longer meets the face of increasing urban population Brazzaville. It is characterized by repeated power cuts forcing people to resort to devices of stabilization and elevation of blood pressure. This electric inconvenience plunges many neighborhoods in the dark, lacking public lighting. Faced with this situation, the wealthy families use power generators and gas lamps while poor families for their lighting use candles and oil lamps .The table below illustrates this: (Table 1) .In Brazzaville, 82 % of the population uses the oil that is the main source of household. Then comes the electricity produced by the National Society of Electricity (NSE).

Table1; Main source of household lighting as Brazzaville

Source of lighting	number of urban	percentage
Electricity N.S.E	34	66%
Electricity private group	04	08%
Gas	00	00%
Oil	41	82%
Candle	16	32%
Lamp battery	01	02%
Solar Energy	00	00%

Source; Spatial dynamics and environmental problems in Brazzaville, p.39

The supply of electricity in Brazzaville is the typology of cities in developing countries where the duality of urban areas, made up of a core team well and poorly equipped suburbs where there is the focus of all urban ills. The electrical energy consumed in Brazzaville is provided by the hydroelectric dam Djoué built in 1957 with a 15 MW. Moukoukoulou dam built with Chinese cooperation in 1978 with 70.000KW. In 2010, the Congolese government had to build the dam Imboulou also with Chinese cooperation. Its capacity is 120 MW. There is also a gas plant M'Pila also opened in 2010, but destroyed during the explosions 2012.Regarding dam Djoué an extra coverage is provided by the Dam by Inga (Democratic Republic of Congo) .There is a growing imbalance between the expansion of the city and its ability to cover electrical equipment. In 2003 the number of subscribers of the NSE (National Society of Electricity was 49,298 (Antsoutsoula, 2004).

Faced with the increased consumption of electricity, before a very high demand and economic changes in the world today, Brazzaville imports electricity from the DRC (Democratic Republic of Congo) whose cost is estimated at 100 billion CFA francs or 200 million dollars. But the import of electricity from neighboring countries do not solve the thorny problem of electricity, especially in outlying areas that lack urban facilities.
The impact of the urban population is visible on the environment of the city of Brazzaville.

5.3 Transportation

As in most cities in sub-Saharan Africa, transport to Brazzaville is a challenging problem. The central districts are still served, but the suburbs are missing almost all easily accessible because of the lack of roads and especially paved roads.

Indeed despite population growth, of the population of the city .i.e. 311,403 inhabitants in Brazzaville in 1974 and 1,373,382 people today, roads are only deteriorating making driving extra difficult. The means most commonly used are taxis and buses equipped, more suited to the middle and poor class. Taxis are about 70% of vehicles on the roads of Brazzaville (Nzoussi, 2014b) .These types of transport are more adapted to the level of neighborhoods. With 750km of paved roads, including 100 in 2008, the city of Brazzaville has a road network dilapidated. The paved roads are scarce from the city center to the periphery and especially in the new areas where they are almost non-existent (Xavier et al, 1992). Forcing carriers to focus on the major roads. The lack of channels and the intense activity of transport on main roads lead to the congestion phenomenon. In Brazzaville bus transit wear the green color. The arms and other taxes imposed by the State through the town hall (Nzolo, 2008).

With transport in Brazzaville, a real network of informal activity is developed. It is parking that has a particular impact on people's lives. Management of public space in Brazzaville is also a damaging issue between the actors who are responsible for managing the said space and people. Parking management in Brazzaville appears as a major event of the materialization of the economic and social crisis (Nzoussi, 2014a) .It is why the management of transport is done by individuals in precarious conditions (Pripode, 2005) .The transportation system in Congo Brazzaville in general and in Brazzaville particular generates a large number of accidents due to surcharge, lack of proper driver training, not following the rules of the road, the lack of traffic signs on some arteries, lack of road traffic, the vehicles ..... unconformity table below shows the accident in February 2004 as an example

Table; 2 Distribution of the number of accidents in Brazzaville in February 2004

Nature of accident	number of accidents	locality	casualties
Fatalities	01	Brazzaville	01
Accidents with serious injuries	17	Brazzaville	52
Accidents with minor injuries	17	Brazzaville	36
Accident with major injuries	40	Brazzaville	43
Accidents with property damage Thin	20	Brazzaville	21
Total	95		153

Source, *Source; Spatial Dynamics and environmental problems in Brazzaville, P.43*

From the foregoing, it should be noted that population growth impacts on the urban environment of Brazzaville. This is justified by the extent that the extension of the city of Brazzaville causes the disappearance of nearby villages with the birth of the suburbs with the type of homes in third world countries.

5.4 The Waste

The waste management is not a priority for most governments; they focus on education, the collection of taxes, agricultural services, water supply and health services (Onibokun, 2001). The drainage systems have become increasingly inadequate and defective because of urban growth and spatial extension (Ndinga-Okina, 2008). Brazzaville each day produces about 400 tons of garbage that is 1200 tons per month. (Ziavoula, 2006)
All these above factors lead to real environmental problems in the city of Brazzaville. And develop many diseases such as typhoid fever, tuberculosis, cholera (Nzoussi, 2014d) ... However, all countries aspire to sustainable development. Registration time for this type of development objectively mask the impossibility of equal development in space (Pourtier 1992, Gaud, 1992 Deleage, 1991). At the end to put the waste in a broader

context of sustainable development, the need to build a new base of knowledge and methods arises (Le Bozel, 1994). As in most cities of the world, in Brazzaville, waste management falls under the municipal authority through its health service (Dornier-Apprill, 2002) but the town has very tiny ways to cope. In some districts of Brazzaville, access remains very difficult because there are almost no roads. People who have no means of management and garbage collection are abandoned or provided waste at their discretion. A household pays over the amount and volume it produces financial incentive is to reduce production and increase source separation (Miranda et al, 1994). If he pays a fee (this is the case in some parts of Brazzaville center accessible to companies including waste management and transportation of the boiler), it will have no incentive to reduce and does not develop the attitude respect of tri (Reschovsky et al, 1994). Impact of the urban population on the city of Brazzaville would compel the government to take to heart the issue of waste management especially in public places, as are the case in markets (Figure 5), and some streets in the city. Structures no longer meet current infrastructure to a population that is growing at a dizzying pace. In other words, we are witnessing an increasing demand for structures, infrastructure and basic facilities, enhancing the concentration of poverty and social exclusion dilapidated neighborhoods and outlying areas, the extension of precarious habitat the marginalization of African youth, economic crisis, a market reduced employment (Badiane, 2004).

Fig5; waste lying on the ground in a market in Brazzaville

5.5 The pollution

Pollution can be defined as the degradation of the environment by chemicals, industrial or household waste. The population growth of the city of Brazzaville also has adverse effects on pollution. This pollution is of two forms.

The first concerns the sewage produced by the resorts, hospitals, households.... These waters are discharged and thrown into parcels, streets, where they eventually evaporate depositing rubbish they contain (Vennetier ,1993). Indeed, the discharge of wastewater in different streams in Brazzaville (Dredging, the Cooler, Mfilou, Madoukou ...) can be done without prior treatment. Thus, removal of the water by heavy rain in a tropical world where rainfall is very strong, with temperature between 1400 and 1600 mm of water / year contribute to land degradation in older neighborhoods .With the rainfall spatial extension of the city, the piping system and evacuation unresponsive in older neighborhoods in this case Ouenzé, Poto Poto, Bacongo, Moungali ... and the poor condition of pipes, aging singularly structures dating from the 1960s and 1980s do not respond in any way to a growing population. This causes significant damage during rainy seasons (flooding).
Because of the lack of companies that can manage household waste, people have resorted to new practices, those of incineration and land filling of waste into the ground. This contributes to the environmental pollution. Added to this is cooking over a wood fire heater.

The second is industrialization. In the 1960s, Brazzaville had achieved remarkable industrialization .These polluting industries so as little air with the emission of gases such as $S0_2$, C0 or $C0_2$. It also included imported goods from Europe such as: cars that emit the different gases into the atmosphere. The damage to the environment becomes a very important issue to the extent that it threatens the health of populations.

5.6 The global warming

Global warming is also one of the crucial problems of the XXI Century. With an unprecedented exponential growth, the city of Brazzaville and other cities of Africa is experiencing a climate change compared to previous years. Located in the tropics, Brazzaville has a tropical climate inter. Maximum temperatures are around 35 degrees .To see this, it suffices to observe the following --Bra Figure **(Figure6).**

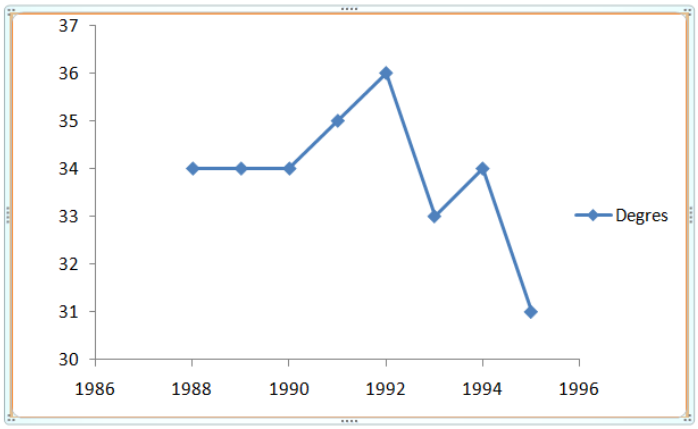

Figure 6; Maximum temperatures in the city of Brazzaville 1988-1995

During the rainy season the temperatures are around 33 degrees, against the dry season temperatures reach parfois15 degrees. The figure below illustrates this. (Fig 5)

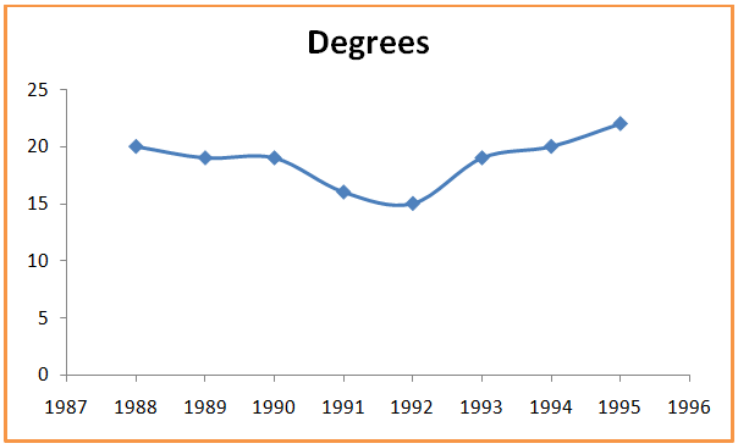

Figure 7; Minimum temperatures in the city of Brazzaville from 1988 to 1996

Global warming in Brazzaville is the corollary of the rapid urbanization of cities. In fact; the occupation of land causes the air pollution, loss of green space. Human activities negatively affect the climate. They emit radiation absorbing gas in the thermal infra. This is particularly carbon dioxide (CO2), ozone (O3), methane (CH4) that has an impact on climate. Climate change causes the greenhouse effect and permanently alters the usual climate of the earth in general and Brazzaville in particular, and leads to disastrous consequences.

5.7 Erosion

The environment of the city of Brazzaville is affected by several problems, including that of water erosion that has grown because of the illegal occupation of land, lack of pipes and especially climate change. The reserve of Tsiemé for example with 1818ha hardly exists after several subdivisions. Thus, the spectacular forms of erosion sites have taken the momentum in the entire city of Brazzaville. The figure below illustrates the water erosion in Brazzaville. It should be noted that the city of Brazzaville is built on a rock that is soft sand. Runoff, missing pipe drainage of rain and other pre cited factors cause very significant erosive activities. This becomes a recurrent erosion site in the city of Brazzaville in neighborhoods such as (Kinsoundi, Makazou, Mikalou, Kombo, Massengo ...)

Fig 8 ; An erosion site in a district of Brazzaville (M'filou)

VI. CONCLUSIONS AND RECOMMENDATIONS

This article answers the question we posed above: the impact of the urban population on the environment of Brazzaville. As we have previously served the city of Brazzaville is experiencing rapid urban population growth in recent years due to its political and social stability. Its growth was less than 4% in previous years was revised upwards particularly passing more than 5% per year. Known to harbor a relatively small population compared to its first urbanization 1934, the town of Brazzaville suffered the brunt of a growing population due to its features it occupies (political, administrative, academic...) and its proximity to the neighboring Congo, the Democratic Republic of Congo or Congo-Kinshasa. In 2014, after the operation known as the slap of seniors, more than 500,000 DRC nationals were expelled from Congo Brazzaville. Population growth impacts on the spatial extension contributing significantly negative at birth and peripheral neighborhoods are born a disproportionate manner and anarchic. Thus, environmental problems and a lot of their consequences appear to be regularly touching the vulnerable and needy population. The current state of the urban environment of Brazzaville requires some recommendations.

These recommendations will certainly fight against environmental pressures become a major concern for the government, to save the people of hazards and improve their lives. The state must; define a new urban plan for the city, trying to create conditions in regions and villages to stop the rural exodus that contributes to the increase in urban population. Develop a good policy and a law of the land. Prohibit the import of used cars in poor condition contributing to global warming. Build urban roads that meet international standards while taking into account the quality of the rock on the ground. Establish a good policy to waste management by devoting large budgets .Augment the budget for the city hall while avoiding the financial mismanagement that hampers the management of the urban structure to consolidate the city.

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Measuring radioactivity level in various types of rice using NaI (Tl) detector

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ABSTRACT: *A study of long- lived gamma emitting radionuclides in rice consumed in Nineveh Province (IRAQ) were performed. The study targeted the natural radionuclides ^{226}Ra, ^{232}Th and ^{40}K .The rice samples originated from seven different countries. NaI(Tl) detector was used to measure the radionuclides level. The radioactivity concentrations of ^{226}Ra, ^{232}Th and ^{40}K ranged from 51.15 to 109.26 Bq/kg,13.67 to 71.97 Bq/kg and 231.87 to 691.71Bq/kg. In order to evaluate the radiological hazard of the natural radioactivity, radium equivalent activity, gamma absorbed dose rate, internal and external hazard indices , gamma index and finally alpha index have been calculated . Hence rice consumption in Nineveh province (IRAQ) is radiologically safe for the presence of the investigated radionuclides.*

KEYWORDS: *NORM, Gamma spectrometry, Rice samples, Activity concentration, Nineveh province.*

I. INTRODUCTION

Radioactivity in the environment originates from natural and anthropogenic (man-made) sources. Natural radionuclides include isotopes of potassium (^{40}K), uranium (^{238}U and its decay series), and thorium (^{232}Th, and its decay series). These natural occurring radioactive materials (NORM) are long-lived (in the order of 10^{10} year) and are typically present in environmental samples [1,2].

Anthropogenic radionuclides are products of nuclear processes in industrial, medical, and military applications. Releases to the environment can be either controlled (regulated discharges) or uncontrolled (accidents). For example, it was estimated that 9 x 10^{16} Bq of the cesium isotope ^{137}Cs, were released to the environment from the Chernobyl accident in environmental samples is an indicator of a previous contaminating event [3]

Natural and anthropogenic radionuclides are found in terrestrial and aquatic food chains, with subsequent transfer to humans through ingestion of food. Therefore, there is a global interest in human radiation exposure due to radionuclide intake from food [4,5].

Among the types of food that are commonly consumed worldwide is rice. Hence, studies on the radioactivity of rice have been performed in various regions across the globe Results of these studies helped in establishing baselines of radiation exposure to people from consumption of rice [6].

Gamma radiation has always been existed in environment since the big bang occurred. During the last few decades radioisotopes and nuclear explosions in upper layers of the atmosphere contaminated and polluted the earth badly .The radioactive nuclides, produced due to those explosions, contaminated the entire environment. At surface layers of soil, these radioactive elements have higher level of concentration because their migration to down to the earth is limited [7,8].

Rice is the staple food of Asia, including Malaysian community. An average quantity of rice taken by an adult is about 100 g per day. The quantity is seen to be very small, but without realizing there are radionuclides present in the rice that can affect the body. Amount of radionuclides accumulated in the body can be known by measuring the concentration of radionuclide contained in the rice. Present study was conducted to measure and compare the concentration of uranium, thorium and potassium in the different samples of rice. The effective dose per annum contributed was also accounted as well [7].

The plants absorb these radionuclide from soil with some others minerals during their growth. These dangerous isotopes enter to human beings as food. Most of the non-edible parts in these components are returned to the soil as organic fertilizer where they may again be utilized in the soil–plant pathway and/or are mixed with feed for livestock [9].

Foodstuffs are known to contain natural and man-made radionuclides which after ingestion, contribute to an effective internal dose. The naturally occurring radionuclides especially ^{40}K and the radionuclides of ^{238}Uand ^{232}Th series are the major source of natural radiation exposure to the man. It has been estimated that at least one-eighth of the mean annual effective dose due to natural sources is caused by the consumption of foodstuff [10,11].

Man- made radionuclides, produced by human activities also contribute to the environmental radioactivity, and one of these important radionuclides of environmental concern, is ^{137}Cs [12].

For contamination assessment of the foodstuff consumed by the population, it is very important to know the baseline value, or the level of radiation dose of both natural and synthetic radionuclides received by them [11].

Some researchers have performed on determination of different radionuclides concentration in Iranian food samples, and dose assessment from consumption of that foodstuff by the population [13].Hence the aim of this study was to quantify the content of ^{226}Ra, ^{232}Th and ^{40}K of rice samples consumed in Nineveh province (IRAQ), and to estimate radium equivalent activity, gamma absorbed dose rate, external and internal hazard indices, gamma index and alpha index by using NaI(Tl) detector.

II. MATERIALS AND METHODS

2.1 Sampling and samples preparing

Rice samples were collected from Nineveh province(IRAQ) local market . The collection took place between Dec. 2013 and Feb. 2014. Seven samples of rice were collected , every one of these samples weight about (900) gm. The samples dried by placing it in the oven of 110 ̊c about 24 h, then crushed to pass through 2 mm sieve to be homogenized in size. The homogenized rice samples were sealed in plastic containers and left for at least 4 weeks to reach secular equilibrium between parent radionuclides and the daughters [14,15].

2.2 Gamma spectrometry

Gamma- ray spectrometry analysis of the rice samples for natural radioactivity was carried out by using Na(Tl) detector of radius(3(3.8cm) and thickness(2.5cm).The detector was interfaced to a PC-computer with a program installed for this purpose to make it equivalent to a multi-channel analyzer .The system also contains the usual electronic components of preamplifier, amplifier and power supply. The detector has resolution (FWHM) of (33.3keV) for the (1332 keV) γ-ray line of ^{60}Co. The γ-ray spectrometer energy calibration was performed using ^{137}Cs and ^{60}Co point source in a lead protected box ,then the concentration of natural radionuclides in these samples was determined from the peaks at 911 keV ^{228}Ac for ^{232}Th, the peak at 1460 keV for ^{40}K and the peak at 609keV(^{214}Bi)for ^{226}Ra .

The activity concentration of ^{226}Ra, ^{232}Th and ^{40}K was calculated using the following relation[16] :

$$A = \frac{\sum N - \sum B.G}{\varepsilon . I . t . m} \qquad (1)$$

A: The activity concentration

$\sum N$: The net peak area at energy E of radionuclides ^{226}Ra, ^{232}Th and ^{40}K at presence the samples.

$\sum B.G$: The net peak area at energy E of radionuclides ^{226}Ra, ^{232}Th and ^{40}K for background radiation at the absence the samples.

ε : Gamma efficiency evaluated in function of the transition energy.

I: The absolute intensity of transition.

t : The sample counting time 10800 sec.

m: The weight of the sample 0.9 kg.

III. RESULTS AND DISCUSSION

3.1. Activity concentrations of ^{232}Th,^{40}K and ^{226}Ra

Table(1) shows the activity concentrations of the main natural radionuclides of the ^{238}U series ,^{232}Th series and ^{40} K in seven rice samples of Nineveh province (IRAQ).From table1, it is observed that, the activity concentration of ^{232}Th ranged from 13.67 Bq/kg (Kalrose sample) to 71.97 Bq/kg (Amber sample) with an average value of 39.11 Bq/kg, for the ^{226}Ra concentration ranged from 51.15 Bq/kg (Amber sample) to 109.26 Bq/kg (Kalrose sample) with an average value of 84.12 Bq/kg, and ^{40}K activity concentration ranged from 231.87(Kalrose sample) to 691.71Bq/kg (Amber sample) with an average value of 435.34 Bq/kg .

The average activity concentration of the present study of ^{232}Th is lower than the world average value of 45 Bq/kg, activity concentration of ^{226}Ra is higher than the world average of 32 Bq/kg, and the activity concentration of ^{40}K also higher than the world average of 412 Bq/kg [17]. Other observation of table1is the average activity concentration of ^{40}K is higher than the average activity concentration of ^{232}Th and ^{226}Ra.

The activity concentration of ^{232}Th , ^{226}Ra and ^{40}K of different samples of rice in Nineveh province are shown in figs.1, 2 and 3.

Table1: Activity Concentration in (Bq/kg) of ^{226}Ra, ^{232}Th and ^{40}K in rice samples investigated in this study

Sample No.	Sample Name	Origin	^{226}Ra	^{232}Th	^{40}K
1	Amber	IRAQ	51.15	71.97	691.71
2	Nawras	Turkey	80.82	43.31	483.22
3	Al-deek	Thailand	80.20	40.70	500.76
4	Mahmoud	India	86.75	53.73	331.24
5	Kalrose	America	109.26	13.67	231.87
6	Al-alah	Pakistan	73.45	32.56	502.71
7	Abu-alnessr	Uruguay	107.21	17.85	305.91
Average±S.D.	--------	----------	84.12± 19.99	39.11± 20.23	435.34± 155.89

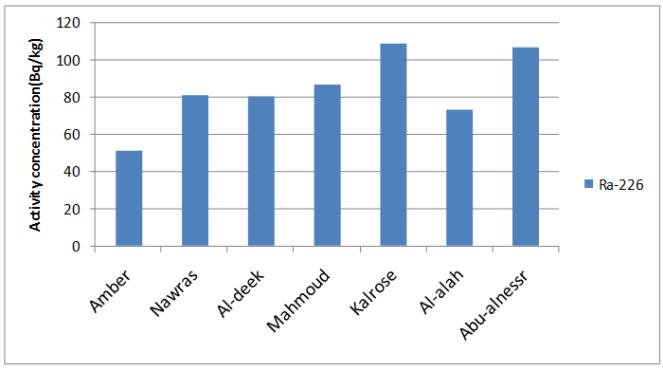

Fig.1: Activity concentration of ^{226}Ra in rice samples.

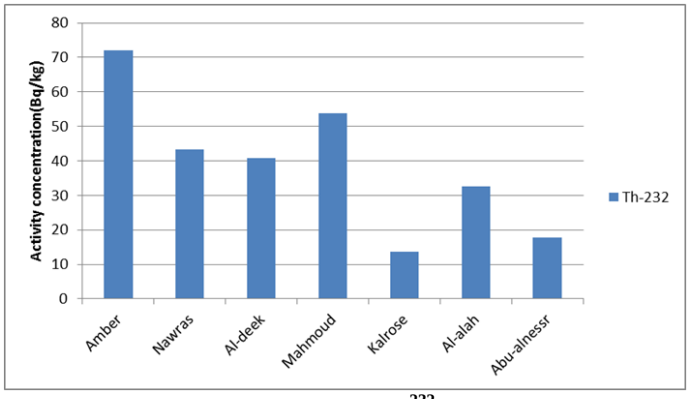

Fig.2: Activity concentration of ^{232}Th in rice samples

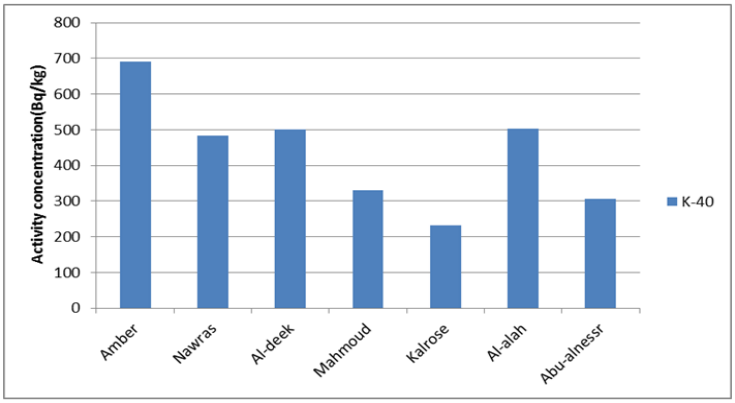

Fig.3: Activity Concentration of ^{40}K in rice samples

3.2 Radiological Parameters

3.2.1. Radium equivalent activity (Ra_{eq})

To represent the activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K by a single quantity, which takes into account the radiation hazards associated with them, a common radiological index has been introduced. The index is called radium equivalent activity (Ra_{eq}) which is used to ensure the uniformity in the distribution of natural radionuclides ^{226}Ra, ^{232}Th and ^{40}K and is given by the expression [18]:

$$Ra_{eq}\,(Bq/kg) = A_{Ra} + 1.43A_{Th} + 0.077A_K \qquad (2)$$

Where ,A_{Ra}, A_{Th} and A_K are the specific activities concentrations of ^{226}Ra,^{232}Th and ^{40}K in (Bq/kg) respectively.

The calculated values are varied from 146.67 Bq/kg (Kalrose sample) to 207.33Bq/kg (Amber sample) (table 2). These values with an average value of 173.52 Bq/kg are lower than the permissible maximum value of 370 Bq/kg [19].

3.2.2 Gamma Absorbed Dose Rate (D)

The total absorbed dose rate (nGy/h) in the outdoor at 1 m above the ground due to the activity concentrations,^{226}Ra, ^{232}Th and ^{40}K was calculated by using the following equation [10]:

$$D\,(nGy/h) = 0.462A_{Ra} + 0.604A_{Th} + 0.0417A_K \qquad (3)$$

The absorbed dose in the present study ranged from 68.47 nGy/h in (Kalrose sample) to 97.20 nGy/h in (Amber sample) with an average value of 81.24 nGy/h (table 2), which is higher than the permissible maximum value of 51 nGy/h reported by [10]. The relation between radium equivalent and gamma absorbed dose rate is shown in fig.4 below.

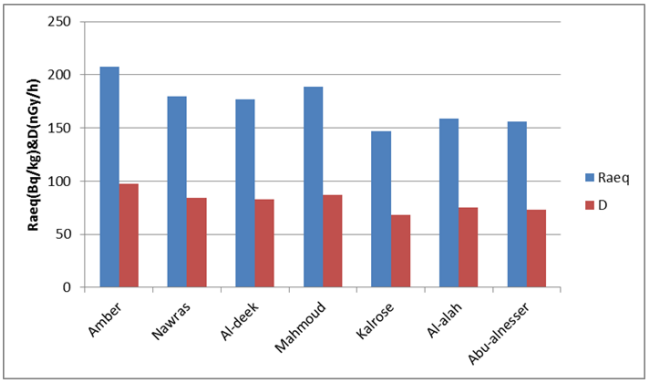

Fig.4: Radium Equivalent activity and Absorbed dose rate for rice samples.

3.2.3 External hazard index (H_{ex})

To limit the external gamma-radiation dose from building materials, an extensively used hazard index, the external hazard index (H_{ex}) was calculated from the equation [20].

$$H_{ex} = A_{Ra}/370 + A_{Th}/259 + A_K/4810 \leq 1 \quad (4)$$

The values of outdoor radiation hazard index (H_{ex}) vary from 0.396 (Kalrose sample) to 0.559 (Amber sample) with an average value of 0.467 ,where all values of H_{ex} are less than the critical value of unity.

3.2.4 Internal hazard index (H_{in})

Radon and its short-lived products are also hazardous to the respiratory organs. So internal exposure to radon and its short-lived products is quantified by internal hazard index and is expressed mathematically as [21] :

$$H_{in} = A_{Ra}/185 + A_{Th}/259 + A_K/4810 \leq 1 \quad (5)$$

The calculated values of H_{in} are ranged from 0.627 (Al-a'lah sample) to 0.745 (Mahmoud sample) with an average of 0.695, this is lower than the recommend limit.

The relation between the values of H_{ex} and H_{in} with rice samples is shown in fig.5 below.

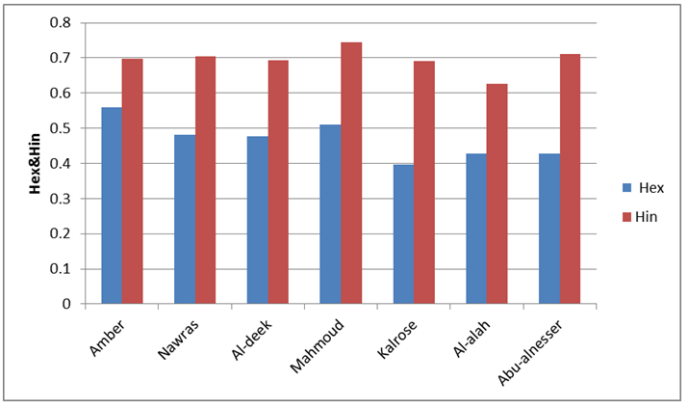

Fig.5: External and Internal hazard indices for rice samples.

3.2.5 Gamma Index (I_γ)

The gamma index (I_γ) for rice samples was calculated by using the following equation [22] :

$$I_\gamma = \frac{A_{Ra}}{150} + \frac{A_{Th}}{100} + \frac{A_K}{1500} \leq 1 \quad (6)$$

I_γ varies from 1.01 (Al-a'lah sample) to 1.52 (Amber sample), with an average value of 1.20.

The values of I_γ for all rice samples are higher than the critical value of unity.

3.2.6 Alpha index (I_α)

Also several indexes dealing with the assessment alpha radiation due to the radon inhalation. In the present study, the alpha index was determine through the following formula [23]:

$I_\alpha = A_{Ra}/200$

I_α varies from 0.255 (Amber sample) to 0.546 (Kalrose sample) with an average value of 0.420.

The values of I_α for all rice samples are less than unity.

The relation between the values of I_γ and I_α with rice samples is shown in fig.6 .

The values of radium equivalent activity (Ra_{eq}), gamma absorbed dose rate(D), external and internal hazard indices (H_{ex}, H_{in}), gamma index(I_γ) and alpha index are listed in table 2.

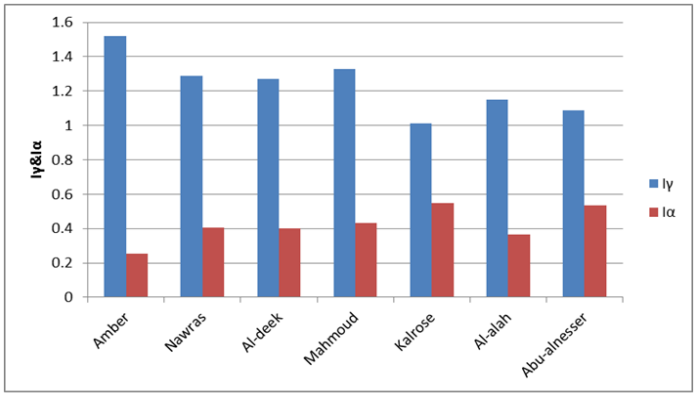

Fig.6: Gamma index (I_γ) and Alpha index (I_α) for rice samples.

Table 2: Radium equivalent activity, gamma absorbed dose rate, external hazard index, internal hazard index, gamma index and alpha index for rice samples consumed in IRAQ.

Sample No.	Sample name	Origin	R_{aeq} (Bq/kg)	D (nGy/h)	H_{ex}	H_{in}	I_γ	I_α
1	Amber	IRAQ	207.33	97.20	0.559	0.698	1.52	0.255
2	Nawras	Turkey	179.96	84.32	0.481	0.704	1.29	0.404
3	Al-deek	Thailand	176.97	83.16	0.478	0.694	1.27	0.401
4	Mahmoud	India	189.09	87.13	0.510	0.745	1.33	0.433
5	Kalrose	America	146.67	68.47	0.396	0.691	1.01	0.546
6	Al-alah	Pakistan	158.73	75.09	0.428	0.627	1.15	0.367
7	Abu-alnesser	Uruguay	155.9	73.36	0.428	0.710	1.09	0.536
Average±S.D.	--------	------	173.52±21.17	81.24± 9.70	0.467± 0.05	0.695±0.03	1.2± 0.17	0.420± 0.10

CONCLUSION

It is important to determine the activity concentration level in order to evaluate the health hazard. The results of the average activity concentrations of ^{226}Ra, and ^{40}K for seven rice samples collected of seven countries from Nineveh province (IRAQ) were higher than the permissible maximum values reported by the world average, but the average activity concentration of ^{232}Th was lower than the permissible maximum value reported by world average. The results of the present work values of average radium equivalent, average external hazard index, average internal hazard index and average alpha index were found to be lower than their corresponding allowed limits given by world average, while the average values of gamma absorbed dose rate and gamma index were higher than the allowed limits given by world average. It was found that rice consumption in Nineveh province (IRAQ) is radiologically safe for the presence of the investigated radionuclides.

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Design of a Chlorinator in a Water Treatment plant for Small Village Community in Borno State, Nigeria

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***ABSTRACT**: The chlorinator is use as a discharge for chlorine which service as a disinfectant of bacterial in the rural water treatment plant in a small village community in Borno State. The percentage of chlorine was evaluated to be approximately 0.00002% which is within the accepted international standard limit for drinking water. The retention time of 5hrs was taken for the tank with volume of 0.0101m^{3}and diameter of 250mm and a calculated height of 206mm, the diameter of the orifice is approximately 1.5mm. Wood was use as the material for the construction of the tank because of its high resistance to chemicals.*

***KEY WORDS:** water treatment, chlorinator, chlorine, ozonization*

I. INTRODUCTION

The final process in water engineering is disinfection. This refers to the destruction of water-borne pathogens, which can be accomplished by physical or chemical means. [5]

The wide spread use of rapid sand filters results in a final filtrate of great clarity which is however, not always free of bacteria and other organisms. These have to be reduced, either completely or certainly to a negligible proportion, by some form of disinfection. In practice the vast majority of water works use chlorine compounds, but in some rare cases, it can be done by the addition or certain chemicals, by ozone ultraviolet light or boiling. [1]

The excess lime process of softening kills bacteria. It is not widely used but because of the bactericidal effect of the high PH values incidental to the process, it is occasionally adopted where the raw water is not only hard but also polluted.

Ozonization: Ozonization is also a good means of disinfection and produces high quality water those the process depends on the production on site of Ozone, O_3, by the passage of high tension, high frequency electric discharges through the atmosphere. The Ozone is subsequently absorbed in the water to be treated and has a powerful bacterial action without imparting taste to the water. It is a costly process needing skilled maintenance and may not yet be considered suitable for adoption in smaller village communities in preference to chlorination. In addition to its high cost it suffers from the fact that ozone is not very persistent and water treated by this method at source might be re-infected at a later stage in the distribution system [l].

Boiling: Raising water to its boiling point will disinfect it. Because no important water borne disease is caused by spore forming bacteria or other heat resistant organisms, this is a safe and commendable practice where drinking water safety is suspected. It is re-sorted to also as an emergency measure in the form of boiling water always by health water authorities. [5]

Sunlight: Sunlight is a natural disinfectant principally as a desiccant. Irradiation ultraviolet light intensifies disinfection and makes it a manageable undertaking, but other sources of ultraviolet light may be used such as mercury-vapour lamps to intensify the disinfection. [5]

II. CHLORINATION

Bleaching powder (Chlorinated lime) and sodium hypochlorite of different commercial brands are widely used for sterilizing small water supplies. For rural schemes a solution made from bleaching powder is more convenient. It has 20% to 25% available chlorine and is easy to handle although bulky and comparatively instable. If opened once a day for 10min, 5% of its strength is lost in 40 days, if left open all the time, it will lose 15% of its strength, it could be used in simple chlorinating ports these are pots charge with an equal weight mixture of bleaching powder and sand. Solution is kept in dark as there is a serious loss of strength if they are exposed to light. Containers should be made of wood, plastics, ceramics or cement, which are resistant to corrosion. The maximum chlorine concentration is 5% made by mixing 4kg of powder having 25% chlorine, with 20 liters of water [6]. The injection of the bleaching powder is by gravity feed or by special chlorine pumps. In clear water 0.5-1.0mg/1 of free residual chlorine should ensure sterilization. Doses of this magnitude are used on the small, unsophisticated works for which this method is suitable [I].

In most modern works of any size chlorine gas is used, chlorine is supplied as a liquefied gas in cylinders or drums and injected into the water through a chlorinator. The chlorinator is a fairly complicated apparatus which reduces the pressure of the gas leaving the cylinders, controls the rate of flow, mixes water and delivers it to the pump or injector which forces it into the filtered water. Since chlorine is very corrosive, all piping and pumps have to be of suitable resistant materials [5].

In hot environment such as Maiduguri and its surrounding villages, the rate at which the gas leaves the cylinders is too high, the rapid transition from liquid to gas causes extremely low temperatures. Therefore, the hotter the weather the greater is the risk of freezing (or formation of crystals) within the tube between the cylinder and chlorinators [5].

III. DESIGN OF CHLORINATOR

For designing of the chlorinating tank, the required concentrated solution of bleach and water in the chlorinator that will be diluted with the water in the filter sump to give the required (0.00002% to 0.00005%) free chlorine which is acceptable standard for drinking must be known.

As earlier stated the concentration of bleach for drinking purposes is 0.5mg per litre of free chlorine i.e. (0.00002% to 0.00005%). For 2% concentration of chlorine in solution, 100ml of bleach is diluted in 10 litres of water that is, $0.0001m^3$ of bleach is diluted in $0.01m^3$ of water. Hence the total volume of 2% concentrated solution of free chlorine in the chlorinator is $0.0001m^3$ of bleach + $0.01m^3$ of water = $0.0101m^3$.

Thus volume of chlorinating tank V = $0.0101m^3$

For a chlorinating tank diameter of 250mm, and from

Volume (v) = $\frac{\pi d^2}{4}$ x h

Where h is height of tank and d is the diameter.

It follows that h = $\frac{0.0101 \text{ x } 4}{\pi \text{ x } 0.025^2}$ = 0.206m = 206mm.

Hence the chlorinator is 250mm diameter and 206mm deep.

For a retention time of 5hrs, the discharge Q = $\frac{\text{volume}}{\text{time}} = \frac{V}{T}$

Thus, Q = $\frac{0.0101}{5 \text{ x } 3600}$ = 5.6x $10^{-7}m^3/s$. which is the discharge from the chlorinator, also from Q = cd a $\sqrt{2gh}$

Where cd is coefficient of discharge through orifice (cd <1) is area of outlet orifice.

It follows that a = $\frac{Q}{cd\sqrt{2gh}}$

The cd for small circular orifice is 0.4

a = $\frac{5.6 \text{ x } 10^{-7}}{0.5\sqrt{19.62 \text{ x } 0.206}}$

a = 5.571 x $10^{-7}m^2$, but a = $\frac{\pi d^2}{4}$

d^2 = $\frac{4 \text{ x } 5.571 \text{ x } 10^{-7}}{\pi}$ = 7.093 x 10-7

d = 0.0011m=1.1mm

Hence diameter of orifice d ≅ 1.5mm is selected

Percentage free chlorine in the solution of 5.6 x $10^{-7}m^3$ of 2% chlorine and $0.003m^3$ of water per second will be $(\frac{5.6 \times 10^{-7}}{0.003}) \times 100 \times \frac{1}{1000} = 0.000018\% \cong 0.00002\%$

It can be seen that the percentage free chlorine in the solution that will be formed in the filtered water sump per second is 0.00002% which is within the accepted drinking range of 0.00002% to 0.00005%.

IV. MATERIAL SELECTION AND SPECIFICATIONS

The material selected for the chlorinator is wood, which could be locally carved into the required dimension and also provided with a means of mounting to the top of the filter as shown in the diagram.

Wood is selected because of its high resistance to chemicals especially as the tank is to contain a 2% solution of chlorine. The wood should be also carved with a suitable cover so as to reduce loss of strength of the solution.

During shutdowns or repairs the tube connecting the chlorinator and the filtered water tank can be constricted by means of a clip valve to stop flow. The diameter of pipe from the filtered water sump is 0.1m (100mm) and is properly painted to avoid corrosion.

V. CONCLUSION

The need for portable drinking water in our rural communities cannot be over emphasize. The cheapest and most easily adaptable method of disinfecting water in such communities is chlorination. Other methods such as Ozonization could also be integrated into the process as a future alternation means of disinfecting water.

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Crystal structure and electrical characterization of mixed lithium ferrite ceramics.

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ABSTRACT: *A Cobalt and Aluminium substituted Lithium ferrite (M- type) samples with the general chemical formula $Li_{0.5}Fe_{0.5+x}Al_{12-2X}$ Co xO_{19} were synthesized using reacting oxide by high temperature solid state reaction technique. The structural characterization of compound has been carried out from X-Ray diffraction powder pattern. The compounds are in single hexagonal phase without traces of uncertainly ambiguous reflection. From XRD pattern lattice parameters has recorded with increasing doped aluminum element in the range from a = 5.807 Å to 5.906 Å and c = 22.507 Å to 22.585 Å pertaining the space group $P6_3/mmc$ (No.194). The mass density of the ferrites were found linearly varies and depends upon the mass and volume of sample. The X-Ray density has depends upon the lattice constant and molecular weight of the compounds. The average particle size was also estimated. The compounds were studies magnetically by using Guoy's method in the temperature range 300 to 550 K, the result shows that the compounds are paramagnetic in nature.The Curie molar constant was work out.*

KEY WORDS: *Magnetoplumbite, Hexaferrites, Curie molar constant, Seebeck coefficient.etc.*

I. INTRODUCTION:

A Lithium hexaferrites $Li_{0.5}Fe_{12.5}O_{19}$ mangnetoplumbite (M-Type) has been a great technological interest in many electromagnetic devices from a long time. High electrical resistivity, low eddy current losses, low magnetic losses, and very good thermal and chemical stability. Lithium ferrite material has a great importance for microwave applications. In the family of hexagonal ferrites, the Mangnetoplumbite hexaferrites (M-Type) created much attention due to wide range of application in industries and created potential to interest in technological and scientific research due to their application importance such as high density magnetic recording, microwave device materials, hard disc in computer system. The application need particularly magnetic and electrical specification with the view, many attempt have been improved the properties of hexagonal ferrites using different tract of additives. The calcium hexferrites [1-6] have magnetic properties comparable to BaM and Sr M. In Calcium ferrites many attempt has been made to replace Fe^{+3} ions with Al^{+3}, Cr^{+3} and Co^{+3} etc. A compound with the combination of bivalent-tetravalent cation was also used to replace Fe^{+3}ion such as Cu-Ti, Co-Ti, Co-Sn, Zn-Sn etc.[7, 8] without any appreciable change in BaM structure. When Fe^{+3} ions are replace by non magnetic ions like Ti^{+4} and Sn^{+4} etc. In the same way Lithium ferrites substituted with Al and Co has been studied structurally, electrically and magnetically [9]. In the present study a series of five sample with chemical formula $Li_{0.5}Fe_{0.5+x}Al_{12-2X}Co_XO_{19}$ (x = 2, 3, 4, 5 and 6) were prepared. Lithium ferrites have attracted considerable attention because of the squareness of hysterisis loop coupled with superior temperature performance the crystal structure of M-type like compound with a space group $P6_3/mmc$ (194)can be described as superposition of two structure block namely R-block with composition $BaFe_6O_{11}$ and S-block with composition Fe_6O_8 [10] in the stoichiomatric ratio.

II. EXPERIMENTAL:

All the polycrystalline powder sample were synthesized by high temperature solid state reaction using A.R grade oxides with proper stoichiomatric ratio Li_2O, Fe_2O_3,Al_2O_3 and Co_2O_3 mixture. Li_2O oxide was carefully dehydrated before the mixing procedure. After grinding the mixture under acetone acid for six hours. During the preparation of pellets of thoroughly grounded mixture in the proper molar ratio with 5% of PVA as a binder are prepared by applying 10 tone pressure per square inch. These pallets slowly heated in the furnace at 600 ^{0}C for 5 - 6 hours to remove binder. Then it was fired at 1200 ^{0}C for 120 hours continuously, after that the

furnace were cooled at the rate of 20^0C per hours up to 1000 ^{0}C and then 50^0C per hours and then cooled in natural way the phase of final sample were verified by Philips X-ray diffrectometory using N-filter copper radiation. The mean grain size of multicrystalline samples was in the range 150 - 200 $A^{0.}$ All the samples show single phase formation with a space group $P6_3/mmc$ (194). X-ray pattern of the samples as shown in fig.1.1

The D.C electrical resistivity was measure by the methods using LCR meter /Q meter.[11]. The end faces of pellets were coated with thin layer of conducting silver paste and measurement were made from room temperature to 800 K Thermoelectric power measurement were carried out after sandwiching the thick pellet between two copper rod from room temperature to 550^0C

III. RESULT AND DISCUSSION:

In the present work, the Cobalt and Aluminium substituted Lithium hexaferrites were introduced with general chemical formula $Li_{0.5}Fe_{0.5+x}Al_{12-2X}Co_XO_{19}$ (X = 2, 3, 4, 5 and 6). The ions in Ba-M compounds can be replaced partly by Co^{+3} or completely Li^{+1} and combination of Fe^{+3} and Al^{+3} ions without changing the crystal lattice symmetry [12]. In all the specimens substituted ions would be chosen to keep electrical neutrality and to have a similar ionic radii in these ferrites. The Cobalt and Aluminium play an important role in the property variation. XRD technique is used to confirms the formation of hexagonal M structure of compounds belonging to a space group $P6_3$ /mmc (194) Homawalt 1956. Due to the resemblance of ionic radii of Fe^{+3}withCo^{+3} and Al^{+3} ions [13, 14]. The ferrites ions will replace by cobalt and aluminium. It is seen that former ions are very easily replaced at any substituted variation in all specimens [15]. The hexagonal lattice parameters '*a*' and 'c' decreases linearly with the substitutional variation co $^{+3}$ and Fe $^{+3}$ concentration in all specimens. The decrease in lattice parameters due to close packing of lattices in the materials [16-18]. The decrease in lattice parameter and cell volume agree with result for Ba / Sr ferrite [19-20]. The numerical values of compositional data such as lattice constant, cell volume and X- ray density are tabulated in table -1. The observed value of electrical conductivity, activation energy and curie molar constant for specimens are also tabulated in table – 2.

From the plot of ln σ vs (1/ T) x 10^{-3} K for the entire sample was almost linear. The electrical conductivity of these ferrites increases with increasing ferrite ion concentration. The electrical conductivity of sintered specimens varies from to 2.193 x10^{12} Ω^{-1} cm to 5.78 x10^{-6} Ω^{-1} cm of these ferrites. The other workers have obtained a conductivity value of 2 x10^{-2} Ω^{-1}cm for Li-ferrite that obtained is 2.3 x 10^{-6} Ω^{-1} cm [21].

In the present work the electrical conductivity value obtained for the compounds are 2.193 x 10^{-12} Ω^{-1}cm to 5.78 x 10^{-6} Ω^{-1}cm. The value of the conductivity may be partly attributed to the low evaporation of lithium from the sample prepared different from these of Rozlescu etal 1974 and Venugopal Reddy 1981.The variation of activation energy with the substitutional variable parameters x -may be explain on the basis of Vewrway model [22-24], a small number of ferrous ions (Fe^{+2}) are generally developed during sintering process which lead the conductivity in ferrites suggesting the hopping mechanism according (Fe^{+2}-Fe^{+3}+e^-) [25,28]. However these transition take place for a very small interval of time and are not detectable by the ordinary method. This valence exchange mechanism of Verwey may be considered for these ferrites as general applicable to M-type ferrite.

Table 1: crystallographic structural data of lithium hexaferrites

Compounds	Lattice parameters		Cell Volume $(A^0)^3$	Mol. Wt gm	X-Ray Density gm/cc
	a (A^0)	c (A^0)			
$Li_{0.5}Fe_{2.5}Al_8Co_2O_{19}$	5.859	22.323	663.81	780.89	3.9065
$Li_{0.5}Fe_{6.5}Co_6O_{19}$	5.695	21.262	597.22	1024.42	5.6963

Table 2 Electrical conductivity parameters of compounds

Compounds	Electrical Resistivity at room temperature. Ω cm^{-1}	Activation energy E in (eV)	Electrical Conductivity at room temperature. Ω^{-1} cm
$Li_{0.5}Fe_{2.5}Al_8Co_2O_{19}$	4.559x10 ^{11}	0.77	2.193 x10 $^{-12}$
$Li_{0.5}Fe_{6.5}Co_6O_{19}$	1.72x10 ^{5}	0.39	5.78 x10 $^{-6}$

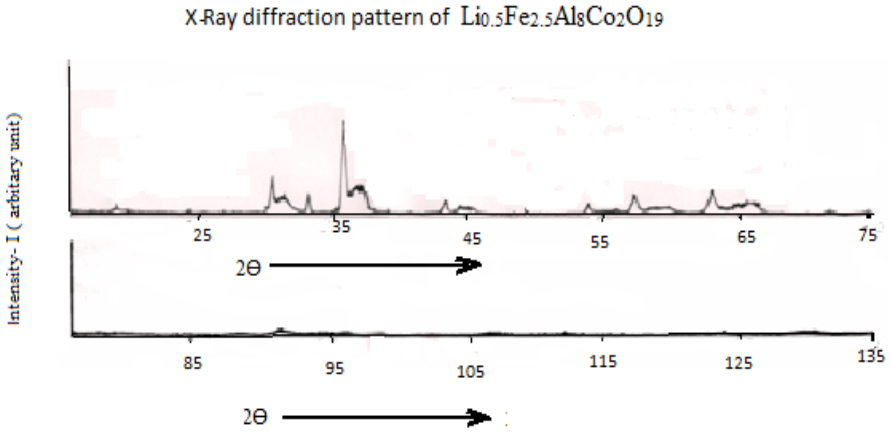

Fig. 1

IV. CONCLUSION:

In this present work, lithium hard ferrites are to check the formation of ferrite containing Al^{+3} and Co^{+3} ions along with Fe^{+3} ions. All these compounds have a magnetoplumbite structure (M-type) through the site distribution changes. No changes occur in the charge distribution but the site distribution is change due to strichiometric changes and the values of lattice parameters '*a*' and 'c'. The variation in electrical conductivity and activation energy may be due to chemical composition and a small number of ferrous ions Fe^{+2} ions are generally developed during the sintering process in the compounds.

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Effect of different molarities of Sodium Hydroxide solution on the Strength of Geopolymer concrete

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ABSTRACT : *This paper contains the experimental study of strength of geopolymer concrete for different molarities of sodium hydroxide solution. This paper also contains results of the laboratory tests conducted to find out the effect of sodium hydroxide concentration on the strength of the geopolymer concrete. In these days the world is facing a major problem i.e. the environmental pollution. We can use fly ash instead of cement in the construction in order to reduce environmental pollution. The Concrete made by using Fly ash and alkaline liquid mixture as a binder is known as geopolymer concrete. In this study for the polymerization process alkaline liquids used are Sodium Hydroxide (NaOH) and Sodium Silicate (Na_2SiO_3). Different molarities of sodium hydroxide solution i.e. 8M, 10M and 12M are taken to prepare different mixes and the compressive strength is calculated for each of the mix. The size of the cube specimens taken are 150mm X 150mm X 150mm. Curing of these cubes is done in an oven for 3 days and 28 days. The Compressive strength of these geopolymer concrete specimens is tested at 3 days and 28 days. The results show that there is increase in comp. strength of geopolymer concrete with increase in molarity of Sodium Hydroxide Solution. Ordinary Concrete Specimens are also manufactured with cement as binder. It is found that the Compressive strength of Geopolymer Concrete specimens is higher than the Compressive strength of Ordinary Concrete Specimens.*

KEYWORDS - *Alkaline Binder, Fly ash, Geopolymer, Green Concrete, Inorganic Polymer, molarity.*

I. INTRODUCTION

The biggest problem to the human beings on this planet is environmental pollution. Environmental pollution means adding impurities to the atmosphere. Ecosystem is badly affected by this kind of pollution. This Pollution is caused by so many reasons. In the construction field, Cement is the main ingredient for the production of concrete. But the production of cement requires large amount of raw material. During the production of cement burning of lime stone take place which results in emission of carbon dioxide (CO_2) gas into the atmosphere. There are two different sources of CO_2 emission during cement production. Combustion of fossil fuels to operate the rotary kiln is the largest source and other one is the chemical process of burning limestone. Concrete is used globally second only to water. Due to increase in demand of concrete there is increase in production of cement which results in increase in environmental pollution and global warming. In 1995 the production of cement was 1.5 billion tons which goes on increasing up to 2.2 billion tons in 2010. 1 ton of production of cement causes 1 ton of emission of CO_2 into the atmosphere. Among all the greenhouse gases, CO_2 alone causes 65% of total global warming. Geopolymer is a light weight, inorganic polymer. Joseph Davidovits in 1979 proposed a theory that an alkaline liquid could be used to react with byproduct material such as fly ash and rice husk ash to produce binders [1].

Several efforts are in progress to supplement the use of Portland cement in concrete in order to address the global warming issues. These include the utilization of supplementary cementing materials such as fly ash, silica fume, granulated blast furnace slag, rice-husk ash and metakaolin, and the development of alternative binders to Portland cement. Almost all the states in India have thermal power plants and abundant availability of fly ash. The ingredients of the alkaline solution viz. sodium hydroxide and sodium silicates are

cheap and easily locally available [2]. In this respect, the geopolymer technology shows considerable promise for application in concrete industry as an alternative binder to the Portland cement. In terms of global warming, the geopolymer technology could significantly reduce the CO_2 emission to the atmosphere caused by the cement industries. Studies on the fly ash based geopolymer concrete dates back to three decades only. Most of the studies are done under heat cured regime. At 60°C to 90°C temperature the polymerization process is fast [3]. Most parts of India come under tropical region where the normal temperature during summer is above 30°C [4]. Geopolymer which is naturally cured at ambient outdoor temperature can be considered as a curing free concrete [5].

II. MATERIALS USED

2.1 Fly ash: - It is obtained from Thermal Power Plant, Parli, Beed, Maharashtra. The properties of fly ash are given in table 1,

Table 1: Properties of Fly Ash

Parameters	Experimental Value in %	Requirements as per IS 3812-2003 in %
Silica	64.11	> 35
Aluminium Oxide	18.58	> 70
Iron Oxide	4.32	> 70
Calcium Oxide	1.21	-
Sodium Oxide	0.21	< 1.5
Potassium Oxide	1.02	< 1.5
Magnesium Oxide	0.24	< 05
Loss of Ignition	0.64	< 12

2.2 Aggregates: - Locally available coarse aggregate is used. Maximum size of coarse aggregate used is 20 mm and specific gravity is 2.66. The coarse aggregate was used in saturated surface dry (SSD) condition.
Manjra river sand is used as fine aggregate. Specific gravity of fine aggregate used is 2.61 and fineness modulus was 2.76. Fine aggregate was sieved for the size less than 5 mm and used in dry condition.
The properties of aggregates are given in table 2,

Table 2: Properties of Aggregates

Property	Coarse Aggregate (20mm)	Fine Aggregate(Sand)
Fineness Modulus	8.14	2.76
Specific Gravity	2.66	2.61
Bulk Density	1533.33Kg/m^3	1254.24Kg/m^3
% Voids	45.24%	51.76%

2.3 Alkaline Solution: - Alkaline Solution plays an important role in geopolymerisation process. In this case the mixture of Sodium Hydroxide (NaOH) and Sodium Silicate (Na_2SiO_3) is used as alkaline Solution. Sodium hydroxide in pellets form with 99% purity and Sodium silicate solution (Grade A53 with SiO_2 = 29.43%, Na_2O = 14.26% and water = 56.31%) were used as the alkaline activators. In order to make sodium hydroxide solution, sodium hydroxide pellets were dissolved in potable water. Both the liquid solutions were then mixed together and alkaline solution was prepared.

2.4 Water: - The potable drinking water which is available in the concrete technology lab is used for this purpose of making concrete.

III. MIX PROPORTIONS

In this experimental work, three different grades of geopolymer concrete cubes for three different molarities of sodium hydroxide solution were prepared. M20, M25, M30 were the three grades of concrete and 8M, 10M, 12M of sodium hydroxide solution. To activate the aluminosilicate based materials with alkalis generally requires heat curing for the formation of alkali-activated binders. The concrete cube specimens were kept in oven for heat curing. These specimens were cured in an oven at 90^0c temperature for the period of 24 hours.

3.1 Preparation of Alkaline Solution:

Photo 1: Alkaline Solution

In this paper, the comp. strength of geopolymer concrete is examined for the mixes of different molarities of Sodium Hydroxide (NaOH) such as 8M, 10M and 12M. The Molecular Weight of Sodium Hydroxide is 40gm (Addition of Atomic Mass of Na=23, O=16, H=1). i.e. 8M Sodium Hydroxide Solution requires 320 gms. Of NaOH, 10M Sodium Hydroxide Solution requires 400 gms. Of NaOH and 12M Sodium Hydroxide Solution requires 480 gms. Of NaOH. The Sodium Silicate (Na_2Sio_3) to Sodium Hydroxide (NaOH) ratio used in this experiment is 1.5.

To prepare 8M Sodium Hydroxide Solution, 320 gms. Of NaOH pellets are weighed and they can be dissolved in distilled water to form 1 liter solution. Firstly, take the volumetric flask of 1 liter capacity, sodium hydroxide pellets are added slowly to distilled water to prepare 1 liter solution. The weights to be added to get required molarity are given in table 3,

Table 3: Weights of NaOH Pellets

Required Molarity	Weight of Sodium Hydroxide in gms.
8M	320
10M	400
12M	480

3.2 Mixing, Casting and Curing:

The density of geo-polymer concrete is assumed as 2440 Kg/m^3 because there are no code provisions for the mix design of geopolymer concrete. The other calculations are done by considering the density of concrete. The total volume occupied by the aggregates (Coarse and fine aggregates) is assumed to be 65%. The alkaline liquid to fly ash ratio is taken as 0.30. The quantities of all ingredients are kept constant as given in table below except the molarity of NaOH is changed in the each mix. The conventional method used in the making of normal concrete is adopted to prepare geopolymer concrete. First, the fine aggregate, coarse aggregate and fly ash are mixed in dry condition for 3-4 minutes and then the alkaline solution which is a combination of Sodium hydroxide solution and Sodium silicate solution is added to the dry mix. The mixing is done about 6-8 minutes for proper bonding of all the materials. After the mixing, the cubes are casted by giving proper compaction. The sizes of the cubes used are of size 150mm X 150mm X150mm. The cubes are demoulded after 1 day of casting and placed in an oven. The curing of geopolymer concrete cubes is done by placing the cubes in hot air oven. For oven curing, the cubes are placed in an oven at 90^0 c for 3 days and 28 days. Mixing Proportions of geopolymer concrete is given in table 4,

Table 4: Mixing Proportions of Geopolymer Concrete

Ingredients (Kg/m^3)	Different Mixes		
	M20	M25	M30
Fly Ash	383	463.50	530
Fine Aggregate	546	530.70	514
Coarse Aggregate (20 mm)	1188	1154.06	1117
Sodium Silicate Solution	120	120	1200
Sodium Hydroxide Solution	80	80	80

IV. RESULTS

The test is done on geopolymer concrete cubes in compressive testing machine to determine its compressive strength after the age of 3 days and 28 days. The compressive strength results obtained are given in table 5,

Grade of Concrete	Molarity	3 Days Comp. Strength (Mpa)	28 Days Comp. Strength (Mpa)
M20	8M	13.48	29.62
M20	10M	15.26	31.39
M20	12M	17.03	33.17
M25	8M	16.80	32.43
M25	10M	18.57	34.21
M25	12M	20.35	35.98
M30	8M	20.41	42.80
M30	10M	22.19	45.02
M30	12M	23.97	47.24

Table 5: Experimental Results of Geopolymer Concrete

In order to compare the Comp. Strength of Geopolymer Concrete with the Comp. Strength of Normal Concrete, normal concrete cubes were also casted and its strength is measured at the age of 3 days and 28 days. The compressive strength results obtained are given in table 6,

Table 6: Experimental Results of Normal Concrete

Grade of Concrete	3 Days Comp. Strength (Mpa)	28 Days Comp. Strength (Mpa)
M20	10.22	20
M25	12.64	24.32
M30	15.98	29.62

From experimental Results of normal Concrete and geopolymer Concrete obtained, we can conclude that, the rate of gain of strength of geopolymer Concrete is more than the normal Concrete. Also the maximum Comp. Strength of geopolymer Concrete is higher than the maximum comp. strength of normal Concrete at the age of 3 days and 28 days. This property of rapid strength gain permits geopolymer concrete to be applied in areas where a fast and reliable fix is required such as on highways. The faster a highway can be repaired, the sooner it can be reopened to restore the traffic flow.

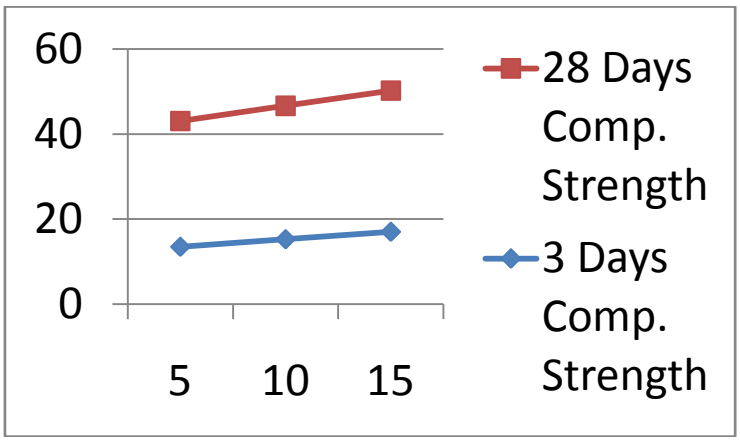

Fig. 1: Comp. Strength of M20 Grade GPC at the age of 3 days and 28 days for different molarities of NaOH Solution

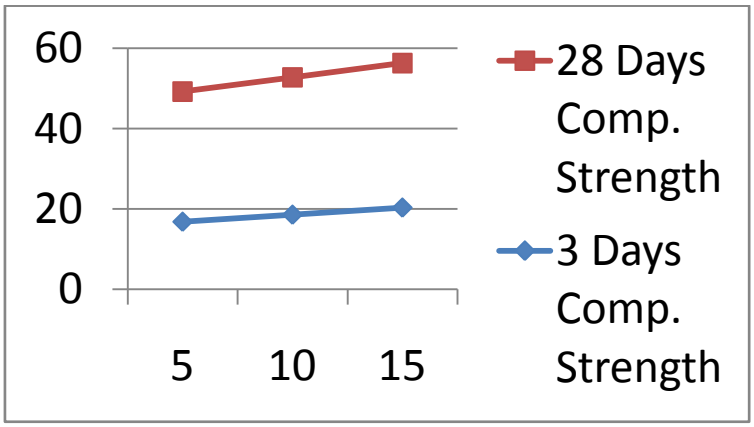

Fig. 2: Comp. Strength of M25 Grade GPC at the age of 3 days and 28 days for different molarities of NaOH Solution

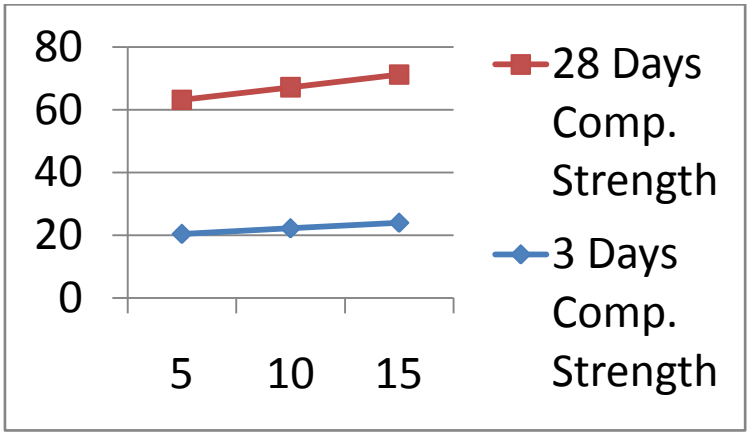

Fig. 3: Comp. Strength of M30 Grade GPC at the age of 3 days and 28 days for different molarities of NaOH Solution

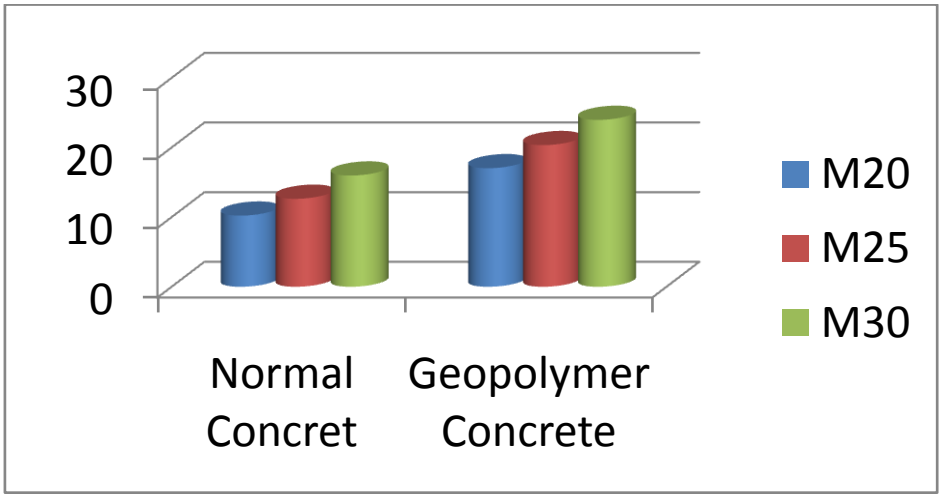

Fig. 4: Variation of Comp. Strength of Concrete at the age of 3 days for different grades

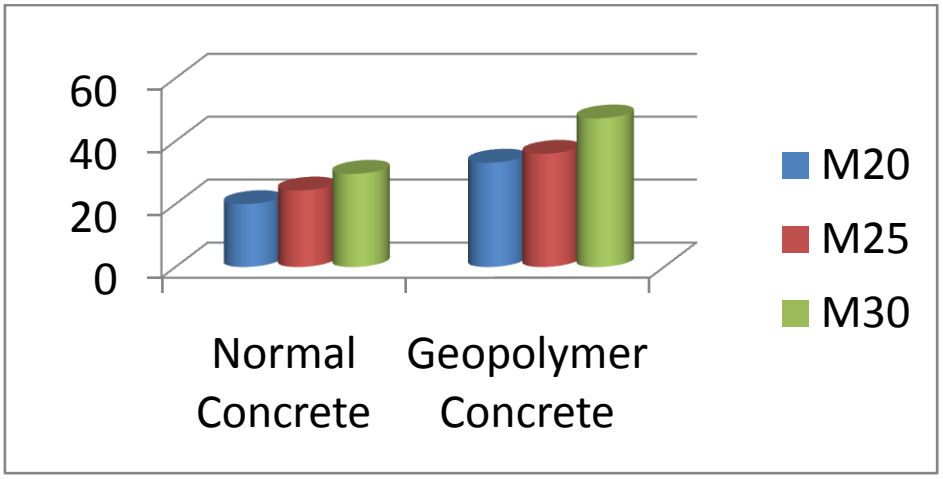

Fig. 5: Variation of Comp. Strength of Concrete at the age of 28 days for different grades

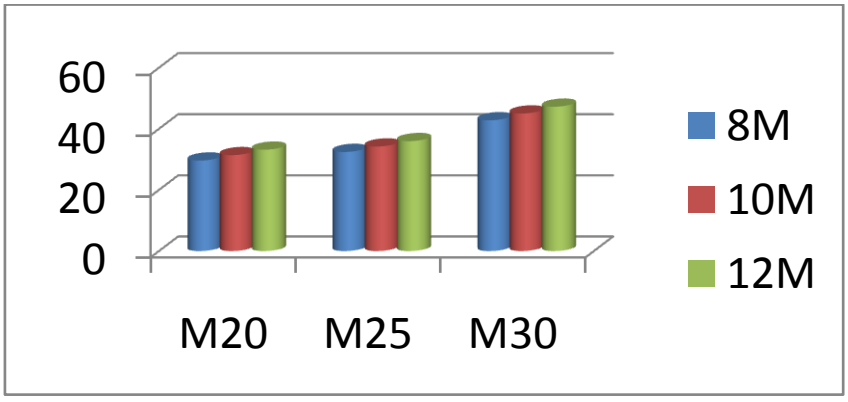

Fig. 6: Variation of Comp. Strength of GPC at the age of 28 days for different grades at different molarities of NaOH solution

V. CONCLUSION

1) It is observed that, the rate of gain of Comp. strength of geopolymer concrete is more than the conventional concrete made up of ordinary Portland cement.
2) It is also observed that, the maximum Comp. strength of geopolymer concrete is more than that of conventional concrete made up of ordinary Portland cement.
3) Comp. strength of geopolymer concrete increases with increase in molarity of sodium hydroxide (NaOH) solution.
4) If not handled properly, Sodium hydroxide can be very harmful to health if mishandled. It has been rated with a classification of 3 in terms of danger to health (0 being the least hazardous, and 4 being the most).
5) Sodium hydroxide is also very corrosive to areas such as the eyes, skin, and nose.
6) One application of geopolymer concrete is in the construction and repair of highways, roads, and airport runways.
7) Another possible application of geopolymer concrete is in maritime settings. Due to its high resistance to salt water, geopolymer concrete may be used for concrete structures that will be under constant attack from salt water.
8) Because of its high resistance to acids and toxic waste, geopolymer concrete can be applied in various highly acidic and toxic environments.

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5083 type Al-Mg and 6082 type Al-Mg-Si alloys for ship building

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ABSTRACT: *Marine transport is increasing its use of aluminium by capitalizing on its two leading qualities: lightness and corrosion resistance. The most popular aluminium alloys for use in corrosive environmentssuch as seawater are the 5xxx and 6xxx series alloys, which demonstrate adequate strength and excellent corrosion resistance. The traditional and the most often used Al-alloys in shipbuilding are 5083 type Al-Mg alloy for plates, and 6082 type Al-Mg-Si alloy for extrusions. These alloys were found to be reliable in marine service as well as during manufacturing.*

Keywords - *Aluminium alloy, corrosion, ship hull, strength.*

I. INTRODUCTION

Aluminum alloys suitable for use in a marine environment have been available for approximately 30 years, offering significant advantages inreducing structural weight and hull maintenance[1]. Marine transport is increasing its use of aluminium by capitalizing on its two leading qualities: lightness and corrosion resistance. Advanced alloys have enabled the design of high-speed ships, by lightening hulls by 40% to 50% over steel[2]. A lighter hull offers better performance, a shallow draught, lower fuel consumption, less capital outlay for engine and propulsion systems[3].Corrosion resistance, even on the water, makes for more durable hulls, masts and superstructures on pleasure boats and the bridges and superstructures of passenger ships and merchant ships[2].When correct attention has been paid to design, especially as regards use with other materials (and the risk of galvanic corrosion), aluminium is an excellent material in a marine context. One example of this is the extensive use of aluminium in many types of ships and boats. Cathodic protection against corrosion is widely used here[4].

b.

Property	Aluminium	Steel
Specific weight, g/cm^3	2.66	7.85
Melting point (liquidus), °C	640	1450
Coef. of linear exp., 10^{-6} °C^{-1}	23.8	11.7
Specific heat, J kg^{-1} °C^{-1}	960	460
Thermal conductivity, W m^{-1} °C^{-1}	120	50
Proof stress, 0.2 PS, MPa	215	235
Tensile stress, UTS, MPa	305	400
Elongation, %	10	40
Elastic modulus, GPa	70	210

Figure 1 a. The bearing welded into a tube in an aluminium hull, [5]and b. the properties of aluminium versus steel[6].

Figure 1 compares the properties of minimum values for 5083 H116 aluminium alloy and for ordinary strength hull structural steel[6].The most popular aluminium alloys for use in corrosive environmentssuch as seawater are the 5xxx and 6xxx series alloys, which demonstrate adequate strength and excellent corrosion resistance. These series are highly suitable in various marine structures, machinery and portbuildings. To prevent aqueous corrosion when in contactwithsea water, several techniques and methods were developed and annual corrosion were reduced[7-9].

II. THE UNIQUE PROPERTIES OF ALUMINUM

Aluminium is the most widely used non-ferrous metal. It is used excessively in the modern world, and the uses of the metal are extremely diverse due to its many unusual combinations of properties.Topaluminium markets for the industry are transportation, beverage cans and other packaging, and building/construction.Although aluminum is sometimes used as is, many applications involve the addition of small quantities of other metals to create alloys with special properties. Certain alloying elements increase strength, corrosion resistance, machinability, ductility, weldability and strength at high temperatures.

II.I LIGHTNESS-SPECIFIC STRENGTH

With a specific mass of 2700 kg/m^3,on a volume basis, aluminium is only about one-third the weight of steel. Significant weight savings can be made in almost every type of mechanical application.Aluminum's unbeatable strength to weight ratio gives it many uses in the transport industry. As aluminum is lightweight, less energy needs to be used to move a vehicle made with aluminum than one made from a heavier metal, such as steel[2,10,11].

II.II Durability-Corrosion Resistance

Because aluminium quickly forms an impervious oxide skin on exposed surfaces, it is highly resistant to atmospheric corrosion, even in marine conditions. So it does not require painting for protection.Due to its resistance to corrosion, even in a marine environment, aluminum is the primary material of choice in the shipbuilding sector - hulls, masts, pleasure boat superstructures as well as bridges and superstructures on liners and merchant ships. Rigid aluminum packaging is mainly used to protect and stock food, drinks and pharmaceutical products. Aluminum is a preferred metal due to its chemical inertness, stability, corrosion resistant qualities and impermeability to air, light, ultraviolet rays, water vapour, oils and fats, oxygen and micro-organisms[2,10-12].

II.III Thermal And Electrical Conductivity

The specific electrical conductivity of aluminium makes it indispensable for electronics and electrics. Aluminium cables carry twice as much current as copper of the same weight. High thermal conductivity makes it very suitable for heating and cooling applications.Unalloyed aluminium has a thermal and electric conductivity about 60% of copper, which accounts for its development as a conductor, in the form of bars and tubes which are used in numerous electrical applications, such as connectors and distribution bars[2,10,11].

II.IV WORKABILITY-METAL FORMING OF ALUMINIUM

Aluminium can be formed by all the common metal-working techniques, more easily than most. It is easy to cast, or die-cast to precise and complex shapes. It can be forged, rolled to a superfine foil, and extruded into intricate sections, or pressed. Superplastic alloys can be worked almost like vacuum-formed plastics. Aluminium is also one of the easiest and fastest materials to machine[10,13,14].

II.V VERSATILITY AND ATTRACTIVENESS

Aluminium alloys can be stiff or supple, especially strong or particularly corrosion-resistant. It is easy to tailor the metal, by alloying and heat treatment, to meet a wide range of needs. Aluminium is a clean material. It looks good without further finishing, but takes kindly to a wide range of applied coatings, from paints to coloured anodising[10].

II.VI Recyclability of Aluminium

Aluminium is easily reprocessed using 5% of the energy needed for primary smelting: almost one third of all the aluminium used today is produced from scrap, either from production processes or from recycled products. Aluminum cans are 100% recyclable; there are no labels or covers to be removed. Recycling them reduces waste, saves energy, preserves natural resources and lessens the need for municipal landfill, while offering recycling companies and municipalities a significant source of revenue[10,12].

III. ALUMINIUM USER INDUSTRIES

III.I transportatıon

While transportation has typically represented the largest market for aluminum in North America over the past two decades. The majority of this aluminum was used in automotive and light truck applications, as vehicle manufacturers continue to opt for lightweight aluminum solutions to improve fuel economy, reduce emissions and enhance vehicle performance. Aluminum-intensive automobiles include the Audi A8 and Jaguar XK. As auto manufacturers struggle to meet fuel-efficiency standards, they increasingly turn to lightweight aluminum alternatives for many parts.In addition to auto parts, motorcycles and airplane parts increasingly are

made of aluminum. With trains, boats and cars aluminum is useful for this lightweight property (which gives fuel efficiency) but not essential, in planes however maintaining a relatively low weight is vital and aluminum allows planes to have to this. In modern planes aluminum makes up 80% of their weight, and a normal Boeing 747 contains about 75 000 kg of the metal[11,15,16].

III.II packagıng

Aluminium is probably the most versatile packaging material available today. It makes strong, light, secure shipping containers, and it encapsulates pills. It is probably more commonly seen on supermarket shelves than any other product, and it is equally at home in the heat of oven and the cold of freezer. It is exceptionally homogeneous, so that it can be rolled to the thinnest of foils. Its ductility makes it easy to wrap, and to re-seal once opened.In 2009, containers and packaging regained their position as the top market for aluminum. Aluminum is used in products such as beverage cans and bottles, food containers, and household and institutional foil. Product manufacturers and consumers appreciate foil for its impermeability to light, water, and oxygen - making it a preferred barrier material for beverage, food, and pharmaceutical products. Additionally, aluminum's low weight gives it a competitive advantage over other materials with regard to shipping costs.Aluminum is still used in a very big way in the food packaging industry despite recent health worries linking aluminum to Alzheimer's disease[10,11,15].

III.III Buıldıng And Constructıon

Largely due to products in the residential, industrial, commercial, farm, and highway sectors, the 2009 building and construction market accounted for 2.13 billion pounds of net shipments, good for 11.9 percent of total shipments and the third largest North American market for aluminum.The European building industry uses about 1.2 mill. tons of aluminium every year, making it the second biggest user of the metal. Japanese and American building industry use about 915,000 ton and 1,05 million tons of aluminum per year, respectively. It is found everywhere, in roof and wall cladding, windows and doors, stairs and railings, roof frames, scaffolding, greenhouses and home extensions[10,11,15,16].

III.IV Electrıcal Applıcatıons

Aluminum has many advantages for electrical applications. It is lightweight, strong, corrosion resistant, and a highly efficient conductor (aluminum has twice the conductivity, per pound, of copper)—rendering it the material of choice for transmitting power from generating stations to homes and businesses. It is also infinitely recyclable, making it a perfect fit for today's environment.The North American electrical market was the fourth largest for aluminum, accounting for 7.3 percent of all aluminum shipments during the year. Over the past century, aluminum and certain alloys have gradually replaced the copper wires used to transmit and distribute electric power.Today, almost all the electricity networks in Quebec, Canada and the United States use wire made from aluminum or aluminum alloys, bare or insulated, which carry and distribute electricity at a lower cost than copper. Many underground cables are made from aluminum[12,15].

IV. TRADITIONAL ALUMINIUM ALLOYS FOR SHIP BUILDING

Production of seagoing vessels using aluminium began in earnest after World War II with the introduction of MIG welding technology and the invention of the 5000 alloy series. Arc welding swiftly established itself in the world of shipbuilding as the cheaper, quicker and more effective method for joining panels and extrusions than riveting. Even above the waterline, where steel meets aluminium special measures are required to prevent corrosion, namely protective paint, insulation and explosion-bonded aluminium-steel transition joints[17].

The traditional and the most often used Al-alloys in shipbuilding are 5083 type Al-Mg alloy for plates, and 6082 type Al-Mg-Si alloy for extrusions. These alloys were found to be reliable in marine service as well as during manufacturing.

Aluminium alloy 5083 contains 5.2% magnesium, 0.1% manganese and 0.1% chromium. as in Table 1. In the tempered condition, it is strong, and retains good formability due to excellent ductility. 5083 has high resistance to corrosion, and is used in marine applications. It has the low density and excellentthermal conductivity common to all aluminium alloys.Typical applicationsrequire a weldable alloy of high to moderate strength, with good corrosion resistance. Marine applications, unfired welded pressure vessels, TV towers, drilling rigs, transportation equipment, armour plate are the main areas of usage[18].

Table 1 a.Composition of Aluminium 5083 alloy and b. Physical properties[18].

Element	%	Element	%
Aluminium	Remainder	Silicon	0.40 max
Magnesium	4.0 – 4.9	Iron	0.40 max
Manganese	0.40 – 1.0	Copper	0.10 max
Chromium	0.05 – 0.25	Others, each	0.05 max
		Others, total	0.15 max

a.

Property	at	value	unit	Property	At	value	unit
Density	20°C	2,660	kg/m^3	Melting Range		574 – 638	°C
Weight	20°C	2.66 x thickness in mm		Mean Coefficient of Expansion	20°C	24.2	x 10^{-6} / °C
Modulus of Elasticity				Thermal Conductivity	25°C	120	W / m . °C
Tension	20°C	70.3	GPa	Electrical Resistivity	20°C	59.5	Nano-ohm . m
Torsion		26.4		Electrical conductivity			
Compression	20°C	71.7	GPa	(all tempers)	20°C	29	% IACS

b.

In respect to the Al-Mg alloys with Mg content ≥ 3% wt., the Aluminum Association received the H116 and H321 temper. The H116 products are strain hardened at the last operation in the processing schedule, while the H321 is thermally stabilized. In both procedures the same level of mechanical properties is achieved, meeting the specified levels of corrosion resistance which is assessed in accelerated corrosion tests (NAMLT and ASSET), regarding inter-granular and exfoliation types of corrosion. Those new H116 and H321 tempers are specified in the recently established ASTM B928 standard for "High Magnesium Aluminum Alloy Sheet & Plate for Marine Service"[19].

Table 2 Standard temper and temper definitions for Aluminium 6082 alloy[20].

Standard Tempers	Standard Temper Definitions*
F	As fabricated. There is no special control over thermal conditions and there are no mechanical property limits.
O	Annealed. Applies to products that are annealed to obtain the lowest strength temper.
T4	Solution heat-treated and naturally aged.
T5, T5511	Cooled from an elevated temperature shaping process and artificially aged.
T6, T6511	Solution heat-treated and artificially aged.

The alloy 6082 is a high strength alloy for highly loaded structural applications. Typical applications are scaffolding elements, rail coach parts, offshore constructions, containers, machine building and mobile cranes. Due to the fine grained structure this alloy exhibits a good resistance to dynamic loading conditions. 6082 is certified for use in marine applications[21]. Tempers for this alloy were given in Table 2.

V. CONCLUSION

The usage of aluminium, particularly of Al-Mg types, in the marine environments can be examined in terms of property and cost. The total weight saving is 50% when the constructions are replaced by Al alloys. This makes aluminium advantageous for ship building industry. The advantages of aluminium application in the ship building industry can be grouped as being lightweight, having high corrosion resistance and having low cost maintenance. The traditional and the most often used Al-alloys in shipbuilding are 5083 type Al-Mg alloy for plates, and 6082 type Al-Mg-Si alloy for extrusions. These alloys were found to be reliable in marine service as well as during manufacturing.

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Inhibitive Effect of Hydrofluoric Acid Doped Poly Aniline (HF-PANI) on Corrosion of Iron in 1N Phosphoric Acid Solution

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Abstract- *The inhibition effect of Hydrofluoric acid doped poly aniline HF-PANI on mild steel corrosion in 1N phosphoric acid has been studied by mass loss and polarization techniques and AC impedance measurements methods between 303 K and 333K.The inhibition efficiency increased with increase in concentration of HF PANI. The corrosion rate increased with increase in temperature and decreased with increase in concentration of inhibitor compared to blank. Potentiostatic polarization results revealed that HF-PANI act as mixed type inhibitor. The inhibitor of HF-PANI was chemically adsorbed and spontaneous adsorption on the mild steel surface .The values of activation energy (Ea), free energy of adsorption (ΔG_{ads}), heat of adsorption (Q_{ads}), enthalpy of adsorption (ΔH) and entropy of adsorption (ΔS) were calculated. The adsorption of inhibitor on mild steel surface has been found to obey Temkin's adsorption isotherm. SEM analysis was agreed to establish the mechanism of corrosion inhibitor on mild steel corrosion in phosphoric acid medium.*

Keywords: *Corrosion inhibition; AC impedance measurements; Potentiostatic polarization; HF-PANI*

I. INTRODUCTION

Corrosion inhibitors are generally used in industry to reduce the corrosion rate of metals and alloys in making contact with unhelpful environment. Acids are widely used in industry such as pickling cleaning decaling ect. Because of their aggressiveness inhibitors are applied to reduce the rate of unexpected metal dissolution .[1-3]organic compounds rich in hetero atoms such as nitrogen ,oxygen ,unsaturated bonds and **t**he plane conjugated system have been reported as effective inhibitors. In the past few years conducting polymers have been recognized as excellent corrosion inhibitor for the metals. A small quantity of polymer may be effective in inhibiting the corrosion of metals in acidic medium polyaniline has been high environmental stability ,how ever the highly insoluble nature of PANI in aqueous medium is the major limitation in corrosion inhibition application .[4-6]

So, in this present investigation, the corrosion of mild steel in 1N phosphoric acid solution in the absence and presence of HF-PANI at 303 to 333K has been studied by mass loss and polarization methods. It is aimed to calculate the corrosion rate, inhibition efficiency on mild steel corrosion and the thermodynamic feasibility of inhibition via surface coverage on mild steel by adsorbed HF-PANI at various temperatures. The adsorption characteristic of HF-PANI was studied in order to access the mechanism of corrosion inhibition and the adsorption isotherm (s).

II. EXPERIMENTAL DETAILS

2.1. Sample Preparation

Rectangular samples of area 5 cm x1 cm have been cut from a large sheet of mild steel. The samples were polished , drilled a hole at one end and numbered by punching .The surface of specimens was polished with emery papers ranging from 110 to 410 grade sand decreased with trichloroethylene specimens were dried and stored in desiccators for further use.

Table 1Composition of mild steel**:**

2.2. Preparation of Hydrofluoric acid doped Polyaniline:

0.1 mol of aniline was dissolved in 0.1L of 1 mol L^{-1} HCl solution, 0.1 mol ammonium per sulphate solution as oxidant was slowly added with constant stirring for about 1 h. After the addition, the stirring continued for 6 h to ensure complete polymerization. The dark green colored polymer powders were filtered and washed with distilled water. The obtained powders were doped by stirring in 0.1 mol of aqueous ammonia

solution for 4 h. After the doping procedure, PANI powders were filtered and washed repeatedly with distilled water and dried in a vacuum oven at45°C for 48 h.

Some of the synthesized powders were dispersed in 0.2 L of 2 mol L^{-1} solution of hydrofluoric acid. The mixture was constant stirred for about 0.5 h at ambient temperature, the precipitate were filtered after 24 h and dried in a vacuum oven at 45C for48 h to yield hydrofluoric acid doped PANI

From the residue the various concentrations of inhibitor solutions (1 to 5 mg) were prepared. Experiments were carried out in the presence and in the absence of HF-PANI in 1N Phosphoric acid

2.3. Characterization of HF Pani

It shows the FT-IR absorption spectroscopy of the two kinds of the synthesized powders. For the FT-IR spectroscopy of the synthesized emeraldine base PANI, the vibration at 1584 cm−1 is for the quinoid ring, while the vibration at 1493 cm−1 depicts the presence of benzenoid ring unit Furthermore, the peak at 1299 cm^{-1} is related to the C–N stretching of a secondary aromatic amine. The peak at 1160 cm−1 is assigned to vibrations associated with the C–H of N=Q=N (Q = quinoid ring). These results suggest that the synthesized powder was PANI in emeraldine state. Contrary to the FT-IR absorption spectra of emeraldine base PANI, the positions of several peaks of hydrofluoric acid doped PANI shifted towards lower wave numbers. For instance, the absorption peaks of the quinoid ring structures moved from 1584 and 1160 cm^{-1} to 1560 and 1112 cm^{-1}, respectively. The peak for benzene ring at 1493 cm−1 shifted to 1483 cm−1. Therefore, hydrofluoric acid do pants mainly located around nitrogen atoms in the quinoid ring rather than in the benzenoid ring. The FT-IR results showed that hydrofluoric acid had doped onto the PANI.

Figure 1 **FT**-IR spectrum of HF PANI

2.4. Weight loss measurement:

Polished specimens were initially weighed in an electronic balance. Behind that the specimens were balanced with the help of PTFE threads and glass rod in 100ml beaker containing acid in the presence and absence of HF-PANI. The specimens were removed after 4 hours washed with water to eliminate any corrosion products and finally washed with acetone. After that they were dried and reweighed. Weight loss method was carried out in 1N phosphoric acid with HF-PANI in the concentration range of 1mgs to 5 mgs as inhibitors and the temperature between 303 K and 333 K for an immersion period of 4 hours. Mass loss measurements were performed as per ASTM method described previously.

2.5. Potentio static polarization

Polarization measurements were carried out in a conventional three-electrode cell. Mild steel strips coated with lacquer except for an exposed area of 1 cm^2 were used as the working electrode. The saturated calomel electrode and the platinum foil were used as reference and counter electrodes respectively. The potentiostatic polarization measurement was carried out using BAS – 100, a model instrument. The potential of the test electrode was measured with respect to SCE, platinum electrode was used as auxiliary electrode and the experiment was carried out at 303K to333K.

$$IE\ (\%) = \frac{Icorr - I*corr}{ICorr} \times 100 \qquad \text{---------- [1]}$$

Where Icorr and I*corr are corrosion current in the absence and presence of an inhibitor.

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2.6. SEM Analysis

The mild steel specimens were exposed in 100 ml of 1N Phosphoric acid solution having 5 mgs of plant extract for 3 hours at room temperature and washed with distilled water then dried. The nature of film formed on the surface of the metal specimens was analyzed by FT-IR and SEM. The dried specimens were scratched off and the resultant powder mixed with KBr (1:100 ratio) to prepare pellets, then the pellets was introduced into Fourier Transfer Infra-Red spectrophotometer FT-IR, 8400's SHIMADZU, Japan to analyze the sample.

III .RESULT AND DISCUSSION

3.1. Weight loss method

For weight loss experiments, mild steel specimens were immersed in 1N H_3PO_4 solution (100ml) for an optimized time period (3hours). An effect observed and analyzed by comparing the data obtained without and with different concentration of HF -PANI.

Corrosion rate (CR) is directly proportional to the weight Loss Cm^{-2} in a specified time and was calculated (mmpy) by the formula.

$$CR = \frac{87.6 \times W}{\rho \times A \times T}$$ ---------- [2]

Where, W = weight loss in mg, ρ = density (7.51 g/cm3 for mild steel) of material used, A = area in cm^2 and t = exposure time in hours.

Table-1 show the value of inhibition efficiency (IE %), surface coverage (θ) and corrosion rate obtained at different concentration of the inhibitors in 1N phosphoric acid solution for an immersion period of 3 hours. From the mass loss value, the inhibition efficiency (IE %), surface coverage (θ) was calculated using the following equation.

$$IE\ (\%) = \frac{Wu - Wi}{Wu} \times 100$$ ---------- [3]

$$\Theta = \frac{Wu - Wi}{Wu}$$ ---------- [4]

Where Wu and Wi are the corrosion rates of mild steel in the absence and presence of inhibitor respectively at the same temperature .The inhibition efficiency increased with increase in concentration of inhibitors and decreased the temperature from 303K to 333K in 1N phosphoric acids shown in Table-2.

Table-2 Corrosion performance of mild steel in 1N phosphoric acid with HF -PANI at various temperatures (303K -333K

Figure 2 Corrosion behavior of mild steel in 1N phosphoric acid with HF -PANI at various temperatures (303K -333K)

3.2. Potentiostatic polarization curves

The Polarization behavior of mild steel functioning as cathode as well as anode in the test solution is shown in fig.3 for 1N phosphoric acid with HF-PANI at room temperature (303K). The electrochemical data obtained are shown in Table I. It is evident that HF-PANI brings about considerable polarization of cathode as well as anode. HF-PANI acts as a mixed type inhibitor. The non-constancy of Tafel slopes for different inhibitor concentration revealed that the inhibitor act through their interference in the mechanism of the corrosion processes at the cathode as well as anode. The i_{corr} values were decreased with increasing concentration of the inhibitors which indicate that the corrosion process is controlled by adding HF-PANI.

Figure 3 Potentio dynamic polarization for mild steel in 1N H_3PO_4 containing various concentration of HF-PANI.

3.3. A.C Impedance Measurements

A.C impedance measurements were carried out for corrosion of mild steel in 1N phosphoric acid after immersion for about 20 minutes at room temperature (303K). The impedance diagrams for mild steel in 1N phosphoric acid for the various concentrations of the HF-PANI are shown in Figures 2.

The impedance parameters and the inhibition efficiency of HF-PANI for mild steel in 1N phosphoric acid are given in Table 2. The values of charge transfer resistance (R_{ct}) for mild steel in phosphoric acid significantly changed after the addition of HF-PANI. The inhibitor efficiency and R_{ct} values increased with increase in concentration of HF-PANI. The semicircular nature of Nyquist plots obtained for all the experiments indicated that the corrosion of mild steel is controlled purely by charge transfer process. Higher R_{ct} values in the case of 1N H_3PO_4 with HF-PANI indicate that the strongly adsorbed on the surface of mild steel. The double layer capacitance (C_{dl}) decreased with increase in concentration of HF-PANI. The decrease in C_{dl} values in the presence of HF-PANI indicated the fact that these additives inhibit the corrosion by adsorption on the metal surface. The inhibition efficiency obtained from A.C impedance measurements are in good agreement with those obtained from weight loss and potentiostatic polarization studies. [6]

Table 2 A.C impedance parameters of mild steel in 1N Phosphoric acid in the presence and absence of HF-PANI at 303K

Figure 4 A.C impedance parameters of mild steel in 1N Phosphoric acid in the presence and absence of HF-PANI at 303K

3.4. Thermodynamic parameters:

Theoretical fitting of the corrosion data to the kinetic thermodynamic model was tested to show the nature of adsorption. Table 4 shows that the calculated values of energy of activation (Ea) for mild steel corrosion in 1N phosphoric acid with and without inhibitor from 303K to 333K. Energy of activation (Ea) was calculated from Arrhenius equation. [7]

$$\mathrm{Log}\left(\frac{P2}{P1}\right) = Ea/2.303R\left[\frac{1}{T1} - \frac{1}{T2}\right]$$ ---------- [6]

Where P1 and P2 are corrosion rates of mild steel at the temperatures T_1 (303K) and T_2 (313K) respectively.

The values of heat of adsorption ($Q_{(ads)}$) were calculated using the following equation.

$$Q\,(ads) = 2.303R\log[\frac{\theta 2}{1-\theta 2} - \frac{\theta 1}{1-\theta 1}] \times \frac{T1 \times T2}{T2-T1}$$ ---------- [7]

Where θ_1 and θ_2 are surface coverage of the inhibitor at the temperatures T_1 (303K) and T_2 (313K) by the different additives.

The free energy of adsorption [$\Delta G_{(ads)}$] was calculated from the following equation

$\Delta G_{(ads)}$ = -RT ln (55.5K) ---------- [8]

and K is given by

K= θ /C (1- θ) ---------- [9]

Where θ is surface coverage on the metal surface, C is the concentration inhibitor in mole/lit and K is the equilibrium constant. [8]

The enthalpy of adsorption (ΔH) was calculated using the equation

ΔH=Ea-RT ---------- [10]

The entropy of adsorption (ΔS) was calculated using the equation

ΔG=ΔH-TΔS ---------- [11]

The calculated values of energy of activation (Ea), heat of adsorption $Q_{(abs)}$, free energy of adsorption [ΔG (ads)], enthalpy of adsorption (ΔH), the entropy of adsorption (ΔS) are shown in Table 3.

In this case the negative sign of free energy of adsorption (-ΔG(ads)) for HF-PANI indicates that the adsorption of the mild steel surface was a spontaneous process band the adsorption could be chemisorptions. The negative value of enthalpy of adsorption (ΔH) indicates that the reaction was exothermic and adsorption of the inhibitor on the metal surface has taken place.[9-10]

Table-3 Thermodynamic parameter for mild steel in 1N H_3PO_4 with HF-PANI at various temperatures (303K - 333K)

3.5. Adsorption isotherms.

The adsorption of HF-PANI on the metal surface and the interaction between the organic compounds and metal surface, various adsorption isotherms have been tested with several adsorption isotherms such as Langmuir adsorption isotherm known as thermodynamic /kinetic model and Florry- Hyggins model was found to be closest to description of adsorption behavior of the inhibitor, [9-11]under investigation. The plot of θ versus log$C$ give a straight lines of slope(X) and intercept (K') for Temkin adsorption isotherm with HF-PANI as shown in Figures 8

The plot of log[$\theta/(1-\theta)$] versus log$C$ give a straight lines of slope(X) and intercept (K') for kinetic model for HF-PANI (El-Awady et al) as shown in Figures 6. The values of equilibrium constant K (K=k'.1/y), change in the free energy of adsorption (ΔG_{ads}) and number of inhibitor molecules occupying one active site (x) are present in Table 4. Inspection of this table shows that the numbers of active sites are nearly constant and approximately equal to one at all temperatures. [12-13]

This behavior can be discussed on the basis that the adsorption process takes place by the occupation of one active site by a single inhibitor molecule. Also, the equilibrium constant K' decreases with increasing the temperature suggesting that this inhibitor is strongly adsorbed on metal surface at room temperature but desorption process enhanced at higher temperature. Large values of K' mean better inhibition efficiency of a given inhibitor, strong electric interaction between the double layer existing at the phase boundary and the adsorbing molecules. Small values of K', however compromise that such interactions by adsorbing molecules and the metal surface are weaker, denoting that the molecules are easily removable by the solvent molecules from the surface. The negative values of standard free energy of adsorption (ΔG_{ads}) are large and indicate that the adsorption reaction was spontaneous.

According to Flory–Huggins isotherm, a plot of log θ/C versus log [1−θ] gave straight lines of slope (x) intercepts (log XK) and regression coefficients (R2) of HF-PANI are shown in Figures 5. Table 4 gives curve fitting data to Flory–Huggins isotherm. It is seen that, there is a good agreement between the values of K', 1/Y, X, K and ΔG_{ads} obtained from the kinetic model and Flory–Huggins isotherms. The numerical values of K obtained from the Langmuir thermodynamic/kinetic model and Flory–Huggins isotherm are found to be 3123 and 3060 for HF-PANI respectively at 303K. They showed as the temperature increases, the K value decreases when compared with 303K. The higher values of K and ΔG°_{ads}(-30.73 kJ/mole) indicate that the HF-PANI strongly adsorbed on mild steel leads to the inhibition efficiency of HF-PANI (97.36%) and found to be higher. The regression coefficient (R^2) values obtained from kinetic model for HF-PANI are higher when compared with the values obtained from Flory–Huggins isotherm. It indicates that the kinetic model was fit for adsorption of HF-PANI on mild steel.[14-16]

Table 5.Adsorption isotherm parameters of HF-PANI for mild steel in 1N H_3PO_4 by Kinetic model and Florry-Hyggins Model

Figure: .5. Arrhenius plot of HF-PANI for mild steel corrosion in 1N Phosphoric acid

Figure 6 Langmuir adsorption isotherm plot of HF-PANI for mild steel in 1N H_3PO_4

Figure 7. Flory–Huggins adsorption isotherm plot of HF-PANI for mild steel in 1N H_3PO_4
Figure 8. Temkin adsorption isotherm plot of H-PANI for mild steel in 1N H_3PO_4

3.6. SEM analysis

Scanning Electron Microscope images were taken in order to study the changes that occur during the corrosion of mild steel in the presence and absence of the green inhibitor Fig -(9-10) represents the micro graphs of the mild steel samples after exposure to the corrosive environments. Although they show different morphologies, both portrayed severely damaged surface due to the formation of corrosion products. No pits and cracks are observed in the micro graphs after impression of inhibitors in the corrosive media Fig-(10) expect polishing lines, The metal surface was homogeneously covered with the inhibitor molecules .Consequently forming a protective film.

Figure 9. SEM analysis of Mild steel in 1N Phosphoric acid
Figure 10. SEM analysis of Mild steel in 1N Phosphoric acid With HF PANI

3.7. Mechanism of corrosion inhibition

The composition and the structure of the films formed on iron remains subjects of continued interest from FTIR studies on the oxides of iron revealed the presence of Fe_2O_3 in solutions irrespective of the nature of the iron substrate.

At the interface of iron and electrolyte, the dissolution of iron can be written as,

$$Fe + H_2O \longleftrightarrow FeOH_{ads} + H^+ + e^-$$
$$FeOH_{ads} \longrightarrow FeOH^+ + e^-$$
$$FeOH^+ \longleftrightarrow Fe^{2+} + OH^-$$

At medium and high concentrations of phosphoric acid, precipitation of iron-phosphate occurs at interface.

$$6H_3PO_4 + 3Fe \longrightarrow 3\,Fe\,(H_2PO_4)_2 + 3H_2$$
$$3Fe\,(H_2PO_4)_2 \longrightarrow Fe_3\,(PO_4)_2 + 4H_3PO_4$$

However, this precipitation can be weakly observed when the mild steel is treated with phosphoric acid solutions with low concentration. The formation of insoluble phosphate depends on the metal ions present in solutions at interface, concentration of metal ion in the solution and the reactivity of metal surface. G.Gunasekaran and L.R.Chauhan[8] explained that as soon as the HF PANI interacts with dissolving iron to form an organo-metel complex (Fe- HF PANI) and forms a layer.[17]

$$Fe^{2+} + HF\ PANI \longrightarrow [Fe\text{- }HF\ PANI]$$

This layer reacts with phosphate ions to form a layer of $FeHPO_4$/ FeH_2PO_4 to the formation of Fe- HF PANI, since it is mediated or catalyzed by this compound, as is observed by the increased rate of formation of iron phosphates. After certain period, the formation of iron phosphate results in a dense layer and formation of Fe- HF PANI will less. This was reflected by FT-IR analysis of mild steel immersed in 1N phosphoric acid containing 5mgs of HF PANI.

IV. CONCLUSION

1. Corrosion rates of mild steel in 1N phosphoric acid decreased with increasing concentration of HF-PANI.The inhibition efficiency increased with respect to the concentration of inhibitor and decreased with rise in temperature from 303K to 333K.
2. The maximum inhibition efficiency of HF-PANI was found to be 87.25 % and 81.92% in 1N phosphoric acid at 5mgs of inhibitor from mass loss studies and polarization measurement respectively at 303K.The inhibition efficiency obtained from mass loss and polarization measurement showed fairly good agreement.
3. Energy of activation (Ea) values indicated that the addition of HF-PANI hinders metal dissolution and also indicated that, decrease in the adsorption of the inhibitor on mild steel surface with increase in temperature.
4. The negative value of ΔG_{ads} indicated that the HF-PANI was chemically adsorbed and spontaneous adsorption of inhibitors on the surface of mild steel.
5. The higher negative values of heat of adsorption also showed that the inhibition efficiency decreased with rise in temperature
6. The high positive enthalpy values of adsorption (ΔH_{ads}) evident that the plant extract strongly adsorbed on mild steel is probably chemisorptions.
7. The gain in entropy that accompanied by the substitution adsorption process was attributed to the increase in solvent entropy.
8. It is found that the HF-PANI acting as mixed type inhibitor.
9. The adsorption of HF-PANI on mild steel surface from the acid solution followed Temkin's adsorption isotherm.
10. FT-IR and SEM analysis showed the presence of compounds in the plant extract react with metal ion to form the layer of inhibitor on the metal surface.

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Table 1Composition of mild steel**:**

Element	Fe	Ni	Mo	Cr	S	P	Si	Mn	C
Composition (%)	99.686	0.013	0.015	0.043	0.014	0.009	0.007	0.196	0.017

Table-2 Corrosion performance of mild steel in 1N phosphoric acid with HF -PANI at various temperatures (303K -333K

Temp (K)	Conc. of HF-PANI(mgs)	Mass loss studies			Polarization measurement				
		Corrosion Rate (mmpy)	Surface coverage (θ)	IE (%)	E_{corr} Vs SCE (mv)	I_{corr} µA/cm^2	Tafel constant mv/decade		IE (%)
							b_a	$-b_c$	
	Blank	159.25	-	-	-460	260	55	110	-
	1	48.79	0.6936	69.36	-465	54	41	110	79.23
	2	31.95	0.7994	79.94	-470	49	40	102	81.15
	3	22.38	0.8594	85.94	-470	45	42	98	82.69
	4	17.43	0.8905	89.05	-472	36	40	95	86.15
303	5	10.6	0.9334	93.34	-475	26	38	90	90
	Blank	182.73	-	-	-465	610	50	120	-
	1	60.48	0.669	66.9	-475	250	48	105	59.02
	2	50.03	0.7262	72.62	-470	200	42	100	67.21
	3	48.79	0.733	73.3	-480	162	44	98	73.44
	4	40.22	0.7799	77.99	-485	140	40	90	77.05
313	5	30.31	0.8341	83.41	-480	118	42	95	80.66
	Blank	217.06	-	-	-475	1050	65	135	-
	1	85.11	0.6075	60.75	-485	550	52	115	47.62
	2	78.16	0.6399	63.99	-475	460	50	105	56.19
	3	70.39	0.6757	67.57	-475	350	50	102	66.67
	4	64.44	0.7031	70.31	-470	270	45	95	74.29
323	5	38.88	0.8209	82.09	-477	255	40	92	75.71

333	Blank	271.74	-	-	-480	1600	90	140	-
	1	129.48	0.5235	52.35	-470	815	95	120	49.06
	2	120.12	0.558	55.8	-475	725	75	114	54.69
	3	114.62	0.5782	57.82	-480	615	60	102	61.56
	4	104.76	0.6145	61.45	-474	512	55	120	68
	5	99.56	0.6336	63.36	-482	475	60	100	70.31

HF-PANI (mg)	HF-PANI		
	R_{ct} (ohm cm^2)	C_{dl} ($\mu F/cm^2$)	IE (%)
Blank	152.78	6545.47	-
1	734.13	1362.14	59.72
2	919.63	1087.39	63.12
3	1087.14	919.84	68.16
4	1770.38	564.84	76.2
5	2773.9	360.5	81.17

Table-3 Thermodynamic parameter for mild steel in 1N H_3PO_4 with HF-PANI at various temperatures (303K -333K)

Conc. of inhibitor (mg)	E_a (from equ) kJ/ mole	E_a (from plot) kJ/ mole	$-\Delta G_{ads}$ kJ/mole				Q_{ads} kJ/ mole	ΔH kJ/ mole	ΔS kJ / mole
			303K	313K	323K	333K			
Blank	14.95	15.6	-	-	-	-	-	10.79	-
1	27.21	28.45	29.58	30.26	30.51	30.5	1.44	10.79	0.1773
2	36.92	25.14	29.26	29.16	29.02	28.97	4.49	23.05	0.2046
3	45.52	24.56	29.31	28.2	28.36	28.08	6.18	32.76	0.2309
4	49.99	26.15	29.31	28.11	27.93	27.7	9.98	41.36	0.2442
5	62.44	26.02	30.12	28.44	29.1	27.3	11.46	45.83	0.2893

Table 5.Adsorption isotherm parameters of HF-PANI for mild steel in 1N H_3PO_4 by Kinetic model and Florry- Hyggins Model

Inhibitor	Temp. (K)	Kinetic model				Florry- Hyggins Model			
		1/Y	K	$-\Delta G_{ads}$ kJ/mole	R^2	X	K	$-\Delta G_{ads}$ kJ/mole	R^2
TPWE	302	0.9349	3123	30.56	0.9611	0.8703	3060	30.34	0.9456
	313	2.0040	118	21.08	0.8510	1.899	1148	27.87	0.8950
	323	1.8041	111	21.86	0.9020	1.3133	333	24.75	0.9317
	333	3.5920	26	16.62	0.9542	2.1245	430	25.39	0.8870

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	333	3.5920	26	16.62	0.9542	2.1245	430	25.39	0.8870

Figure 1 **FT**-IR spectrum of HF PANI

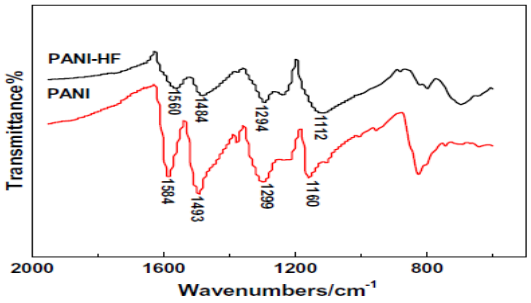

Figure 2 Corrosion behavior of mild steel in 1N phosphoric acid with HF -PANI at various temperatures (303K -333K)

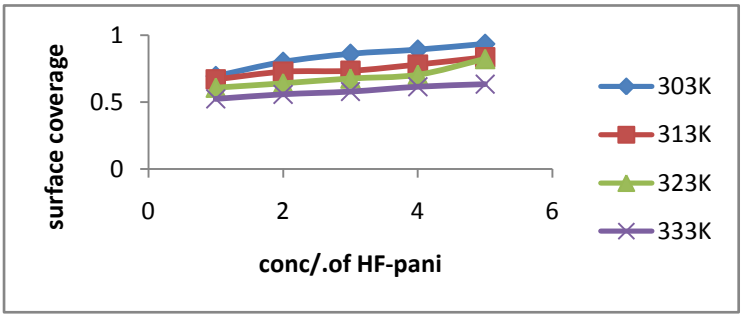

Figure 3 Potentio dynamic polarization for mild steel in 1N H_3PO_4 containing various concentration of HF-PANI.

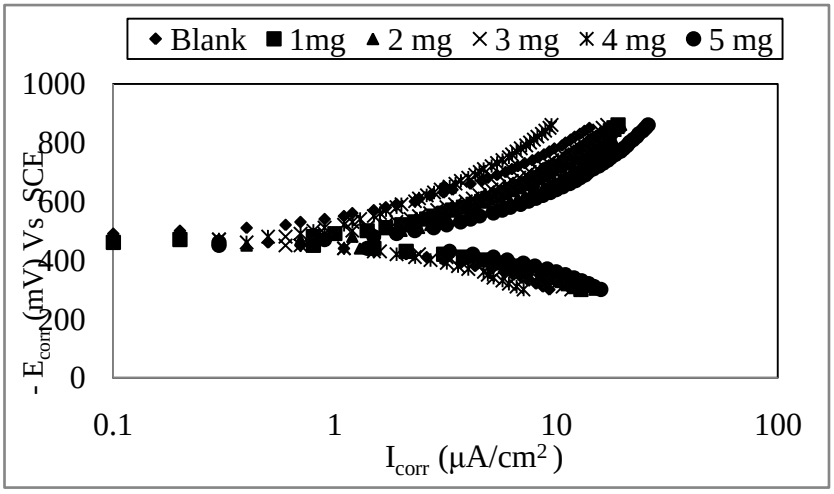

Figure 4 A.C impedance parameters of mild steel in 1N Phosphoric acid in the presence and absence of HF-PANI at 303K

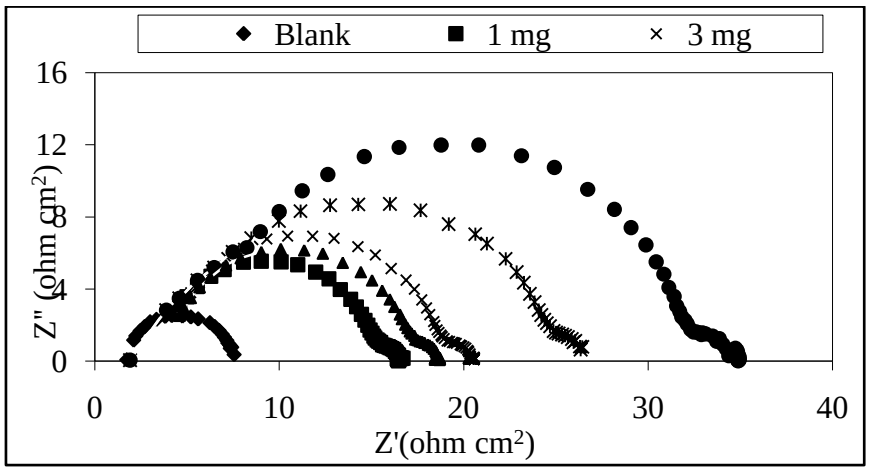

Figure: .5. Arrhenius plot of HF-PANI for mild steel corrosion in 1N Phosphoric acid

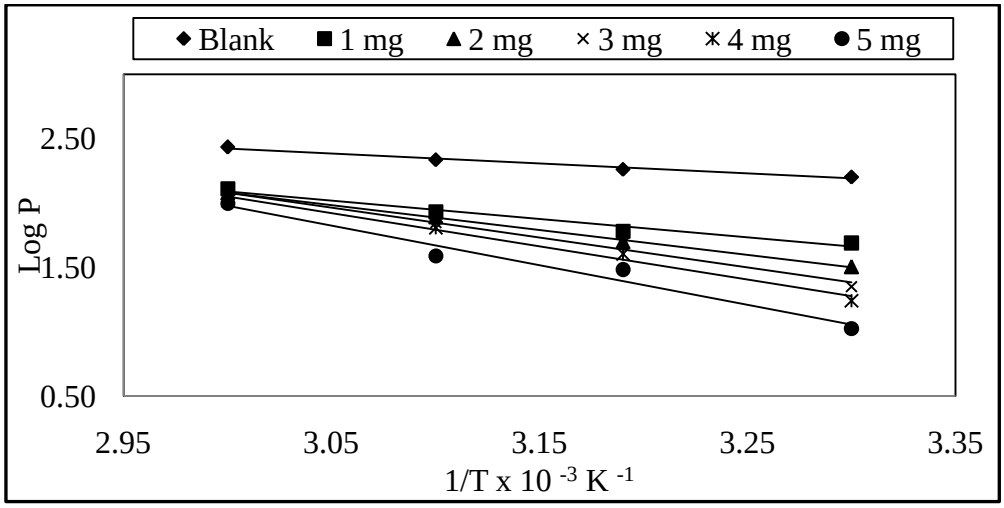

Figure 6 Langmuir adsorption isotherm plot of HF-PANI for mild steel in 1N H_3PO_4

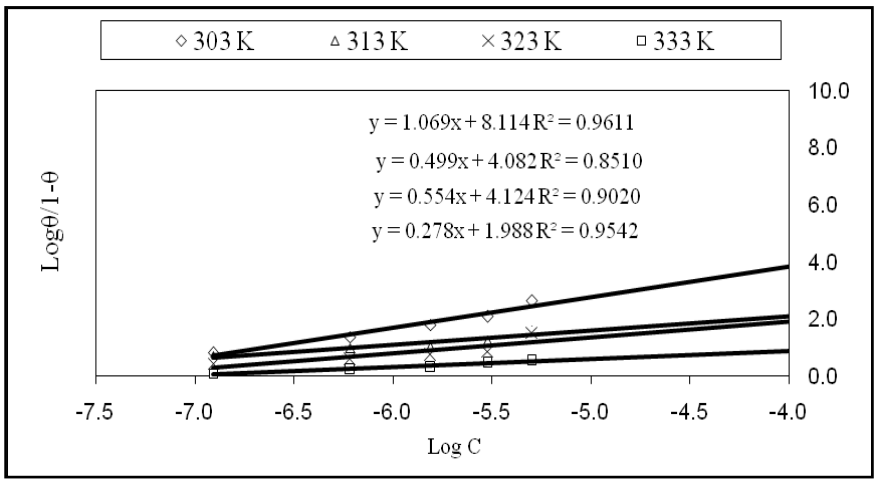

Figure 7. Flory–Huggins adsorption isotherm plot of HF-PANI for mild steel in 1N H_3PO_4

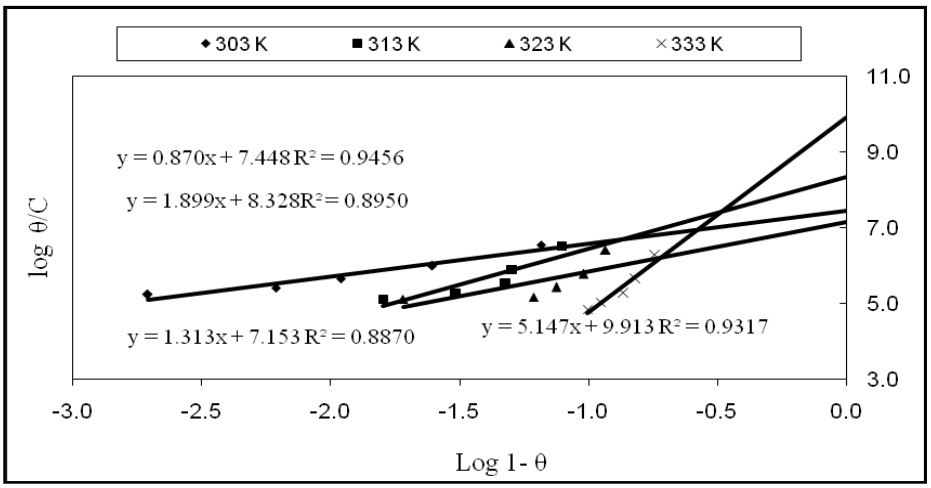

Figure 8. Temkin adsorption isotherm plot of HF-PANI for mild steel in 1N H_3PO_4

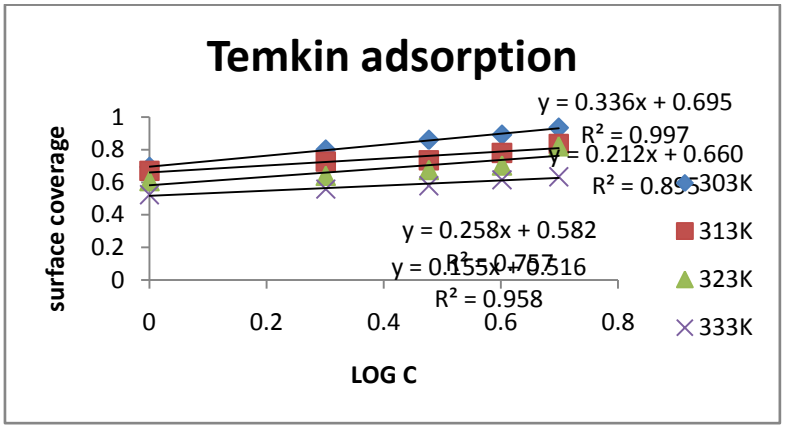

Figure 9. SEM analysis of Mild steel in 1N Phosphoric acid

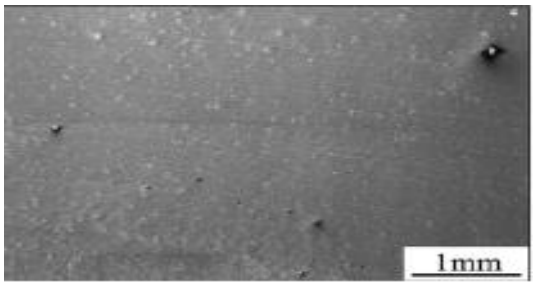

Figure 10. SEM analysis of Mild steel in 1N Phosphoric acid With HF PANI