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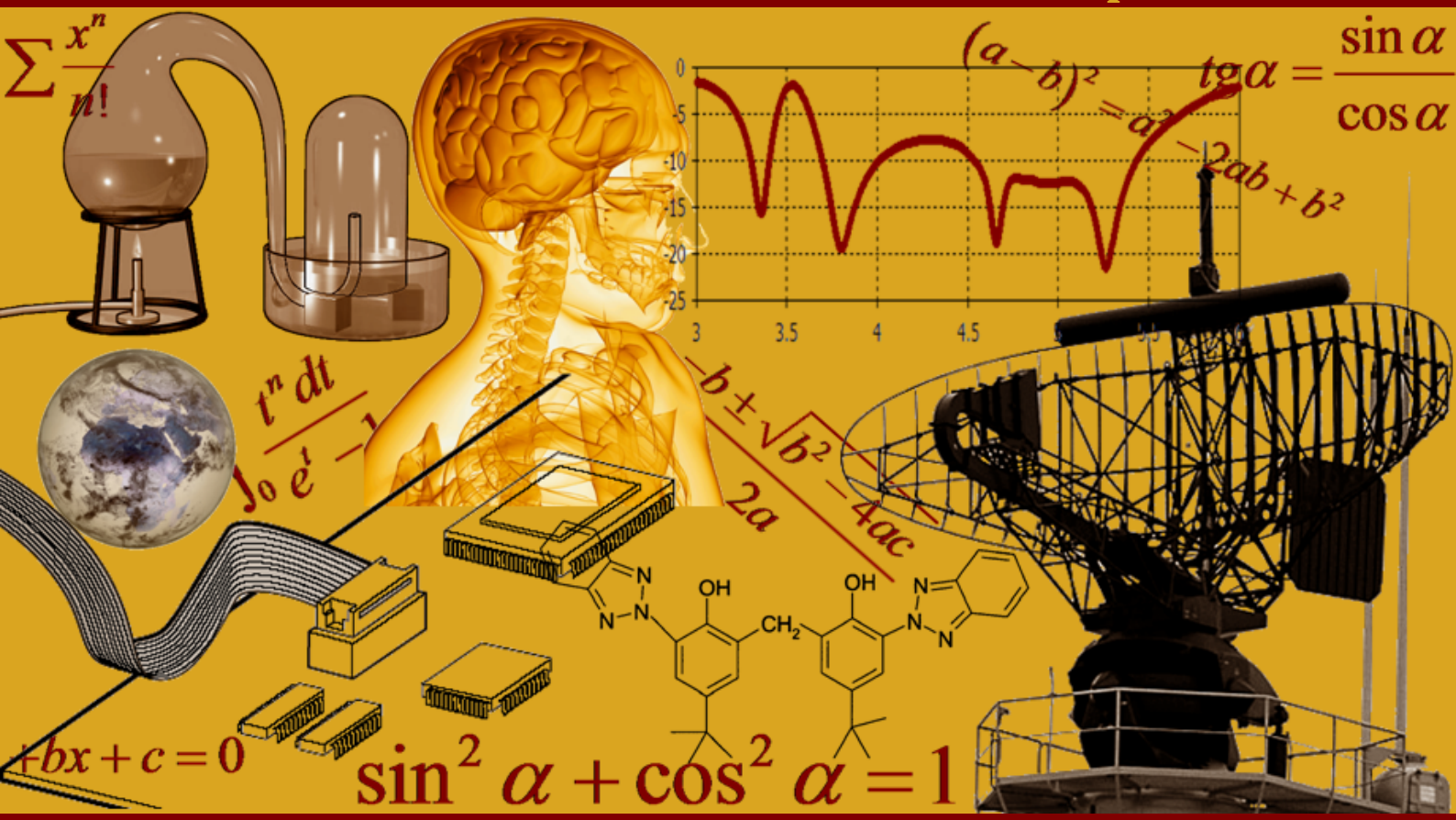

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Perseverance of Poor Solid Waste Management System in Urban Areas: a case of Dodoma Municipality, Tanzania

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ABSTRACT: The study examined factors contributing to perseverance of poor solid waste management system in urban areas. specifically the study identified ways and tools used for proper solid waste management system, examined community awareness and attitude towards solid wastes management system and find out the existence of institutional and legal framework and how community comply with the existing laws/bylaws, rules and regulations towards solid waste management system. Both primary and secondary data were collected from a total of 108 respondents by using questionnaires and interview to obtain opinions and reactions persistence of poor solid waste management in urban areas of Tanzania. Findings revealed that negatively stance and perception of people concerning sanitation issues contributes to poor solid waste management in Tanzania. Preponderance of people has little idea on sanitation and most of households did not have rubbish bins. It is recommended that in absence of environmental education sold waste management will continue to be a problem.

KEYWORDS: Environment, Solid, Waste, Urban, Management, Sanitation, Attitude.

1 INTRODUCTION

The overall goal of urban solid waste management is to collect, treat and dispose of solid wastes generated by all urban population groups in an environmentally and socially satisfactory manner using the most economical means available. Local governments are usually authorized to have responsibility for providing solid waste management services, and most local government laws give them exclusive ownership over waste once it has been placed outside a home or establishment for collection. As cities grow economically, business activity and consumption patterns drive up solid waste quantities. At the same time, increased traffic congestion adversely affects the productivity of the solid waste fleet. Productivity loss is exacerbated by longer hauls required of the fleet, as open lands for disposal are further and further away from urban centers. The challenge is to rationalize worker and vehicle performance, while expanding services to a growing urban population (FAO, 2011).

In developing countries, it is common for municipalities to spend 20-50 percent of their available recurrent budget on solid waste management. Yet, it is also common that 30-60 percent of all the urban solid waste in developing countries is uncollected and less than 50 percent of the population is served. In some cases, as much as 80 percent of the collection and transport equipment is out of service, in need of repair or maintenance. In most developing countries, open dumping with open burning is the norm (World Bank, 2012). Abel, OA (2009) provide that, performance and profitability of Municipal Solid Waste (MSW) management in a low-income city. The research provides an overview of methods and models for integrated planning of a two-phase program: MSW collection and transportation, and MSW treatment. We present the case study of Matadi (the Democratic Republic of Congo) that has a low level of the MSW management compared to other African cities. We develop a spreadsheet model for collection and transportation of MSW which is relevant for low-income cities and enables determining the waste collection fee. A CDM decay model is used to predict the GHG emissions in disposal site. The MSW treatment plant in case of Matadi is evaluated. For the anaerobic digestion technology selected as appropriate for this

plant, the key factors that ensure profitability of the plant are as follows: tipping fee from the municipality (19% of total revenue), amount of carbon credits which can sum up to 16% of the total revenue, expansion of waste collection range from 25 to 50 km. The methods of this study can be used for solving waste problem in other low-income cities where the budget for municipal services is scanty, particularly when starting from a very low level of MSW management. Ajani, OIY (2007) and Arlosoroff, S (1982) age of recipients, location of recipients and occupation of recipients are positively related to the probability of using public waste collection service while the number of years of schooling, amount paid for waste collection service, household size and total monthly income of recipient are negatively related to the probability of using public waste collection service.

According Bartone, C. (2000) large generation of solid waste at high rate need efficient technology to manage the wastes. Of 201 respondents to questionnaire in Abeokuta, 35.8% used waste collection services, 64.2% used other waste disposal options, 16.4% used both, 68.7% and 58.7% were aware of waste collection service and waste management regulations, respectively; while 28.4% separated their solid wastes at source. Blight, G.E. and Mbande, C.M. (1996) a well-managed city with medium or low income may be significantly different from a similar city with poor urban MSW management. Waste stream analysis, material balance and lifecycle assessment may be helpful in sustainable landfill management. Sustainable landfill management may not be possible in absence of complete understanding and required capacity enhancement along with financial support.

Developing and least developed countries are facing serious problems of solid waste management system (Zurbrugg, 2008). Solid waste management is a major environmental concern in many urban areas in Tanzania which needs an immediately action. This situation is severe in cities such as Dar-es-salaam, Mwanza, Arusha and Dodoma region (URT, 2009). Local Government Authorities in many cities are unable to deliver services effectively while illegal dumping of domestic and industrial waste is common practiced. The government in Dodoma Municipality embark on initiatives to addresses problem concerning solid wastes management by mobilizing community working groups under Public-Private Partnership (PPPs) approach about 8-10 solid wastes collectors in Dodoma town by year 2004 were involved and waste collection points established (Dodoma, 2005).

Although numerous efforts undertaken by Municipal government solve problem still solid waste problem dominates exist. With reference to presentation on Community Based Monitoring System (CBMS) in Manila Philippines (2008) discussed that the problem of Solid Waste Management in Dodoma Municipal is out of control in many wards (Dodoma, 2005). Therefore the study examined factors contributing perseverance prevalence of poor Solid Waste Management in urban areas with focus to Makole Ward in Dodoma Municipal. Specifically the study identified ways and tools used by community on solid waste management, examined community's' awareness and attitude towards solid waste and solid waste management; discovered existence of institutional and legal framework.

2 MATERIALS AND METHODS

This study conducted in Dodoma Municipality at Makole Ward in 2012. The study area selected since it generate high rate of Solid Waste and it is unplanned area. Both primary and secondary data were collected from 108 respondents using questionnaires and interview to obtain different opinions and reactions towards factors contributing perseverance prevalence of poor Solid Waste Management in urban areas of Tanzania. These methods give interviewee an opportunity to provide more information and get some clarification from the interviewer on issues about factors contributing perseverance prevalence of poor Solid Waste Management in urban areas of Tanzania. Documentary reviews were also conducted by reviewing regional environment management reports. the collected raw data from the field were processed and analyzed through SPSS programme. Descriptive statistics was mainly used to describe the problem under the study by presenting a combination of variables. A cross tabulation used to simplify the understanding of factors contributing perseverance prevalence of poor Solid Waste Management in urban areas of Tanzania.

3 RESULTS AND DISCUSSION

3.1 SOLID WASTE MANAGEMENT HANDLING WAYS AND TOOLS

Wastes generated through human activities should be properly collected, handled, stored, and disposed to minimize hazard to environment and public health. Findings revealed that 90% of respondents said people do mix Solid Waste and do not sort them at all (Table 1). Solid Waste workers worked with bare hands without protecting themselves by wearing gloves. They also used wheelbarrow and simple spades with short handles. The results are in line with the studies carried by Cointreau (1982) which illustrates that in most cases Solid Waste in developing countries are inadequately handled; Many

municipal councils of developing countries do not encourage their people to sort solid wastes as a result it become very difficult to handle it and thus would be the source of many infectious diseases such as cholera, typhoid etc.

Table 1: Sorting of solid wastes (n=98)

Responses	Frequencies	Percentage
Do not sort	88	**90**
Sort	10	**10**
Total	**98**	**100**

Source: Field data survey, 2012.

Again analysis indicated that community used poor technology in managing solid. The findings indicated that 80.6% of respondents did not have dustbins and only managing solid waste by burning them. This is a poor technology of handling solid waste. By burning solid waste which sometimes contain carbon or petroleum increases carbon dioxide in the air, which is a potential gas that causes global warming as described by (Johansson, 1999).

With respect to awareness and attitude towards solid waste results showed that 84% of respondents had limited knowledge about solid waste and not aware on potential effects to environment. Few respondents (16%) had ideas on solid waste and its effects. Due to lack of relevant knowledge, people are carelessly dumping solid waste in their areas. This situation exacerbates dumping of Solid Waste in the area and therefore causes Solid Waste rampant in the area (Table2).

Table 2: Respondents with knowledge about "solid wastes" and their effects (n=98)

Responses	Frequencies	Percentage
Do not have knowledge	82	**84**
Have knowledge	16	**16**
Total	**98**	**100.0**

Source: Field data survey, 2012.

With respect to environmental education to examine awareness and attitude of community towards Solid Waste management, findings revealed that primary education created awareness among the society about solid waste management (Table 3). Furthermore formal education has an impact on solid waste and has activated community to understand importance of controlling solid waste in their area. In this case formal environmental education should be looked at as a changing agent that is highly required by people.

Table 3: Levels of education in contrast with collection of solid wastes at home (n=98)

Education level of respondent	Respondents who sort solid waste at their homes	Respondents who do not sort solid waste at their homes	Total
No formal education	0	4	**4**
Adult Education	23	0	**23**
Primary Education	37	0	**37**
Secondary Education	8	6	**14**
College	20	0	**20**
Total	**88**	**10**	**98**

Source: Field data survey, 2012.

Analysis on the respondents' awareness and attitudes towards "Solid Waste Management" shows that 91.75% of respondents were not aware on solid waste management. This is a serious factor that leads to persistence prevalence of poor Solid Waste Management in the study area.

Table 4: Respondents with knowledge about solid waste management (n=108)

Responses	Frequencies	Percentage
Do not have knowledge	99	**91.7**
Have knowledge	09	**08.3**
Total	**108**	**100.0**

Source: Field data survey, 2012.

ATTITUDES TOWARDS SOLID WASTE MANAGEMENT

The whole issue of attitudes appears to affect both inhabitants and authorities regarding solid waste management in Dodoma Municipal. The study revealed that 54% of respondents said that it's a responsibility of municipal council to make surrounding/ environment clean, while few respondents (07%) said it's an individual responsibility and 39% of respondents said that the responsibility should be shared between municipal council and the individuals (Table 5)

Table 5: Responsibility for Cleaning Surroundings (n=98)

Response	Frequency	Percentage
Dodoma Municipal Council	53	54
Individuals	07	07
Both Dodoma Municipal Council & Individuals	38	39
Total	98	100.0

Source: Field data survey, 2012.

This result is the same as the study done by Songsore (1992) which revealed that, the establishment of the Waste Management Department of urban areas and Municipals, the public tend to have the view that the Municipals should be solely responsible for managing solid waste.

Such negative attitude increases Solid Waste in the area because people do not remove Solid Waste from the area of their jurisdictions as part of their responsibility. It was revealed by the study that 52.8% of respondents do not do any formal control of Solid Waste in the study area; only 47.2% do some non formal control by burying or burning wastes in the street.

Concerning the existence of institutional and legal framework, findings revealed that there is no strong institutional framework whereby laws and processes involved in Solid Waste Management could give pace to the government and other stake holders to properly implement Solid Waste Management. There is also no governmental or religion institution or private organizations that deal directly with Solid Waste management in the study area in any form. Only few people have been employed by the municipal council to collect solid waste with very little payments. Lack of effective institutional frame work has directly affected Solid Waste Management and reduces efficiency of Solid Waste Management in the study area. Such effect is concurred with the study made by (Sandra, 2001).

According to Sandra (2001) provided that, Solid Waste Management is a municipal responsibility in nearly all developing countries, but private sector and NGOs and other institutions have to be fully involved. Further Sandra mentioned that, the institutions that provide the services typically should also be restructured so that they become more accountable and transparent to the residents and business establishments they serve. Moreover, Sandra (2001) emphasizes that solid waste units in urban areas should not be managed by public health departments/ institutions only; but they should also involve management of engineers and other institutions that are trained in systems design and operations rationalization.

3.2 COMPLIANCE OF RESPONDENTS WITH LAWS, BY-LAWS, RULES AND REGULATIONS

Legal framework is very crucial in the whole exercise of Solid Waste Management. Central Government as well as local government should establish laws, policies and procedures for solid waste management. Findings showed that 52.7% of respondents have no idea of the existence of the Environmental Management Act (EMA) no.20 of 2004. Only 47.3% of respondents had heard about the law, but they did not know its contents and enforcement from the leaders. Despite that 47.3% of respondents heard about Environment Management Act no.20 of 2004, and they are not sure whether leaders act accordingly.

3.3 COMMUNITY AWARENESS ON ENVIRONMENTAL LAWS

Community awareness on the National Environmental Policy (NEP) of 1997 was investigated during the study. The environmental policy is a pillar of any environmental interventions. It links between the environmental review or decisions and the setting of effective laws, clear objectives and strategies. The National Environmental Policy also explicitly gives obligation and responsibility to each environmental stake holder. Findings revealed that 38% of respondents had idea on the NEP 1997 while 62% of respondents had no knowledge about NEP, 1997. This implied that most of community not aware on environmental laws therefore is difficult to solve environmental issues unless education is conducted.

Table 6: Respondents with knowledge about the National Environmental Policy, 1997

Responses	Frequencies	Percentage
Don't have knowledge	67	**62.0**
Have knowledge	41	**38.0**
Total	**108**	**100.0**

Source: Field data survey, 2012.

3.4 KNOWLEDGE OF THE LAW, BY-LAW IN THE STUDY AREA

Lack of knowledge on law by the community and lack law enforcement and bylaws by the local government authority accelerated the spread of Solid Waste in the study area. Ward and Municipal Environmental Officer reports show that different by-laws, rules and regulations established to deal with solid waste management however people do not comply with. Between Tsh.5, 000/= to Tsh.10, 000/= is charged to a person convicted to have deposited solid waste to unrecognised dumping area as penalty this is according to by-law.

4 CONCLUSIONS AND RECOMMENDATION

It is concluded that in Dodoma municipality there is poor system of solid waste management and applied poor technology. Also there is lack of awareness to most of community on how to handle solid waste this situation affects much health of people. It is recommended that, in order to address the problem of poor Solid Waste Management the following should be done each household should have at least 3 containers with lid, one container for recycle stuff, another for domestic garbage, third container for green waste (waste from garden, trees, edge). Sorting wastes should be done at every household and charged fairly for the process of collection up to damping place.

It is highly recommended that there should be a deliberate effort to establish recycling activities in Dodoma Municipality and elsewhere in the country in order to reduce the amount of Solid Waste in the streets. The Recycling activities should well be designed and be monitored by appropriate experts and taking necessary precautions in order to avoid more pollution to the environment.

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Design and Dynamic Analysis of a Parallel Compliant Vibration Mechanism for High Precision Production Line

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ABSTRACT: This study proposes a new design concerning a parallel compliant vibrating mechanism for high precision production lines and enforces dynamic simulating analysis. The conventional mechanism for separating fine particles has based on advantages of spring to make vibrating motion to separate out various particles with radius ranges from 7 mm to 20 mm. But it also has a few defects such as additional weights of the springs, the wear between the kinematic joints. To overcome these limitations, this paper applies the conception of compliant mechanism to design novel model. First, using the principle of compliant mechanism, a parallel compliant vibrating mechanism is developed. The use of ANSYS, finite element analysis (FEA) is performed to explore the results of dynamic analysis concerning both angular velocity of mechanism and both angular acceleration and both equivalent stress and total deformation of compliant segments. The results show that a proposed mechanism can be used in high precision manipulators, actuators, and production line chain. Future work will conclude an investigation into the vibration frequency.

KEYWORDS: Compliant mechanism, Parallel vibrating mechanism, FEA, Dynamic behavior, High precision Production line.

BACKGROUND

A traditional straight vibration mechanism have widely used in many industries such as manufacturing and processing plastics, abrasives, chemicals, pharmaceuticals, foodstuffs, construction materials, fertilizer, coal mining, processing, etc. It is used to separate the materials with corresponding size of particles but it also exists many disadvantages such as expensive cost of maintenance, assembly, high cost manufacturing, a lot of components in a kinematic chain, need for lubricant, etc. In the last decades, Flexure based mechanisms, compliant mechanisms, are mechanisms that reply on elastic deform of components to transfer force, moment, translation, rotation, etc. They have been commonly used in high precision actuators, manipulators, robotics, and chemical environment to other industrial areas because they are a monolithic mechanism, lowest cost for manufacturing. From these view of points, a novel vibrating mechanism is designed to separate the various particles with radius ranges from 7 mm to 20 mm. Compared with the traditional vibrating mechanism, this novel mechanism is monolithic mechanism and offers a lot of advantages such as no joint, high accuracy, no friction, no clearance, backlash, no lubricant, and no maintenance.

1 INTRODUCTION

The vibrating mechanism can separate particles of immovable dimensions by vibrator motion. The linear vibration sieves are widely used in the separation and classification of materials in powder and granular materials. In addition, it is also widely used in many industries such as manufacturing and processing plastics, etc. Conventional vibrating mechanism has some problems concerning the heavy weight, the wear and the lubrication due friction. Therefore, an intermixing the vibrating mechanism and compliant conception was studied to design a novel vibrating model. Compliant mechanisms gain their mobility due to relative flexibility of their flexible hinges. There are many advantages the compliant joints as a mechanism can be built in one piece, the weight, wear, and noise can be reduced, no clearance, no friction, and need for lubrication can

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be eliminated. In the literature review, many previous scientists and engineers, and academic researchers studied on traditional vibrating mechanisms in different fields.

A rotational vibrated disk for separating various particles developed in [1]. And then another study focused on separation of differently shaped fine particles by a new wet shape separator [2]. Next, experimental study on shape separation of particles by using radial settling characteristics through stationary liquid in rotating vessel investigated in [3]. In other study, a settler for continuous particle shape separation presented in [4]. Almost these studies researched on various vibrating mechanisms for separating different particles.

In recent years, there has been great interest of flexible based mechanisms that also called compliant mechanisms using flexure hinges. Several design methodology for compliant mechanisms was presented in [5], while ultra-high precision mechanisms presented in [6]. Elastic elements were also considered in [7]. A flexible micro-gripper was designed and fabricated in [8]. A large variety of high precision mechanisms based on flexible bearings was presented in [9].

The vibration of flexible mechanism versus time effects on the fatigue life, the strength as well as motion specifications; therefore, this research concentrates on the dynamic behaviors.

In this study, this paper uses ANSYS software to perform dynamic analysis. The process of motion in the simulation as follow: the platform 2 of parallel compliant vibrating mechanism moves along the ray with a stable velocity, and then the platform 1 vibrates by four flexible segments. This motion can separate particles whose size smaller than that of the sieves. Finally, this paper explores the result of dynamic analysis concerning both of the angular velocity and the angular acceleration as well as the equivalent stress and the total deformation of compliant segments.

2 SIGNIFICANT AND CONTRIBUTION OF PROPOSED APPROACH

A vibrating compliant mechanism was developed because of monolithic, high accurate, no joint, no friction, no clearance on backlash, no lubricant, and no maintenance. The most special is that it can store elastic energy. This study provides a concept about compliant mechanism used in industrial high precision production line chain.

3 PRINCIPLE OF THE PARALLEL COMPLIANT VIBRATING MECHANISM

3.1 TRADITIONAL STRAIGHT VIBRATING MECHANISM

First, straight vibrating sieve fitted with vibrator motor, the materials are put into it. Next, through a vibration motion of this sieve, the materials ready to move along the prepared tray and separated by the hollows gradually. Thus, for the linear vibration sieves can provide large amount of materials at the inlet and continuous data. Due to the multi-layer structure can be ready to separate the materials with corresponding size, enhanced the capacity and the effectiveness of its removal. The linear vibration sieves are widely used in the separation and classification of materials in powder and granular materials. In addition, it is also widely used in many industries such as manufacturing and processing plastics, abrasives, chemicals, pharmaceuticals, foodstuffs, construction materials, fertilizer, coal mining, and processing, etc. The characteristics of the conventional mechanism include: (1) Vibrating straight low energy consumption, high energy kind of separation, (2) simple structure, operation, and easy maintenance, (3) vibrating screen is designed with straight-closed structure completely, (4) no diffuse dust, (5) continuous operation with high performance, great durability, straight vibrating screen used in the proper connect with other industrial chain. A traditional vibrating mechanism for separating particles is illustrated as in Fig. 1.

Fig. 1. A system diagram of a traditional vibrating mechanism

3.2 PARALLEL COMPLIANT VIBRATING MECHANISM

Based on these characteristics of the conventional vibrating mechanism, a novel compliant vibrating mechanism was designed using flexible hinges and the concept of compliant mechanism in order to separate the various particles with radius ranges from 7 mm to 20 mm. The principle of this mechanism describes as follows: The platform 2 moves along the ray of z-direction with 100mm/s. platform 1 vibrates along x-direction due to flexible segment, which are the elastic elements. The platform 1 has many holes of 15 mm. The range of particle with radius ranges from7mm to 25mm, based on this vibrating mechanism, the particles size is smaller than 15 mm, and they can be separated. Compared with the traditional vibrating mechanism, this novel mechanism is monolithic mechanism and offers a lot of advantages such as no joint, high accuracy, no friction, no clearance, backlash, no lubricant, and no maintenance. Fig. 2 shows a novel compliant vibrating mechanism for separating particles in high precision production line chain.

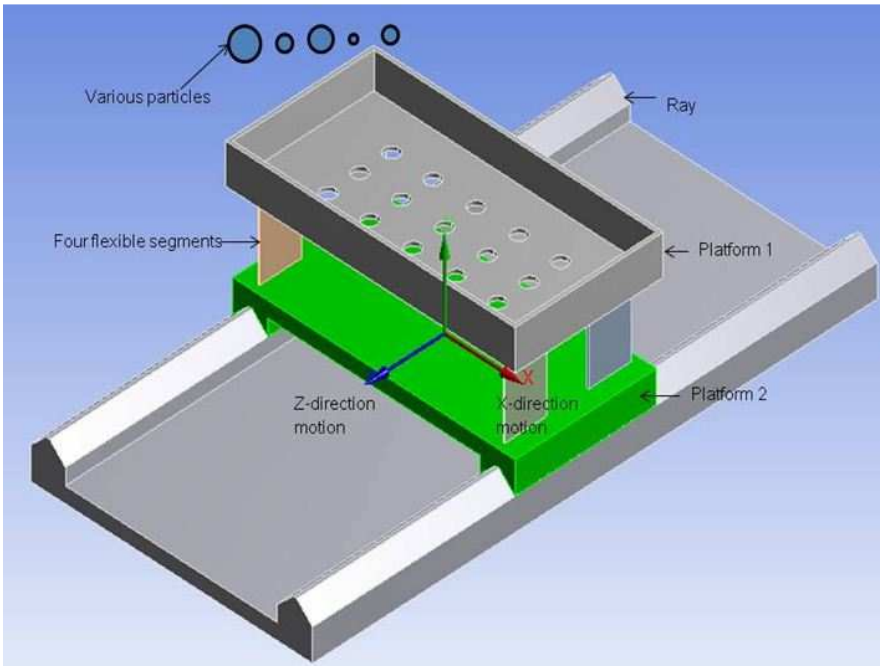

Fig. 2. A system diagram of a novel compliant vibrating mechanism

4 RESULTS AND DISCUSSIONS

In this paper, using ANSYS software, the finite element analysis (FEA) was conducted to explore the equivalent stress and the total displacement of a proposed vibrating mechanism; the position of platform 1 along the X-axis direction, the angular velocity of platform 1 along the Z-axis direction, and the angular acceleration of platform 1 along the Z-axis direction. As the previous analysis settings, this research only focuses on four flexible segments for vibrating. So the total displacement and equivalent stress refers to these ones.

The equivalent stress was shown as in Fig. 3, it shows that the maximum value does not exceed the yield strength (25 MPa), as a result, the structure is safety. Fig. 4 draws the total displacement of the flexible segments. The angular velocity of platform 1 was illustrated as in Fig. 5. And the angular acceleration of platform 1 was explored in Fig. 6. In Figs. 5 and 6 show that before 0.2 seconds, the disturbance is quite large; the possible reason is that it has friction force generation between platform 2 and its rail.

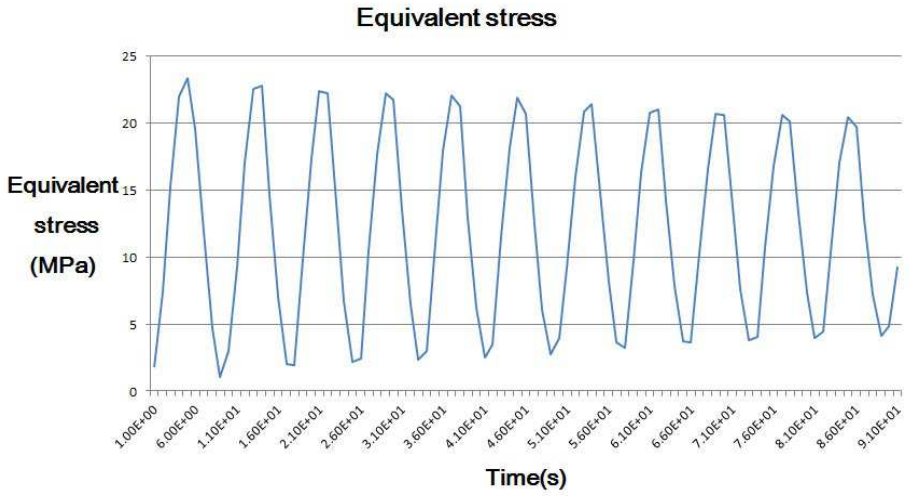

Fig. 3. Diagram of equivalent stress distribution

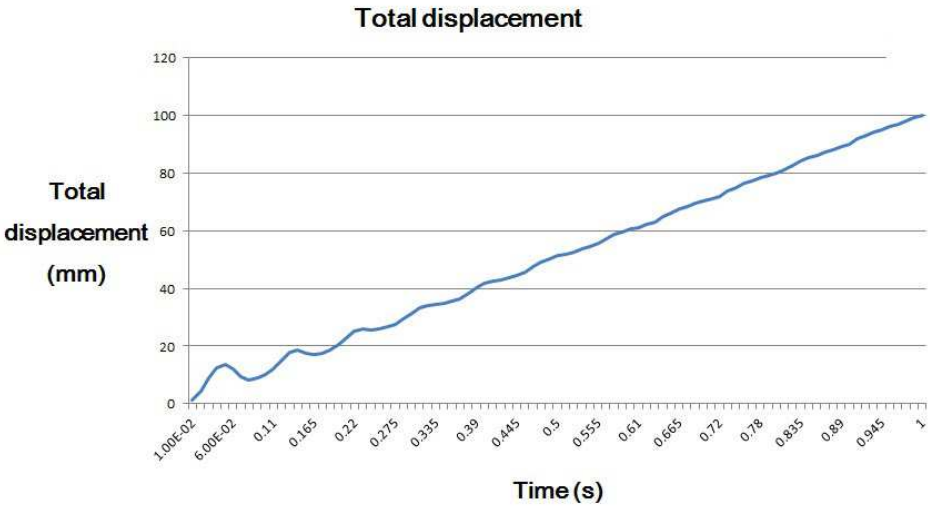

Fig. 4. Schematic diagram of total displacement

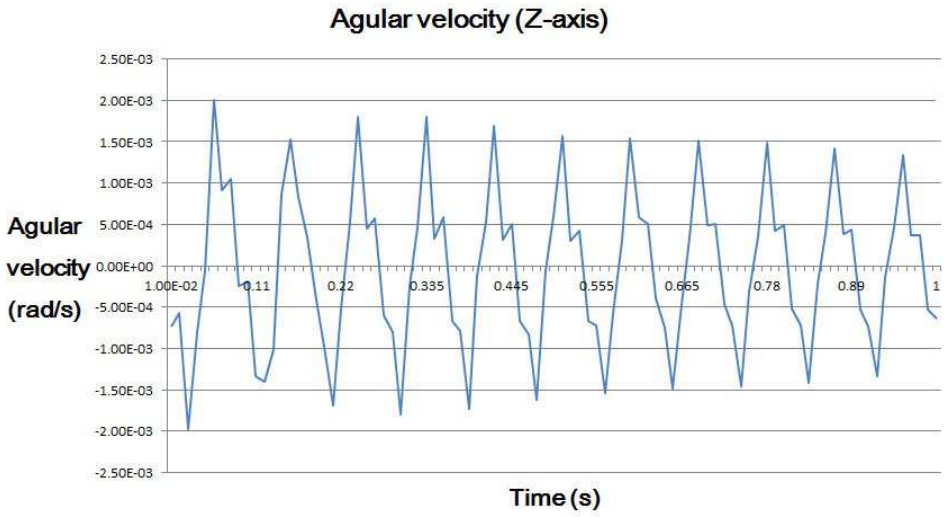

Fig. 5. Schematic diagram of the angular velocity along the Z-axis

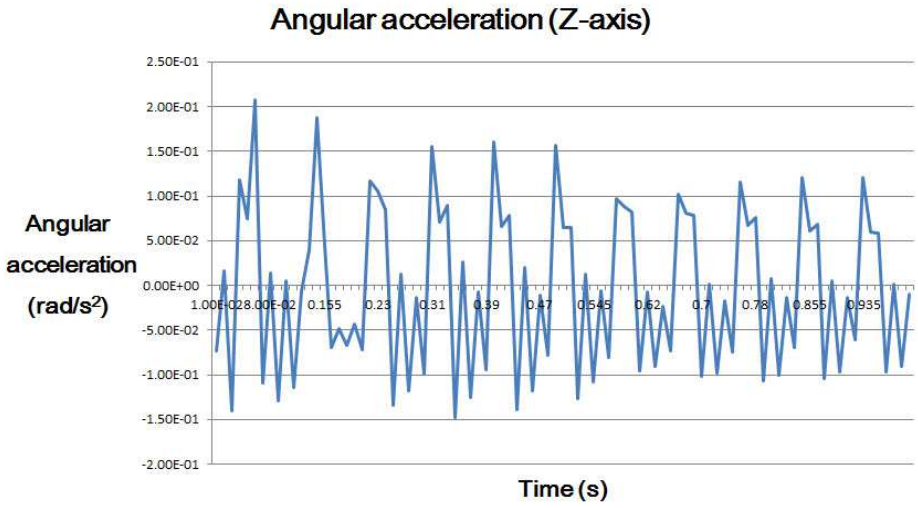

Fig. 6. Schematic diagram of the angular acceleration along the Z-axis

5 CONCLUSION

This paper has focused on a parallel vibrating mechanism based on the flexible segments for industrial production lines. Platform 1 of vibrating mechanism moves along X-axis direction, which contains the hollow with radius of 15 mm, in order to separate the various particles in the radius range from 7 mm to 20 mm. To consider on harmonic vibration, the dynamic behaviors was performed using FEA in ANSYS software. Future work will conclude an investigation into the vibration frequency. It is expected to be used in high precision manipulators, actuators, and production line.

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Effect of vermicompost on protein content of Soybean-*Glycine max*

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ABSTRACT: The term weed is used generally to unprofitable, troublesome or noxious growth and unwante plants in human controlled settings especially farms, fields and water bodies. Mechanical removal and weedicidal spray are common methods to eradicate weeds, but both these methods are not feasible. The disposal and decomposition of weed biomass is also a big problem. The present study deals with the use of weed biomass for the vermicomposting. Vermicompost of three common weeds of this area *Parthenium hysterophorous, Lantana camara* and *Eichhornia cresipes* was prepared as proposed by the Rajkhowa, et .al.(2005).

The prepared vermicompost of all the three weeds was used as biofertilizer in soybean crop separately. The protein content was assessed at the regular interval of 15 days till 75 days, in all the vermicompost treatments. The study revealed that in all the three vermicompost treated soil protein content increased considerably over control. This clearly indicates that weed biomass can be utilized for vermicomposting, and the prepared vermicompost is beneficial for growing of crops.

KEYWORDS: Vermicomposting, weeds, biomass, organic waste, biofertilizer, *Glycine max*.

1 INTRODUCTION

In developing countries like India, the situation is comparatively grimmer as it has the limited resources to feed the burgeoning population .Green revolution improved the quality and quantity of food grains by employing the modern agro technology. Vermicompost is a nutrient rich microbiologically-active organic amendment which results from the interactions between earthworms and micro organisms by the breakdown of organic matter. It is a stabilized, finely-divided peat-like material with a low C: N ratio and high water-holding capacity that constitutes a source of plant nutrients which are released gradually, through mineralization, as the plants need them.

Vermicomposting a biotechnological process which could provide a solution to tackle the problem of safe disposal of weeds as well as capable of transforming garbage into gold with the help of earthworm. It is a faster than composting. Vermicompost is an ecologically pure organic fertilizer[2].

The present study was based on the above aspect of vermicomposting in which an effect has been made on noxious weeds of this area viz *Parthenium , Lantana* & *Eichhornia* for the biotechnological process of vermicompost. And the compost prepared by these three weeds was utilized to assess the effect of this manure on the protein content of soybean (*Glycine max*) crop through bioassay[3].

2 MATERIAL AND METHODS

Vermicomposting of *Lantana camara* , *Parthenium hysterophorous* ,and *Eichhornia cresipes* was done by method proposed by Rajkhowa D.J., Gogoi A.K., Yaduraju N.T.(2005). Soybean (*Glycine max*) is commonly grown Kharif crop of this area- Ujjain,M.P,India.

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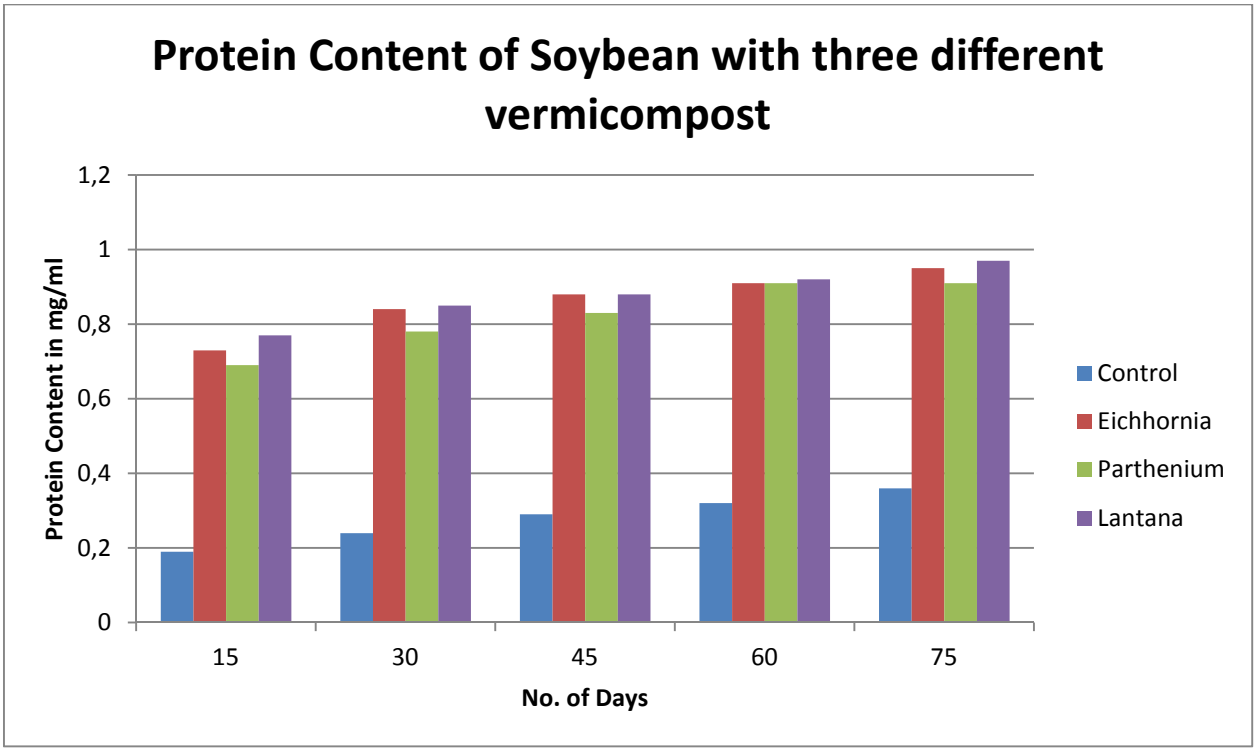
Estimation of protein content was performed by Folin Lowry's method, 1951. Five hundred mg of plant material (leaf) wasweighed and macerated in a pestle and mortar with 10 ml of 20 percent trichloroacetic acid. The homogenate was centrifuged for 15 minutes at 600g. The supernatant was discarded. To the pellet, 5 ml of 0.1 N NaOH was added and centrifuged for 5 minutes. The supernatant was saved and made up to 10 ml with 0.1N NaOH. This extract was used for protein estimation. One ml of the extract was taken in a 10 ml test tube and 5 ml of reagent 'c' was added. The solution was mixed and kept in darkness for 10 minutes. Later, 0.5ml of Folin phenol reagent was added and the mixture was kept in dark for 30 minutes. The sample was read at 660 nm in a UV spectrophotometer[4,5].

3 RESULT AND DISCUSSION

In all the three vermicompost treated soil samples, the protein content of soybean plants increased considerabely over control on all the days .The increase in protein content was more in *Eichhornia* and *Lantana* as compared to *Parthenium,* though parthenium too showed considerable increase in protein contents as shown in the table[6].Similar results have been observed in soybean using cowdung, vermicompost and chemical fertilizer by[7]

Table : showing protein contents of Soybean with three different vermicompost

S.No.	No. of Days	Protein content in mg/ml			
		Control	*Eichhornia*	*Parthenium*	*Lantana*
1	15	0.19	0.73	0.69	0.77
2	30	0.24	0.84	0.78	0.85
3	45	0.29	0.88	0.83	0.88
4	60	0.32	0.91	0.89	0.92
5	75	0.36	0.95	0.91	0.97



Statistical analysis(ANOVA) was performed on the above results to verify the level of significance in three different vermicompost treatments over control on protein contents of soybean crop ,

ANOVA Table

Source of variation	Sum of Squares(Ss)	Degree of Freedom(df)	Mean Square(Ms)	F value
Between Samples	1.801	3	0.6004	-
Within Samples	0.3535	16	0.0220	-
Total	2.1545	18	-	27.9
Note: Significant difference at 5% probability level				

The results obtained after performing ANOVA were highly significant i.e. 27.9 at 5 % significant level. The observations clearly indicate that the vermicopmost is better option to be used as biofertilizer in soybean crop .The study also shows that weed biomass instead of dumping , should be utilized as the biomass for vermicomposting. This study is a step towards improving the level of proteins in soybean crop, which is utilized through out world for its protein contents .This can be milestone for researchers in the food technology improving the quality of soybean.

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Relation entre inégalité de revenu et état de santé: Validation empirique - Cas des Pays des Rives Nord & Sud de la Méditerranée

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ABSTRACT: Au cours de ces dernières années, de nombreux économistes ont posé le problème de l'existence d'une relation entre inégalité de revenu et état de santé. Ils ont examiné dans des études empiriques et ont commencé à proposer des applications de politiques. Cependant, de nombreuses ambiguïtés persistent et, par conséquent, personne ne sait comment cette relation fonctionne réellement. Dans ce cadre, ce se limitera à étudier sur ce qui est connu de nos jours, la relation entre inégalité de revenu et état de santé et offre des suggestions quant à la façon de produire davantage de santé.
Le but de cet article est d'analyser le rapport entre la variable inégalité du revenu proxy par indice du Theil et amélioration de l'état de la santé proxy par la variable espérance de vie , en employant des techniques économétriques, données de panel durant la période 1990-2012. Notre échantillon est composé d'un groupe de 10 pays de la rive nord et sud de la Méditerranés, de la rive nord et sud Méditerranéennes, à savoir la Tunisie, l'Algérie, Maroc, Libye, Egypte, Franc, Italie, Grèce, Espagne, Slovénie. Les résultats confirment la preuve d'une relation significative et positive entre l'inégalité des revenus et amélioration de la santé de l'individu dans les pays de la rive nord de la Méditerranée et une relation significative mais négative dans les pays de la rive sud de la Méditerranée.

KEYWORDS: Income inequality, health, domestic product, Life expectancy, Data of panel.

JEL CLASSIFICATION: C23; I15; O14; O52; O55

INTRODUCTION

Depuis longtemps un débat est ouvert pour expliquer la relation entre inégalité de revenu et état de santé. La hausse des inégalités défavorise en principe l'état de santé de la population.

Les personnes les plus défavorisées, économiquement et socialement, sont aussi les plus vulnérables sur le plan de la santé physique et mentale. Ce constat démontré par une abondante littérature interpelle. Parfois les effets de ces inégalités sont estompés. D'une part, la réduction de ces inégalités favorise l'état de santé Deaton (2001). D'autre part ces inégalités pourraient contribués à l'amélioration de l'état de santé de population.

L'organisation du ce papier est comme suit: une première partie est consacrée à étudier théoriquement la relation entre inégalité de revenu et état de santé. Dans une ne deuxième partie, nous avons besoin de passer en revue la relation entre inégalité du revenu et état de santé. Dans une troisième partie on a discuté le modèle économétrique et les résultats trouvés.

Pour enrichir ce phénomène, la littérature existante a eu recours à de nombreuses explications. On peut en relever deux grands types : celles qui considèrent que la relation entre inégalité de revenu et santé passe à travers le revenu individuel et celles qui considèrent qu'elle passe à travers des indicateurs socioéconomiques certaines caractéristiques du fonctionnement des sociétés.

1 L'EXPLICATION PAR LE REVENU

L'état de la santé dépend des revenus. Si ces derniers sont plus élevés, ils permettent d'accéder à de meilleures conditions de vie comme un logement plus sûr et d'améliorer le pouvoir d'achat et la capacité d'acquérir suffisamment de biens alimentaires. Les populations qui bénéficient d'une bonne santé sont celles qui se trouvent dans les sociétés prospères où la richesse est répartie de façon équitable. Un plus haut revenu encourage l'accès à des biens et services sanitaires et permet une longévité, tels que une alimentation nutritive, eau potable et un système sanitaire et de bons soins. Mais cette vue de niveau été défiée par la possibilité que la corrélation entre revenu et santé est aussi par un lien causal qui court l'autre chemin, de santé au revenu, ces dernières années. Il y a des chemins plausibles à travers que l'amélioration de la santé peuvent influencer l'allure d'augmentation du revenu par leurs effets sur participation de marché de travail ; productivité des travailleurs, investissement dans le capital humain, richesse, et structure d'âge de la population (Bloom et Canning 2000, et Sevella 2002a, Hammoudi et Saches.

Des éléments importants extraits du second rapport sur la santé des Canadiens montrent:

- Les canadiens qui touchent des revenus faibles, seulement 47 % disent qu'ils ont eu une très bonne santé ou excellente, alors qu'ils sont 73 % dans la catégorie à des revenus les plus élevés.
- Les Canadiens à faibles revenus risquent davantage de mourir plus jeunes et de souffrir de maladies que ceux dont les revenus sont plus élevés, indépendamment de l'âge, du sexe, de la race et du lieu de résidence.
- Chaque fois qu'on franchit un niveau de l'échelle des revenus, on constate que les Canadiens sont moins malades, ont une espérance de vie plus longue et une meilleure santé.

Des études montrent que la répartition des revenus dans une société peut être un déterminant beaucoup plus important de la santé que le total des revenus gagnés par les membres de la société. Les écarts importants dans la répartition des revenus accroissent les problèmes sociaux et contribuent à une moins bonne santé dans l'ensemble de la population.

2 L'EXPLICATION PAR DES CANAUX SOCIOÉCONOMIQUES

2.1 LES INÉGALITÉS SOCIO-ÉCONOMIQUE

Les études examinées le lien entre santé aux inégalités socio économiques mentionnent que les inégalités des répartitions des revenus, la concentration de pauvreté sont liées à la mortalité.

D'après le rapport santé canada (1999) sur les déterminants de santé, le ministère signale que « l'état de la santé s'améliore à chaque étape de la hiérarchie des revenus et du niveau social » et que « les populations les plus en santé sont celles qui se trouvent dans les sociétés prospères où la richesse est répartie de façon équitable ».

Il existe un lien entre des revenus plus élevés, la situation sociale est une meilleure santé. En général, les pauvres sont associés aux conditions de vie défavorable comme le mauvais logement, alimentation inadéquate etc.).

Santé canada mentionne qu'une meilleure situation sociale et économique est corrélée avec une meilleure santé. Pour conclure il est évident que le niveau de revenu et la situation sociale semblent les déterminants les plus importants de la santé. Cette proche est basée des analyses statistiques reliant la réparation des revenus et le taux de mortalité d'une population.

2.2 L'ENVIRONNEMENT

Des études récentes sont concentrées sur l'importance de l'environnement sur la santé. L'environnement de l'enfant contribue sur la santé des adultes

Deux ouvrages récents: "Why are sortie people healthy and others not?" (1994, édité par Evans, Stoddart et Barer) et "Tackling Inequalities in Health: An agenda for action" (1995, édité par Benzeval, Judge et Whitehead) ont examiné des travaux d'épidémiologie et ont montré que l'état de santé ne se limité pas de leur accès aux soins, mais dépend aussi d'autres facteurs biologiques et environnementaux. Les principaux facteurs biologiques sont, l'âge, le sexe. Ces derniers ont une bonne relation avec l'état de santé. De même d'autres facteurs génétiques ou accidentels varient les niveaux de santé entre individus. Plus généralement ces facteurs permettent de montrer que quelques personnes sont plus risqués d'être attaquer par certains types des maladies.

L'environnement dans lequel les individus évoluent a aussi un impact déterminant sur leur état de santé. Des facteurs environnementaux sont liés à des maladies comme, le stress, l'hypertension, le cancer. Parmi ces facteurs nous citons :

* Les polluants atmosphériques intérieurs et extérieurs.
* Le bruit.
* Les conditions d'environnement intérieures et de logement.
* La qualité de l'eau, de l'air.
* Les champs magnétiques et les rayonnements.
* Les expositions à des composants chimiques.

Des enfants logés dans un environnement favorable sont susceptibles d'être en bonne santé et leurs capacités d'apprentissages augmentent.

D'autres caractéristiques de l'environnement économique et social ont une influence déterminante sur la santé. Une relation entre santé et qualité de l'environnement économique et social est bien connu. Les personnes qui sont favorisées, ont un niveau de mortalité et morbidité bas.

2.3 L'EMPLOI ET CONDITIONS DE TRAVAIL

L'emploi affecte la santé physique, mentale et sociale. Le travail rémunéré donne un sentiment d'identité et d'utilité, et d'avoir des contacts sociaux. Les chômeurs ont une espérance de vie moins longue et ont plus de problèmes de santé que les personnes qui sont bénéficiés d'un emploi.

Une large étude élaborée par l'OMS a permis de constater que les niveaux élevés des chômages et d'instabilité économiques et politiques dans un pays sont à l'origine de l'apparition des maladies mentales et des effets fatales sur la santé physiques des personnes au chômage, des leurs familles. Ainsi le chômage, le travail stressant ou dangereux sont associés avec une mauvaise santé. Les gens qui sont bénéficiés plus de pouvoir dans les conditions de travail et qui sont soumis à moins de stress au travail, sont en meilleur santé et vivent souvent plus longtemps que ceux qui sont exposés à de stress ou de risques au travail.

Une étude sur la santé des canadiens réalisée pour le compte de l'Organisation mondiale de la santé a permis de remarquer que l'augmentation de taux de chômage et l'instabilité économique dans une société sont à l'origine de problèmes de santé mentale importants et d'effets néfastes sur la santé physique des personnes au chômage, de leurs familles et de leurs collectivités.

2.4 LES MODES DE VIE ET LES COMPÉTENCES D'ADAPTATION PERSONNELLES

Parmi les mesures que l'on peut prendre pour se protéger des obstacles de santé, faire des choix qui améliorent la santé, et acquérir de la confiance en soi. On cite les modes de vie et les compétences d'adaptation personnelles. La mode de vie est un choix personnels mais influencée par des facteurs socio économiques et environnementaux. Chaque individu a un choix de vie qui dépend de son milieu, de son travail, des ses connaissances. Ce choix personnel dépend de l'environnement socioculturel dans lesquelles les personnes vivent, apprennent, travaillent et s'amusent.

Les conditions socio-économiques ont un impact sur le choix du mode de vie dans au moins cinq domaines: la dynamique de la vie, le stress, la culture, les relations interpersonnelles et le sentiment d'appartenance, ainsi que le sentiment de contrôle.

La participation et la communication entre les gens sont créateur de milieux de soutien. Ces deux actes sociaux rendront les personnes plus capables d'opter pour un mode de vie sain dans un monde où il existe plusieurs possibilités.

On se basant sur le Second rapport sur la santé des Canadiens nous constatons :

- « Au Canada, ils ont estimé que le tabagisme est responsable d'au moins le quart de tous les décès des adultes de 35 à 84 ans. Le taux de tabagisme a augmenté sensiblement chez les adolescents et les jeunes, en particulier chez les jeunes femmes, au cours des cinq dernières années. Chez les Autochtones, il est le double de ce qu'il est dans le reste de la population canadienne ».
- « Les comportements à risques multiples, notamment les combinaisons dangereuses d'alcool, de drogue et de conduite automobile, ou d'alcool, de drogue et de relations sexuelles non protégées, sont très élevés chez les jeunes, en particulier les jeunes hommes ».

- « Il existe un lien étroit entre le régime alimentaire en général, la consommation de gras en particulier, et certaines grandes causes de décès, dont les cancers et les maladies cardiaques. La proportion d'hommes et de femmes qui font de l'embonpoint a augmenté régulièrement au Canada entre 1985 et 1996-1997, passant de 22 à 34 % chez les hommes et de 14 à 23 % chez les femmes ».

2.5 DÉVELOPPEMENT SAIN DURANT L'ENFANCE

Les premières phases du développement de l'enfant sont un déterminant puissant de sa santé pour son futur. Les éléments décisifs dans notre première vie jouent un rôle primordial dans le développement de nos cerveaux sur la maturité scolaire et sur la santé dans la vie ultérieure. Ce qui confirme l'accord que les premières phases du développement de l'enfant sont un déterminant puissant de sa santé pour l'avenir. Parallèlement aux autres déterminants, le développement d'un jeune est fortement influencé par son logement et son voisinage, les revenus de sa famille et le niveau de scolarisation de ses parents, l'accès à des aliments nutritifs et à des activités physiques, son patrimoine génétique et l'accès à des soins dentaires et médicaux

Des exemples extraient du Second rapport sur la santé des Canadiens montrent que :

- « Les expériences vécues entre la conception et l'âge de six ans sont celles qui exercent la plus forte influence de toutes les périodes de la vie sur l'organisation et les ramifications des neurones du cerveau. Une stimulation positive au début de la vie facilite l'apprentissage et favorise de meilleurs comportements et une meilleure santé à l'âge adulte ».
- « La consommation de tabac et d'alcool pendant la grossesse peut avoir des conséquences graves à la naissance. L'Enquête nationale sur la santé de la population de 1996-1997 révélait qu'environ 36 % des nouvelles mères qui étaient d'anciennes fumeuses ou fumaient actuellement avaient fumé pendant leur dernière grossesse (environ 146 000 femmes). La vaste majorité d'entre elles ont déclaré ne pas avoir bu d'alcool pendant leur grossesse ».
- « Des liens d'affection et de sécurité entre les parents ou les pourvoyeurs de soins et les bébés au cours des 18 premiers mois de la vie aident les enfants à développer leur confiance, leur estime de soi, leur maîtrise affective et leur capacité d'entretenir des relations positives avec les autres pour leur vie ultérieure ».
- « Les bébés et les enfants négligés ou subissant des abus sont exposés à des risques plus élevés de blessures, à un certain nombre de problèmes de comportement social et cognitif plus tard au cours de leur vie et de décès prématuré ».

2.6 PATRIMOINE BIOLOGIQUE ET GÉNÉTIQUE

Même si les éléments socio-économiques et environnementaux sont des déterminants importants de la santé globale. La composition biologique et organique de base de l'être humain est un élément déterminant essentiel de la santé. Le patrimoine génétique est l'origine des maladies et des problèmes de santé particuliers.

Des éléments extraits du Second rapport sur la santé des Canadiens motionnent :

- « Des études en neurobiologie ont montré qu'en présence de conditions optimales du développement de l'enfant au cours de la phase d'investissement (entre la fécondation et l'âge de cinq ans), le cerveau se développe de façon avantageuse pour le reste de la vie ».
- « Le vieillissement n'est pas synonyme de mauvaise santé. Une vie active et l'accès à des possibilités d'apprentissage tout au long de la vie pourraient s'avérer particulièrement importants pour conserver la santé et la capacité cognitive en vieillissant. Des études sur le niveau de scolarisation et la démence laissent entendre que le fait d'avoir étudié et d'avoir pu apprendre tout au long de sa vie peut doter le cerveau d'une réserve qui compense les pertes cognitives associées au vieillissement biologique ».

2.7 SERVICES DE SANTÉ

Les services de santé jouent un rôle important pour entretenir et favorise la santé. L'ensemble des soins offerts par ces services des santés, traitement et prévention secondaire ont des effets favorables pour la protection des individus contres les maladies et les blessures. Ces activités devraient se poursuivre pour réaliser des progrès en termes de santé. Les pays qui sont bénéficiés d'une infrastructure modernes, hôpitaux, centre médicaux et d'analyse sont ceux qui assurent un système de

santé efficace. On constate que l'infrastructure affecte non seulement la production des marchandises mais également l'approvisionnement en service de santé.

Dans des pays africains ; le taux de mortalité infantile < 5 ans dans les milieux ruraux sont deux fois haut comparé à d'autres régions urbains. La disponibilité de l'électricité, de transport, sont essentiels pour améliorer les fonctionnements des hôpitaux et la prestation des services de santé.

Pour augmenter l'accès aux services sanitaires il faut améliorer les réseaux des routes rurales mené à réduire les couts de productions. L'évidence micro économique confirme le lien entre service de santé et revenu. Par contre la majeure partie de la littérature sur des services de santé et croissance endogène n'a pas bien expliqué les effets macro-économiques des services de santé.

2.8 SEXE

Le taux de mortalité des hommes est supérieur au taux consacrés aux femmes. Les hommes sont plus risqués d'avoir des maladies cardiaques, des blessures mortelles accidentelles, des cancers et du suicide. Presque dans tous les pays l'espérance de vie chez de femmes est plus élevée que chez les hommes.

Alors les femmes vivent plus longtemps que les hommes, elles sont plus exposées à la dépression, à un stress, à des maladies chroniques comme l'arthrite et les allergies, à des blessures et au décès imputables à la violence familiale.

On constate que chez les canadiens, Si les taux de mortalité par cancer ont diminué pour les hommes, ils sont restés relativement constants chez les femmes, essentiellement à cause de l'augmentation du nombre de décès par cancer du poumon. Les jeunes filles ont maintenant davantage tendance à fumer que les garçons. Si l'augmentation du taux de tabagisme chez les jeunes femmes n'est pas combattue, les taux de cancer du poumon chez elles continueront à augmenter chez ces dernières.

2.9 CULTURE

Certaines personnes et certains groupes peuvent faire face à des risques additionnels pour leur santé à cause d'un milieu socio-économique déterminé dans une large mesure par des valeurs culturelles dominantes contribuant à continuer certaines situations comme l'exclusion, la stigmatisation, la perte ou la dévaluation de la langue et de la culture et le manque d'accès à des soins et services de santé adaptés à la culture du patient.

Dans la société canadienne, malgré des améliorations importantes depuis 1979, les taux de moralité infantile chez les Étrangers, en 1994, étaient encore deux fois plus élevés que ceux de l'ensemble de la population canadienne. La prévalence des grandes maladies chroniques, notamment le diabète, les problèmes cardiaques, les cancers, l'hypertension, l'arthrite et les rhumatismes est aussi sensiblement plus élevée dans les milieux étrangers et semble être en augmentation.

3 REVUE DE LA LITTÉRATURE

En se référant sur le document intitulé health inequality and economic dévelopment (Deaton 2001). On constate que la réduction des inégalités de revenu s'accompagne d'une amélioration de la santé de la population pour le simple raison que les effets du revenu sur la santé sont plus importants chez les pauvres que chez les riches.

Hammond (1951) explique que la politique alimentaire de guerre mise en œuvre dans les années 40 a permis l'accès des travailleurs au lait frais et aux vitamines, à telle enseigne que leur état de santé s'est effectivement améliorés pendant les hostilités. Lorsque il y eu diminution des inégalités de revenu en période de guerre, ce processus est associé avec une amélioration de l'espérance de vie des travailleurs.

Wilkinson (1989) montre qu'au Royaume_Unis, le rythme de déclin de la mortalité des enfants et des adultes ralentit lorsque les inégalités de revenu se creusent.

Fogel a étudié la relation entre les inégalités de revenu et les écarts d'espérance de vie, le coefficient de Gini pour l'Angleterre est passé de 0,65 au début XVIII siècle à 0,32 en 1973. Durant ce période, l'écart de l'espérance de vie a également diminué et l'écart social de longévité a été éliminé à sept huitième.

En 2010, Wilkinson et Pickett sont concentrés sur les arguments utilisés par Wilkinson en 1996 et réaffirment que « les sociétés qui offrent les meilleures conditions de vie à leurs citoyens sont celles qui ont les écarts de revenus les plus faibles

(Japon, pays scandinaves), à l'inverse, les sociétés les plus inégales (États-Unis, Royaume-Uni et Portugal) ont les plus mauvais indicateurs de bien-être des pays riches ».

4 RELATION ENTRE INÉGALITÉ DE REVENU ET ÉTAT DE SANTÉ VALIDATION EMPIRIQUE

Cette parie est consacrée à étudier empiriquement la relation entre inégalité du revenu et état de santé, pour 10 pays De la rive nord et sud méditerranéennes en utilisant des techniques économétriques, données de panel durant la période 1990-2012.

4.1 DONNÉES ET VARIABLES

Les données utilisées sont extraites :

Les donnés produit intérieur brut par habitant sont extraites des statistiques « chaines indexe » rendent les informations comparables entre pays. Les données sur l'espérance de vie à la naissance, le taux de scolarisations sont extraites de la base des données « world developpement indicators ». Les données portant sur dépenses en santé par habitant ($ US courants) sont extraites de la base « health nutrition and population » mise à disposition en ligne par « the world Bank ». Les données sur l'inégalité du revenus mesurées par l'indice du Theil sont extraites by the University of Texas Inequality Project. Les données ont une structure de panel cylindrée de 10 pays portant sur la période allant de 1990 à 2012.

4.2 LES VARIABLES RETENUES POUR L'ANALYSE SONT

- Variable expliquée :

a) L'espérance de vie à la naissance : le nombre d'années qu'un nouveau né pourrait vivre si les conditions normales de mortalité à sa naissance devraient être les mêmes tout au long de sa vie.

Les variables explicatives sont :

b) Le Produit intérieur brut par habitant : Le produit intérieur brut (PIB) est un indicateur économique utilisé pour mesurer la production dans un pays donné. Il est défini comme la valeur totale de la production de richesses (valeur des biens et services créés - valeur des biens et services détruits ou transformés durant le processus de production) dans un pays donné au cours d'une année donnée par les agents économiques résidant à l'intérieur du territoire national. C'est aussi la mesure du revenu provenant de la production dans un pays donné. On parle parfois de production économique annuelle ou simplement de production.

c) Le taux de scolarisation : c'est le rapport du nombre total d'inscrits (sans considération d'âge) à la population d'âge correspondant officiellement au niveau d'éducation considéré. On considère le taux de scolarisation dans l'enseignement primaire, secondaire et dans l'enseignement supérieur.

d) Dépenses en santé par habitant ($ US courants) :

Le total des dépenses de santé est la somme des dépenses de santé publiques et privées en tant que ratio de l'ensemble de la population. Il englobe la prestation de services de santé (préventifs et curatifs), les activités de planification familiale, les activités ayant trait à la nutrition et l'aide d'urgence réservée à la santé mais il exclut la prestation d'eau et de services d'hygiène. Les données sont en dollars américains courants.

e) Les inégalités de revenu visent la disparité existant entre les revenus des individus « riches » et ceux des individus « pauvres ».

Tableau 1. Statistique descriptive : pays de la rive nord de la méditerranée (PRNM)

Variable	Mean	Std. Dev.	Min	Max
LEV	4.549826	.2544136	4.1	4.97
LPIB	8.522957	.2691408	8.1	8.99
LS	4.557043	.2572321	4.1	4.98
LDIP	1.903989	.5090911	1.1	2.56
LIG	3.659361	.062982	3.580145	3.787173

Source: *Construction of the author*

(LEV, LPIB, LS, LDIP, lIG représentent les logarithmes népériens de EV, PIB, S, DIP, IG)

Tableau 2. Statistique descriptive : pays de la rive sud de la méditerranée (PRSM) :

Variable	Mean	Std. Dev.	Min	Max
EV	70.49565	2.956924	62	76
PIB	3167.339	2760.685	626	14802
S	74.43478	13.81845	42	86
DIP	249.9652	122.787	66	525
IG	49.2256	4.57011	38.33761	55.28433

Source: *Construction of the author*

Modèle et cadre théorique :

Nous commençons avec la fonction suivante :

$$logEV_{it} = \theta_i + \alpha_{1i}\log PIB_{it} + \alpha_{2i}\log S_{it} + \alpha_{3i}\log DS_{it} + \alpha_{3i}\log INQ_{it} + \mu_{it} \quad (1)$$

Où EV : représente la variable santé mesurée par (espérance de vie)

PIB : la production ou produit intérieur brut.

S : Taux de scolarisation.

DS : Dépenses en santé par habitant ($ US courants) :

INQ: it represents a proxy of income inequality measured by Theil index which is provided by the University of Texas Inequality Project.

Les méthodes d'estimation : Nous estimons dans cette partie le modèle représenté dans la relation (1) en utilisant différentes méthodes. Nous proposons des estimateurs classiques dans le contexte des données de panel tels que les modèles à effets fixes ou aléatoires**.**

4.3 RESULTS OF ESTIMATION BY THE METHOD OF THE DATA OF STATIC PANEL:

By using the method of the data of static panel for 10 countries of the north and south bank Mediterranean 1990-2012, we obtain the results presented in the table 3 .

Tableau 3. Pays de la rive nord de la méditerranée (PRNM) :

Variable dépendante	**Effet s fixe**	**Effets aléatoire**
Log espérance de vie (LEV)		
C	**(5.654331)*** **	**(.1891963)**
L PIB	**(.0373214)*** **	**(.0190518)*** **
LS	**(.7082387)*** **	**(.8265627)*** **
LIG	**(-1.060985)*** **	**(.1765047)**
LDS	**(-.0690114)**	**(.0580154)*** **
Degré de liberté (K)	**4**	**4**
Nombre d'année	**23**	**23**
Nombre des pays	**5**	**5**
Nombre d'observations	**115**	**115**
Prob$>\chi^2$ (4)	**0.0000**	

*** signification au risque de 10%**

****signification au risque de 5%**

***** signification au risque de 1%**

On doit maintenant choisir le test qu'on va l'utiliser tout en se basant sur le test de Hausman qui fait la comparaison entre les effets fixes et les effets aléatoires avec 4 degrés de liberté. Il consiste à tester l'hypothèse nulle d'indépendance entre les erreurs et les variables explicatives dans le but de voir quel test on va opter.

Et puisque la **Prob**$> X^2$ **(4)** = (0.0000) < à 5%, on rejette l'hypothèse nulle. Autrement dit les erreurs dépendes des variables explicatives. Et par conséquent on va opter le test à effet fixe c'est-à-dire que tous les pays ont le même effet individuel.

Pour les pays de la rive nord de la Méditerranée, les résultats montrent des impacts significatifs pour les variables explicatives log PIB, log taux de scolarisation et log inégalité du revenu. Ces résultats montrent que l'élasticité de l'espérance de vie par rapport aux inégalités du revenu est négative (**(-1.06)**.

Un niveau plus élevé d'inégalité est directement associée à une baisse de l'espérance de vie. Ainsi, l'augmentation de l'indice de Theil de dix points de pourcentage démunie le niveau de l'espérance de vie de 10.6 %, ce qui défavorise l'état de la santé de la population.

Les résultats trouvés dans cette étude confirment à ceux trouvés dans les travaux de Deaton 2001, Hammond (1951) et Wilkinson (1989) où l'amélioration de l'état de santé progresse lorsque les inégalités de revenu se creusent. De même on constate aussi que l'accroissement du produit intérieur brut, de taux de scolarisation de 10% entraine une augmentation respectivement de l'espérance de vie (3,7%, et 7,08 %).

Tableau 4. Pays de la rive sud de la Méditerranée (PRNM) :

Variable dépendante	**Effet s fixe**	**Effets aléatoire**
Log espérance de vie (LEV)		
C	**(2.676257)*****	**(3.817236)***
L PIB	**(.0142603)***	**(.0006162)**
LS	**(.0909289)*****	**(-.0383305)*****
LIG	**(.218775)*****	**(.0433162)**
LDS	**(.0418521)***	**(.0793906)*****
Degré de liberté (K)	**4**	**4**
Nombre d'année	**23**	**23**
Nombre des pays	**5**	**5**
Nombre d'observations	**115**	**115**
Prob$> X^2$ **(4)**	**0.0000**	

*** signification au risque de 10%**
****signification au risque de 5%**
***** signification au risque de 1%**

Et puisque la **Prob**$> X^2$ **(4)** = (0.0000) < à 5%, on va opter le test à effet fixe.

Pour les pays de la rive sud de la Méditerranée toutes les variables explicatives (PIB, S, DS, et IG) sont significatives et positives mais avec des coefficients des élasticités diffèrent à ceux trouvées dans les (PRNM).

Notre estimation donne un coefficient d'élasticité de l'espérance de vie par rapport aux inégalités du revenu positif et il est égal à **0.21**. Le résultat trouvé montre un effet positif de l'inégalité de revenu sur l'état de santé. Ce résultat est inattendu et cohérent avec certaines études théoriques qui impliquent que l'augmentation de l'inégalité contribue à la croissance à travers un certain nombre de canaux, que ce soit économique, politique ou social. L'augmentation de taux de scolarisation de 10% entraine une augmentation de l'espérance de vie de l'ordre de 9 %.

La variable GDP vérifie l'hypothèse théorique elle contribue positivement à l'amélioration de l'espérance de vie. Dans les (PRSM) une augmentation du PIB de 10% entraine une hausse de l'espérance de vie de 1,4%.

4.4 IMPLICATION ET CONCLUSION

Les effets du produit intérieur brut, le taux de scolarisation, inégalité du revenu et les dépenses de santé la sur l'amélioration de santé ont été examinés au cours de la présente étude. De même on a discuté et soulevé plusieurs questions sur l'inégalité de revenu et la santé ; la principale question que l'on se pose étant de savoir si l'inégalité de revenu affecte la santé des individus. Une grande majorité des études indiquent l'existence d'une relation statistiquement significative entre inégalité de revenu et santé. Le résultat empirique concernant les pays de la rive nord de la Méditerranée montre un effet significatif entre inégalité de revenu et espérance de vie. On constate un impact marginal négatif de l'indice de Theil sur l'évolution de l'espérance de vie. Ainsi un niveau moins élevé d'inégalité est directement associée à une progression de l'espérance de vie et par conséquence une amélioration de la qualité de vie des individus. Ainsi, l'augmentation de l'indice de Theil de dix points de pourcentage démunie le niveau de l'espérance de vie de 10.6 %, ce qui défavorise l'état de la santé de la population.

Les résultats trouvés dans cette étude confirment à ceux trouvés dans les travaux de Deaton 2001, Hammond (1951) et Wilkinson (1989) où l'amélioration de l'état de santé progresse lorsque les inégalités de revenu se creusent.

Concernant les pays de la rive sud se la Méditerranée, les résultats trouvés sont un peu différents à ceux passés en revue de la littérature. Ces résultats mentionnent que l'augmentation de l'indice du Theil (augmentation d'inégalité) favorise l'état de la santé de la population. Ces résultats peuvent êtres expliqués par exemple, une augmentation de l'inégalité des revenus peut avoir un impact positif sur le taux d'épargne global d'un pays si les gens les plus riches ont économisé une plus grande proportion de leur revenu que les personnes les plus pauvres. Cela signifie un taux plus élevé de l'investissement, une croissance plus élevée et donc un taux de pauvreté faible et une amélioration de l'espérance de vie.

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Performance Comparison in Hybrid H- Bridge Multilevel inverter for Various PWM Strategies

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ABSTRACT: In this paper nine level Hybrid H- Bridge Multilevel inverter is analyzed for the various multi-carrier Pulse Width Modulation strategies. For the same nine level inverter output this particular topology has reduced count of switches, on comparing with the conventional Cascaded H Bridge Multilevel Inverter. For a single phase, nine level inverter output this topology requires one H-bridge and a half Bridge cell with Four equal voltage sources. Instead of sixteen controlled switches as in conventional method, this topology requires only twelve switches to obtain nine level output. The reductions in components count lowers, cost and complexities. Performance parameters have been analyzed for the nine level Hybrid H Bridge Multilevel inverter.

KEYWORDS: Alternate phase opposition disposition, Hybrid H-Bridge Multilevel Inverter, phase disposition, phase opposition disposition, phase shift pulse width modulation, sinusoidal pulse width modulation.

1 INTRODUCTION

Multilevel inverter (MLI) has wide range of high-power applications and feeds demands in industries in recent years. The aptness of MLI attracts the hot researchers in the direction of renewable energy sources for its numerous benefits. As renewable energy sources such as photovoltaic, wind and fuel cells can be easily interfaced to a multilevel inverter system of high power applications, MLI still gains further credit to its field. MLI can operate at high switching frequencies while producing lower order harmonic components.

A multilevel inverter is a power-electronic system that generates a desired output voltage by synthesizing several levels of dc input voltages. The main advantages of multilevel inverters are lower cost, higher performance, less electromagnetic interference, and lower harmonic content [1].The most common multilevel inverter topologies are the diode-clamped, flying-capacitor, and cascaded H-bridge inverters with separate dc voltage sources [2]. The diode clamped multilevel inverter

topology, restricts the use of it to the high power range of operation. Moreover flying capacitor based multilevel inverter also exhibits a disadvantage including more number of capacitors [3].

In recent years, the cascaded H-bridge inverters have wide applications. The merit includes modularity and the ability to operate at higher voltage levels and as the number of levels increases, the quality of the output signal will be improved. In addition inverter output voltage waveform will be closer to a sinusoidal waveform [4].

Moreover, high voltages can be managed at the dc and ac sides of the inverter, while each unit endures only a part of the total dc voltage. Needs of high number of semiconductor switches, involvement of separate DC source for each of H-bridge, voltage balancing issues are the notable drawbacks of cascaded H bridge inverter.

On comparing with the usual Cascaded H-Bridge multilevel inverters, for the same nine level output, this Hybrid H-Bridge multilevel inverter topology, the number of switches used reduced is only twelve switches. Therefore for this cost & simplicity reason, this multilevel inverter has some value of importance. Hence this paper focuses on applying various multi carrier based PWM techniques to this Hybrid H Bridge multilevel inverter to analyze and compare the various parameters like THD & V_{rms}.

2 HYBRID H-BRIDGE MULTILEVEL INVERTER TOPOLOGY DESCRIPTION

2.1 GENERAL STRUCTURE

The Hybrid H-Bridge Multilevel Inverter proposed in this paper is shown in Fig. 1. The cascaded half-bridges and full-bridge inverters are involved to form Hybrid H-Bridge Multilevel Inverter. The cascaded half-bridges produced dc voltage as output which is connected to full-bridge as DC input. Each half-bridge can make the DC source to be implicating into the voltage producing or to be bypassed. Therefore, by controlling of the cascaded half-bridges, the number of DC sources connected in the circuit will be changed, that leads to a variable DC voltage. To produce ac waveforms just alternate the direction of the dc voltage by using full bridge. Hence, the switching frequency of devices in the H-bridge equals to the base frequency of the desired ac voltage.

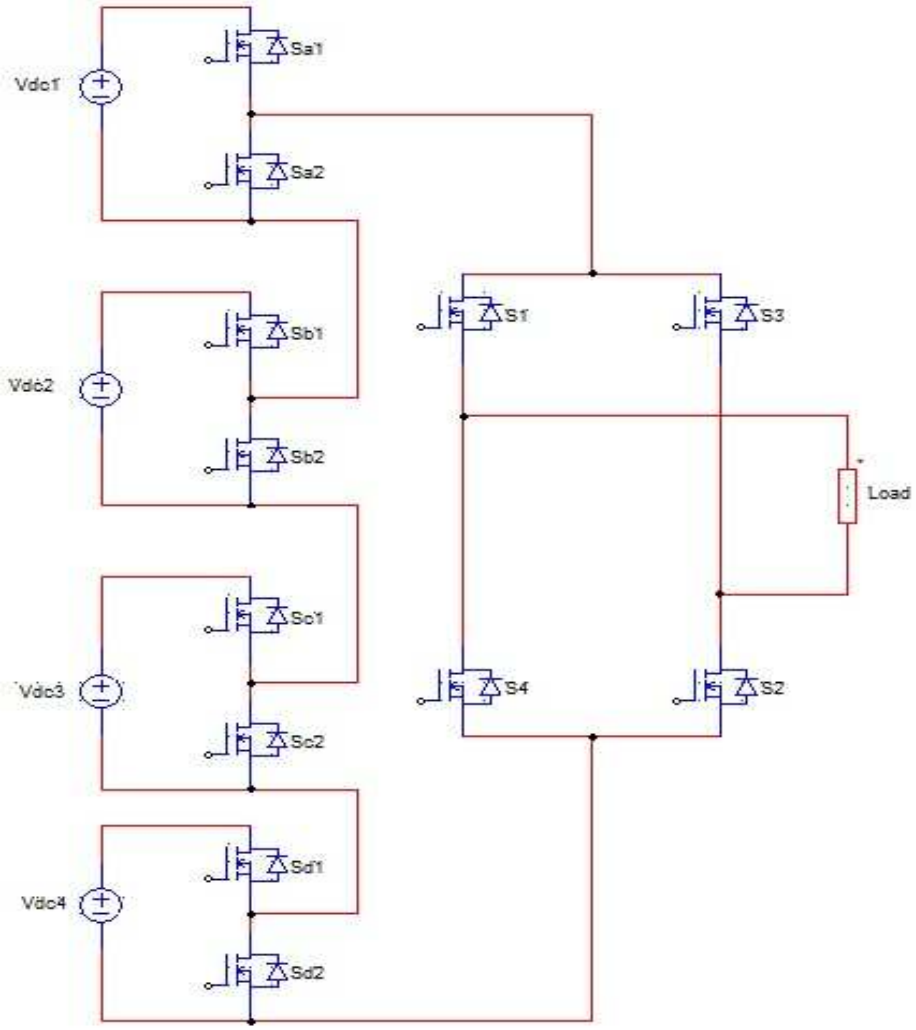

Fig. 1. 9-Level Hybrid H-Bridge Multilevel Inverter

Table 1. Switching Patterns for 9 levels Hybrid H-Bridge Multilevel Inverter

S. No	Multi conversion Cell		H-Bridge		Voltage levels
	On switches	Off switches	On switches	Off switches	
1	Sa1,Sb1, Sc1, Sd1	Sa2,Sb2, Sc2, Sd2	S1, S2	S3, S4	$+4V_{dc}$
2	Sa2,Sb1, Sc1, Sd1	Sa1,Sb2, Sc2, Sd2	S1, S2	S3, S4	$+3V_{dc}$
3	Sa2,Sb2, Sc1, Sd1	Sa1,Sb1, Sc2, Sd2	S1, S2	S3, S4	$+2V_{dc}$
4	Sa2,Sb2, Sc2, Sd1	Sa1,Sb1, Sc1, Sd2	S1, S2	S3, S4	$+1V_{dc}$
5	Sa2,Sb2, Sc2, Sd2	Sa1,Sb1, Sc1, Sd1	S1, S3	S2, S4	0
6	Sa2,Sb2, Sc2, Sd1	Sa1,Sb1, Sc1, Sd2	S3, S4	S1, S2	$-1V_{dc}$
7	Sa2,Sb2, Sc1, Sd1	Sa1,Sb1, Sc2, Sd2	S3, S4	S1, S2	$-2V_{dc}$
8	Sa2,Sb1, Sc1, Sd1	Sa1,Sb2, Sc2, Sd2	S3, S4	S1, S2	$-3V_{dc}$
9	Sa1,Sb1, Sc1, Sd1	Sa2,Sb2, Sc2, Sd2	S3, S4	S1, S2	$-4V_{dc}$

2.2 SWITCHING OPERATION

By turning on controlled switches S1 ,S2, (S3 and S4 turn off) the output voltage $+V_{dc}$ is produced across the load. Similarly turning on of switches S3, S4 (S1 & S2 turn off) $-V_{dc}$ output is produced across the load. Similarly turning on of switches S1, S3 (S2 & S4 turn off) Zero output is produced across the load. The above Table 1.clearly shows the switching patterns for 9 level of output

3 MULTIPLE CARRIER PULSE WIDTH MODULATION TECHNIQUES

In this PWM technique, more than one carrier wave which be either triangular or saw tooth wave form can be used. This paper focuses on various strategies.utilising more than one triangular wave as carrier and the reference wave is sinusoidal. Though there are many carrier wave arrangements, in this paper, the following four arrangements have been carried out. THD and V_{rms} values for these four strategies for various modulation indexes are compared.

3.1 Phase disposition PWM strategy.
3.2 Phase Opposition Disposition PWM strategy.
3.3 Alternate Phase Opposition Disposition PWM strategy
3.4 Phase Shift PWM strategy.

In these Multicarrier PWM schemes, several triangular carrier waves are compared with the single Sinusoidal reference wave. The number of carriers required to produce N level output is (m-1) where m is the number of carrier waveforms. The single sinusoidal reference waveform has peak to peak amplitude of A_m and a frequency f_m. The multiple triangular carrier waves are having same peak to peak amplitude A_c and same frequency f_c. The single sinusoidal reference signal is continuously compared with all the carrier waveforms. A pulse is generated, whenever the single sinusoidal reference signal is greater than the carrier signal. The frequency ratio m_f is as follows: f_c / f_m

3.1 PHASE DISPOSITION PWM STRATEGY (PDPWM)

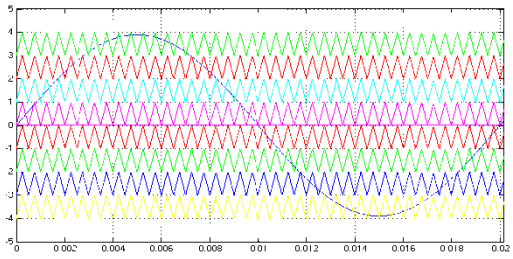

Fig. 2. Carrier arrangement for Phase Disposition PWM strategy

The above fig. 2 shows, Phase Disposition PWM strategy (PDPWM), where (m-1) carrier signal with the same frequency f_c and same amplitude A_c are positioned such that the bands they occupy are contiguous. The reference wave form is single sinusoidal. During the continuous comparison, if the reference wave form is more than a carrier waveform, then the active switching device corresponding to that carrier is switched on. Otherwise, that concerned device is switched off.

Amplitude of modulation index for PDPWM is

$$m_a = 2A_m / (m-1) A_c$$

3.2 PHASE OPPOSITION DISPOSITION PWM STRATEGY (PODPWM)

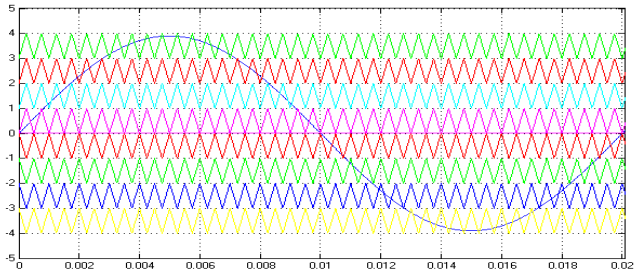

Fig.3. Carrier arrangement for Phase Opposition Disposition PWM strategy

POD PWM strategy is shown in fig.3, where the carrier waveforms, above the zero reference are in phase. The carrier waveforms below are also in phase, but are 180 degrees phase shifted from those above zero. The reference wave form is single sinusoidal. During the continuous comparison, if the reference wave form is more than a carrier waveform, then the active switching device corresponding to that carrier is switched on. Otherwise, that concerned device is switched off.

Amplitude of modulation index for PODPWM is

$$m_a = 2A_m / (m-1)* A_c$$

3.3 ALTERNATE PHASE OPPOSITION DISPOSITION PWM STRATEGY (APODWM)

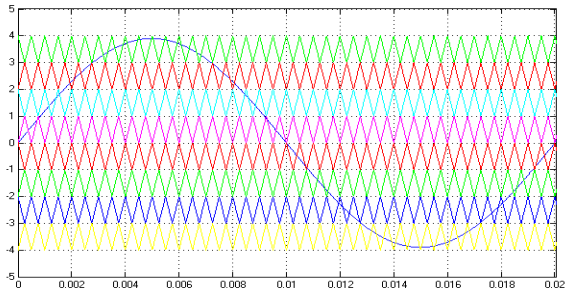

Fig. 4. Carrier arrangement for Alternate Phase Opposition Disposition PWM strategy

The above fig. 4 shows APOD strategy where the multiple carriers having same amplitude are phase displaced from each other by 180 degrees alternately. During the continuous comparison, if the reference wave form is more than a carrier waveform, then the active switching device corresponding to that carrier is switched on. Otherwise, that concerned device is switched off.

Amplitude of modulation index for PODPWM is

$m_a = 2A_m / (m-1)* A_c$

3.4 PHASE SHIFT PWM STRATEGY (PSPWM)

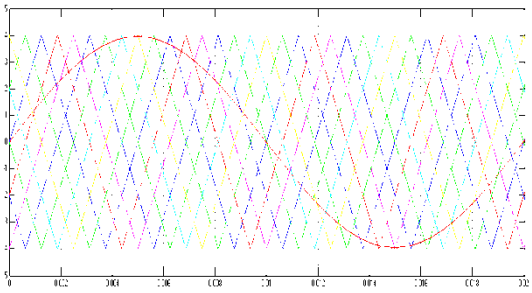

Fig. 5. Carrier arrangement for Phase shift PWM strategy

The above fig. 5 shows PSPWM strategy where the multiple carriers having the same amplitude and frequency which are shifted to one another by certain degrees decided by the No. of levels. Thus for nine level output, 8 triangular carrier waves which are phase shifted by 45 degrees is utilized .The reference waveform is single sinusoidal (i) for odd m_f the waveforms have odd symmetry resulting in even and odd harmonics and (ii) for even m_f , PSPWM waves have quarter wave symmetry resulting in odd harmonics only.

Amplitude of modulation index for PSPWM is

$$m_a = A_m / (A_c /2).$$

4 SIMULATION RESULTS

The fig. 6 shown below is the simulink model of the 9 –level Hybrid H Bridge Multilevel inverter using power system block set. The following parameter values are used for simulation: V_1 =100v, V_2 =100v, V_3 = 100v, V_4= 100v .Gating signals for Phase shifted carrier wave arrangement and three different, level shifted carrier wave arrangements are simulated.

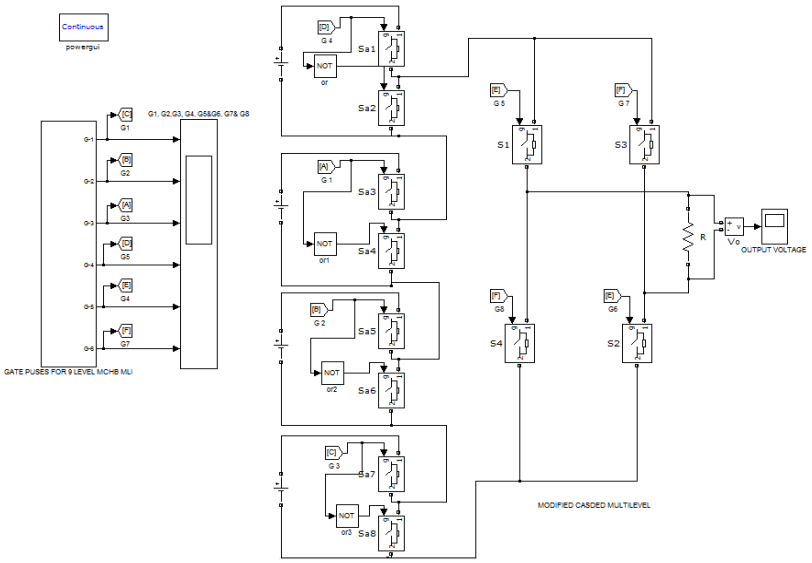

Fig. 6. Simulink Modeling of the Hybrid H-Bridge Multilevel Inverter

Simulations are done for various values of m_a and the corresponding THD% are observed using FFT block and listed in Table 2 The $V_{r\,ms}$ (fundamental) of the output voltage for various values of m_a and the corresponding Voltages are listed in Table3.The comparison of Vrms and THD is shown in fig 7 & 8.

Table 2. THD comparison

M_a	PD PWM	POD PWM	APOD PWM	PS PWM
1	13.55	13.25	13.12	12.9
0.9	16.62	16.59	16.51	16.25
0.8	16.93	16.68	17.11	16.17

Table 3. V_{rms} comparison

M_a	PD PWM	POD PWM	APOD PWM	PS PWM
1	399.9	401	399.8	400
0.9	359.8	359.7	359.8	360.2
0.8	319.9	319.6	319.9	319.9

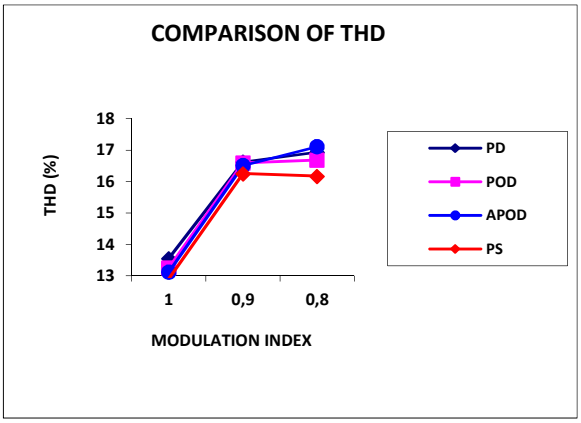

Fig. 7. Comparison of V_{rms}

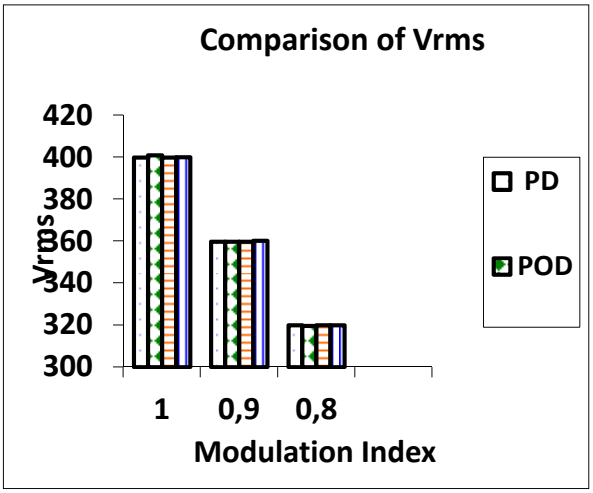

Fig. 8. Comparison of THD

The Simulated 9-level Output Voltage waveform of Hybrid H Bridge MLI using PDPWM Strategy is shown in fig. 9 and Fig. 10 shows the FFT plot of 9-level Hybrid H Bridge MLI using PDPWM Strategy. The Simulated 9-level Output Voltage waveform of Hybrid H Bridge MLI using PODPWM Strategy is shown in fig 11 and Fig: 12 shows the FFT plot of 9-level Hybrid H Bridge MLI using PDPWM Using PODPWM Strategy. The Simulated 9-level Output Voltage waveform of Hybrid H Bridge MLI using APODPWM Strategy is shown in fig 13 and Figure: 14 shows the FFT plot of 9-level Hybrid H Bridge MLI Using APDPWM using PODPWM Strategy. The Simulated 9-level Output Voltage waveform of Hybrid H Bridge MLI using PSPWM Strategy is shown in fig 15 and Fig: 16 shows the FFT plot of 9-level Hybrid H Bridge MLI using PSPWM Strategy.

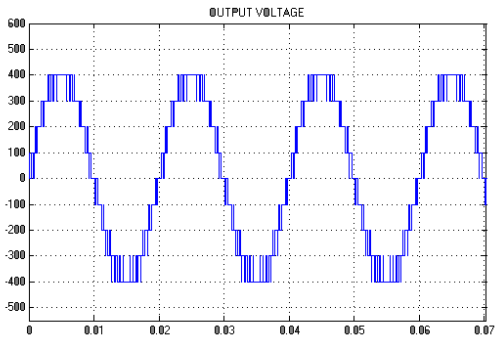

Fig.9. Simulated 9-level Output Voltage waveform of Hybrid H Bridge MLI Using PDPWM Strategy

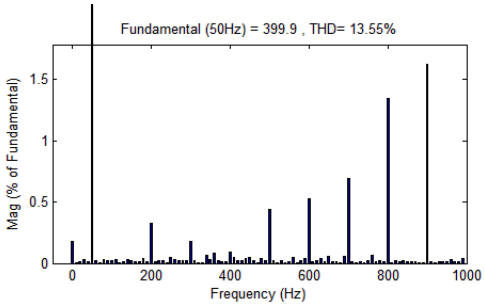

Fig. 10. FFT plot of 9-level Output Voltage waveformHybrid H Bridge MLI Using PDPWM Strategy

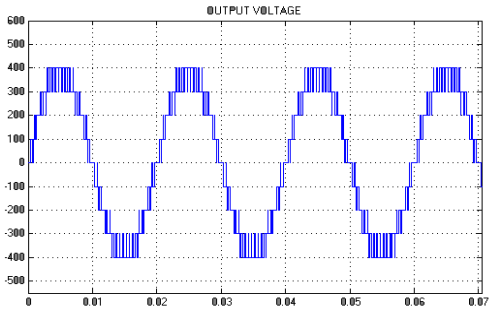

Fig .11. Simulated 9-level Output Voltage waveform of Hybrid H Bridge MLI Using PODPWM Strategy

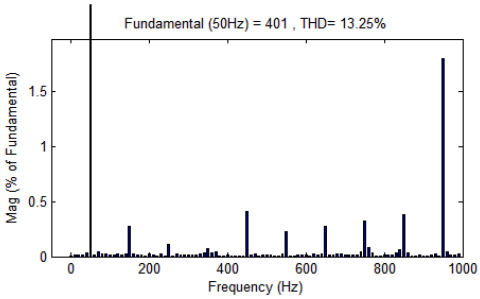

Fig. 12. FFT plot of Hybrid H Bridge MLI Using PODPWM Strategy

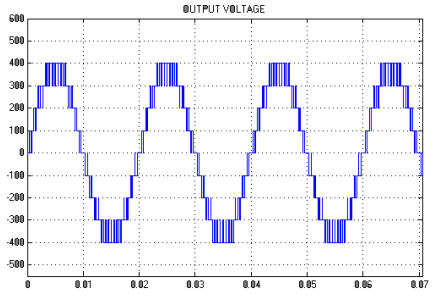

Fig .13. Simulated 9-level Output Voltage waveform of Hybrid H Bridge MLI Using APODPWM Strategy

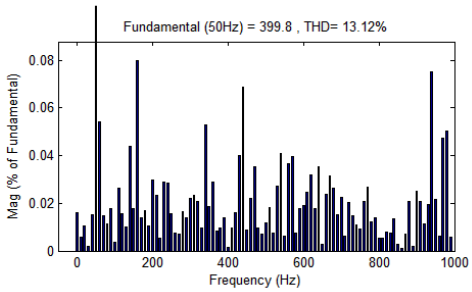

Fig. 14. FFT plot of Hybrid H Bridge MLI Using PODPWM Strategy

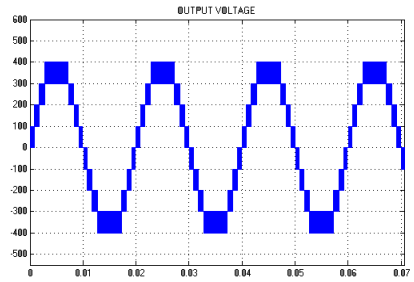

Fig. 15. Simulated 9-level Output Voltage waveform of Hybrid H Bridge MLI Using PSPWM Strategy

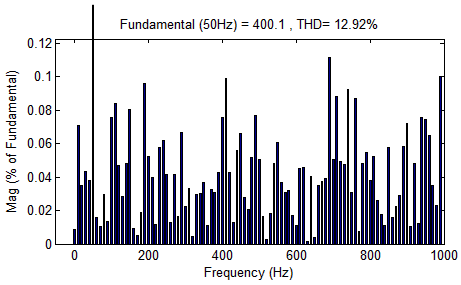

Fig. 16. FFT plot of 9-level Hybrid H Bridge MLI Using PSPWM Strategy

5 CONCLUSION

Hybrid H Bridge multilevel inverter has been analyzed for various multi carrier sinusoidal Pulse Width Modulation strategies. This topology has the credit of having only twelve switches, instead of 18 switches in the conventional plants, which support reduction in switching losses, cost and circuit complexity.

Performance factors like %THD and V_{RMS} have been measured, and analyzed for Phase shifted carrier wave arrangement and three different, level shifted carrier wave arrangements both applied to the Single phase nine levels Modified cascaded multilevel inverter. The values have been measured for various modulation indexes. It is found that the PDPWM strategy provides appreciable %THD and acceptable V_{RMS}. In addition, it is also observed that it has less number of dominant harmonics than the other strategies.

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Etude comparative des différents modèles de maturité en gestion des projets

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ABSTRACT: The information technology and communication have become an essential support for all activities of companies. They have emerged as a strategic asset in the service operations and management of the company.
In this context, the key challenge for the company is to maximize its information system in order to make a major lever for achieving its objectives. However, companies face a lot of problems for the implementation of their information system. This is typically a notion of maturity that is required.
In this article, we aim to study the maturity of projects and models most used in the literature, while providing a comparative study between the different models of maturity in project management.

KEYWORDS: Information System, Management Project, Performance, Maturity Model.

RESUME: Les technologies de l'information et de la communication sont devenues un support incontournable de l'ensemble des activités de l'entreprise. Elles s'imposent désormais comme un actif stratégique au service des opérations et du pilotage de l'entreprise.
Dans ce contexte, l'enjeu essentiel pour l'entreprise est d'exploiter au maximum son Système d'Information afin d'en faire un levier majeur de l'atteinte de ses objectifs. Or, les entreprises rencontrent beaucoup de problèmes pour la mise en œuvre de leur système d'information. C'est typiquement une notion de maturité qui s'impose.
Dans cet article, nous avons l'ambition d'étudier la maturité des projets et ses modèles les plus utilisés dans la littérature, tout en offrant une étude comparative entre les différents modèles de maturité dans la gestion des projets.

MOTS-CLEFS: Système d'information, Gestion des projets, Performance, Modèle de maturité.

1 INTRODUCTION

Depuis les dernières années du 20ème siècle, une révolution sociale forte a commencé, il s'agit d'une révolution basée sur l'information et la connaissance, qui est entraînée par l'évolution de l'informatique et des technologies de la communication ITC [1]. En outre, la mondialisation et les progrès des technologies, en particulier des technologies de l'information, ont radicalement contribué au changement des environnements internes et externes pour les organisations commerciales [2].

Dans le domaine de la gestion de la technologie, les gestionnaires de programmes souffrent de dérapages horaires, et de l'incapacité à atteindre les objectifs [3]. En plus, Les entreprises sont confrontées à des mutations que certains n'hésitent pas, désormais, à qualifier de permanentes. Ces mutations, qu'elles soient d'ordre économique, technologique,

réglementaire, démographique ou social, ont des conséquences profondes sur l'organisation, le contenu du travail et les compétences attendues des salariés [4].

En fait, Chaque entreprise définit sa stratégie pour répondre aux objectifs qu'elle s'est fixée. Mais une fois la stratégie définie, beaucoup d'organisations rencontrent des problèmes pour la mettre en exécution en sélectionnant les bons projets et en affectant les ressources appropriées. C'est typiquement un problème de maturité. Ainsi, Un projet informatique dans une entreprise est mature si l'ensemble des processus qui le composent est maîtrisé et permet d'atteindre les objectifs fixés, cette maîtrise se contrôlant au fur et à mesure de l'avancement de projet [5]. D'ailleurs, beaucoup d'organisations se tournent vers l'amélioration de processus pour améliorer leur probabilité de réussite [6], [7], [8]. Pour cela, les Modèles de maturité sont utiles pour les organisations qui mettent l'accent sur l'amélioration des processus incrémentaux [9].

Dans cette optique, des travaux réalisés dans divers secteurs industriels [10], [11], [12], [13] ont démontré les avantages de l'utilisation des modèles de maturité et la corrélation existante entre l'amélioration de la maturité en management de projet et la performance du projet [14], [15], [16], [17], [18].

Le but de la création des modèles est donc de permettre une amélioration constante et permanente des processus pour augmenter la qualité des produits développés [19]. En effet, les entreprises s'intéressent de plus en plus au développement de nouveaux outils et modèles pour mieux piloter leurs projets afin d'augmenter leur probabilité de succès et la performance globale de l'entreprise [20].

Dans cette communication, nous avons l'ambition de mettre en évidence le concept de maturité dans la gestion des projets. A l'issue de cette communication, nous montrons ainsi, les différents modèles de maturité les plus revus dans la littérature, en faisant une comparaison entre les caractéristiques de chaque modèle.

Dans la première section, nous examinons le concept de maturité des projets. Ensuite, nous étudions les modèles de maturité en gestion des projets à partir d'une revue générale de la littérature. Quant à la troisième section, sera consacrée à l'étude comparative des différents modèles en gestion des projets. Alors que la dernière section, évoquera les conclusions et les perspectives de notre communication.

2 CONCEPT DE LA MATURITÉ D'UN PROJET

Dans la littérature, il existe plusieurs définitions de maturité mais il n'y a pas une définition générale pour expliquer ce qu'est la maturité d'un projet. D'après Andersen, la maturité est la « qualité ou l'état de devenir mûr » [21]. Pour Kerzner, la maturité est « liée au développement des systèmes et des processus répétitifs qui représentent une haute probabilité de succès d'un projet » [22]. La mesure de la maturité permet de « montrer l'état atteint par rapport à l'état dans lequel le projet devrait être » [23] et ainsi de disposer des informations nécessaires pour faire évoluer/standardiser les processus. Pour Ramirez, Un projet est dit mature si l'ensemble des processus qui le composent est maîtrisé et permet d'atteindre les objectifs fixés, cette maîtrise se contrôlant au fur et à mesure de l'avancement du projet. Selon Ramirez aussi, « le concept de maturité comprend [5] :

- La définition des critères de succès ;
- La capacité à produire des succès répétitifs ;
- La compréhension des causes de succès et des moyens de prévenir ou de corriger les problèmes courants ».

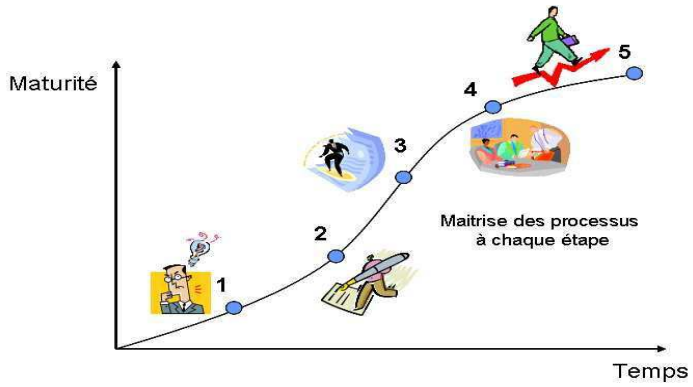

Figure 1.Représentation des niveaux de maturité.

3 LES MODÈLES DE MATURITÉ EN GESTION DES PROJETS :

Un modèle est par définition « une représentation d'une abstraction d'une partie du monde réel, exprimée dans un langage de représentation » [24]. Un modèle de maturité, dans le domaine du management de projet, est un outil qui permet de définir le niveau de maturité d'une entité isolée ou d'une société. Avec un modèle de maturité, il est possible de faire des comparaisons entre entités de même nature [22].

L'objectif d'un modèle de maturité est d'améliorer l'efficacité de l'entreprise en identifiant, en analysant et en rendant plus performants les processus régissant le travail. Le modèle de maturité sert de référence pour apprécier la façon dont le travail est organisé et permet d'améliorer les pratiques en place [5].

Ainsi, les modèles de maturité fournissent un outil d'évaluation qui compare la performance du projet à celle de meilleures pratiques établies. Afin de permettre l'achèvement dans de bonnes conditions du projet, le modèle de maturité nécessite [5]:

- D'établir un étalonnage des niveaux de maturité.
- De déterminer où et quand il est nécessaire de mettre en œuvre un plan de progrès puis un plan d'amélioration permanente.

La mesure de la maturité permet alors de montrer l'état d'avancement atteint par rapport à l'état dans lequel le projet devrait être, c'est-à-dire la situation du projet par rapport à un objectif fixé [5]. Cette maturité peut être évaluée par le niveau de progrès du processus et des procédures exigés pour la planification et le développement des projets.

Dans le cadre de notre étude, nous avons réalisé un état de l'art sur les modèles de maturité existants [25], [26], [27], [28] et nous avons identifié plus de 30 modèles. Parmi ces modèles, nous avons choisi les modèles particulièrement orientés sur le management des projets. Les modèles étudiés sont :

- Capability Maturity Model Integration [29].
- Berkeley PM Process Maturity Model [30].
- PM Solutions Project Management Maturity Model [31], [32].
- Organizational Project Management Maturity Model « OPM3 » [27].
- Portfolio, Programme & Project Management Maturity Model « P3M3» [33].
- Project Management Maturity Model [22].

4 COMPARAISON ENTRE LES DIFFÉRENTS MODÈLES DE MATURITÉ DE PROJETS

En quelques années, l'utilisation des modèles de maturité a vite été élargie à divers domaines. Dans ce paragraphe, nous allons présenter, dans le tableau ci-dessous, ceux que nous considérons comme les principaux en management des projets, avec une étude des caractéristiques de chaque modèle. Ils sont les plus cités dans la littérature [34], [35] et les plus utilisés dans les entreprises :

Tableau 1. Tableau Descriptif des différents modèles.

Modèle de Maturité	*Description*	*Niveaux de Maturité*	*Domaine de base*	*Questionnaire*
Capability Maturity Model Integration	un modèle pour l'amélioration des processus logiciels développé par le Software Engineering Institute (SEI).	5 niveaux	9 Domaines PMBOOK	Pas de questionnaire spécifique
BerkeleyPM Process Maturity Model	Un modèle est conçu pour démontrer la valeur du management de projet en Calculant son rendement.	5 niveaux	9 Domaines PMBOOK	Pas de questionnaire (Méthode et simulation)
PMSolutions Project Management MaturityModel	Un modèle qui décrit les étapes nécessaires pour augmenter le niveau de maturité en management de projet et améliorer la performance.	5 niveaux	9 Domaines PMBOOK	Pas de questionnaire (Méthode, interview, benchmark,…)
Organizational Project Management Maturity Model « OPM3 »	Un modèle qui se focalise sur la corrélation claire entre les aptitudes d'une organisation à gérer des projets, des programmes et des portefeuilles et son efficacité à mettre en œuvre sa stratégie.	4 niveaux	9 Domaines PMBOOK	Questionnaire spécifique.
Portfolio, Programme & Project Management Maturity Model « P3M3 »	Un modèle qui se focalise sur l'addition du management de portefeuille et de programme au modèle décrivant les principaux secteurs de processus qui contribuent à réussir les projets.	5 niveaux	9 Domaines PMBOOK	Pas de questionnaire spécifique.
Project Management Maturity Model	Un modèle qui permet de seulement d'évaluer la maturité de l'organisation et de le comparer à d'autres organisations.	5 Niveaux	9 Domaines PMBOOK	Questionnaire spécifique (183 questions)

Parmi les six modèles présentés, nous retrouvons certaines caractéristiques communes [5] :

- Définition des échelles de maturité (5 niveaux pour la plupart d'entre eux)
- Rapprochement des concepts issus du PMBOK avec les niveaux de maturité décrits par le CMMI.
- Regroupement des processus par domaines (à ces processus correspondent des meilleures pratiques à mettre en œuvre pour prétendre passer au niveau de maturité suivant)
- L'évolution vers un niveau n+1 n'est possible qu'à condition d'avoir rempli tous les objectifs de niveau n.

Cependant, chacun des modèles a ses propres définitions des processus à évaluer . En effet, les modèles de maturité présentés fournissent des pratiques en management de projet à mettre en place pour atteindre un niveau de maturité dans l'organisation [5].

Dans notre étude et d'après l'étude bibliographique, nous considérons que les modèles de maturité constituent un outil d'évaluation des performances de l'entreprise en termes de management des projets

5 CONCLUSION ET PERSPECTIVES

Dans cette communication, nous avons présenté une étude comparative des différents modèles de maturité en gestion des projets les plus utilisés et les plus étudiés dans la littérature. Cette étude a pour but d'explorer ces modèles afin d'en montrer les caractéristiques.

Dans une première partie, nous avons déterminé le concept de la maturité des projets d'après une revue de la littérature. Puis, dans une deuxième partie, nous avons étudié les modèles de maturité en gestion de projets en offrant une étude comparative entre l'ensemble des modèles.

Par ailleurs, dans de futurs travaux, il serait intéressant d'explorer la maturité en gestion des projets dans les PME marocaine, à partir d'une étude bibliographique générale, des études de cas et les résultats de notre enquête menée.

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Studies On Some Aspects Of Burrows Pattern Of Monitor Lizard (*V.bengalensis*) In The Karachi And Hyderabad, Sindh, Pakistan

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ABSTRACT: In the Areas of two major cities of sindh viz Karachi and Hyderabad for the observation were carried out about the Burrows pattern, Holes (House made methods) of V.bengalensis (Monitor lizard) were studied in semi dry areas of the Karachi and Hyderabad (sites) It was observed that the burrows of V.bengalensis has showed much variation in their nature.Several type of habitat (burrows pattern) were studied in the different areas of Karachi and Hyderabad . It was noticed that the mostly size (Hole of mouth & length) of burrows of mature V.bengalensis was almost same in various observation of burrows in the selected studies area.

KEYWORDS: Burrows pattern V.bengalensis Karachi, Hyderabad, Sindh.

INTRODUCTION

Present Studies was conducted Due to much attention and significant presence of V.bengalensis in the selected studies areas of Karachi and Hyderabad accept all others Reptiles.These investigation was carried out between Febuary 2013-Febuary 2014 at the Karachi and Hyderabad located in sindh province of Pakistan. V.bengalensis made their burrows with Different pattern, Monitor lizard made their burrows/Holes/House for shelter from predators as wel as for resting during drought conditions. V.bengalensis made their burrows by the Diging with the help of strong claws, and some time occupying existing burrows / holes of any other reptiles or other animals too. Monitor lizard were observed at various sites in the study areas, as like university of Karachi, Safari park, Malir cannt area, Cape monze,Hawks bay, Near Baharia twon,near Dha city,near jokhya more (Karachi) and in Hyderabad Different burrows pattern were studies in different areas of Hyderabad as like Kotri, Hatri, Karachi mori, Hyderabad mori, near jamshoro, near to Dargah Baba salahuddin,near to Hyderabad Air- port, near to Hussainabad Etc. Some knowledge available on the habitat of V.bengalensis in Karachi and Thatta sindh [4] and general description on the burrows pattern of V.bengalensis is[1] and a good notes available for burrows of V.bengalensis in Agra india [3] and a V.good information for Holes and basking activity[5]

METHODS

In all Selected studies area were observed for burrows pattern, due to this ,In each sites sampling area measurements were adopted by Gupta and sinha2001, in which sampling area measurements were 1km x 1.5km as selected for observation,which was further divided in to smaller transects for 100m x 150m. in every sampling area 5 smaller transects were randomly selected for sampling of given area. For the measurements of straight tunnels depth of the hole at which the tunnel terminated was taken by a smooth semi elastic stick in single tunnel type and the measured with scale as wel as the width of the burrows measurement with scale also.In case of multi tunnel burrows usually measure with the help of fresh plant sticks were used or more elastic stick were used and some time use elastic iron rod,thin iron rod were used for measurement of Holes after that iron rod measured with scale. For sampling, field studies, Burrows searching, (Habitat searching), and for climatic analysis,soil,sand quality,water availability, Burrows measurements and some others important

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factors were noted by the help of five field assistance and a good four wheel jeep and car and some bikes were also used for good field studies for burrows searching and measurements.

RESULTS

During the studies Six, main burrows pattern were observed .mostly were at ground levels.Most of the burrows 71.45% were active Burrows noticed(Table=01) .These Micro Habitat/ Burrows were Catogories in the following types

1. Tree or Hollow tree trunk Burrow:-Very few burrows were observed in hollow tree trunk or on the tree habitat (Fig =02) Mostly tree trunk use of V.bengalensis for feeding on birds and their eggs too

2. Eleveted areas Burrow:- It is observed that V.bengalensis mostly like to made their burrows on angular slope.it was noticed that V.bengalensis made a small tunnel as like 1-1.9m size.Mostly for resting short time and long time when drought condtion occurse.these type of burrows found in Karachi and Hyderabad.(Fig=08-09)

3. Gutters/Manholes/Pipe Burrow:- Generaly this type of habitat of V.bengalensis were also used in the human colony for taken of food items available there in the form of insects Etc.V.bengalensis live in that available place and capture their preys(.Fig=01).

4. Building Gaps/Stony types Burrow:-Monitor lizard were occupying building Gaps in human living areas this type of burrow were observed in the University of Karachi and in Hyderabad areas.(FIg=03) These type of burrow monitor lizard used as for easy going place where food items birds.insects easily available.it is a shelter of monitor lizard also for their enemies.

5. The nests of Termite Burrow:-These type of burrows were mostly observed at that place where dead organic matter available in in the form of dead trees base (Fig=06) Etc,which were provide food for termites.V.bengalensis mostly inhabiting in termite mounds for shelter as wel as taken food on termites too.

6. Small Mounds Burrow:- These type of burrows were noticed in three different origin which were in agricultural soil mounds,semi dry areas mounds,near to river bank mounds (Fig=08-10) This type of burrows were made for easily approach for food items too.

During observation 80% of burrows Holes at ground levels, such as elevated land tree trunk, Gutters/manholes, Termite mounds,Small mounds,stony types Etc. The Burrows mean length was 110cm and burrows diameter was 10.5cm respectively. Mean length of tunnel in multy tunnel was also same in lenth, unusually the mouth opening of burrow has a convex roof structure with out any cover.

DISCUSSION

During our studies it is very much intresting that the observation of V.bengalensis of Burrow length size and width diameter was also similar in all reported case of burrows of V.bengalensis in the different areas of Karachi and Hyderabad, may be due to the body size of mature V.bengalensis which is similar to report by[3].In the studies of Burrow pattern of V.bengalensis we find out maximum burrows at ground levels, which are similar by some previous workers as like [7],[1],[3],[4]. It was noticed that V.bengalensis made their Burrows for shelter and for resting during hibernation period.The maximium burrows were investigated in the vegetation areas and on the river banks Etc,where types of tree were dominated in it.In the agricultural wall as wel as river banks wall the soil condition is very much soft and suitable for burrows made easily, as wel as second advantage is more food items easily available for V.bengalensis that's-why V.bengalensis made their burrows in these sites, this investigation is almost similar by [3]. During investigation of Burrows of V.bengalensis, one case was reported in building gaps in Karachi university where a monitor lizard shelterd in building gaps.some previous work also support in same investigation as like[2],[3],[4].We also investigate that V.bengalensis found in gutters and manholes pipe Etc, as before same report by some workers,[8],[3],[4].One study sites (Karachi university) also report that V.bengalensis live on the tree or hollow tree trunk for shelter as wel as feeding on birds and their eggs too. Which is similar by [9],[3].In our investigation very few sites report that V.bengalensis shelter in Termite nests.Termite nests were observed in Hatri forestry areas (Hyderabad) where dead plant bodies were in more abundant, in that places suitable for building of termite nests and mounds. V.bengalensis occupying termite mounds and feed on termite too. [1],[3]; were also report in the same manners. In the investigation of burrows pattern one stony types shelter of V.bengalensis was also report in Hyderabad sites.this is similar by [5]. In all types of V.bengalensis burrows are very much threatened by human activity and increasing human population need more and more places for their needs is directly propotional to the degaradation of burrows of V.bengalensis, needs very much intention for conservation of V.bengalensis in various parts of sindh.

(Fig=01)V.bengalensis Burrow,Man- hole/gutter Habitat at University of Karachi

(Fig=02) V.bengalensis Burrow, Plant / Tree habitat at University of Karachi.

(Fig=03) V.bengalensis Burrow, Building gaps/stony habitat at Karachi university

(Fig=04) V.bengalensis, Ground levels Habitat at Malir Cantt Karachi

(Fig=05) V.bengalensis Burrow, Stony small mound at Malir Cantt karachi

(Fig=06) V.bengalensis Burrow,Termiteria,Termite nests Burrow at Hotri Hyderabad

(Fig=07V.bengalensis Burrow, Big stony Burrow near Darbar Baba Salahuddin at Hyderabad

(Fig=08) V.bengalensis Burrow, Small mounds Burrow at Jokhya more near D.H.A City karachi

(Fig=09) V.bengalensis Burrow, Sand dunes Burrow with Convex mouth at Hyderabad Mori (Canal)


(Fig=10) V.bengalensis Burrow, Sand dunes Burrow (Convex mouth) at kotri Hyderabad

Table=01.Study areas (Sites) and types of pattern of Burrows of V.bengalensis in Karachi & Hyderabad (Sindh).

Nos	Study Areas(Sites)	Type of Burrow / Habitat	No of Active Burrows
1.	Karachi	Plant or Tree trunk	01
2.	Karachi &Hyderabad	Elevated areas	55
3.	Karachi	Gutter/manholes/pipes	01
4.	Karachi	Building gaps/wall crevices	01
5.	Hyderabad	Nests of termite/termit mounds	02
6.	Karachi/Hyderabad	Small mounds	50

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ELECTROCHEMICAL BEHAVIOR OF CHLORAMPHENICOL AND ITS DETERMINATION USING CYCLIC VOLTAMETRY

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ABSTRACT: This work uses a method that enhances the performance of glassy carbon electrode (GCE) for the determination of chloramphenicol (CAP). The electrochemical properties of chloramphenicol at electrochemically pretreated glassy carbon electrode were studied using cyclic voltammeter (CV). Electrochemical pretreatment of the electrode greatly enhanced the reduction peak current (Ip) of CAP. CAP shows an irreversible reduction peak at -0.674 V *vs.* Ag/AgCl at the GCE in 0.05 M acetate buffer of pH 5. Detailed experiments were carried out to establish the electrochemical property, the optimal buffer and its pH, electrode pretreatment potential, scan rate dependence study and effect of concentration. Following optimization pH of buffer solution, the peak current response for the reduction of CAP shows an enhanced response, 2.0 times greater than the bare GCE. A series of four CAP determination in 1.6×10^{-6} to 2×10^{-4} M concentration range show a linear calibration curve with r = 0.99997. At this range the limit of detection was LOD = 2.45 µM with a standard deviation of SD = 0.03814. The method was successfully applied to three CAP containing pharmaceutical samples: CAP eye drop, CAP palmitat oral suspension and CAP as sodium succinate and the level of CAP in these samples was verified.

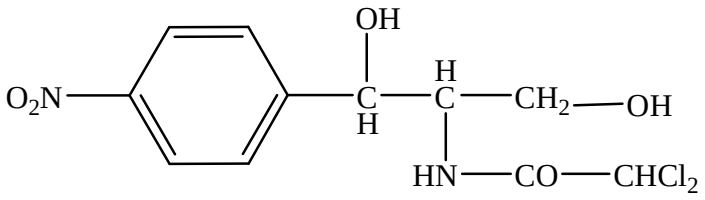
KEYWORDS: glassy carbon electrode (GCE), chloramphenicol (CAP), cyclic voltammetric (CV), pharmaceutical samples.

1 INTRODUCTION

Drug control has been on the global agenda for more than a century.[1] From environmental engineering point of view, pharmaceuticals including antibiotics are a new group of manmade chemicals of concern entering the environment at concentrations such that their health effects are unknown. Antibiotics or antimicrobial drugs are the drugs that fight infections caused by bacteria or other microbes. They are small molecules that at low concentrations inhibit the growth of microorganisms or kill them. Some of the natural antibiotics are benzyl penicillin, streptomycin, chloramphenicol, tetracyclines and macrolides.[2-4]

Use of Antibiotic that might result in deposition of residues in meat, milk and eggs must not be permitted in food intended for human consumption. If use of antibiotics is necessary as in prevention and treatment of animal diseases, a withholding period must be observed until the residues are negligible or no longer detected. The use of antibiotics to bring about improved performance in growth and feed efficiency, to synchronize or control of reproductive cycle and breeding performance also often lead to harmful residual effects.[5]

Chloramphenicol (CAP) {2, 2-dichloro-N-[2-hydroxy-1-(hydroxymethyl)-2-(4-nitrophenyl) ethyl] acetamide}, is an effective broad-spectrum antibiotic that has widely been used since the 1950s to treat food-producing animals (Fig. 1.1).[7] It has also been used in veterinary medicine as a highly effective and well-tolerated broad-spectrum antibiotic for domestic animals, poultry, as well as aqua-agriculture farming. [6]



$C_{11}H_{12}Cl_2O_5$

M = 322.0123

Figure 1.1.Structure of chloramphenicol (CAP) [6]

Chloramphenicol is produced naturally by Streptomyces venezuelae. It is now produced by chemical synthesis followed by a step to isolate stereoisomers. The first commercial production of chloramphenicol in the United States was reported in 1948. It may be released to the environment and may be found in various waste streams because of its use as a medicinal and research antimicrobial agent. If it is released into the atmosphere, chloramphenicol will exist primarily in the particulate phase. Removal of atmospheric chloramphenicol would occur mainly through dry deposition. The atmospheric half-life of chloramphenicol is 12 hours, as it will react with photochemically produced hydroxyl radicals. If released to water, chloramphenicol will be essentially nonvolatile. Adsorption to sediment or, bioconcentration in aquatic organisms is not expected to be important process. If released to soil, chloramphenicol is expected to have high soil mobility. Volatilization of chloramphenicol is not expected from either dry or wet soils. Exposure to chloramphenicol may occur through inhalation, dermal contact, ingestion, or contact with contaminated water or soil. The solubility of chloramphenicol in water at 25 ^{0}C is 2.5 g/l over a wide range of pH. Various biodegradation studies indicate that chloramphenicol may biodegrade in soil and water. It is degraded by biological, chemical, and photolytic means and undergoes oxidation, reduction and condensation reactions upon exposure to light in aqueous solution.[7, 8]

Chloramphenicol is an antimicrobial agent with restricted use. It is used to combat serious infections where other antibiotics are ineffective. It can be used against gram-positive cocci and bacilli and gram-negative aerobic and anaerobic bacteria. Because of its well-known risk to cause cancer, aplastic anemia and carcinogenic properties, its use in human and veterinary medicine is limited by its toxicity. Currently it is used in eye ointments to treat superficial ocular infections involving the conjunctiva or cornea, in topical ointments to treat the external ear or skin, in various tablets for oral administration, and in intravenous suspensions to treat internal infections.[8]

Accordingly, the determination of CAP has to be screening; identifying and quantifying with complex and strict protocol to be obeyed in edible tissues, pharmaceutical formulations and milk and milk products. Thus, a sensitive and reliable method for the determination of CAP at residual levels is urgently needed.[9, 10]

2 OBJECTIVES AND SIGNIFICANCE OF THE STUDY

The objective of this work relies on studying the electrochemical behavior of chloramphenicol and determining its level in pharmaceutical formulations using cyclic voltammeter.

Significance of the study

The use of CAP in human and veterinary medicine is limited by its toxicity and its use in developed countries is limited to topical application for the treatment of eye infections. However, human use of CAP is found primarily in developing countries due to its low cost.[29] Thus, evaluating and monitoring the level of CAP is necessary to ascertain that the drug should not be misused and does not cause a danger to human and animal health. This research can therefore signify to; create awareness in users about the impacts of CAP and it can be used as a starting material for others who want to search further about CAP as well as other similar antibiotic drugs.

3 EXPERIMENTAL PART

3.1 APPARATUS

Voltammetric measurements were performed using a BAS 100B electrochemical analyzer and a one compartment glass cell vial with a three-electrode configuration (BAS Cell Stand C3). The electrodes used were a glassy carbon disk working electrode with a diameter of 3 mm, a platinum wire auxiliary electrode, and an Ag/AgCl (3 M NaCl) reference electrode. The pH of the buffer solution was measured with Jenway instruments digital pH meter with a glass combination electrode. Mass of solid reagents was measured using Denver instrument balance. All potentials are reported with respect to Ag/AgCl (3M NaCl) reference electrode.

3.2 REAGENTS

All chemicals were analytical grade and organic solvents were HPLC grade. CAP capsule (Sigma-Aldrich USA) was obtained from local pharmacy. Acetic acid, acetone, sodium acetate, sodium dihydrogen phosphate, disodium hydrogen orthophosphate decahydrated, sodium hydroxide, ethyl acetate, and hydrochloric acid were used as received. All the chemicals were in "Blulux" brand form. Distilled water was used throughout the experiment.

3.3 PREPARATION OF SOLUTIONS

A 0.05 M acetate buffer (pH 5) was prepared by dissolving the required amount of sodium acetate in distilled water and the pH of the solution was adjusted by addition of drops of acetic acid and sodium hydroxide. Fresh stock solutions of CAP of concentration 1×10^{-4} M were prepared in distilled water. The working solutions for the voltammetric investigations were prepared by serial dilution of the stock solution with aqueous buffer solutions.

3.4 ELECTROCHEMICAL PRETREATMENT OF GLASSY CARBON ELECTRODE

The glassy carbon electrode was polished with Al_2O_3 powder on a micro-cloth pad and thoroughly rinsed with distilled water. Electrochemical pretreatment of glassy carbon electrode was performed by anodic oxidation at +1.000 V in acetate buffer (pH 5). The electrode was then cycled between –1.000 V and +1.000 V at a scan rate of 100 mV s^{-1} until a stable voltammogram was obtained.

3.5 PREPARATION OF ANALYZED SAMPLES SOLUTIONS

Three samples of CAP were analyzed in this work namely; CAP eye drop, CAP oral suspension and CAP sodium succinate.

3.5.1 CHLORAMPHENICOL EYE DROPS.

10 mL of chloramphenicol eye drop was transferred to five 50 ml volumetric flask and diluted with 10 mL of 0.05 M acetate buffer (pH 5). Standard solution of 1×10^{-4} M CAP was added at 0, 1, 2, and 3 mL volumes to each of the flasks. Then, each flask was made 50 mL with 0.05 M acetate buffer (pH 5).

3.5.2 CHLORAMPHENICOL PALMITATE ORAL SUSPENSION

5 mL of the sample was diluted in 20 mL acetone in four different 50 mL flasks. Addition of standard solution of 1×10^{-4} M CAP was then applied at 0, 1, 2, and 3 mL volumes to each of the flasks. The solution was made ready for voltammetric analysis by filling each flask with 0.05 M acetate buffer (pH 5). Measurements were carried out sequentially from low to high concentration and the vice versa.

3.5.3 CHLORAMPHENICOL SODIUM SUCCINATE

The powder sample per vial was dissolved in 20 mL distilled water. This procedure was repeated for another 3 powder samples followed by addition of 1×10^{-4} M CAP standard solution with 0, 1, 2 and 3 mL volumes. The solutions were transferred to a 50 mL flask and filled with 0.05 M acetate buffer (pH5).

4 RESULT AND DISSCUSION

4.1 ELECTRODE PRETREATMENT

In studying the electrochemical behavior of CAP at electrochemically pretreated GCE cyclic voltammetry was applied. As described in the experimental section, a +1.000 V potential was applied to the freshly polished and cleaned glassy carbon electrode in a solution of acetate buffer for two seconds, followed by cycles between +1.000 V and -1.000 V in the same solution until a stable background voltammogram was obtained.

Figure 5.1 compares the cyclic voltammogram of 1 x 10^{-4} M capsule CAP obtained at a bare and electrochemically pretreated GCE. As it is seen, the peak current of CAP at about -0.674 V obtained at pretreated GCE is 2.0 times greater than that of the bare electrode. This indicates that surface pretreatment improves the poor detection limit of normal carbon electrodes. Thus, there is a substantial enhancement in the peak currents when the glassy carbon electrode is electrochemically pretreated.

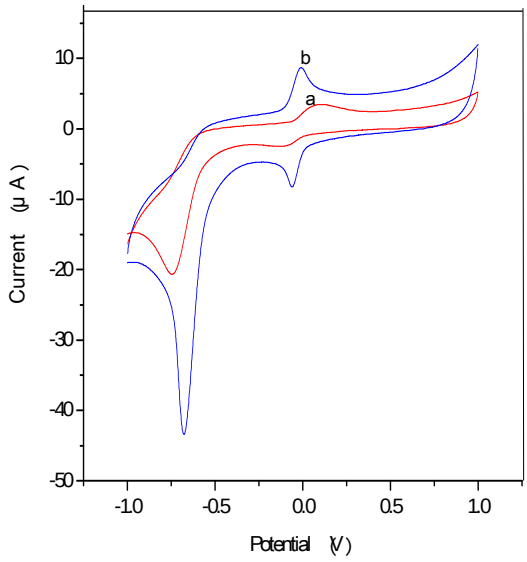


Figure 4.1 Cyclic voltammogram of 1 x 10^{-4} M CAP at: (a) bare GCE; (b) treated GCE; in 5 x 10^{-2} M acetate buffer (pH 5) at a scan rate of 100 mV s^{-1}

4.2 ELECTROCHEMICAL BEHAVIOR OF CAP AT TREATED GCE

The Cyclic Voltammogram

The electrochemical behavior of CAP was characterized by cyclic voltammetric technique as shown in Figure 4.2 below. During the first cycle, in the cathodic direction, a reduction peak (peak A) was observed at -0.674 V. On the reverse anodic scan no oxidation peak was observed corresponding to peak A, indicating that the reduction peak is irreversible while an oxidation peak (peak B_1) appeared at 0.005 V. During the second cathodic sweep, a new reduction peak (peak B_2) that is chemically reversible with peak B_1 was observed at -0.068 V.

Hence the observed peaks of CAP in Figure 5.3 can be described by the following electrochemical reactions. [7]

$$R\text{-}NO_2 + 4e^- + 4H^+ \longrightarrow R\text{-}NHOH + H_2O \quad \text{peak A} \qquad (5.1)$$

$$R\text{-}NHOH \rightleftharpoons R\text{-}NO + 2H^+ + 2e^- \quad \text{peak} B_1/B_2 \qquad (5.2)$$

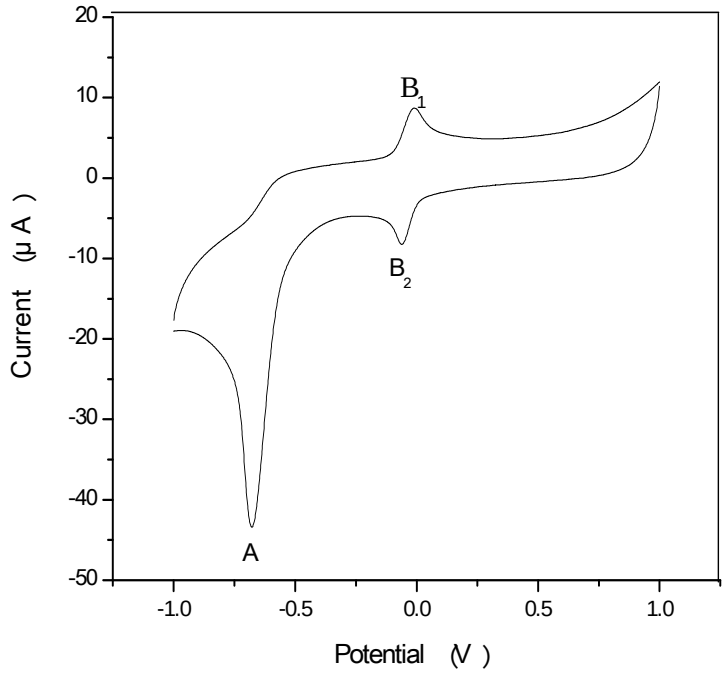


Figure 4.2 Cyclic voltammogram of 1 x 10^{-4} M CAP at treated GCE; in 5 x 10^{-2} M acetate buffer (pH 5) at a scan rate 100 mV s^{-1}

According to some literatures, the electrochemical reduction of nitro- aromatic compounds has been claimed to be a complex process that depends on; the number of nitro groups, their relative positions on the ring, and the nature of the substituent on the aromatic system.[30] CAP-NO_2 type nitro compounds display two reduction peaks (Fig. 4.2); the first one (peak B_2) is similar to those appearing in the reduction of the nitro compounds lacking a proton donor group and the second peak (peak A) is a new wave appearing at less negative potentials, associated with nitro to hydroxylamine reduction through a self-protonation reaction. The cathodic peak potentials of nitro CAP, change to less negative potentials when the position of this group in the main molecule is changed from ortho-,meta- to para- position.[31] The electrolytic reduction of nitro group (-NO_2) to hydroxylamine group (-NHOH) involves four electron irreversible reduction, whereas reduction of (–NO) to (–NHOH) involves two electron reversible reduction. [11-15]

As the number of cycles is increased the peak currents of the redox couple (B_1 and B_2) peaks increased while the peak current of peak A decreased for the first four repetitive cycles (Fig.4.3), showing that the product of the irreversible reduction of CAP remained on or near the electrode surface and was oxidized on the anodic sweep. This indicates that the irreversible reduction of CAP (peak A) is responsible for the formation of B_1 and B_2.

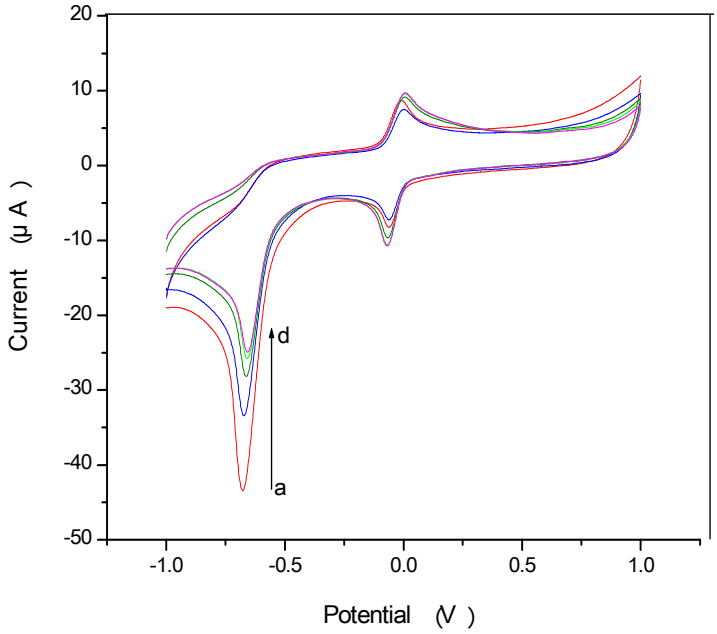


Figure 4.3 Cyclic voltammogram of 1 x 10^{-4} M CAP: for four repetitive cycles, (a) to (d) at treated GCE; in 5 x 10^{-2} M acetate buffer (pH 5) at a scan rate of 100 mV s^{-1}

4.2.1 EFFECT OF BUFFER AND pH OF SUPPORTING ELECTROLYTE

A series of buffer solutions including acidic buffer, KCl/HCl; acetate buffer, CH_3COOH/CH_3COONa and phosphate buffer, KH_2PO_4/Na_2HPO_4 were tested as supporting electrolytes for their suitability in the determination of CAP. The peak height and shape of the voltammograms were considered for the choice of the supporting electrolytes (Figure 4.4 compares their cyclic voltammogram). The optimum buffer solution chosen for subsequent studies was acetate buffer and was used throughout the study.

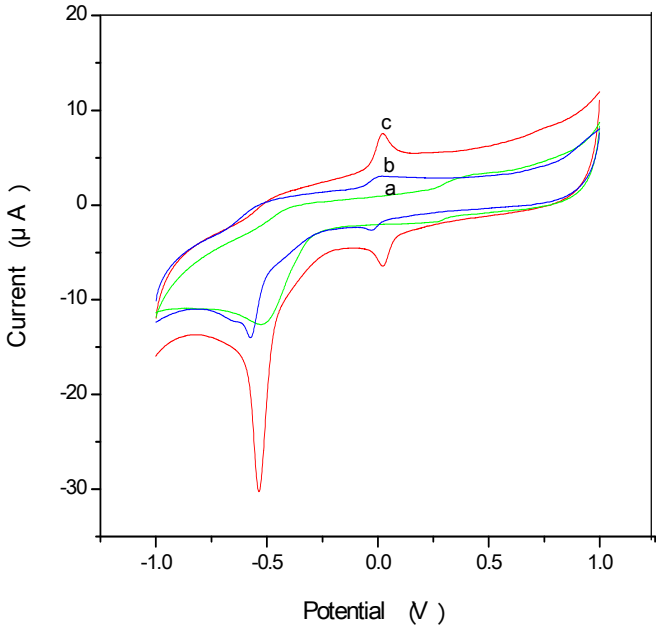


Figure 4.4 Cyclic voltammograms of 2 x 10^{-4} M CAP in: (a) 1M KCl/HCl buffer (pH 0.9), (b) 1M KH_2PO_4/Na_2HPO_4 buffer (pH 6); (c) CH_3COONa/CH_3COOH buffer (pH 5.3); 5 x 10^{-2} M at treated GCE with scan rate of 100 mV s^{-1}.

The influence of pH on the peak current of CAP was investigated over the range of pH 4- 6. There is a variation in current and peak potential with pH; when the pH is increased, the peak current is shifted to a more negative potential (Figure 4.5) The peak current is low at high pH ranges and starts increasing as the pH decreases and reaches maximum at pH 5, then decreases slightly low pH. The high current values in acidic buffer solutions are expected since the reduction of the nitro group of CAP to hydroxylamine involves H^+ ions (eqn. 4.1).

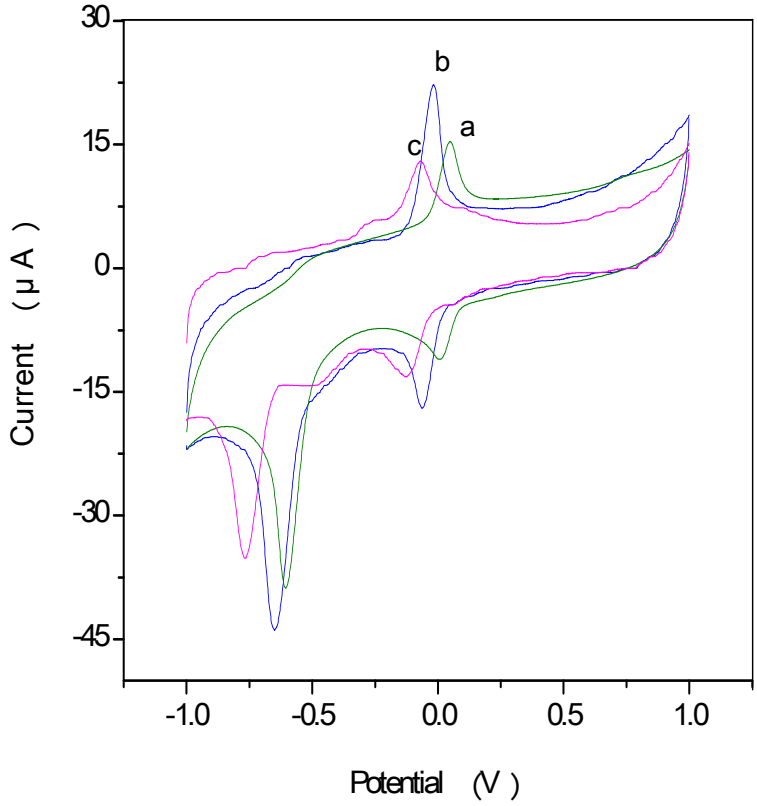


Figure 4.5 Cyclic voltammogram of 2 x 10^{-4} M CAP in pH range of (a) pH 4, (b) pH 5 and (c) pH 6 in 5 x 10^{-2} M acetate buffer at treated GCE and a scan rate of 100 mV s^{-1}

The shift in the cyclic voltammetry peak potential that can be obtained easily corresponding to the peak current, as a function of pH was studied and linear dependence was observed (Fig. 4.6). A linear range which is described by the following equation was obtained.[7]

$$Ep/V = -83.65pH + 397.65;\ r = -0.99134 \quad (4.3)$$

The dependence of the peak potential on the pH has slope of -83.65 mV per unit pH. This implies that the ratio of the number of protons to the electrons is 1:1 for the step in which the electrode Process is reversible which is in accordance to equation (4.1). Electrode processes involving a weak acid or a weak base have a potential - pH variations which show a change in slope at pH = pKa. [7]

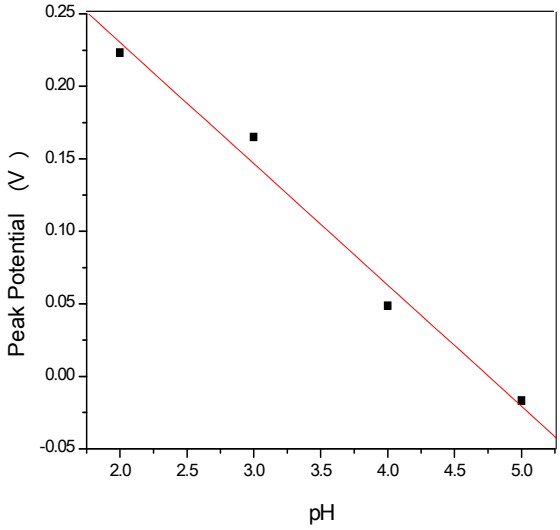


Figure 4.6 Shift in the CV peak potential of 2 x 10^{-4} M CAP as a function of pH

4.2.2 SCAN RATE DEPENDENCE STUDY OF PEAK CURRENT

The net cathodic peak current has a linear relationship with the square root of the scan rate ($v^{1/2}$) with a correlation coefficient (r) of 0.9982 as can be seen in the inset of the graph (Figure 4.7). The results indicated that the electrochemical reaction of chloramphenicol is a diffusion controlled process.

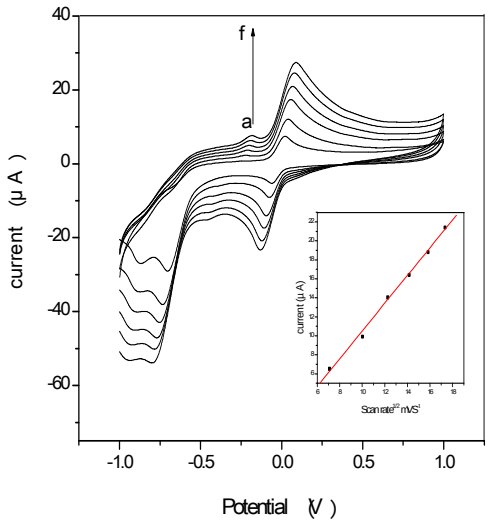


Figure 4.7 Cyclic voltammogram of 2 x 10^{-4} M CAP at different scan rates (a) 50 to (f) 300 mVs^{-1} in 0.05 M acetate buffer (pH 5) at treated GCE.

$$y = A + B * x;\ i_p = 1.46041.v^{1/2} - 4.08729 \quad (4.4)$$

4.2.3 EFFECT CAP CONCENTRATION ON PEAK CURRENT

Figure 4.8 shows the cyclic voltammetry responses of chloramphenicol solutions in the concentration range of 1.6 x 10^{-6} to 2 x 10^{-4} M. The net peak current was found to be directly proportional to the bulk concentration of CAP in the given concentration range with a linear relationship of (r = 0.999), as shown in the inset of the figure.

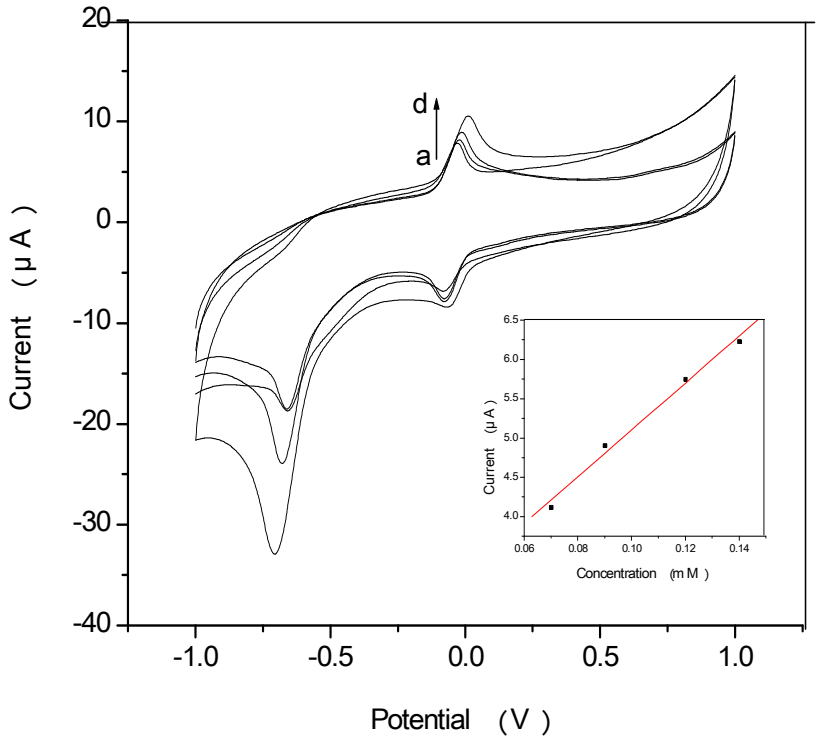


Figure 4.8 Cyclic voltammograms of CAP at different concentration range of (a) 0.0016, to (d) 0.2 mM in 0.05 M acetate buffer (pH 5) at treated GCE and a scan rate of 100 mV s^{-1} with a plot of peak current as a function of concentration in the inset of the figure.

4.3 DETERMINATION OF CONCENTRATION AND THE DETECTION LIMIT

Cyclic voltammeter was applied to determine the concentration of CAP in the three samples: CAP eye drop, CAP oral suspension and sodium succinate. The concentration of CAP in these samples was determined from the calibration curve plotted as standard concentration added *Vs* corrected peak current (the product of the peak height (h) and dilution factor (d)) represented in (eqn 4.5).

$$y = A + B * x,\ y = h.d \quad (4.5)$$

Where y = corrected peak current in µA. A = y-intercept in µA, B = slope of the curve and *x* = concentration in $mgmL^{-1}$

The unknown concentration "x" was then calculated at zero current response (h = 0) by extrapolating the linear curve to the left of the origin. At this point the value of "x" becomes the ratio of negative of y-intercept to the slop of the graph (x = -A/B). The magnitude of the ratio was taken as the required concentration of CAP in the given sample.

4.3.1 ANALYSIS OF CAP AS EYE DROP

The amount of CAP was detected in CAP eye drop sample using CV. The analysis was applied in 10 mL of the sample followed by standard addition of 1 x 10^{-4} M CAP solution. The net peak current increases with increase in the volume of standard added. The plot of peak current versus concentration added (inset of Fig.4.9) show good relationship of r = 0.998.

The concentration of CAP in the sample was then calculated to be x = 5.79 $mgmL^{-1}$ from the calibration curve at zero current response (h = 0) and is the ratio of –A = 101.375µA to B = 1.75.

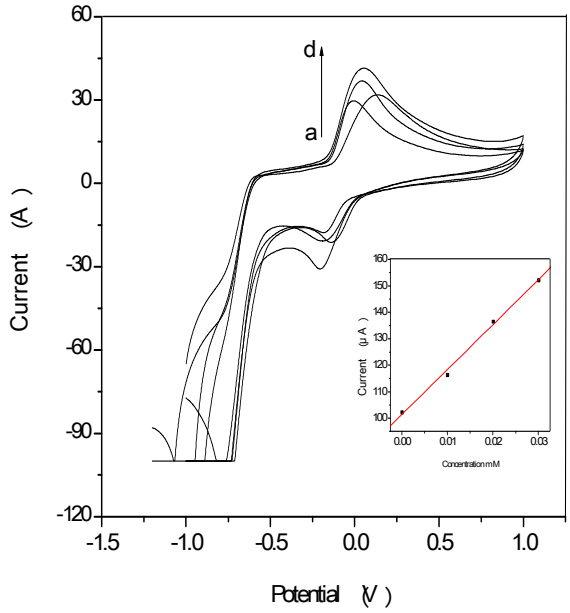


Figure 4.9 Cyclic voltammogram of CAP eye drop at additions; (a) 0, (b) 1, (c) 2 and (d) 3 mL 1 x 10^{-4} M CAP in 0.05 M acetate buffer (pH 5) at treated GCE and a scan rate of 100 mV s^{-1} with a plot of peak current as a function of concentration in the inset of the figure.

4.3.2 ANALYSIS OF CAP AS ORAL SUSPENSION

The analysis was applied in the same manner with the analysis of CAP in eye drop samples and the net peak current increases linearly with concentration added. The plot of peak current versus concentration added show good linear range of r = 0. 99927. (Inset of Figure 4.10).

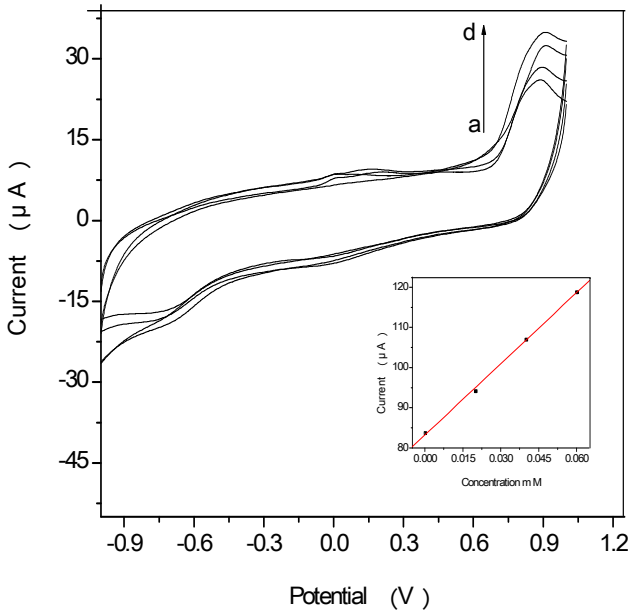


Figure 4.10 Cyclic voltammograms of CAP oral suspension at additions; (a) 0, to (d) 3 mL of 1 x 10^{-4} M CAP in 0.05 M acetate buffer (pH 5) at treated GCE and a scan rate of 100 mV s^{-1}.

The concentration of CAP with A = 80.245 µA, B = 0.5988 and extrapolating the curve to zero current was *x* = 26.802 $mgmL^{-1}$.

4.3.3 ANALYSIS OF CAP AS SODIUM SUCCINATE

In this case the analysis was carried out in the powder sample per vial by dissolving the powder in distilled water followed by addition of different volumes of 1 x 10^{-4} M CAP solution. As usual, an increase in peak current with increasing concentration was observed. The plot of peak current as a function of concentration added (inset of fig.4.11) gave a linear relationship of r = 0. 99999, slope of B =2.409 and y-intercept of A = 321.27µA.

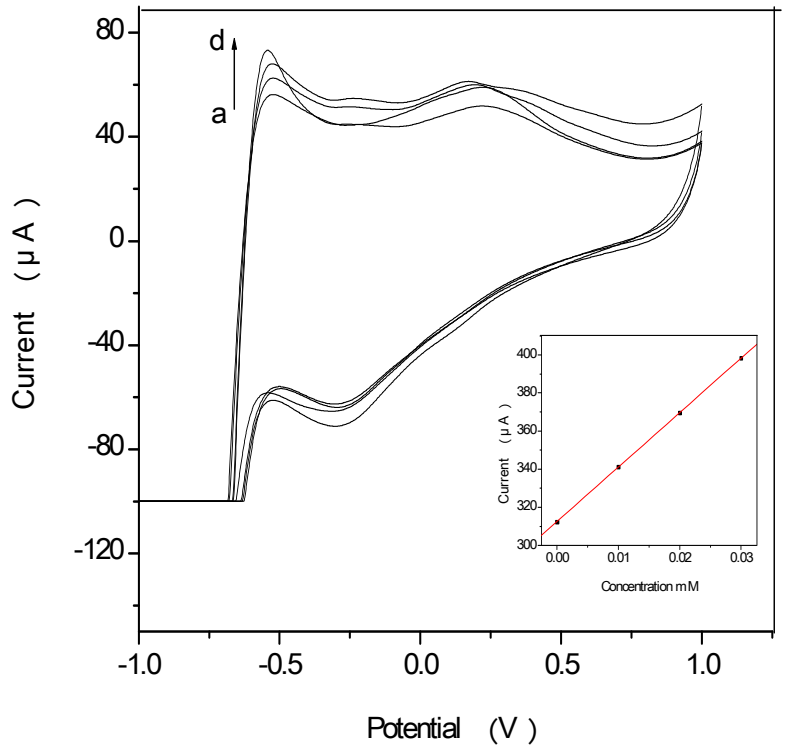


Figure 4.11 Cyclic voltammograms of CAP Sodium Succinate at additions; (a) 0, to (d) 3 mL of 1 x 10^{-4} M CAP in 0.05 M acetate buffer (pH 5) at treated GCE and a scan rate of 100 mV s^{-1}.

Calculation of concentration from the calibration curve at extrapolated zero current value gave a concentration of x = 109.3 $mgmL^{-1}$.

4.4 COMPARISON ON CONCENTRATION DETERMINED WITH PHARMACEUTICAL VALUES

The concentrations of CAP obtained in these three tablet samples were compared with the given pharmaceutical values. The values obtained from the voltammetric analysis show very good agreement with the pharmaceutical ones. As it is seen (Table 1), all the voltammetric results are greater than the pharmaceutical values.

From the results obtained, we can understand that cyclic voltammeter has good detection limit and give stable voltammogram.

Table 1 Comparison between cyclic voltammeter analysis results and pharmaceutical values.

No.	Sample type	Concentration Expected (mgmL-1)	Concentration found (mgmL-1) ± SD	Concentration difference (mgmL-1)
1	CAP Eye drop	5	5.79 ± 1.73241	0.79 (13.6%)
2	CAP Oral suspension	25	26.802 ± 0.713	1.802 (6.72%)
3	CAP Sodium succinate	100	109.3 ±0.14911	9.3 (8.5%)

Key; SD = standard deviation

5 CONCLUSION

The method described in this work has shown that CPA can be determined by cyclic voltammetry using electrochemically pretreated glassy carbon electrode with electrochemical stability in pH 5 acetate buffer solution. This electrode exhibited excellent performance for the reductive detection of chloramphenicol. Well-defined voltammograms were obtained at the GCE, which exhibited higher sensitivity. The electrochemical pretreatment, the buffer system and the optimized instrumental parameters were found to greatly influence the response of the voltammeter method. This method was successfully applied for the determination of CAP in pharmaceutical formulations (eye drop, oral suspension and sodium succinate), showing that the method is sensitive and precise as the experimental results are closer to the pharmaceutical values. Thus, electrochemical pretreatment of GCE solves the poor detection limit of normal GCE for CAP determination successfully and this pretreatment is more important and reasonable.

6 RECOMMENDATION

Since cyclic voltammeter can be used in both quantitative analysis and for displaying well-defined voltammograms (qualitative analysis), it is recommended to use this technique for determining the level of chloramphenicol in other sources and also other similar antibiotics.

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Ergonomics Evaluation and Design Modification of Foot Operated Punching Machine used by Workers

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ABSTRACT: There are many causes of WMSDs, and to prevent them, the whole work situation must be taken into consideration; it is therefore a difficult issue to handle. First, it is important to understand what is going on, to get rid of any biases, to find out the facts. Then, it is necessary to address and evaluate the seriousness of the situation prevailing in the workplace. If the situation is acceptable, it may be sufficient to simply remain alert and ready to intervene at the slightest sign of deterioration. If, however, it becomes obvious that the situation is problematic, either because there are already signs of identified. This project demonstrates that there is ample room for ergonomic improvements in the lock industry. We need to continue to identify problems and, more importantly, implement solutions to reduce the risk of injuries in situations where we know problems exist.

KEYWORDS: WMSDs (work related musculoskeletal disorder), Elbow, Upper Arm, Lower Arm,

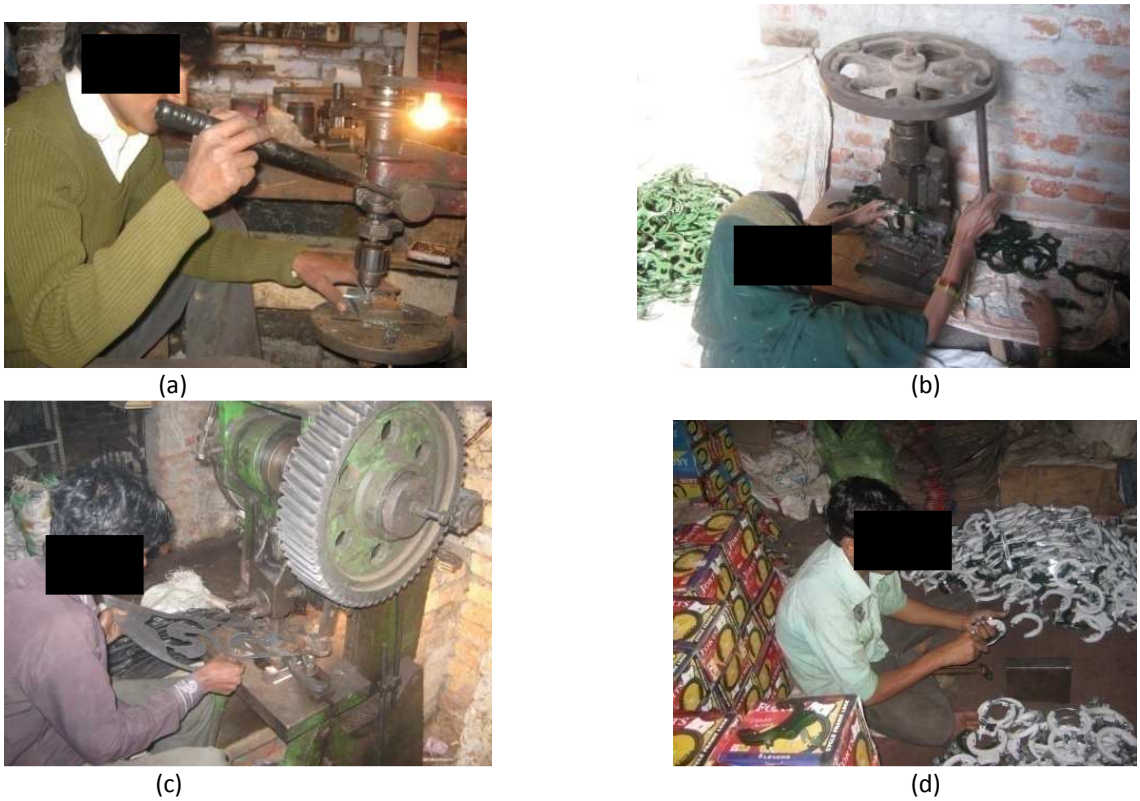
1 INTRODUCTION

In 1994 (NIOSH 1997) work related upper extremity compressed 13 % of the illness cases involving lost day from work and the total illness cases reported is 69 %. In 1990's there are lots of occupational health problem to be encountered. In 1990 the bureau of labour collect the statistics report which shows that all the reported cases of occupational illness 56% were associated with repeated traumas. According to Bernard (1997), the bureau of labour statistics (BLS 1990) reported a further cause in that there were approximate 705800 (32 %) cases of over exertion or repetitive motion injuries among all the injuries repeated. They also reported that 92576 injuries or illness occurred as a result of repetitive motion. The percentage of work related musculoskeletal disorder (WMSD) to total injuries and illness has continued to increase from 62 % in 1995 to 66 % in 1999 (BLS 2000a). In 1999 approximate 25000 WMSD's cases were reported with the meat processing industry (BLS200b). There were approximately 26266 new CTS cases reported in 1998 (BLS 2000c).The prevalence of clinically verified commutative trauma disorder of wrist and Luanda, consisting primarily of tendon disorder ranged from 1% to 25 % in an industrial working population. According to the force demand and repetitiveness of the works (Silverstein 1985, Silverstein et al 1986).Work related neck and upper lib musculoskeletal disorders is a worldwide problem in north America, 20% of newspaper employees in Canada (Polanyi el al 1997) and 11.7% of U.S workers identify themselves with upper limb discomfort (Morse et al 2003) further 30% of non manual U.K workers report discomfort at one or more sites in the neck or upper limbs (Palmers et al 2001). In Taiwan the prevalence of neck and shoulder discomfort is 14.8 % and 16.8 %. In a survey of 17669 workers respectively (Lee et al 2005).WMSDs of the shoulder are common in manufacturing and construction trades. The prevalence of the disorders such as shoulder tendonitis has been reported to be as high as 30-40% (Olson 1987, Holmstrom el al. 1992). Herbert el al. (1981) estimated an18% prevalence for supraspinatus tendonitis in shipyard welders

and an overall incidence rate of 15-20% for the welder population. Rosrcrance et al. (1996) reported that 41% of a sample of construction workers in a pipe trades complained of the work related shoulder pain with tasks performed in differing posture s including directly overhead Hagberg and Wegman found that material handling and force/torque exertion with the aid of human powered hand tools, account for approximately 45% of all industrial overexertion injuries in US. Yun et al. reported 51.4% cases of shoulder MSDs problems among VDT workers in Bank of Korea. In an epidemiological investigation of WMSDs according to Smith et al. among the nursing student in Japan, the shoulder was the most affected part (14.9%). Similarly, among rural Australian nursing students, Smith and Leggat observed prevalence rates of 23.8% for shoulder WMSDs while Chyan et al. reported rates of 58% for shoulder WMSDs among Taiwanese hotel restaurant workers .Based on a cross – sectional study of 104 workers at an aluminum smelter, Hughes et al. recorded a prevalence rate of 11.6% elbow and forearm injuries. Similarly Ritz recorded a prevalence rate of 14% for humeral epicondylitis, among gas and water work employees.

2 TASK SELECTION

An industrial survey was conducted in lock factory in Aligarh. There were different types of operation performed on the machine for making locks. In this survey it was observed that workers faced many problems related to, work related musculoskeletal disorders (WMSDs). There were different types of task such as hand operated drilling, foot operated punching, and hand operated punching, flattening and assembly operation. Figures of these tasks as shown below.



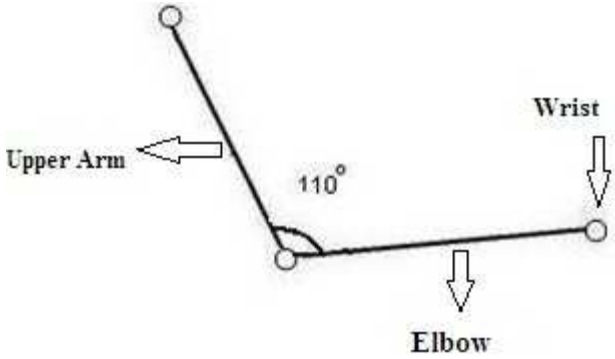
(a) (b)

(c) (d)

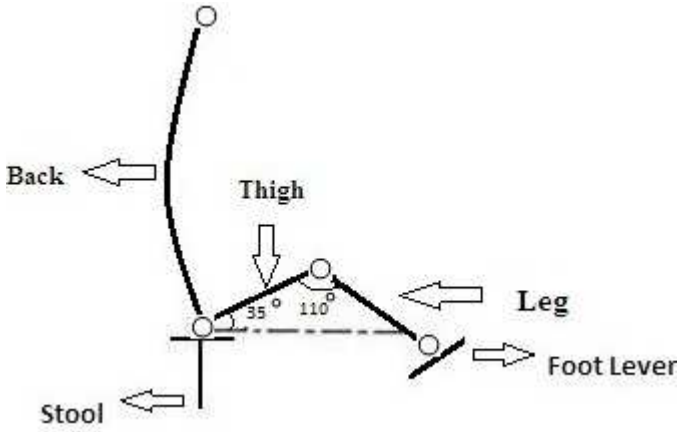
Figure 1:- (a) Hand operated drilling machine, (b) Hand operated punching machine, (c) Foot operated punching machine, (d) Final inspection

3 PROBLEM FORMULATION

There were different task in lock factory. The task selected for study purpose was foot operated punching Machine using power press. In this task, operator performs the operation with poor posture such that they bear the pain in thigh, wrist and back.



(a)



(b)

Figure 2:- (a) Position of hand during operation, (b) Position of Feet during operation

SPECIFICATION OF TASK

- Height of machine=56”
- Height of driller=28”
- Height of foot lever=9”
- Height of stool=17”
- Height of unfinished product=12”
- Distance between the unfinished product and hand=14”
- Distance between foot lever and stool=15”

4 MODIFICATION POSSIBLE

In this task the operator performed the operation with poor posture; their posture could be modified with ergonomics point of view. The existing postures of the operator are as given below.

4.1 EXISTING POSITION OF HANDS AND LEGS

During operation, the operator performed the task in such a manner that their existing posture was not good with ergonomics point of view. The angle of their forearm and knee joint with horizontal axis was very wide, thus they bear the pain during operation.

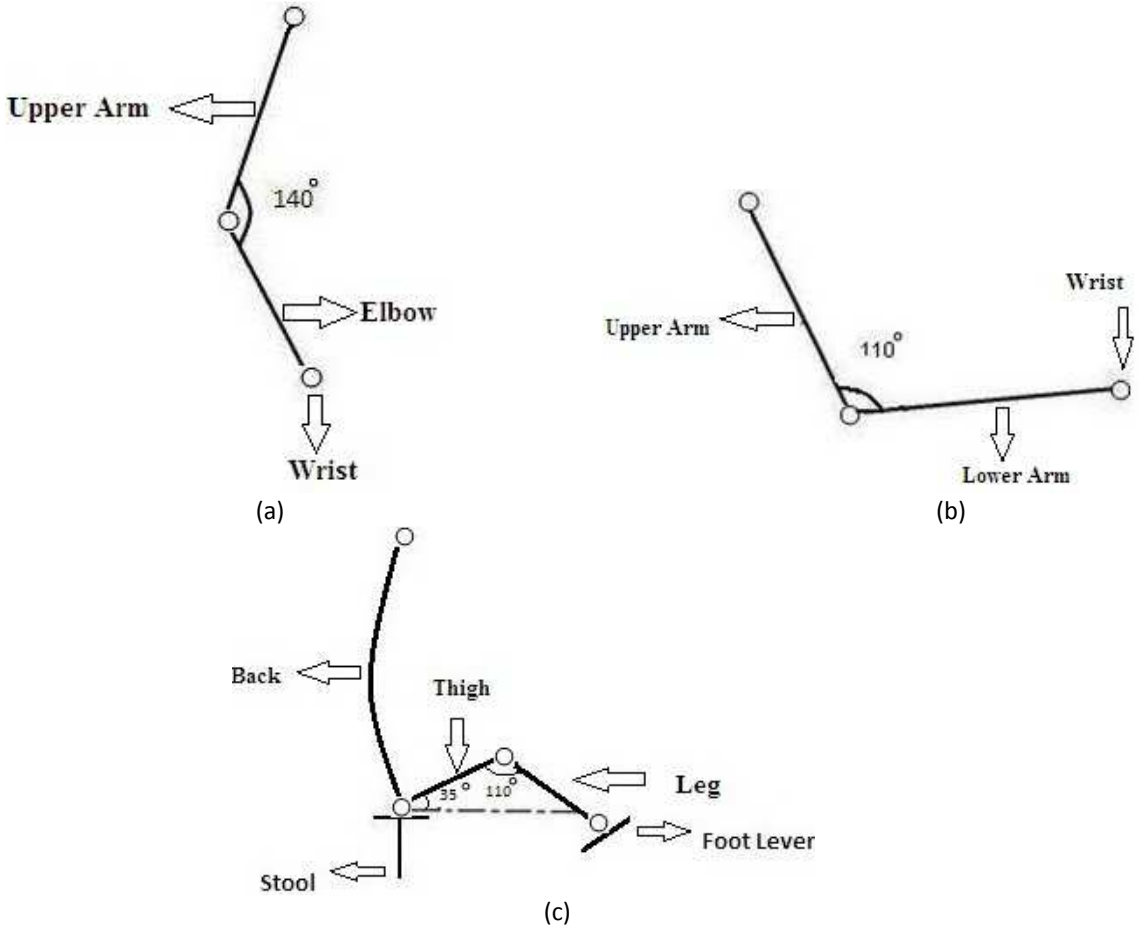


Figure 3:- When operator taking unfinished product, (b) during operation, (c) Pressing the foot lever

5 MODIFICATIONS IN FOOT LEVER

5.1 CHANGING THE POSITION OF FOOT LEVER

In this task, foot lever was so far away from the operator such that operator did not feel comfort during operation. If the foot lever was shifted to the center of the machine then the angle of knee joint will be reduce 110^0 to 90^0. Thus the operator needs to apply less effort.

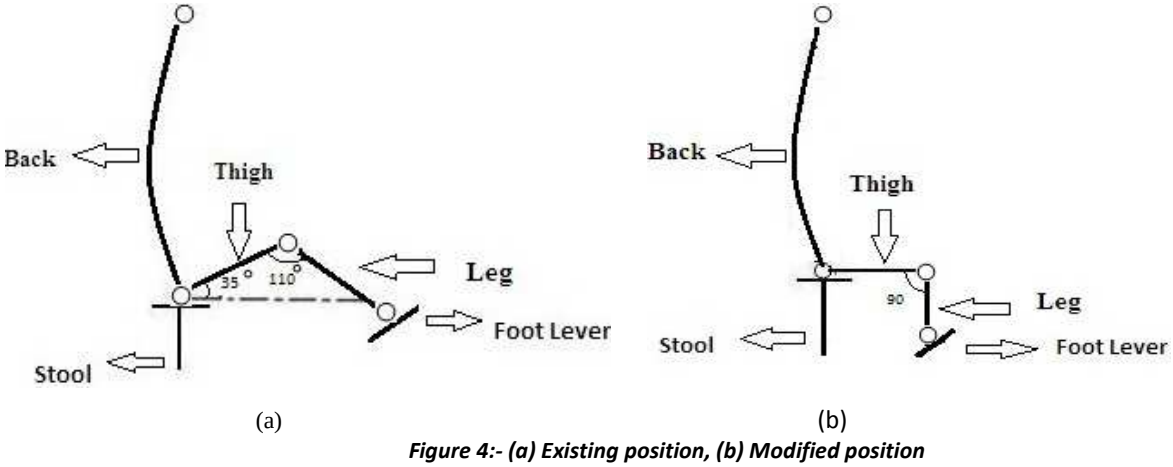
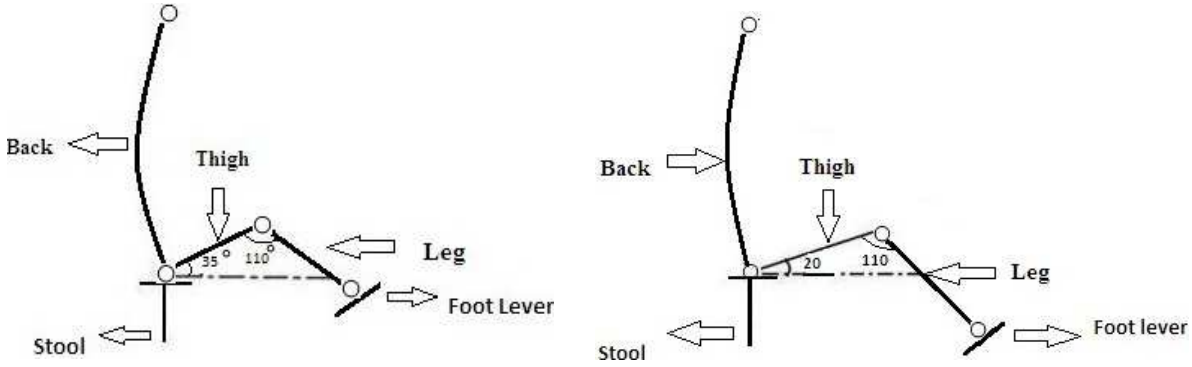


Figure 4:- (a) Existing position, (b) Modified position

5.2 DECREASE THE HEIGHT OF FOOT LEVER

If the height of foot lever was decreased then the angle between the thigh and horizontal axis will be reduced from 35^0 to 20^0. Thus the thigh pain would be minimized.

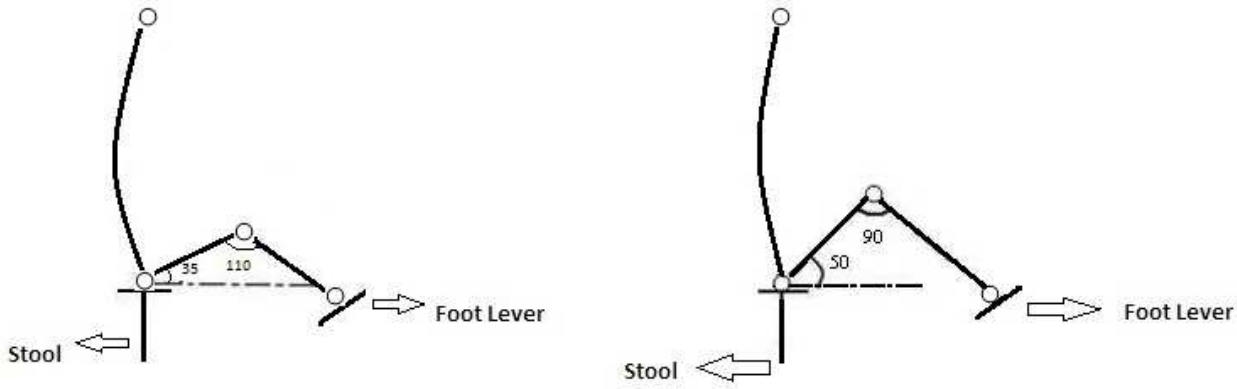


(a) (b)

Figure 5:- (a) Existing position, (b) Modified position

5.3 DECREASE THE DISTANCE BETWEEN FEET AND FOOT LEVER

If the distance between the feet and foot lever was minimized then the angle between the knees joint will be minimize from 110^0 to 90^0, and increase in angle between the thigh and horizontal axis.



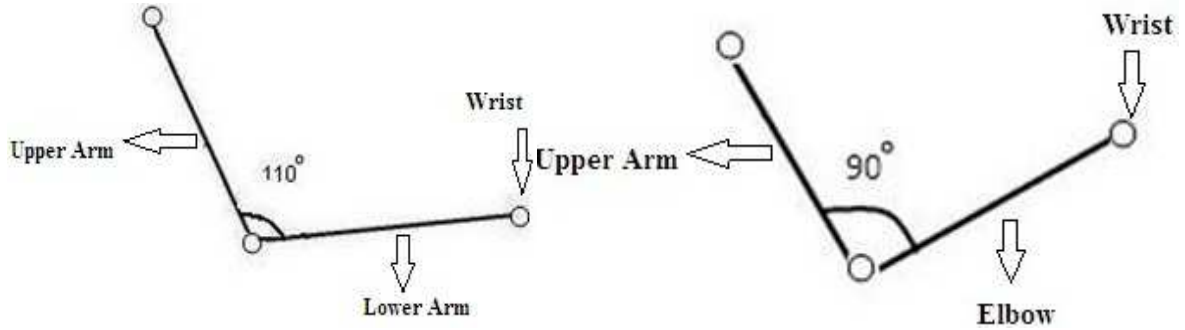
(a) (b)

Figure 6:- (a) Existing position, (b) Modified position

6 MODIFICATION IN THE HEIGHT OF STOOL AND MACHINE

6.1 INCREASE THE HEIGHT OF STOOL

If the height of stool was increased then the elbow flexion angle of the operator could be reduced. During this operation the angle of elbow flexion was 110^0 and when the height of stool was increased then elbow flexion angle will be reduced to 90^0. Thus the operator could perform the same task with less effort.

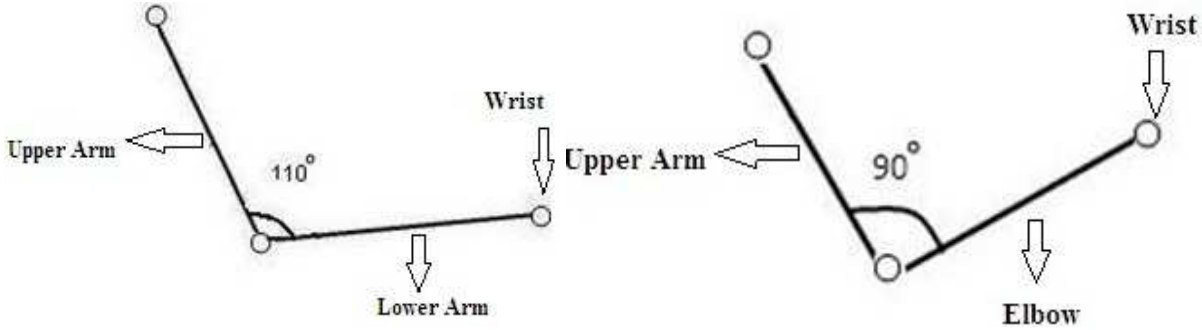


(a) (b)

Figure 7:- (a) Existing Position of hand, (b) Modified Position of hand

6.2 INCREASE THE HEIGHT OF MACHINE TABLE

Elbow flexion angle can also be reduced by increasing the height of machine table. In this operation the height of drilling machine table was 28" such that during operation angle of elbow flexion of operator was 110^0. If the height of table was increased then the elbow flexion angle could be reduced to 90^0.

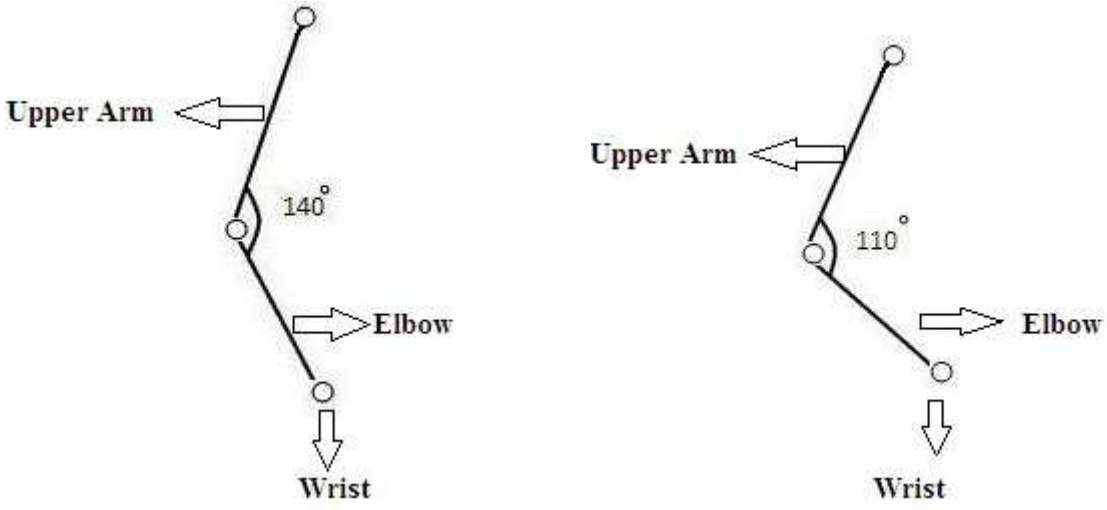


(a) (b)

Figure 8:- (a) Existing Position of hand, (b) Modified Position of hand

6.3 MODIFICATION IN THE HEIGHT OF UNFINISHED CONTAINER

When the operator was taking the unfinished product then the elbow flexion angle was 140^0. If the height of unfinished container was increased then the elbow flexion angle could be reduced to 110^0.



(a) (b)

Figure 9:- (a) Existing Position of hand, (b) Modified Position of hand

7 IMPROVEMENT IN WORK PLACE, TASK AND TOOL

The risk of work related musculoskeletal disorders can be reduced by applying ergonomics principles. Workstation design, equipment and tools, work environment, and work organization are work components that affect ergonomic risk factors. An ergonomic design can include such factors as adjustable seating, angled hand tools, or a work pace that can change to suit the worker

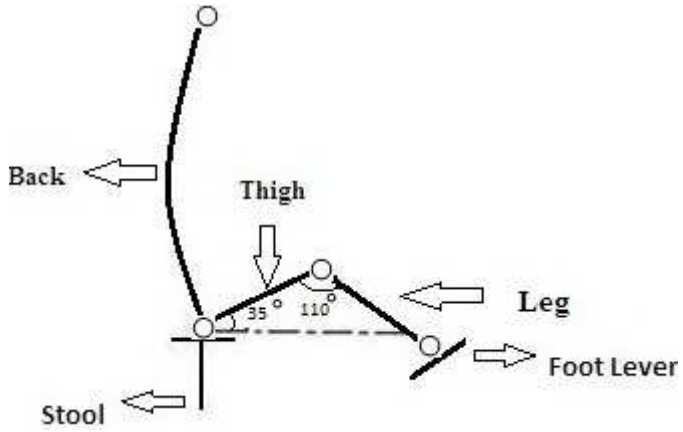
Working with the arms above shoulder height increases the risk of developing shoulder injuries. Awkward postures can be reduced by raising the worker on a platform and/or lowering the work piece. In this task the operation of machine is not so good ergonomics points of view. There were lots of awkward postures such that the operator did not perform the operation comfortably.

There are different types of risk factor during the operation.

- Uncomfortable of seating arrangement.
- Bending and twisting of hand.
- Lifting done above shoulder height.
- Adjustability of work table.
- Raising of elbow during operation.

7.1 CHANGING THE POSITION OF FOOT LEVER

In this task foot lever is so far away from the operator such that the angle of knee joint was 110^0 which is more uncomfortable for operation so we required to reduce that angle such that operator could performed the operation with less effort.



(a)

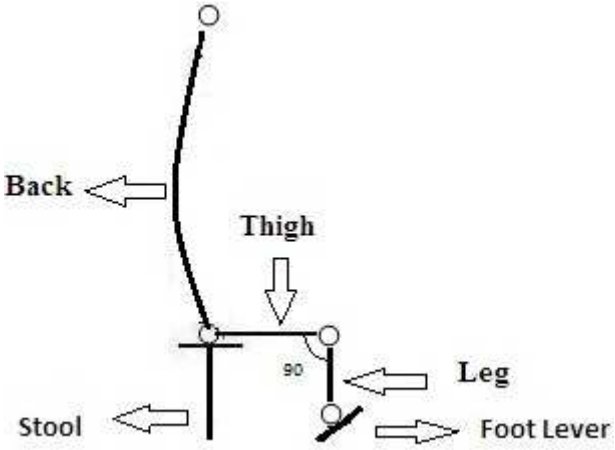
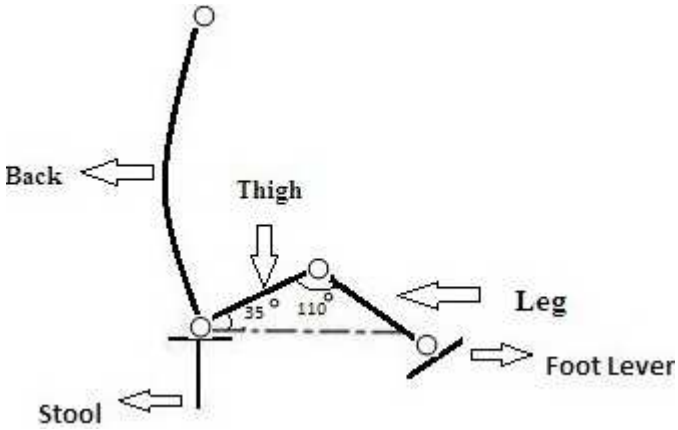


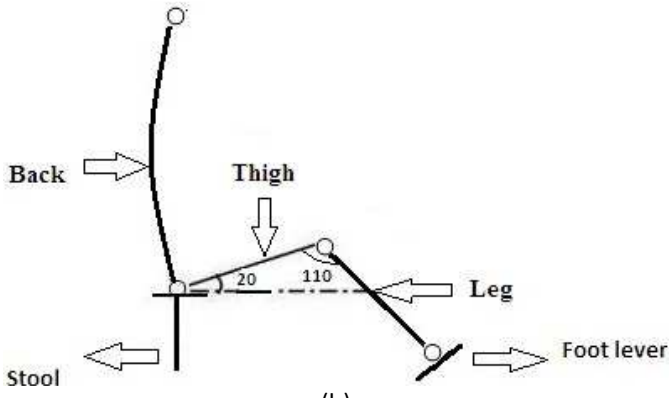
Figure 10:- (a) Existing position, (b) Modified position

7.2 DECREASE THE HEIGHT OF FOOT LEVER

In this task the height of foot lever is very high such that the operator was not feeling so good and they bear the pain in thigh so if the height of foot lever was decreased then the angle between the thigh and horizontal axis will be reduced from 35^0 to 20^0. Thus the thigh pain would be minimized.



(a)

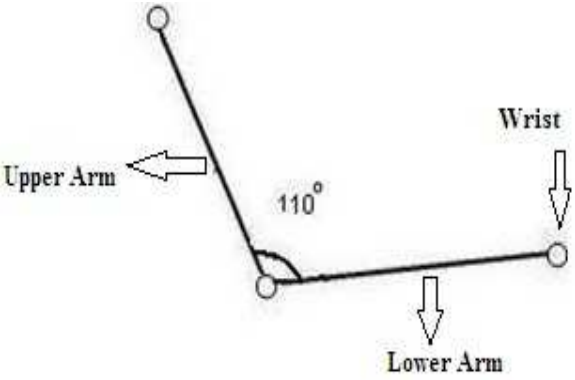


(b)

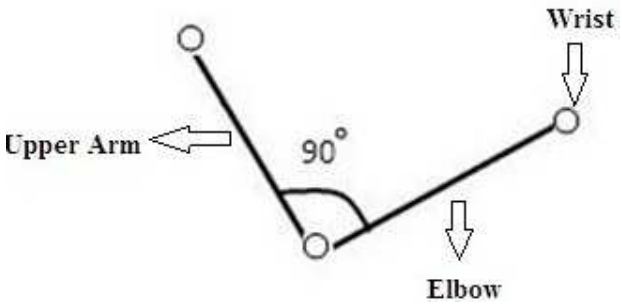
Figure 11:- (a) Existing position, (b) Modified position

7.3 INCREASE THE HEIGHT OF MACHINE TABLE

An ergonomic design can include such factors as adjustable seating, angled hand tools, or a work pace that can change to suit the worker. In this task if the height of machine table increased than we can reduce the elbow flexion angle from 110^0 to90^0.



(a)



(b)

Figure 12:- (a) Existing Position of hand, (b) Modified Position of Hand

7.4 FINAL MODIFICATION

Work-related musculoskeletal disorders (MSDs) are impairments of body structures such as muscles, joints, tendons, ligaments, nerves, bones or a localized blood circulation system caused or aggravated primarily by the performance of work and by the effects of the immediate environment where the work is carried out. In this task we have observed all awkward posture such as location of foot lever, position of foot lever, stool height, machine table height etc. In final modification, we have changed the location of foot lever (into the middle of the machine) and increase the height of machine table such that the angle of knee joint and elbow flexion angle would reduce from 110^0 to 90^0 and 110^0 to 90^0 respectively. So the operator can do the same work with less effort and feel more comfort than the previous same work.

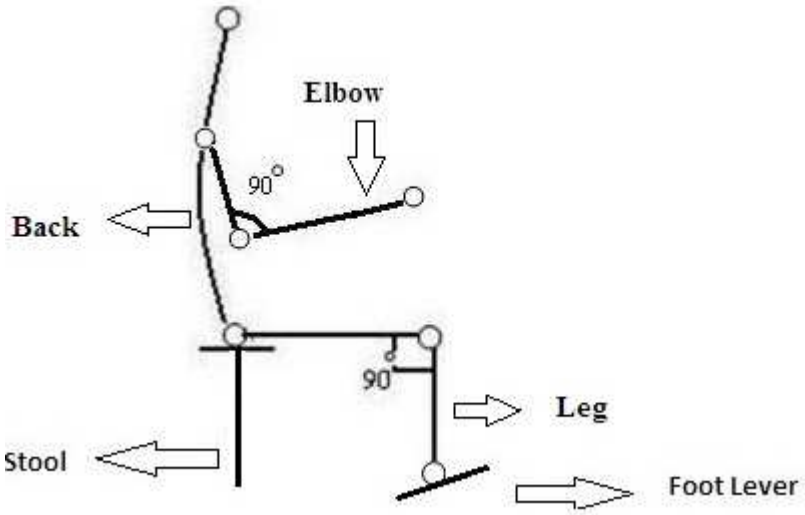


Figure 13:- Final Modification

8 CONCLUSIONS

WMSDs of muscles, tendons and nerves are a major cause of lost work in many labour-intensive industries. Occupational risk factors include continual repetition of movements, fixed body positions, forces concentrated on small parts of the body, and lack of sufficient rest between tasks.

Prevention must aim at eliminating the repetitiveness of the work by proper job design. Where this is not possible, preventive strategies such as good workplace layout, tool and equipment design, and proper work practices should be considered. Early recognition of these disorders is very important because medical treatments are unlikely to be effective once these injuries become longstanding. Preventive and control measures, in order to be truly effective, require significant involvement on the part of the workers, their representatives, and management to improve occupational health and safety

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Horticulture in India: A focus for two decades from 1991

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ABSTRACT: The study covers area, production and productivity of horticulture in India during the selected period of the study. The findings would help to understand the trends and set future course of action with regard to development of horticulture in India. In India, demand of horticultural crops and their export opportunities have been continuously increasing. It is felt that the significance of the crops which are becoming highly remunerative due to its price, especially horticultural crops. The study finds that the focus will be needed on the interstate variations of production of horticultural crops.

KEYWORDS: area, production, productivity, growth rate, crop.

1 INTRODUCTION

Horticulture is one form of diversification. Horticultural crops have been referred to as “garden crops”. This classification are those grown under any of the fields of horticulture such as floriculture or vegetable crops production, pomology or fruit crops production, and ornamental horticulture (floriculture and landscape horticulture), as well as spices and medicinal plants. Horticulture literally means garden culture or culture of garden crop. The horticulture sector encompasses a wide range of crops e.g., fruit crops, vegetables crops, potato and tuber crops, ornamental crops, medicinal and aromatic crops, spices and plantation crops.

The importance of horticulture in improving the productivity of land and also providing ample opportunities for sustaining large number of agro-industries which generate substantial employment opportunities, improving economic conditions of the farmers and entrepreneurs, enhancing exports and, providing nutritional security to the people, is widely acknowledged. Horticultural products are generally utilized with high moisture content and are therefore highly perishable. These crops can be defined as “intensively cultured plants directly used by man for food, for medicinal purposes, or for esthetic gratification”. Intensive culture means a large input of capital, labor and technology per unit area of land (Janick, 1972).

Diversification of agriculture has been taking place in several forms in India. Horticulture is one form of diversification. However, horticultural development had not been a priority in India until recent years. In the period 1948-80, the main focus of the country was on cereals.

much planned efforts had not been made for horticultural development, except for some technical support and development efforts for specific commodities like spices, coconut and potato. During 1980-92 there was consolidation of institutional support and a planned process for the development of horticulture. It was in the post-1993 period that a focused attention was given to horticulture development through an enhancement of plan allocation and knowledge-based technology (NHB, 2005).

Horticulture, has gained commercial tone in recent years and is an important component of Agriculture, having significant share in the economy of the country. India has the advantage of diverse agro-climatic conditions which enables it to produce a wide range of horticultural crops round the year. Horticulture contributes nearly 28 per cent of GDP in agriculture and 54 per cent of export share in agriculture. In past one decade, the change in cropping pattern is more towards the horticulture

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sector and commercial crops. In India, demand of horticultural crops and their export opportunities have been continuously increasing. It is felt that the relative significance of the crops which are becoming highly remunerative due to price factor, especially horticultural crops, should be increased in the cropping pattern mix, as there is a positive nexus between increases. Fruits and vegetables are the largest sub-sector of horticultural crops in the relevance of such crops and growth in overall output (Joshi et a1. 2006 and Birthal et a1., 2007). This study would be proceeded with the following objective like to analyze the trends in area, production and productivity of horticultural crops in India. In order to accomplish the objective the study makes use of secondary data. The data were collected from various reports of Horticulture Data Base published by National Horticulture Board, Ministry of Agriculture, and Government of India, reports published by Directorate of Economics & Statistics and Directorate General of commerce Intelligence and Statistics. Data were also gathered from publications of Economic & Political Weekly Research Foundation. The data used for analysis are year wise data started from the period of introducing Globalization period that is 1991-92 to 2009-10. The data on area, production, productivity and exports of horticulture for India are used. Data on area, production and productivity of select crops were also used in the analysis. To understand states' share, data pertaining to each state of India on a particular point (recent year) were used. The statistical tool like annual growth rate is used to portray trends in the variables under study. The data (including computed) are tabulated and tabular analysis is carried out.

2 ANALYSIS AND DISCUSSIONS

2.1 AREA UNDER HORTICULTURAL CROPS: CROP WISE

In this section the trends in area under select horticultural crops in India are analyzed. The data with growth rate for select crops viz., fruits, vegetables, plantation, and spices are given in Table 1.

Table 1
Area Under Horticultural Crops: Crop Wise Growth Rate In India From 1991-92 To 2009-10

(Area in 000' hec)

YEAR	FURITS	VEGETABLES	PLANTATION CROPS	SPICES
1991-92	2874	5593	2298	2005
1992-93	3206 **(12)**	5045 **(-9.87)**	2337 **(2)**	2315 **(13.4)**
1993-94	3184 **(-1)**	4876 **(-3.3)**	2448 **(5)**	2472 **(6.3)**
1994-95	3246 **(2)**	5013 **(3)**	2546 **(4)**	2215 **(-12)**
1995-96	3357 **(3.4)**	5335 **(3)**	2733 **(7.3)**	2216 **(0.05)**
1996-97	3580 **(7)**	5515 **(3.4)**	2824 **(3.3)**	2372 **(7.04)**
1997-98	3702 **(3.4)**	5607 **(2)**	2847 **(1)**	2524 **(6)**
1998-99	3729 **(1)**	5873 **(5)**	2905 **(2)**	2531 **(0.27)**
1999-00	3797 **(2)**	5191 **(-12)**	2753 **(5.2)**	2500 **(-1.2)**
2000-01	3869 **(2)**	6250 **(20.4)**	2862 **(4)**	3200 **(22)**
2001-02	4010 **(4)**	6156 **(-1.5)**	2984 **(4)**	3220 **(1)**
2002-03	3788 **(-6)**	6092 **(-1)**	2584 **(0)**	3220 **(0)**
2003-04	4661 **(23)**	6082 **(-0.2)**	3102 **(4)**	5755 **(78.73)**
2004-05	5049 **(8.3)**	6744 **(11)**	3147 **(4)**	5909 **(2.68)**
2005-06	5324 **(5.4)**	7213 **(7)**	3283 **(4.3)**	2366 **(-59.96)**
2006-07	5554 **(4.3)**	7579 **(7)**	3207 **(-2.3)**	2448 **(3.3)**
2007-08	5857 **(5.4)**	7849 **(4.0)**	3190 **(-1)**	2617 **(6.4)**
2008-09	6101 **(4.2)**	7976 **(1.6)**	3217 **(1)**	2629 **(0.4)**
2009-10	6329 **(4.0)**	7985 **(0.1)**	3265 **(1.4)**	2464 **(-7)**

Source: National Horticulture Board, Ministry of Agriculture, Government of India

Figures in brackets are growth rates.

As far as fruits are concerned the area under fruits has increased over the study period. The growth rate of area under fruits posted only slow growth rate with fluctuations after 1992-93 (which registered 12 percent growth rate). But after 2000-01 the growth rate gained except during the year 2002-03. There is a decline in the growth rate after 2003-04. The growth

rate stood at 4.0 percent during the ending period of the study. It may be inferred that the growth rate of area under fruits showed fluctuations during the study period. But, the growth was slow during the first half of the study period and it was a little faster in the next half of the study period. The area under fruits increased from 2874 thousand hectares in 1991-92 to 6329 thousand hectares in 2009-10.

With regard to vegetables, it may be noted from the table that the area under vegetables was 5393 thousand hectares during the initial years of study i.e., 1991-92. It posted a slow growth rate after 1994-95 till 2003-04. But after the period the growth rate was positive. It may be concluded that the area under vegetables though registered slow growth rate and negative in a few years of study, in terms of absolute figures it has increased over the study period. The area under vegetables was 5393 thousand hectares during 1991-92 and it was 7985 thousand hectares in 2009-10.

As far as plantation crops are concerned, it may be noted that the growth rate was positive and considerable till 2005-06 (excluding 2002-03). Then it recorded a negative rate during 2006-07 and 2007-08. In the last two years of study it gained back**.** By and large it may be stated that the area under plantation has increased in absolute figures from 2298 thousand hectares during 1991-92 to 3265 thousand hectares during 2009-10. However the growth rate has been slow only.

It may be noted from the table that the area under spices was 2005 thousand hectares during 1991-92. It recorded a considerable growth rate till 1997-98. It gained back during 2000-01 and in 2003-04 the growth rate was noticeable by 3.8 percent. But after that with a little fluctuation the area under horticulture was reducing. The growth rate of area under spices dropped steeply as – 78.7 in 2003-04. It may be stated that the area under spices through has increased over the study period in absolute terms it posted negative figure in some periods. In the last six years of the study period it is declining.

2.2 TRENDS IN PRODUCTION OF HORTICULTURAL CROPS

The data on production of select horticultural crops in India for the period along with the growth rate are given in Table 2.

It may be noted from the table that the production of fruits was 28632 thousand tonnes during 1991-92. The growth rate of production of fruits was notable till 1995-96 (4 percent to 15 per cent). In the year 1996-97, the growth rate declined to -3 percent. It recorded an increase in 1997-98 and maintained positive growth till 1999-2000. In the years 2000-01 and 2001-02, the growth rate was negative as -5.1 and -0.3 respectively. Since 2002-03 the growth rate had been positive and notable. It may be concluded that the production of fruits in India was 28632 thousand tonnes in 1991-92 and it increased nearly by two and half times as 71516 thousand tonnes in 2009-10.

However the growth rate was fluctuating in between and especially in the middle years of study period it showed a negative growth rate.

The data regarding production of vegetables could be seen from the table. At the outset, it may be noted that the production of vegetables (in thousand tonnes) has increased from 58532 thousand tonnes in 1991-92 to 133738 thousand tonnes in 2009-10 thus recording a 2.28 fold increase over a period of 19 years. The growth rate of production was as high as 20.4 per cent during 2002-03. Like in the case of fruits the growth rate of vegetables was sluggish in the years 2001-02 and 2002-03. The growth rate of production however recovered and it was considerable in the remaining years.

It may be concluded that except a few years the production of vegetables showed positive growth with fluctuations in it. The production of vegetables was 58532 thousand tonnes in 1991-92 and it increased 2.28 fold as 133738 thousand tonnes in 2009-10.

With regard to plantation crops, it may be noted from the table that the quantity of production of plantation crops was 7498 thousand tonnes during 1991-92 and it increased to 11063 thousand tonnes during 2009-10 posting more than one and half a fold increase over 19 years. The growth rate of production increased in the initial three years of study period, but showed a stagnation till 2004-05 except the year 2003-04. Then the growth rate recorded and stood as 5.2 during the ending period of study 2009-10.

Table 2
Crop wise Growth rate of Production of Horticulture Crops in India from 1991-92 to 2009-10

(Production in 000 tonnes)

YEAR	FURITS	VEGE	PLANTATION	SPICES
1991-92	28632 (-)	58532 (-)	7498 (-)	1900 (-)
1992-93	32955 **(15)**	63806 **(9.1)**	8347 **(11.3)**	2291 **(21)**
1993-94	37255 **(13)**	65787 **(3.1)**	8666 **(6.2)**	2515 **(9.78)**
1994-95	38603 **(4)**	67286. **(3)**	9763 **(10.1)**	2477 **(1.51)**
1995-96	41507 **(8)**	71594 **(6.4)**	9360 **(-1.4)**	2410 **(-3)**
1996-97	40458 **(-3)**	75074 **(5)**	9730 **(1)**	2805 **(16)**
1997-98	43263 **(7)**	72683 **(-3.2)**	9449 **(-3)**	2801 **(-0.1)**
1998-99	44042 **(2)**	87536 **(20.4)**	11063 **(17)**	3091 **(10.3)**
1999-00	45496 **(3.3)**	90823 **(4)**	9204 **(-17)**	3023 **(-2.1)**
2000-01	43138 **(-5.1)**	93849 **(3.3)**	9458 **(3)**	3023 **(0)**
2001-02	43001 **(-0.3)**	88622 **(-6)**	9697 **(3)**	3765 **(25.4)**
2002-03	45203 **(5.1)**	84815 **(-4.2)**	9697 **(0)**	3765 **(0)**
2003-04	45942 **(3)**	88334 **(4.1)**	13161 **(36)**	5113 **(36)**
2004-05	50867 **(11)**	101246 **(15)**	9835 **(-25.2)**	8051 **(57.5)**
2005-06	55366 **(9)**	111399 **(10)**	11263 **(15)**	3705 **(-54)**
2006-07	59563 **(8)**	114993 **(3.2)**	12007 **(7)**	3953 **(7)**
2007-08	655557 **(10.1)**	128449 **(12)**	11300 **(-6)**	4357 **(10.2)**
2008-09	68466 **(4.3)**	129077 **(0.4)**	11336 **(0.3)**	4145 **(-5)**
2009-10	71516 **(4.4)**	133738 **(4)**	11928 **(5.2)**	4016 **(-3.12)**

Source: Economic Political Weekly Research Foundation, 2011

Figures in brackets are growth rates.

It may be concluded that the growth rate of quantity of production showed fluctuations. But by and large the production of plantation crops increased from 7498 thousand tonnes during 1991-92 to 11928 thousand tonnes during 2009-10 (1.6 fold increase).

The table 2 provides data on quantity of production of spices in India and its growth rate for the study period. It may be noted from the table that the production of spices was 1900 thousand tonnes during 1991-92 and it increased to 3091 thousand tonnes during 1998-99. In between there was remarkable increase to 5113 thousand tonnes during 2003-04 and to 8051 thousand tonnes during 2004-05. But in the subsequent two years it declined and in 2007-08 it regained. It stood at 4016 thousand tonnes in 2009-10. But it may be seen that in the last five years of the study production of spices shows a declining trend. It may be concluded that the production of spices was 1900 thousand tonnes during 1991-92 and it stood as 4016 thousand tonnes during 2009-10 (more than double fold). The production of spices was high during the years 2003-04 and 2004-05. But in the subsequent years it recorded a declining trend.

2.3 TRENDS IN PRODUCTIVITY OF HORTICULTURAL CROPS

Production per hectare of land area is the measure of understanding efficiency of any crop. As such in this section the productivity of horticultural crops in India is analyzed.

In this section, the productivity trends of select horticultural crops are analyzed viz., fruits, vegetables, plantation and spices. The details on productivity and its growth rate are shown in Table 3.

It may be noted from the table that the productivity per hectare of fruits was 10 metric tonnes per hectare in 1991-92. It showed an increasing trend with fluctuations up to 1999-2000. Then it declined a little in the subsequent two years. It recovered in the year 2002-03. It dropped in 2003-04 and gained in the subsequent years.

It may be concluded that the production of fruits (metric tonnes per hectare) has recorded an increase, though not steady, over the study period. The productivity of fruits was 10 metric tonnes per hectare in 1991-92 and it was 11.3 metric tonnes per hectare in 2009-10.

TABLE 3
Productivity of Select Horticultural Crops in India from 1991-92 to 2009-10

(Productivity in M.T/HEC)

YEAR	FURITS	VEGETA	PLAN	SPICES
1991-92	10 (-)	10.5 (-)	3.3 (-)	1 (-)
1992-93	10.3 **(3)**	12.6 **(20)**	3.6 **(9.1)**	1 **(0)**
1993-94	11.7 **(14)**	13.5 **(7.14)**	3.6 **(0)**	1.1 **(10)**
1994-95	11.9 **(12)**	13.4 **(-0.74)**	3.8 **(6)**	1.1 **(0)**
1995-96	12.4 **(4.2)**	13.4 **(0)**	3.5 **(-8)**	1.2 **(9.1)**
1996-97	11.3 **(-9)**	13.6 **(1.5)**	3.4 **(-3)**	1.1 **(-8.3)**
1997-98	11.7 **(4)**	13.0 **(-4.41)**	3.3 **(-3)**	1.2 **(9.1)**
1998-99	11.8 **(0.85)**	14.9 **(15)**	3.8 **(16)**	1.2 **(0)**
1999-00	12.0 **(2)**	15.2 **(2.01)**	3.3 **(-13.1)**	1.2 **(0)**
2000-01	11.1 **(-8)**	15.0 **(-1.31)**	3.3 **(0)**	1.2 **(0)**
2001-2002	10.7 **(-4)**	14.4 **(-4)**	3.3 **(0)**	1.2 **(0)**
2002-03	11.9 **(11.2)**	13.9 **(-3.4)**	3.3 **(0)**	1 **(-17)**
2003-04	9.9 **(-17)**	14.5 **(4.3)**	4.2 **(27.2)**	1.4 **(40)**
2004-05	10.1 **(32.02)**	15.0 **(3.4)**	3.1 **(-26.1)**	1.6 **(14.2)**
2005-06	10.4 **(3)**	15.4 **(2.6)**	3.4 **(10)**	1.6 **(0)**
2006-07	10.7 **(3)**	15.2 **(-1.2)**	3.7 **(9)**	1.7 **(6.3)**
2007-08	11.2 **(5)**	15.9 **(5)**	3.9 **(5.4)**	1.1 **(-35.2)**
2008-09	11.2 **(0)**	16.2 **(2)**	3.5 **(-10.2)**	1.6 **(45.4)**
2009-10	11.3 **(0.8)**	16.7 **(3.1)**	3.7 **(6)**	1.6 **(0)**

Source: National Horticulture Board, Ministry of Agriculture, Government of India

Figures in brackets are growth rate.

As far as vegetables are concerned, the productivity showed an increasing trend (though fall in between) between 1991-92 and 1999-2000. It showed a decline during 2000-01 to 2002-03. Then it regained and of course with fluctuations it recorded an increasing trend. It may be concluded that the productivity per hectare of fruits in India showed an increasing trend over the years except in a few years at the middle of the study period. Productivity of vegetables was 10.5 metric tonnes per hectare and it increased to 16.7 (ever high) during the end of the study period, 2009-10.

With regard to productivity of plantation crops, the data did not show any marked increase over the study period. During 2003-04, however, it was 4.2 metric tonnes per hectare. It may be concluded that the productivity of plantation crops did not show any significant increasing trend. It has remained stagnant in some of the years. The productivity was 3.3 metric tonnes per hectare during 1991-92 and it was 3.7 metric tonnes per hectare during 2009-10.

The data on spices can also be seen from table 4.8. The productivity of spices was 1 metric tonne per hectare during 1991-92 and it was 1.2 metric tonnes per hectare during 1997-98 and remained same for the consecutive years. Since 2003-04 it picked up a little as 1.4 metric tonnes per hectare and to 1.7 metric tonnes per hectare during 2006-07. It stood at 1.6 metric tonnes per hectare during 2009-10.

It may be concluded that the productivity of spices did not show significant increasing trend and it was stable in the middle years of study period. However, the productivity of spices has increased from 1 metric tonne per hectare during 1991-92 and it has increased to 1.6 metric tonnes per hectare during 2009-10.

3 FINDINGS

3.1 TRENDS IN AREA

- The growth rate of area under fruits showed fluctuations during the study period. But the growth was slow during the first half of the study period and it was little faster in the next half of the study period. The area under fruits increased from 2874 thousand hectares in 1991-92 to 6329 thousand hectares in 2009-10.

- The area under vegetables though registered slow growth rate and negative in a few years of study, in terms of absolute figures it has increased over the study period. The area under vegetables was 5393 thousand hectares during 1991-92 and it was 7985 thousand hectares in 2009-10.
- The area under plantation has increased in absolute figures from 2298 thousand hectares during 1991-92 to 3265 thousand hectares during 2009-10. However the growth rate has been slow only.
- The area under spices through has increased over the study period in absolute terms it posted negative figure in some periods. In the last six years of the study period it is declining.

3.2 TRENDS IN PRODUCTION

- The production of fruits in India was 28632 thousand tonnes in 1991-92 and it increased nearly by two and half times as 71516 thousand tonnes in 2009-10. However the growth rate was fluctuating in between and especially in the middle years of study period it showed a negative growth rate.
- Except a few years the production of vegetables showed positive growth with fluctuations in it. The production of vegetables was 58532 thousand tonnes in 1991-92 and it increased 2.28 fold as 133738 thousand tonnes in 2009-10.
- The growth rate of quantity of production of horticultural crops showed fluctuations. But by and large the production of plantation crops increased from 7498 thousand tonnes during 1991-92 to 11928 thousand tonnes during 2009-10 (1.6 fold increase).
- The production of spices was 1900 thousand tonnes during 1991-92 and it stood as 4016 thousand tonnes during 2009-10 (more than double fold). The production of spices was high during the years 2003-04 and 2004-05. But in the subsequent years it recorded a declining trend.

3.3 TRENDS IN PRODUCTIVITY

- The production of fruits (metric tonnes per hectare) has recorded an increase, though not steady, over the study period. The productivity of fruits was 10 metric tonnes per hectare in 1991-92 and it was 11.3 metric tonnes for hectare in 2009-10.
- The productivity per hectare of fruits in India showed an increasing trend over the years except in a few years at the middle of the study period. Productivity of vegetables was 10.5 metric tonnes per hectare and it increased to 16.7 (ever high) during the end of the study period, 2009-10.
- The productivity of plantation crops did not show any significant increasing trend. It has remained stagnant in some of the years. The productivity was 3.3 metric tonnes per hectare during 1991-92 and it was 3.7 metric tonnes per hectare during 2009-10.
- The productivity of spices did not show significant increasing trend and it was stable in the middle years of study period. However, the productivity of spices has increased from 1 metric tonne per hectare during 1991-92 to 1.6 metric tonnes per hectare during 2009-10.

4 CONCLUSION

The study reveals that the area under horticultural crops has increased over the study period from 1991-92 to 2009-10. With regard to fruits, vegetables and plantation the area has increased. Spices showed an increasing trend in the initial years but declining trend in the last six years of the study period. The quantity of production of horticultural crops has more than doubled during the study period. With regard to fruits it is nearly 2.5 fold, vegetables 2.28 fold, plantation 1.6 fold and spices a little more than double. The leading states in horticulture are Maharastra, West Bengal, Andhra Pradesh, Uttar Pradesh, Tamilnadu, Karnataka, Gujarat and Bihar. The productivity of horticultural crops has increased over the study period. It is much in case of fruits and vegetables. The study also reveals that in terms of quantity, exports of horticultural produces has increased 55 times over the study period of 19 years. In terms of value, the export of horticulture has achieved a phenomenal growth. The study has revealed that there are interstate variations in production of horticultural crops which needs to be addressed. Special attention may be paid to increase the area under and production of horticultural crops particularly in North Eastern States and in Union Territories of India.

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Cloud Computing Algebraic Homomorphic Encryption Scheme

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ABSTRACT: Although cloud computing is growing rapidly, a key challenge is to build confidence that the cloud can handle data securely. Data is migrated to the cloud after encryption. However, this data must be decrypted before carrying out any calculations; which can be considered as a security breach. Homomorphic encryption solved this problem by allowing different operations to be conducted on encrypted data and the result will come out encrypted as well. In this paper, we propose the application of Algebraic Homomorphic Encryption Scheme based on Fermat's Little Theorem on cloud computing for better security.

KEYWORDS: Cloud computing, homomorphic encryption, security, cryptography, algebraic homomorphism, Fermat's Little Theorem.

1 INTRODUCTION

Cloud computing opens up a new world of opportunities, but mixed in with these opportunities are numerous security challenges that need to be considered and addressed. Among these challenges are availability, third party control, and data security. Data in the cloud is usually globally distributed which raises concerns about jurisdiction, data exposure, and privacy. If all data stored in the cloud was encrypted, that would effectively solve many issues. However, a user would be unable to leverage the power of the cloud to carry out computation on data without first decrypting it, or shipping it entirely back to the user for computation. The cloud provider thus has to decrypt the data first, perform the computation then send the result to the user.

Homomorphic encryption schemes allow the transformation of cipher-text $C(m)$ of message m, to cipher-text $C(f(m))$ of a computation/function of message m, without disclosing the message. Therefore, the user could carry out any arbitrary computation on the hosted data without the cloud provider intervention.

In this paper, we propose applying Algebra Homomorphic Encryption Scheme Based on Fermat's Little Theorem (AHEF) on cloud computing to solve the data security and third party control issues. AHEF is based on the concept of fully homomorphism and Fermat's little theorem.

This paper structure is as follows: related work and approaches are discussed in section 2. Then, section 3 gives a brief overview of homomorphic encryption and section 4 introduces the application of AHEF on cloud computing. The scheme of the new methodology is described in Section 5. Finally, we give a short summary of our contributions in section 6.

2 RELATED WORK

In 1978, Ronald Rivest, Leonard Adleman and Michael Dertouzos introduced for the first time the concept of Homomorphic encryption. Since then, little progress has been made for almost 30 years. The encryption system of Shafi Goldwasser and Silvio Micali, that was proposed in 1982, was an additive Homomorphic encryption, but it could encrypt only a single bit. In the same notion, Pascal Paillier proposed a provable security encryption system in 1999 that was also an

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additive Homomorphic encryption. Few years later, in 2005, Dan Boneh, Eu-Jin Goh and Kobi Nissim invented a security system that can perform an unlimited number of additions but only one multiplication.

Most recently, Craig Gentry proposed the first fully homomorphic encryption scheme in 2009. That system evaluates an arbitrary number of additions and multiplications; and thus computes a function of any type on the encrypted data.

The application of fully homomorphic encryption is an important brick in cloud computing security. Generally, we could outsource the calculations on confidential data to the cloud, while keeping the secret key to decrypt the result of calculation.

3 HOMOMORPHIC ENCRYPTION

The proposed algebraic homomorphic encryption scheme is based on the concept of fully homomorphism, and uses a subset of it. It is also based on Fermat's little theorem and Fraction Module.

Fermat's little theorem is one of the four number theorems. It states that if p is a prime number, then for any integer a, the number $a^p - a$ is an integer multiple of p. In the notation of modular arithmetic, this is expressed as:

$$a^{p-1} \equiv a \ (mod\ p) \tag{1}$$

If a is not divisible by p, Fermat's little theorem is equivalent to the statement that $(a^{p-1}) - 1$ is an integer multiple of p:

$$a^{p-1} \equiv 1 \ (mod\ p) \tag{2}$$

Fraction Module is simply a new operation. When discussing homomorphic encryption in this paper, we call this operation similar module operation, and use the symbol *smod* to present it.

4 ALGEBRA HOMOMORPHIC ENCRYPTION SCHEME BASED ON FERMAT'S LITTLE THEOREM

Xiang and Cui came up with the Algebraic Homomorphism Encryption Scheme based on Fermat's Little Theorem (AHEF), which can be described as follows:

1. Select two large secure prime numbers p and q. Let $N = pq$, such that p and q are secret, and N is public.
2. A rational number x can be expressed as the fraction form $x = \frac{x_a}{x_b}$, such that the numerator x_a is an integer, and the denominator x_b is a positive integer.
3. Select a random integer r. The encryption algorithm is $E(x)$, and the encrypted cipher text is:
$$c = E(x) = fmod\left(\left(\frac{x_a}{x_b}\right)^{r(p-1)+1}, N\right) \tag{3}$$
4. Decryption algorithm $D()$, such that
$$x = D(c) = fmod(c, p) \tag{4}$$

A fully homomorphic encryption scheme, such as AHEF, must respect both addition and multiplication operations as shown below.

4.1 MULTIPLICATIVE HOMOMORPHISM

Let x and y be rational numbers, then AHEF meets the multiplicative homomorphism, i.e.

$$E(xy) = fmod(E(x)E(y), N) \tag{5}$$

Or

$$xy = D\big(E(x)E(y)\big) = fmod(E(x)E(y), p) \tag{6}$$

4.2 ADDITIVE HOMOMORPHISM

Let x and y be rational numbers, then AHEF meets the multiplicative homomorphism, i.e.

$$E(x + y) = fmod(E(x) + E(y), N) \tag{7}$$

Or

$$x + y = D\big(E(x) + E(y)\big) = fmod(E(x) + E(y), p) \tag{8}$$

4.3 MATHEMATICAL EXAMPLE

A simple example to verify the nature of algebraic homomorphism of AHEF is given below.

Selecting $p = 173$, $q = 199$, then $N = pq = 34427$.

Let $x = 2.4$ and $y = -1.75$. Now, we will express x and y as fractions: $x = \frac{12}{5}, y = -\frac{7}{4}$

Then, we will randomly select $rx = 17$, $ry = 26$. AHEF can be used to encrypt x and y:

$$E(x) = fmod\left(\left(\frac{12}{5}\right)^{r_x(p-1)+1}, N\right) = \frac{28730}{18170}$$

$$E(y) = fmod\left(\left(\frac{-7}{4}\right)^{r_y(p-1)+1}, N\right) = \frac{-28379}{13671}$$

4.3.1 MULTIPLICATIVE HOMOMORPHISM

$$D\big(E(x)E(y)\big) = fmod(E(x)E(y), p)$$
$$= fmod(\frac{28730}{18170} \times \frac{-28379}{13671}, p)$$
$$= fmod(\frac{-815328670}{248402070}, p)$$
$$= \frac{smod(-815328670, 173)}{smod(248402070, 173)}$$
$$= \frac{-84}{20} = xy$$

4.3.2 ADDITIVE HOMOMORPHISM

$$D\big(E(x) + E(y)\big) = fmod(E(x) + E(y), p)$$
$$= fmod(\frac{28730}{18170} + \frac{-28379}{13671}, p)$$
$$= \frac{smod(smod(28730 \times 13671, p) + smod(18170), p), p)}{smod(18170 \times 13671, p)}$$
$$= \frac{smod(smod(392767830, 173) + smod(-515646430, 173), 173)}{smod(248402070, 173)}$$
$$= \frac{smod(48 + (-35), 173)}{20}$$
$$= \frac{13}{20} = x + y$$

The security of AHEF algorithm is based on the difficulty of dividing by a large integer. Due to the random number being used in the encryption process, for the same plaintext x, the two encrypted results are not the same, i.e. $E1(x) \neq E2(x)$, but $D(E1(x)) = D(E2(x))$.This feature guarantees that users cannot infer the original data through statistical laws. More security properties can be found in [1].

5 AHEF SCHEME

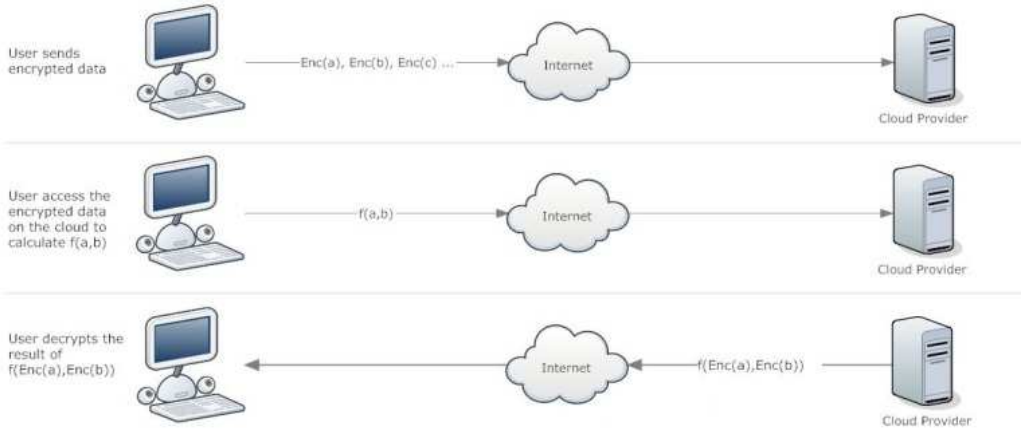

Fig. 1. AHEF Applied to Cloud Computing

As shown in Fig. 1, the process will start by sending the encrypted data to the cloud provider. The user can access the encrypted data on the cloud. Moreover, she can do calculations on that encrypted data, get the encrypted result. Then, decrypt the result on premise for better security.

6 SUMMARY

In this paper, AHEF algorithm was applied to cloud computing in order to carry out different calculations on encrypted data without decryption. The obtained result is encrypted as well and can be decrypted securely on premise.

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PERCEPTIONS OF FACULTY AND STUDENTS TOWARDS ENVIRONMENTAL CONCERNS AND PRACTICES OF PALOMPON INSTITUTE OF TECHNOLOGY PALOMPON, LEYTE PHILS.: IMPLICATIONS TO ENVIRONMENTAL EDUCATION

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ABSTRACT: The Philippine Environment Policy (Presidential Decree No. 1151) has declared a continuing policy of the state (a) to create, develop, maintain and improve conditions under which man and nature can thrive in productive and enjoyable harmony with each other, (b) to fulfill the social, economic and other requirements of present and future generations of Filipinos, and (c) to insure the attainment of an environment quality that is conducive to a life of dignity and well-being. The respondents as faculty who were surveyed were moderately concerned about the environment. Majority of the respondents were generally concerned about the destruction of rainforest, the destruction of ozone layer, GM foods, the dumping of hazardous waste. They were least worried about the loss of wetlands, hunting, and nitrate pollution. Thus, the perception of faculty on environmental concerns and practices in four colleges of PIT, Palompon, Leyte as surveyed, the results were quite different from various surveys among the students. In the survey, the students were most concerned about the economy ranked as the first, then the environment, and the unemployment came next. In other words, the concern of the faculty on environment went beyond their personal experience.

KEYWORDS: Environment, rainforest, wetlands, ozone layer, GM foods.

INTRODUCTION

The Philippines have extensive environmental problems due to the lack of environmental awareness and many people are trying to do something about these. We hail these individuals, groups, communities, and organizations doing their share to make their little patch of earth more sustainable.

We often read from the newspapers, see in televisions and heard over the radio several environmental calamities. Our forests are being denuded; land, water and air are being polluted. The protective ozone layer is being destroyed. The earth's climate is warming due to increasing carbon dioxide in the atmosphere. Many species of plants and animals are getting extinct. These and many more are our concerns [Deauna and Dorado, 1996].

Aware of these environmental problems, the Secretary of Science and Technology has challenged the science community to harness the powerful potentials of science and technology for the judicious management of the environment. As we reel from the effects of our own destructive practices in our quest for profit and material enrichment, we are continually enjoined to harness.

Science and technology in forging action plans for regeneration and development since knowledge and understanding derived from the life sciences can provide the foundation for the judicious management of the environment needed in ensuring the daily survival of humanity.

Likewise it supports the Pres. Decree No. 1152 sec. 53 states that Department of Education and Culture shall integrate subjects on environmental education in its school curricula at all levels. It shall also endeavor to conduct special community education emphasizing the relationship of man and nature as well as environmental sanitation and practices.

With regards to Palompon Institute of Technology (PIT) as an Institution of higher learning who's educational program primarily aims to provide quality education of the maritime industry and allied technological occupations and social services and has been encountered many ecological problems like pollution, waste disposal, and deforestation. But the most serious problems as perceived by the students and faculty are the waste disposal garbage.

Thus, this study on perceptions of faculty and students on environmental concerns and practices has to be conducted and can be represented as an analysis towards environmental education in PIT Palompon, Leyte.

OBJECTIVES

This study was aim to identify environmental concerns and practices as perceived by the faculty and students in four colleges of PIT Palompon, Leyte and their implication to environmental education.

Specifically, this study sought to answer the following questions:

1. In what extent that the four colleges of PIT, Palompon, Leyte perceived in terms of;

1.1 environmental concerns

1.2 environmental practices

2. Is there a significant correlation between the environmental concerns and practices to the perception in four colleges of PIT, Palompon, Leyte.

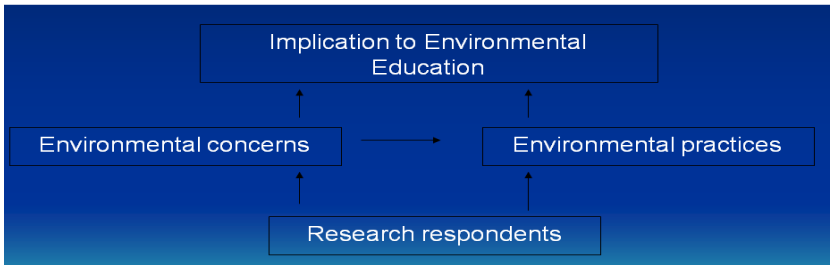
3. What are the implications can be drawn to achieve environmental education in PIT, Palompon, Leyte?

RESEARCH HYPOTHESES

There is a significant correlation between the environmental concerns and practices to the perception in four colleges of PIT Palompon, Leyte.

CONCEPTUAL FRAMEWORK

The figure below illustrates the analysis of environmental concerns and practices of the sampled faculty and students of PIT Palompon, Leyte and their implication to environmental education.



SIGNIFICANCE OF THE STUDY

It was the researcher's strong belief that the result of the study was beneficial to the following:

School Officials/Administrators of PIT

The findings of this study helped the members in encouraging people in sorting out their waste and other environmental practices like reusing and recycling of material components.

The Education

The result of the study could be a great help to teachers, students, school personnel, and members of the family to provide information on public views on a wide range of environmental issues.

Individual Concerns

The results of the study could help change their way of life so that future generations can continue to enjoy a good quality of life and environment. These give it great potential to contribute environmental education in the campus.

METHODOLOGY

Methods Used

A descriptive-normative cross-sectional survey method of investigation was used in this study. It was a method of describing phenomena based on the collection of data and statistical analysis of numerical values.

Research Respondents

The respondents of this study were the faculty and students in four colleges of PIT Palompon, Leyte and stratified random sampling was used to select samples.

Research Instrument

The main instrument of this study was the questionnaire. This was provided a profile of the sampled faculty and students with regards to their perceptions about the environment and the environmental concerns and practices. The perception of these respondents could also shed light on the understanding and implementation of environmental education in PIT Palompon, Leyte.

Research procedure

The procedure used in this study was patterned mostly from the study of Ragrario (2005).

The questionnaire was distributed to sampled students and faculty of PIT who were then asks about their environmental concerns and practices. The respondents were given two weeks to answer the questionnaire and after such time, they had collected or retrieved.

The instrument was pre-tested for other students and faculty not included in the sampled faculty and students to determine the validity of the content.

Questions, which were not clear, were restructured to fit the level of understanding of the respondents and the less important were deleted.

Statistical Treatment of Data

All data were treated statistically following the formulas specified for each problem

1. To determine the profile of the research respondents, simple percentage was used. Simple calculation used conversion of the raw scores into percentage. This was done by dividing the total number of cases and the quotient was multiplied by 100.

The formula is:

% = No. of respondents X 100

Total number of cases

2. To determine the environmental concerns and practices of the respondents, simple percentage and ranking were used.

The formula is:

% = No. of respondents X 100

Total number of cases

3. To determine the correlation between the environmental concerns and practices and the perception in four colleges of PIT, Palompon, Leyte, Pearson Product- Moment correlation was used.

$$r_{xy} = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{\left[N\sum x^2 - (\sum x)^2\right]\left[N\sum y^2 - (\sum y)^2\right]}}$$

r_{xy} = correlation between X and Y

Σx = sum of score X

Σy = sum of score Y

Σxy = sum of the product of X and Y

N = number of cases

Σx^2 = sum of square X score

Σy^2 = sum of squared Y score

SUMMARY, DISCUSSION AND IMPLICATIONS

It is not surprising the respondents were generally very concerned about the destruction of rainforest is the most talked about the environmental problems because of recent experiences during landslide in Southern Leyte and some parts of Luzon. The relationship of destruction of rainforest with landslide, which cause extensive damaged to the communities and extinction of species.

Likewise, the destruction of ozone layer is commonly discussed especially in the light of the increase in incidence if cancer and catarrh. Majority of the respondents believed the quality of our environment is slowly deteriorating and they gain their environmental knowledge from television and school or colleges. As perceived, the respondents gave importance on clear air and clean water.

With regards to environmental practices, the participation of four colleges of PIT faculty on environmental friendly practices and the environmental activities they want the community to initiate and get involved had significant difference with other. Also they perceived almost the same on environmental activities they want to suggest. There were support from local government, more information dissemination, penalties and financial incentives.

Majority of the respondents do not belong to any environmental friendly organization. They also thought that the recent media campaign encouraged us to think more about the environment and engaged in more environmental friendly activities. They thought that the government is uncertain in doing a good job in protecting the environment.

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Arithmetic and Logical Models of Stranded Transmission Line Conductors for Voltage and Voltage-Drop Analysis

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ABSTRACT: Transmission lines are used for transportation of energy from the point of generation to the point of usage. A transmission line may be single-core conductor or stranded conductor. Stranding reduces line reactance, skin effect and the tendency of occurrence of corona effect. Transmission line parameters such as inductance and capacitance depend on the geometric mean radius (GMR) of the line. GMR is essential for Voltage and Voltage-Drop analysis which is necessary to ensure save operation of power system. Arithmetic and logical models of triangular, hexagonal, circular and sector shaped stranded conductors are presented. The models which accurately predict the Cartesian coordinates of centers of strands are coded into computer programs which facilitate both the accurate graphical drawing and accurate computation of GMR of stranded conductors.

KEYWORDS: Power Transmission, Stranded Conductors, Geometric Mean Radius, Line Parameters, Electric Field, Magnetic Field, Geometry.

1 INTRODUCTION

Energy is required by man to carry out useful work which is essential in his day to day activities. The electric power system is one of the tools for converting and transporting energy which plays an important role in meeting the daily energy demand of man.

An Electric power system consists of three main sub-systems: the generating sub-system, the transmission sub-system and the distribution sub-system [1,2,3]. It cost a lot of money to install any of these sub-systems. Electricity itself is a useful but dangerous thing to leave with, so a lot is at stake in an electric power system. Every care must be taken to ensure safe operation so as to prevent damages of equipment and loss of life.

To design and operate an Electric power system, the various types of calculations that have to be carried out to ensure safe operation may be grouped under the following three headings [1,2,3].

(i) Voltage and voltage-drop calculations: to ensure that the voltage at specified points remain within appropriate limits.
(ii) Load-flow calculations: to ensure that the current in the various branches of a network does not exceed a safe working limit.
(iii) Fault calculations: to determine current and voltage under abnormal conditions, such as short-circuit, in order to ensure safety, also to select suitable fuses or circuit breakers or to set protective gear.

Energy is usually preferred to exist in electrical form due to the ease of transportation of electrical energy and the ease of converting electrical energy to other forms of energy. The electrical energy cannot always be produced where needed. There is, therefore, the need for transportation from the place of production to the place of utilisation. This is where electrical power transmission and transmission lines come in [1,2,3].

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Transmission lines are basically electricity conductors made of aluminum in most cases. Copper conductors are sometimes but very rarely used. This is because, despite the fact that copper has almost twice the conductivity of aluminum, aluminium has a weight and price advantage over copper. For equivalent resistance and weight, aluminum has larger diameter and hence lower electric field intensity and consequently a less chance of corona occurrence compared with copper.

There are overhead transmission lines as well as under-ground cables. A conductor may be single-core type or of multiple-strand type. The latter is called stranded conductor.

Around every current-carrying conductor, there are both electric field ($\overline{E}$) and magnetic field ($\overline{B}$) as illustrated in Fig. 1 [1,2,3,4]. Conductors made of same material connected to the same voltage source will have the same number of lines of electric flux. Consider two conductors having equal cross-sectional areas, made of same material; one of which is single-core and the other is multiple-strand. The surface area of the multiple-strand type is larger than that of the single-core type. This implies a lower voltage gradient, electric field intensity and hence less tendency to ionize the surrounding air at the surface of the multiple-strand type than at the surface of the single-core type. Thus stranding reduces the tendency of occurrence of corona effect [1,2,3,5,6]. Corona effect is undesirable in that it results in energy loss and communication interference. Stranding also reduces line reactance and skin effect [1,2,3,7,8]. To further reduce tendency of occurrence of corona effect, bundled conductors are used at very high voltage levels. Two, three or four conductors are said to be bundled together if they serve as a single-phase of a power system.

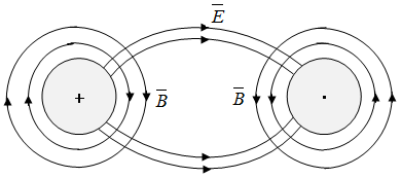


Fig. 1. Magnetic and Electric Fields Associated with Conductors

The basic line constants are inductance, capacitance and resistance per unit length. These constants are essential in voltage and voltage-drop calculations and they can be computed from the dimensions of the line [1,2,3,9,10,11,12].

A current carrying conductor is surrounded by a magnetic field ($\overline{B}$) as shown in Fig. 1. This field is due to the current flowing in the conductor. The field links with the conductor and results in flux linkage. The flux linkage gives rise to reactive voltage drop along the conductor. The flux linkage, F is proportional to the current I in the conductor. That is $F = LI$ (1)

The proportionality constant L is the self-inductance of the conductor. The reactive voltage drop is given as $V_{drop} = \frac{\partial NF}{\partial t}$.

N is the number of turns linked by the flux. F_e is the external flux linkage at distance D from the one-metre long cylindrical conductor shown in Fig. 2, F_i is the internal flux linkage, r is the radius of the conductor and μ is the permeability of the space around the conductor. F_e and F_i [1,2,3] are given as

$$F_i = \frac{\mu I}{8\pi} = \frac{\mu I}{2\pi} \ln\left(e^{1/4}\right)$$
$$F_e = \frac{\mu I}{2\pi} \ln\left(\frac{D}{r}\right) \quad (2)$$

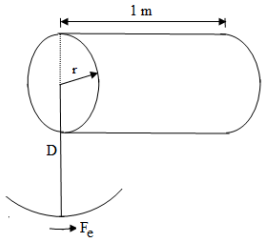


Fig. 2. A Cylindrical Conductor External Flux

At distance d from the conductor, total flux linkage [1,2,3] is therefore given by

$$F_t = F_i + F_e = \frac{\mu I}{2\pi} ln\left(e^{1/4}\right) + \frac{\mu I}{2\pi} ln\left(\frac{\mathcal{D}}{r}\right) = \frac{\mu I}{2\pi} ln\left(\frac{\mathcal{D}}{e^{-1/4} r}\right) = \frac{\mu I}{2\pi} ln\left(\frac{\mathcal{D}}{GMR}\right) \quad (3)$$

Where $GMR = e^{-1/4} r$ and is called the geometric mean radius (GMR) or self geometric distance (Self GMD) of the conductor. GMR accounts for the presence of internal flux linkages. It is the radius of a fictitious conductor assumed to have no internal flux but with the same total flux as the actual conductor of radius r. Comparing equation (1) and (3) gives

$$L = \frac{\mu}{2\pi} ln\left(\frac{\mathcal{D}}{GMR}\right) \quad (4)$$

Thus line inductance depends on the geometric mean radius of the conductor. Line capacitance also depends on geometric mean radius (GMR). Evaluation of geometric mean radius is therefore very important for voltage and voltage-drop calculations [1,2,3].

The Geometric Mean Radius (GMR) is a measure of line inductance and line capacitance. For a single core conductor, GMR is the radius of the conductor multiplied with $e^{-¼}$. For a stranded conductor containing N strands, the GMR is N^2- root of the product of each strand's GMR and distances from each strand to other strands [1,2,3]. This is expressed mathematically as

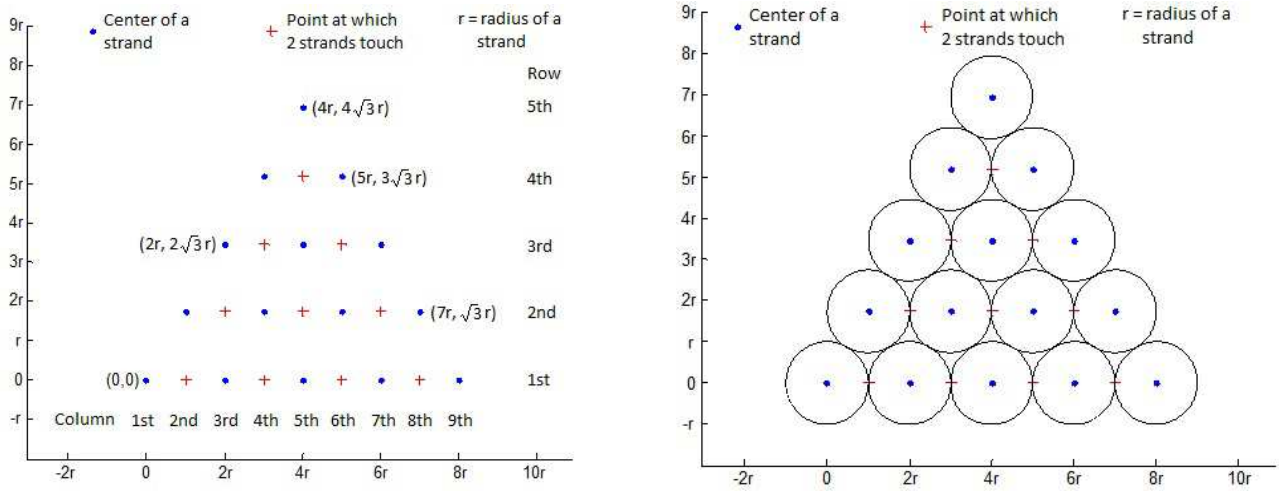
$$GMR = \sqrt[N^2]{(e^{-1/4} r)^N \text{ x } D_1 \text{ x } D_2 \text{ x } D_3 \text{ x} \ldots \text{x } D_N} \quad (5)$$

r is the radius of each strand. D_k is the product of distances between the k^{th} strand and other strands. Distance between two strands is the distance between their centers. To compute the GMR of a conductor, its geometric configuration must be known. In this paper, arithmetic and logical models are developed for the prediction of the Cartesian coordinates of the centers of strands in a stranded conductor and automatic computation of GMR of the conductor. Furthermore, the model facilitates graphical drawing of stranded conductors. Hexagonal, circular, triangular and sector shaped stranded conductors are considered.

2 ARITHMETIC AND LOGICAL MODELS OF STRANDED CONDUCTORS

2.1 TRIANGULAR SHAPED STRANDED CONDUCTOR

A careful study of triangular shaped stranded conductors reveals some pattern with regard to locations of centers of strands as illustrated in Fig. 3 and Table 1. The centers of strands are located at points along w rows and c columns. N is the number of strands in the stranded conductor. s is serial number and r is the radius of each strand.



(a) Centers of Strands (b) Strands

Fig. 3. Triangular Shaped Stranded Conductor with s = 5, N = 15, w = 5 and c = 9

Based on the sequence in Table 1, N and s are found to be related as in Eqns. (6) and (7). Similarly, w and c are found to be related to s as in Eqns. (8) and (9) respectively. A center of a strand is at the intersection of a row and a column but not all

intersections of rows and columns are centers of strands. Fig. 3 is drawn for s=5, N=15, w=5 and c=9. In Fig. 3, blue dots indicate intersections which are the centers of strands while red plus symbols indicate intersections which are not centers of strands but points at which strands on the same rows meet tangentially. Two adjacent intersections along a row or a column cannot be centers of strands. The distance between two adjacent intersections along a row is r while the distance between two adjacent intersections along a column is $\sqrt{3}r$ The number of intersections along a row reduces by two as you move from one row to the next. The first intersection on the first row and first column is a center of a strand and has the Cartesian coordinate (0, 0). All these observations are used to develop the flowchart of Fig. 4 to compute the Cartesian coordinates of the centers of the strands. The output, Center is an N by 2 matrix containing x and y coordinates of the centers. The distance between two centers (x_1, y_1) and (x_2, y_2) is given as in Eqn. (10). The N by 2 matrix Center facilitates both the graphical drawing of the stranded conductor and the computation of the GMR based on Eqns. (5) and (10).

Table 1. Triangular Shaped Stranded Conductors data

Serial Number (s)	Number of Strands (N)	Number of Rows (w)	Number of Columns (c)
1	1	1	1
2	3	2	3
3	6	3	5
4	10	4	7
5	15	5	9

$$N = s(s+1)/2 = 0.5s^2 + 0.5s \tag{6}$$

$$s = -0.5 + \sqrt{0.25 + 2N} \tag{7}$$

$$w = s \tag{8}$$

$$c = 2s - 1 \tag{9}$$

$$d = \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2} \tag{10}$$

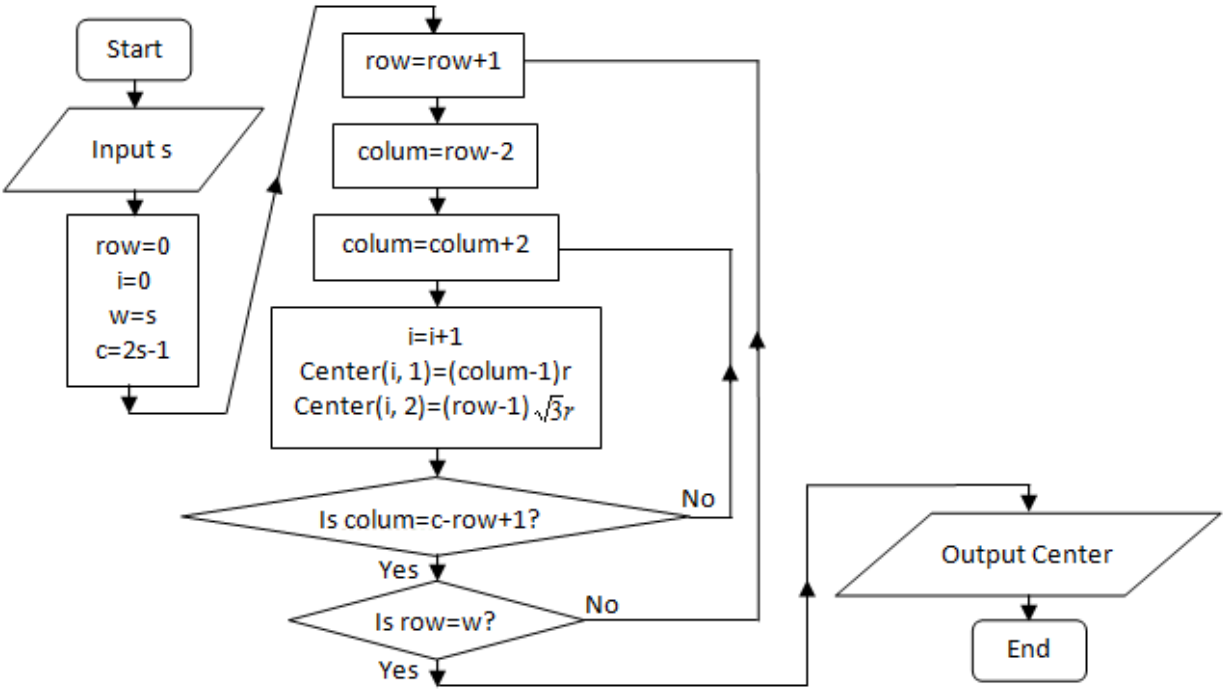
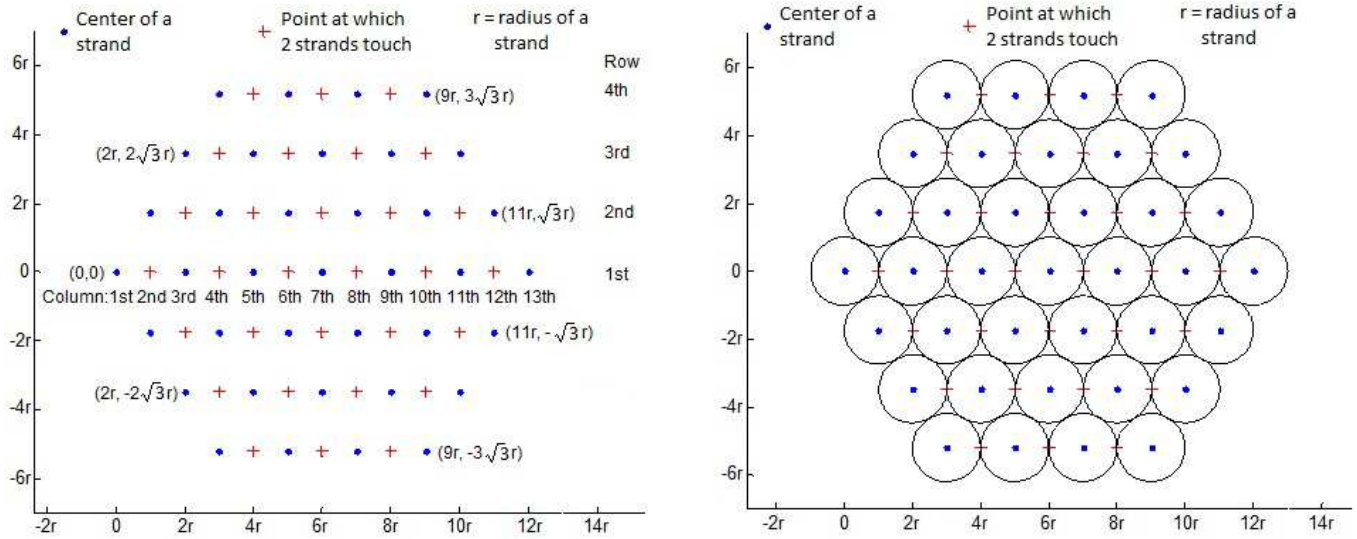


Fig. 4. Flowchart for the Arithmetic and Logical Model of Triangular Shaped Stranded Conductor

2.2 HEXAGONAL SHAPED STRANDED CONDUCTOR

A careful study of hexagonal shaped stranded conductors reveals some pattern with regard to location of centers of strands as illustrated in Fig. 5 and Table 2. The centers of strands are located at points along w rows and c columns in the first quadrant. Each of the centers of strands in [w-1] rows (first row exempted) is duplicated in the fourth quadrant with equal x coordinate but equal and opposite y coordinate.



(a) Centers of Strands (b) Strands

Fig. 5. Hexagonal Shaped Stranded Conductor with s = 4, N = 37, w = 4 and c =13

Table 2. Hexagonal Shaped Stranded Conductors data

Serial Number (s)	Number of Strands (N)	Number of Rows (w)	Number of Columns (c)
1	1	1	1
2	7	2	5
3	19	3	9
4	37	4	13
5	61	5	17

Based on the sequence in Table 2, N and s are found to be related as in Eqns. (11) and (12). Similarly, w and c are found to be related to s as in Eqns. (13) and (14) respectively. A center of a strand is at the intersection of a row and a column but not all intersections of rows and columns are centers of strands. Fig. 5 is drawn for s=4, N=37, w=4 and c=13. In Fig. 5, blue dots indicate intersections which are the centers of strands while red plus symbols indicate intersections which are not centers of strands but points at which strands on the same rows meet tangentially. Two adjacent intersections along a row or a column cannot be centers of strands. The distance between two adjacent intersections along a row is r while the distance between two adjacent intersections along a column is $\sqrt{3}r$. The number of intersections along a row reduces by two as you move from one row to the next. The first intersection on the first row and first column is a center of a strand and has the Cartesian coordinate (0, 0). All these observations are used to develop the flowchart of Fig. 6 to compute the Cartesian coordinates of the centers of the strands. The output, Center is an N by 2 matrix containing x and y coordinates of the centers. The N by 2 matrix Center facilitates both the graphical drawing of the stranded conductor and the computation of the GMR based on Eqns. (5) and (10).

$$N = 1 + 3s(s-1) = 3s^2 - 3s + 1 \tag{11}$$

$$s = \frac{3 + \sqrt{9 - 12(1-N)}}{6} \tag{12}$$

$$w = s \tag{13}$$

$$c = 1 + 4(s-1) \tag{14}$$

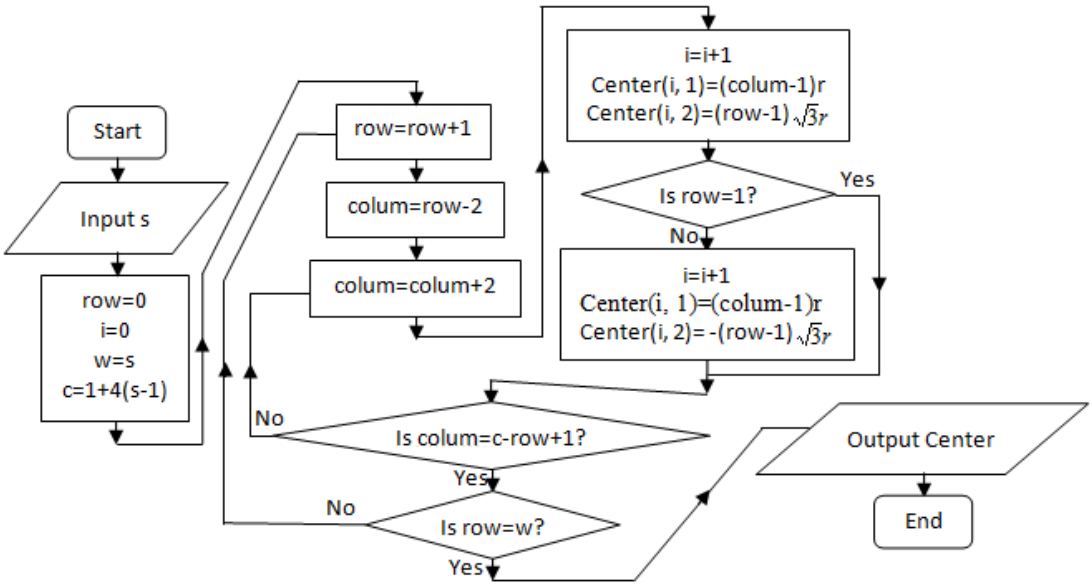
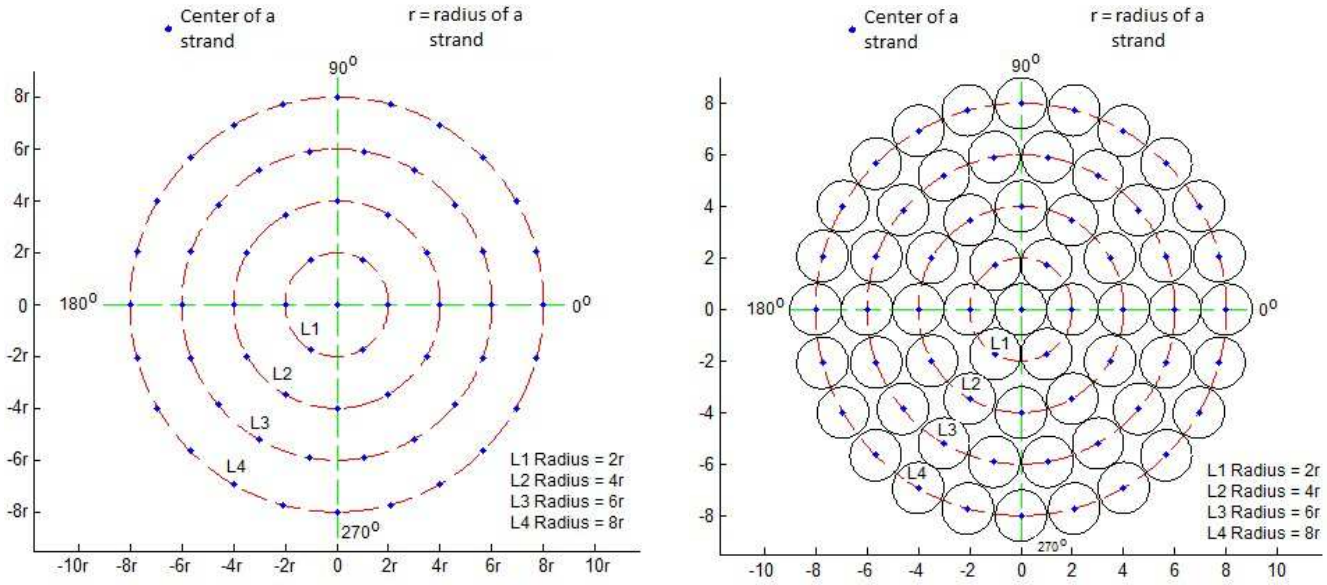


Fig. 6. Flowchart for the Arithmetic and Logical Model of Hexagonal Shaped Stranded Conductor

2.3 CIRCULAR SHAPED STRANDED CONDUCTOR

A careful study of circular shaped stranded conductors reveals some pattern with regard to location of centers of strands as illustrated in Fig. 7 and Table 3. The center of one strand is located at the point (0, 0). The centers of other strands are located at points along circumference of C concentric circles. The concentric circles L1, L2, L3, ... , LC with radii 2r, 4r, 6r, ... , 2Cr respectively have a common center at (0, 0) and are drawn with broken red lines in Fig. 7. 6, 12, 18, ... , 6C centers are on concentric circles L1, L2, L3, ... , LC respectively.



(a) Centers of Strands (b) Strands

Fig. 7. Circular Shaped Stranded Conductor with s = 5, N = 61 and C = 4

Table 3. Circular Shaped Stranded Conductors data

Serial Number (s)	Number of Strands (N)	Number of Concentric Circles (C)
1	1	0
2	7	1
3	19	2
4	37	3
5	61	4

Based on the sequence in Table 3, N and s are found to be related as in Eqns. (11) and (12) which are also applicable to hexagonal shaped stranded conductor. C is found to be related to s as in Eqn. (15). Generally, the centers on concentric circle Ln are located at the intersection of the circumference of concentric circle Ln and 6n lines drawn from (0, 0) with angle $(360/6n)^{o}$ between the 6n lines. Fig. 7 is drawn for s=5, N=61 and C=4. All these observations are used to develop the flowchart of Fig. 8 to compute the Cartesian coordinates of the centers of the strands. The output, Center is an N by 2 matrix containing x and y coordinates of the centers. The N by 2 matrix Center facilitates both the graphical drawing of the stranded conductor and the computation of the GMR based on Eqns. (5) and (10).

$$C = s - 1 \tag{15}$$

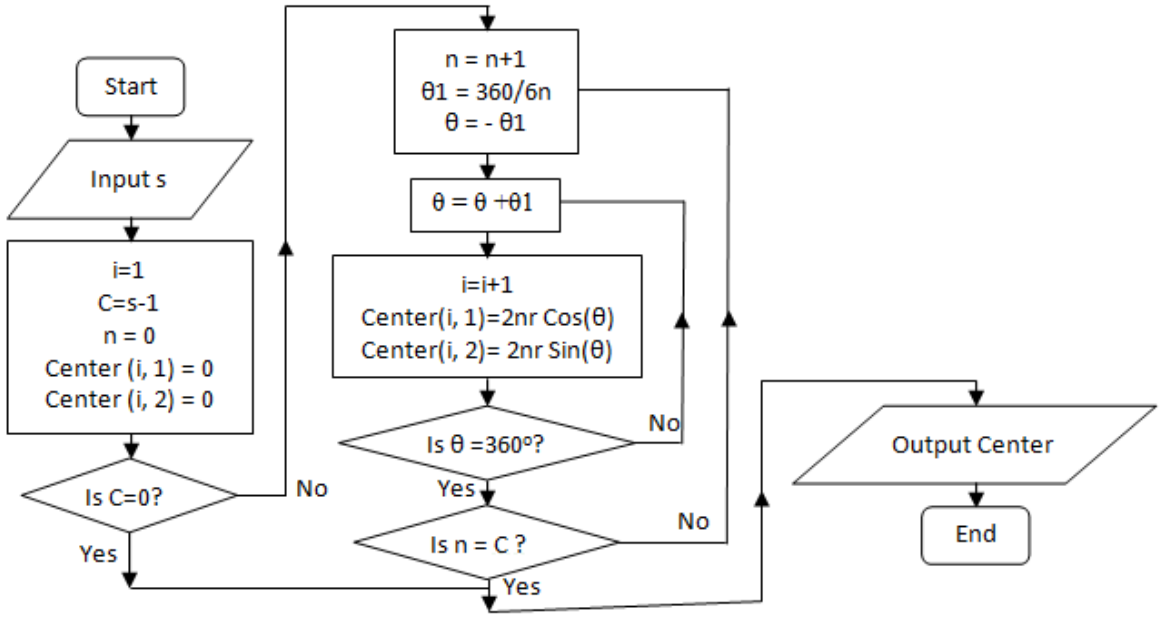


Fig. 8. Flowchart for the Arithmetic and Logical Model of Circular Shaped Stranded Conductor

2.4 SECTOR SHAPED STRANDED CONDUCTOR

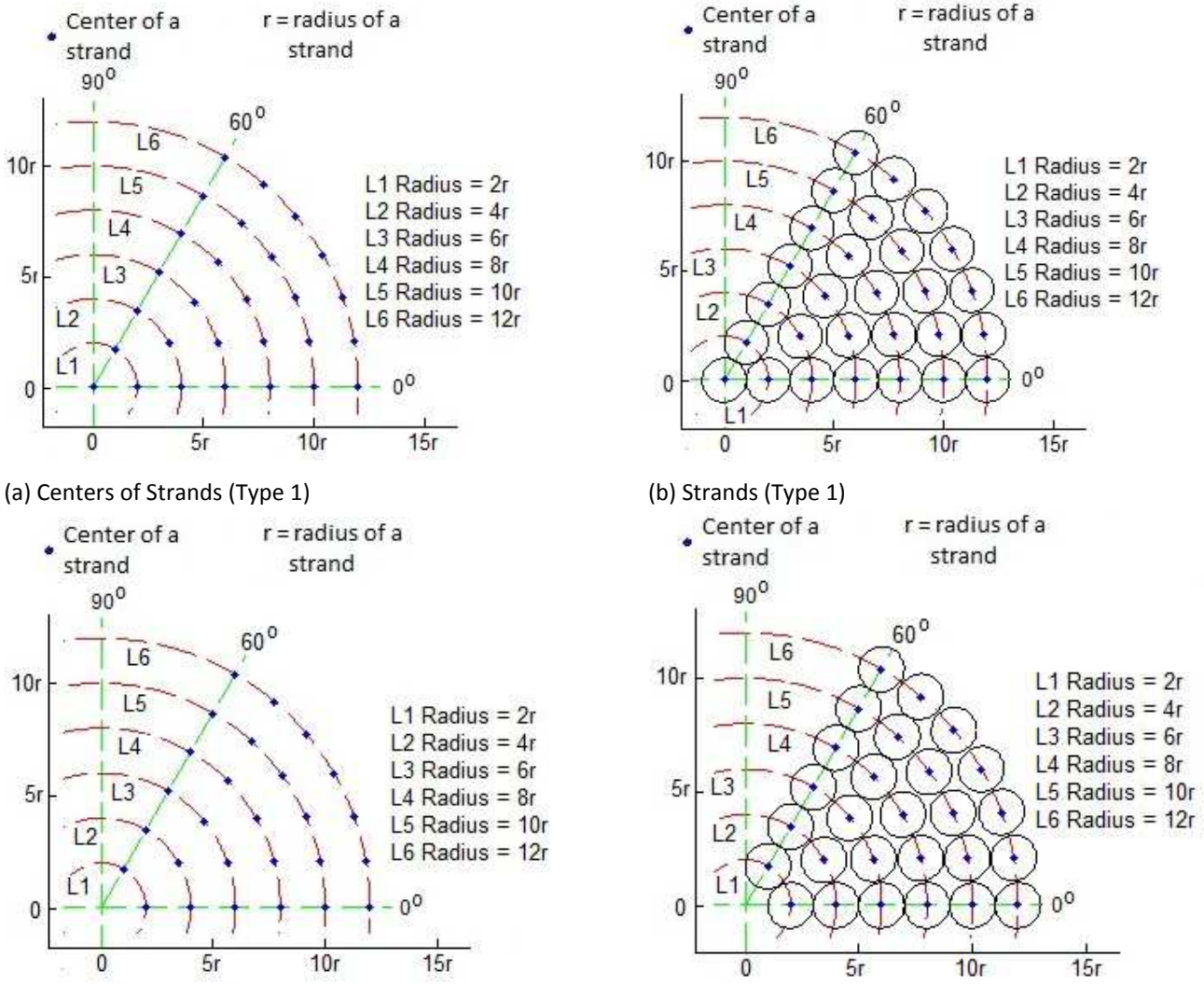
Sector shaped stranded conductor is derivable from circular shaped semiconductor. Strands are located between the lines 0^{o} and 60^{o} only. The two types are similar except that the strand with center at (0, 0) is included in type 1 but omitted in type 2 as shown in Fig. 9.

The arithmetic and logical models of Figs. 4, 6 and 8 are coded into computer programs.

3 RESULTS

Reliability of the developed computer programs is verified. The prediction of centers of strands is found to be accurate as shown by accurate drawing of the stranded conductors some of which are shown in Figs 3(b), 5(b), 7(b), 9(b) and 9(d). The computation of GMR is also found to be accurate as some of the results are compared with manually calculated values as

shown in Table 4. Using the developed computer programs GMR values are evaluated for different values of s for triangular, hexagonal, circular and sector shaped stranded conductors. The results are displayed in Table 5.



(a) Centers of Strands (Type 1)

(b) Strands (Type 1)

(c) Centers of Strands (Type 2)

(d) Strands (Type 2)

Fig. 9. Circular Shaped Stranded Conductor with s = 5, N = 61 and C = 4

Table 4. Comparison of GMR Values Obtained from the Arithmetic and Logical Models with those Manually Calculated

Triangular Shaped Stranded Conductors				**Circular Shaped Stranded Conductors**			
Serial Number (s)	**Number of Strands (N)**	**GMR (Manually Calculated)**	**GMR (Obtained from Program)**	**Serial Number (s)**	**Number of Strands (N)**	**GMR (Manually Calculated)**	**GMR (Obtained from Program)**
1	1	0.7788r	0.7788r	**1**	1	0.7788r	0.7788r
2	3	1.4605r	1.4605r	**2**	7	2.1767r	2.1767r
3	6	2.1023r	2.1023r	**3**	19	3.7883r	3.7882r
4	10	2.7323r	2.7323r	**4**	37	5.3745r	5.3744r
5	15	3.3573r	3.3573r	**5**	61	6.9499r	6.9488r

Table 5. GMR Values Obtained from the Arithmetic and Logical Models for Different Values of s

Triangular Shaped Stranded Conductor			Hexagonal Shaped Stranded Conductor			Circular Shaped Stranded Conductor			Sector Shaped Stranded Conductor (Type 1)			Sector Shaped Stranded Conductor (Type 2)		
Serial No	No of Strands	Geometric Mean Radius	Serial No	No of Strands	Geometric Mean Radius	Serial No	No of Strands	Geometric Mean Radius	Serial No	No of Strands	Geometric Mean Radius	Serial No	No of Strands	Geometric Mean Radius
s	N	GMR	s	N	GMR	s	N	GMR	s	N	GMR	s	N	GMR
1	1	0.7788r	**1**	1	0.7788r	**1**	1	0.7788r	**1**	1	0.7788r	**1**	0	-
2	3	1.4605r	**2**	7	2.1767r	**2**	7	2.1767r	**2**	3	1.4605r	**2**	2	1.2480r
3	6	2.1023r	**3**	19	3.5817r	**3**	19	3.7882r	**3**	6	2.1787r	**3**	5	1.9892r
4	10	2.7323r	**4**	37	4.9948r	**4**	37	5.3744r	**4**	10	2.8755r	**4**	9	2.6998r
5	15	3.3573r	**5**	61	6.4112r	**5**	61	6.9488r	**5**	15	3.5599r	**5**	14	3.3976r
6	21	3.9796r	**6**	91	7.8292r	**6**	91	8.5172r	**6**	21	4.2375r	**6**	20	4.2375r
7	28	4.6004r	**7**	127	9.2481r	**7**	127	10.0824r	**7**	28	4.9111r	**7**	27	4.9111r
8	36	5.2202r	**8**	169	10.6676r	**8**	169	11.6456r	**8**	36	5.5823r	**8**	35	5.5823r
9	45	5.8393r	**9**	217	12.0874r	**9**	217	13.2075r	**9**	45	6.2517r	**9**	44	6.2517r
10	55	6.4580r	**10**	271	13.5074r	**10**	271	14.7684r	**10**	55	6.9200r	**10**	54	6.9200r
20	210	12.6344r	**20**	1141	27.7131r	**20**	1141	30.3592r	**20**	210	13.5773r	**20**	209	13.5773r

4 CONCLUSION

Arithmetic and Logical Models of Triangular, Hexagonal, Circular and Sector Shaped Conductors have been developed and coded into computer programs. The models predict accurately centers of strands; compute accurately the Geometric Mean Radius and provide graphical drawing of stranded conductors. The models are useful in evaluation of transmission line parameters and therefore useful for Voltage and Voltage-Drop Analysis of Electric Power Systems.

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HEAVY METAL CONCENTRATION OF COCOYAM AND PAWPAW CROPS GROWN AROUND ANAEKIE OBIAKOR ILLEGAL DUMPSITE, AWKA, ANAMBRA STATE, NIGERIA

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ABSTRACT: Heavy metal concentration of crops (cocoyam and pawpaw) grown around Aneakie Obiakor Illegal Dumpsite, Awka was studied. Plants samples were collected from the waste dumpsite and control site during wet season, and analysed for level of concentration of 10 heavy metals using Atomic Absorption Spectrophotometric method (AAS). The result was compared with the control site and WHO/FAO standard. It was observed that all the heavy metals present in the plants were within WHO/FAO safe limit with the exception of Pb, Hg, As and Cd. The study revealed that the presence of solid wastes on agricultural soil results in heavy metal accumulation in soil and bioaccumulation in plants. The work therefore, recommended regular monitoring of metals in plants for prevention of excessive buildup of the metals in the food chain.

KEYWORDS: Heavy Metals, Concentration, Dumpsite, Cocoyam, Pawpaw.

1 INTRODUCTION

Soil is a crucial component of the human environment; and land management is the key to soil quality. Various land uses like industrial activities resulting to the use of synthetic products like pesticides, paints, batteries, plastics, among others, can result in heavy metal contamination of the soil, (S. Donahue and Auburn, 2000). Many current studies have shown that heavy metals and metalloid from municipal wastes containing paper, food wastes, metals, glass, ceramics and ashes accumulate and persist with densities greater than 6g/cm^3 in the soils at environmentally hazardous levels (Carlson, 1976 and Alloway 1996). Most waste dumpsites in many towns and villages in Nigeria attract people as fertile grounds for cultivating varieties of crops. The cultivated plants take up the metals either as mobile ions presents in the soil solution through the roots (Davies, 1983) or through foliar absorption (Chapel, 1986). The uptake of the metals by crops results in the bioaccumulation of these elements in the plant tissues. This is known to be influenced by the metal species, plant species and plant parts (Juste and Mench, 1992). Indeed, it has been reported that plant grown on soils possessing enhanced metal concentration due to pollution have increased heavy metal ion content (Alloway and Davies 1971; Grant and Dobbs, 1977).

Human activities, including industrialization, urbanization, commercial and household activities lead to generation of large amount of wastes in the environment. The waste production increases on daily basis (Ojiebe, 2005) and is compounded by population explosion, decreasing standards of living and low level environmental awareness (Beg, Mahmood and Naeem 1985). The people's attitude in littering the environment (Nwoke and Nwoke, 2006), the inadequate machinery of waste management skills of the staff in handling domestic waste leads to the accumulation of waste in the environment. In many cases, the refuse dumpsites are located wherever land is available without regard to safety, health hazard and aesthetic value of the environment (Ojiebe, 2005).

The presence of metals in the food chain, leads to the local populace being exposed to multiple hazardous pollution sources which are potential threats (Bridge, 2004) Prolonged human consumption of unsafe concentrations of heavy metals in foodstuffs may lead to the disruption of numerous biological and biochemical processes in the human body. According to Marshall et al., 2003 heavy metal accumulation results in toxic concentrations in the body, with some elements acting as

carcinogens and others associated with developmental abnormalities in children. There is a growing global concern over the detection of metal in crops which affect food quality and safety. Food safety is a basic need for any population and supplying it is one of the World's most complex challenges especially in the face of an expanding population and environmental constraints (Arogunjo, 2007; Wong et al., 2002; Mashall et al., 2003). Plant crops are often grown in polluted and degraded environmental conditions. Hence, data on heavy metals in the soils and plant are important in determining the quality and health impact such soil and plant will have on the food chain. To this effect, this study assesses the heavy metal concentration grown around Anaekie Obiakor Dumpsite in Awka.

1.1 THE PROBLEM OF THE STUDY

Dumpsites accumulate heavy metals in soil which constitute hazard to the environment and human health, especially when crops produced in these dumpsites are consumed (Okoronkwo, Ano and Odoemenam 2005; Anikwe and Nwobodo, 2002; A. A. Amusan, 2005). Municipal waste contains such heavy metals as As, Cd, Co, Cu, Fe, Hg, Mn, Pb, Ni, and Zn which end up in the soil as the sink when they are leached out from the dumpsites. Soil is a vital resource for sustaining two human needs of quality food supply and quality environment. Plants grown on a land polluted with municipal, domestic or industrial wastes can absorb heavy metals inform of mobile ions present in the soil solution through their roots or through foliar absorption. These absorbed metals get bioaccumulated in the roots, stems, fruits, grains and leaves of plants (Fatoki, 2000). Data on heavy metals in the soils and plants are important in determining the quality and health impact such soil could have on the food chain (Akinola et al, 2011).

A casual visit to Anaekie Obiakor Dumpsite promptly reveals that there is no form of management at all. All sorts of wastes are carelessly dumped there. Apart from the obnoxious odour, the presence of rodents and disease-carrying vectors; one major problem easily noticed by anybody is the endless released of leachate from the dump, particularly during rainy season. There is no doubt that as soon as it rains, the leachates, with all its contents infiltrates and pollutes both the soil and ground water of the area.

In Anaekie Obiakor Dumpsite, there is yet to be established data on heavy metals like; lead arsenic, zinc, cadmium, mercury, silver, nickel, copper, iron and chromium. Farming activities such as crop production goes on in this area. Cassava, plantain, vegetables, corn, yam, cocoyam, potatoes and fruits such as pawpaw are grown in this farm land. Crops absorb whatever is present in the soil medium and therefore these hazardous metals are also absorbed and become bioaccumulated in the roots, stems, fruits, grains and leaves of the crops (Fatoki 2000), which may finally be transferred to man in the food chain. Also, when wind blows, it carries the dust particles emitted from the dumpsite to the leaves of foods crops planted around the area. Plants around Anaekie Obiakor dumpsite are observed to have a blanket deposit of fine particles on the leaves surface after rainfall.

Heavy metal pollution may constitute hazard to the health of the inhabitants of Anaekie Obiakor community who grow and consume crops grown around the dumpsite. Heavy metals become toxic in human when they are not metabolized by the body and accumulate in the soft tissues causing health problems (Usman, Nda-Umar, Gobi, Abdullahi, Jonathan, 2012). Therefore, there is a great need to assess the heavy metal content of the plant of the dumpsite in order to ascertain the risk effect of ingesting crops grown around the area.

1.2 AIMS AND OBJECTIVES

The aim of this work is to assess the concentration of heavy metals in the crops planted around Aniekie Obiakor Dumpsite, Awka.

To achieve the above aim, the following objectives will be required:

- To determine the heavy metals concentration of some plants around the dumpsite.
- To suggest possible ways of managing or reclaiming contaminated soil.

1.3 RESEARCH HYPOTHESES

The paper tested the following hypotheses:

Ho: There is no significant difference in the heavy metal concentration of pawpaw plant in the dumpsite (polluted) and that of the control site.

Ho: There is no significant difference in the heavy metal concentration of the cocoyam plant in the dumpsite (polluted) and that of the control site.

1.4 AREA OF THE STUDY

The dumpsite studied is situated at Anaekie Obiakor Lane. Anaekie Obiakor Lane is located in Awka, the capital of Anambra State, Nigeria. Awka has an estimated population of 301,657 according to the 2006 Nigerian census. The city is located between latitude 6^{o} 13'N and 6^{o} 15'N and longitudes 7^{o} 04'E and 7^{o} 06'E. Awka is located in Awka South Local Government Area of Anambra state. Awka lies about 300meters above sea level in the valley on the plains of the Mamu River. It lies within the derived Guinea Savannah Zone of Nigeria (Egbokhare, Francis, Oyetade, Oluwole, 2002).

Awka is the tropical zone of Nigeria and experiences two distinct seasons; the rainy season (April - October) and dry season (November - March). The rainy season is characterized by heavy down pours accompanied by thunder storms, heavy flooding, soil leaching, extensive sheet outwash, ground infiltration and percolation (Egboka and Okpoko, 1984).

On the other hand, the dry season begins when the dry continental North – Eastern wind blows from the Mediterranean Sea across the Sahara Desert down to Southern Nigeria. It is characterized by extensive aridity and a lot of particulates generation. Again, there is marked lowering of water table and intense leaf fall (Egboka et al, 1984). The dry season is characterized by high temperatures and low humidity, while wet months have lower temperatures and lower relative humidity. The area lies within the zone characterized by relative warm temperatures. Although the temperatures vary slightly, depending on the period of the year, the dry season has high temperatures and lower humidity. The temperature is generally between 27^{o} C - 30^{o} C between June and December but rises to 32^{o} C - 34^{o} C between January and April with the last few months of the dry season marked by intense heat.

Awka is sited in a fertile tropical valley but most of the original Rain Forest has been lost due to clearing for farming and human settlement. The people of Awka are well known for blacksmithing, farming and trading. Many economic activities go on in Awka, establishment carrying out government duties and private sectors including companies like Juhel, which manufacture drugs within the town and export it to other countries.

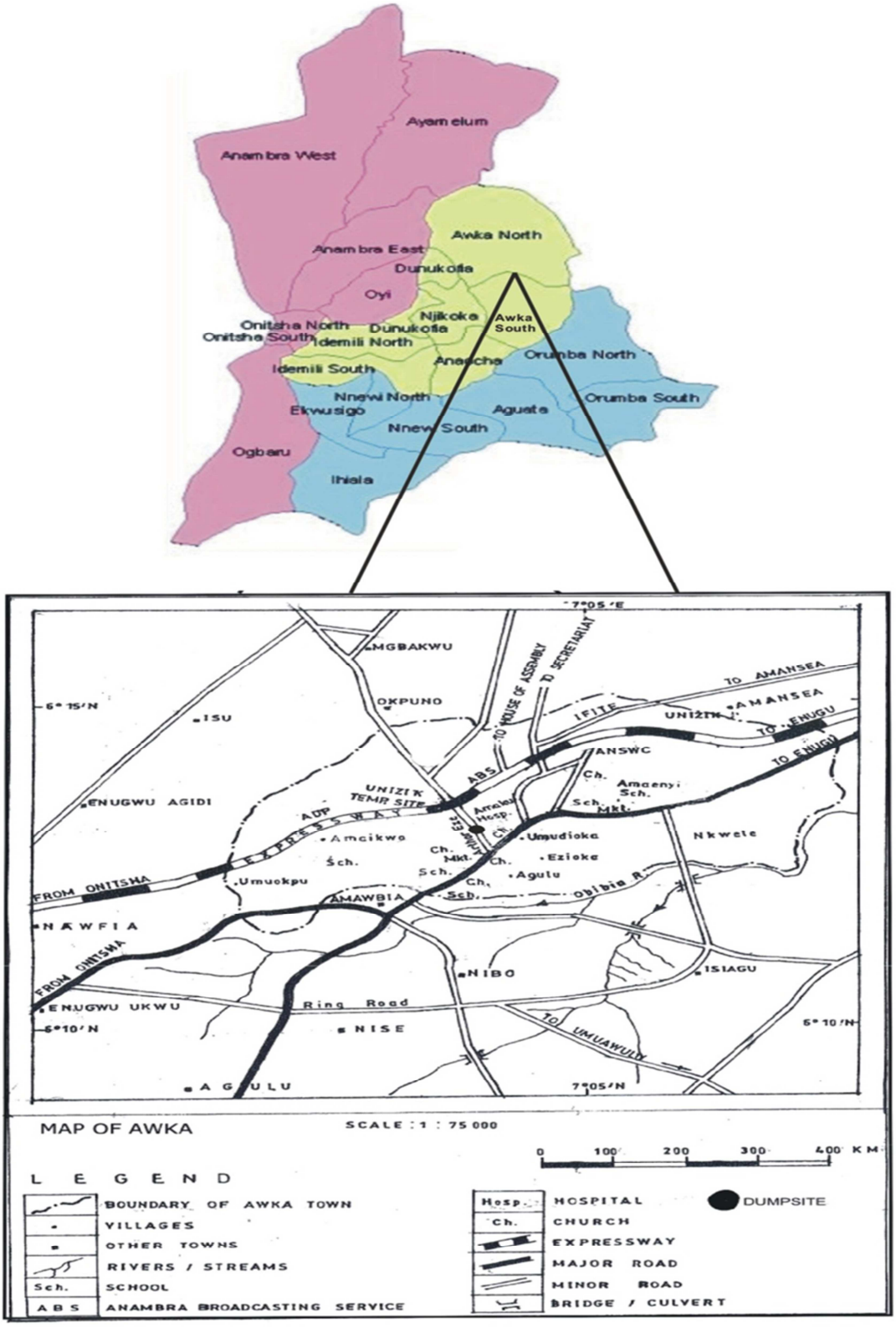

Fig. 1. Map of Anambra State Showing Awka; Map of Awka showing the dumpsite (dot on the map)

1.5 THE CONCEPTUAL FRAMEWORK OF THE STUDY

The conceptual framework of the work is hydrogeopollution cycle (Egboka, Nwankwor, Orajaka, Ejiofor, 1989). Hydrogeopollution cycle involves two processes; hydrologic and geologic cycles. In the both processes pollutants and contaminants may be produced and cyclically dispersed from one point of hydrologic cycle to another. Pollutants and contaminants may be generated through natural or anthropogenic processes and circulated into the environment (atmosphere, pedosphere, lithosphere, biosphere and hydrosphere) through the activities of air, water, chemical, physical and microbiological processes. These complex and cycle processes may be continuous with respect to distance and time and may be localized or regional in areal spread. Thus, pollution at one source or area may threaten nearby or distant places unless it spread is checked or controlled.

Pollutants from dumpsites can reach soil, plant and man through a combination of the actions involving the hydrologic and the geologic cycle. The geologic cycle involves movement of rock, sediment and soil. Geologic characteristics of rock can play a role in contaminants spread or retention. The hydrologic cycle involves water evaporation, precipitation, ground water flow, water run-off and aquifers. The sources of pollution and contamination can be either point sources or distributive sources. Through a complex interplay of both hydrologic and geologic cycles, a combination termed; hydrogeopollution cycle (Fig 1.1). Contaminant and pollutant spread can be enhanced from either point sources or distributive sources.

In view of the above, this work is meant to examine the distribution of heavy metals around the study area. This study is prompted by the fact that agricultural activities and human habitation is very close to the dumpsite. Moreover, heavy metal is dangerous to human health and the environment

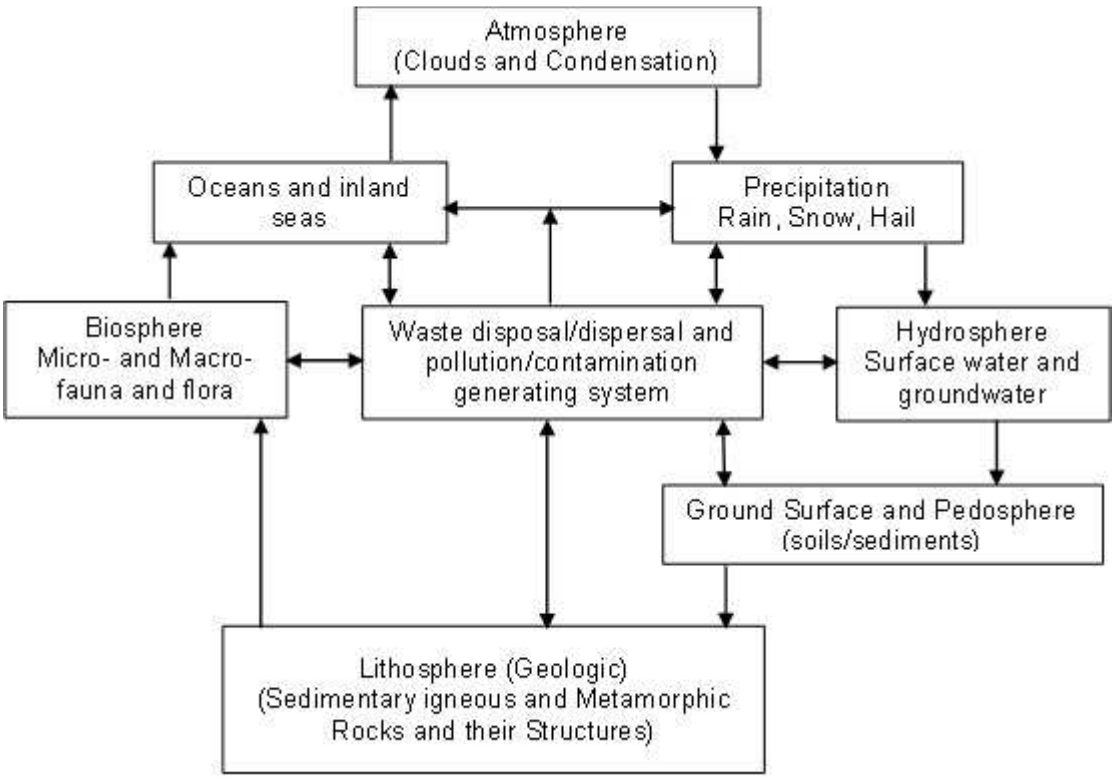

Fig. 2. The Hydropollution Cycle

2 RESEARCH METHODOLOGY

Experimental design was used to derive information used for the study. Laboratory analyses of the plant samples collected from Anaekie Obiakor dumpsite and Anaekie Obiakor lane (control sites) were carried out. This methodology was chosen because the data needed for the study include heavy metals concentration of the plant samples.

Two plant samples; pawpaw and cocoyam were collected from the farm which shared the boundary with the dumpsite and two samples from the control site (Anaekie Obiakor Lane, 2km away from the dumpsite). The heavy metals studied are: Cd, Hg, As, Pb, Cr, Fe, Ag, Zn, Ni and Cu (table 1.1). The roots of the plant samples were collected and stored in polythene bags which had already been labelled and carried to the laboratory for analyses.

The samples obtained from ashing was dissolved with $50cm^3$ of concentration hydrochloric acid (HCl) and made up to $100cm^3$ with distilled water. This was filtered into plastic sample bottle using filter paper. The heavy metal content of the plant root was determined using the atomic absorption spectrophotometers (AAS) Unican 969 Instrument. The trace metals in the samples were determined with aliquots of the digest. The quantity of each trace metal in each sample was calculated by proportion methods using the standard curve method. The absorbance and concentration were read from a calibration curve drawn by computer software attached to AAS.

Table 1. Concentrations of Heavy Metals (Mg/kg) (mg/l) in Plant Root from Anaekie Obiakor Dumpsite and Control Site.

Heavy Metals	**Dumpsite**		**Control site**		**Safe Limit of Heavy Metals WHO/FAO 2001/1999**
	Pawpaw	**Cocoyam**	**Pawpaw**	**Cocoyam**	**Plant**
As	0.20	0.10	0.03	0.02	**0.03**
Cd	0.76	0.81	0.22	0.30	**0.20**
Zn	0.20	0.20	ND	ND	**9.40**
Pb	0.55	0.51	0.21	0.10	**0.30**
Cr	0.34	0.25	0.12	0.02	**1.30**
Hg	0.96	0.79	0.51	0.30	**0.05**
Cu	0.10	ND	ND	ND	**73.0**
Ni	0.12	0.20	0.01	0.01	**2.00**
Fe	0.56	0.71	0.31	0.41	**425**
Ag	ND	ND	ND	ND	**-**
TOTAL	**3.79**	**3.57**	**1.41**	**1.16**	**-**

ND: Not Detected

Source: Author's Laboratory Analysis and Computation (2012); WHO/FAO (2001, 1999)

3 DISCUSSION OF RESULTS

Table 1.1 shows the distributions of heavy metals in the plant roots of Anaekie Obiakor dumpsite as well as the control site. The result revealed that the dumpsite has higher concentration of heavy metals than the control. In comparison with the WHO/FAO Standard, all the heavy metals studied are within Safe Limit exception of Cd, Hg, Pb, and As (Table 1.1). Silver (Ag) was not detected in any of the plant sample. The detection of higher concentrations of heavy metals in the plants of the dumpsite could be attributed to the fact that the area regularly receives very high quantities of domestic waste.

The safe limit of cadmium in plant is 0.20mg/kg (Table 1). High concentration of cadmium exerts detrimental effects on human health and causes severe diseases such as tubular growth, kidney damage, cancer, diarrhea and incurable vomiting. The concentration of lead if exceeding the maximum permissible limits (0.30 mg/kg) in human, affect nervous system, bones, liver, pancreases, teeth and gum & causes blood diseases. Mercury is more toxic than Cd and Pb. The concentration of mercury exceeding the maximum permissible limit (0.05mg/kg) in food and food stuff cause serious health problems such as loss of vision, hearing and mental retardation and finally death occurs. Arsenic is extremely toxic. The concentration of arsenic exceeding the maximum permissible limit (0.03mg/kg) in foodstuff causes short term (nausea, vomiting, diarrhea, weakness, loss of appetite, cough and headache) and long term (cardiovascular diseases, diabetes and vascular diseases) health effects.

In view of the above, the human population of the study area which ingest crops especially cocoyam and pawpaw grown around the area are exposed to high risk of Cd, Pb, As and Hg poisoning and the associated health effect since their levels in plant were found above WHO/FAO Safe Limit.

3.1 DISCUSSIONS ON STATISTICAL ANALYSES

Hypothesis One:

From the calculations made, tested at 5% significant, the calculated value, 0.55 is greater than the tabulated, which is 0.05. This shows that there is no significant difference between the heavy metal concentration of the pawpaw from the dumpsite and that of the control.

The implication of this is that though pawpaw plant from the dumpsite had higher percentage of heavy metal concentration than that of the control, the difference is not statistical significant. This is due to the short duration of time the pawpaw plant stayed in the soil before being used for the experiment.

Hypothesis Two:

Again, the result of the analysis of hypothesis two showed that the there is a significant difference between the heavy metal concentration of the cocoyam from the dumpsite and that of the control site.

This implies that the cocoyam plant from the dumpsite has higher concentration of heavy metals studied when compared with the control.

4 CONCLUSION AND RECOMMENDATIONS

The plants of Anaekie Obiakor Dumpsite contain higher concentration of heavy metals when compared with the control. The observed concentrations of heavy metals in the studied plants were below the FAO/WHO limit guideline for food exception of Pb, Cd, As and Hg.

The paper makes the following recommendations:

- There should be regular monitoring of metals in plants for prevention of excessive buildup of the metals in the food chain
- The present dumpsite should be treated accordingly to minimize the impact of persistent heavy metals in the area to be used for further economical use of the land.

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RACIAL CONFLICTS IN SOUTH AFRICA: ARGUMENTS AND DEFECTS OF THE APARTHEID STRUCTURES

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ABSTRACT: The article summarizes the racial conflicts in South Africa between the white and black population, apartheid structures, seasonal effects from the conflicts, and involvement of the United Nations in the racial issues. This paper is meant as a contributor towards the ongoing search for new means of managing ethnic conflicts in Africa. Using South Africa as a case study, it compares the management of ethnic and racial conflicts and shows the difficulties in managing deep-rooted and complex conflicts. The government of South Africa has taken bold constitutional steps to reduce tension, but the continuing ethnic and religious conflicts raise questions about the effectiveness of these mechanisms. The paper shows that ethnic conflict arose as a result of the denial of the basic human needs of access, identity, autonomy, security and equality, compounded by the autocratic roles played by the government and the military. Preservation of the ethnic peace is dependent upon the type and effectiveness of the available conflict management mechanisms and also the respective government's policy choices and decisions. For achieving a lasting peace, South Africa should challenge the actions of ethnic leaders who have used violent ethnic conflict for personal gain. The final conclusion of the paper is that ethnic conflicts are negative sum game in which there are no benefits for both sides.

KEYWORDS: Apartheid, Racial conflict, Racism, Repression, South Africa.

1 INTRODUCTION

If not mediated, conflicts become contagious and can spread quickly across borders like cancer cells. Scientist like Ted Gurr and Monty Marshall have written that most African conflicts are caused by the combination of poverty, weak states and institutions[1].

During the 1960s, the governmental policies in terms of racial inequality in South Africa and the United States of America began to move in opposite directions. In one of them, the national government implements a program for racial segregation, and in the other, the government tried to apply policies for racial integration. As a result to that, sharp differences can be expected in rates of racial conflicts, which occurred in both countries in the past 40 years. In the mention time interval, relations in both countries were filled with conflicts.

In a contrast, in the periods after 1948, the laws of the apartheid[2] in South Africa did separation on officially defined races in all sectors of society. These laws controlled marriages, unions, work reservation, public goods and residential segregation. The rise of the apartheid in the country was marked with many restrictive laws, including the law for prohibition

1 Monty G. Marshall and Ted Gurr, (2001) Peace and Conflicts "A Global Survey of Armed Conflict, Self Determination Movements and Democracy".
2 The apartheid was a system of legal racial segregation, implemented by the Government of the National Party of South Africa between 1948 and 1994, in which the rights of the majority African population were limited and there was established a rule by the white minority population.

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of mixed marriages in 1949, and many other laws which forbid the stay of racial categories in the specific areas, known as homelands.

The black South Africans, Hindus and Coloureds[3] (and others who joined the movement against the apartheid) experienced a rise in state repression in South Africa. Since 1960, the state is increasingly attacking her opponents. The state repression forbids organizations, made political arrests, detain persons for long periods, without criminal act or any other reason. Despite these repressive measures, the racial clashes with the state authorities continue, and they are increased during the 1980s.

It is important to note that most of these conflicts were caused by colonialism, which compounded inter-racial conflict by capitalising on the isolation of racial groups. The divide and conquer method was used to pit ethnicities against each other, thus keeping the people from rising up against the colonisers. Distribution of economic resources was often skewed to favour a particular group, pushing marginalized group to use their ethnicity to mobilise for equality. Ethnicity has a strong influence on one's status in a community. Ethnic conflicts are therefore often caused by an attempt to secure more power or access more resources.

2 THEORETICAL ARGUMENTS AND DEFECTS OF THE APARTHEID STRUCTURES, MOBILIZATION AND SEASONAL EFFECTS

South Africa with over 40 million people has long been polarized along racial lines. The country is made up of whites, indigenous Africans, Coloreds and Indians. The black people form the majority of the population with about 30 millions people, the whites 5 million, and the Coloreds and Indians share 3 million. In South Africa class was determined by race, with black population at the bottom of the ladder. Indigenous Africans were forced to live in impoverished and segregated ethnic homelands under the apartheid regime.

I would like to start with an analysis of the effects before the repressive measures are taken by the state. For example, let's take the violent actions of the police, taken against black protesters. The research of Olivie and Olzak in the Witwaterswand-Vaal region in South Africa[4], concludes that the violence of the police and repression have great effects in rates of protests and conflicts, but in opposite direction. The state sponsored the repression, including arrests and detentions, which increased the conflicts rates, but decreased the rates of the anti-apartheid protests. Olivie explains that peaceful protests seek lower cost of labor and resources for them to suppress, then needed for conflicts. Despite that, he notices that the state repression escalate racial violence as the repression rates are intensified.

According to the Report of the National Advisory Commission on Civil Disorders, it is concluded that almost always the incidents are connected with action by the police. All the great protests that took place in Harlem, Vats, New York and Detroit are caused by routine arrests of the black population for minor offences by the white members of the police. But the police are not just provocation. Their duty is to maintain order and to insure public safety in the disturbing living conditions in the ghetto, they are involved in more common and more sharper conflicts with the population in the ghettos then the population in other areas. So even do the ghettos have a greater number of black population, the police comes to symbolize white power, white racism and white repression.

Mc Adams[5] claims that, the political climate of repression against the black population and the lost of the external financial support of the black organizations reduce the rebellion of the black population. Former research, also suggest that police violence often increase the racial tension, depending on the scope of the police actions, crowd reactions and racial composition of the bystanders, participants and observers. Gerhard Mare states that these conflicts appear to be a response to the uneven development in South Africa, which caused ethnic groups to mobilize to complete for resources along ethnic and racial lines[6].

If we focus on one of these measures, we will realize that the police actions are more brutal on events who involve human rights protests, demonstrations against the apartheid, racial conflicts and attacks. For example, since 1960 South Africa is a state which is easy dominated. It is easy to notice that the violence against the black population by the police was

3 In South Africa, the Coloured known also as Bruinmense, Kleurlinge or Bruin Afrikaners are an ethnic group of mixed races who own Sub-Saharan African heritage, but it is not enough so they can be considered as black according to the law of South Africa.
4 Susan Olzak, Johan L.(1998), "Racial Conflict and Protest in South Africa and the United States".
5 Doug McAdam (1982), "Political Process and the Development of Black Insurgency, 1930-1970".
6 Gerhard Mare and Hamilton C. (1987) "An Appetite For Power: Buthelezi' Inkatha and South Africa".

noticed as extension of the African dominance and organ structure. The protests in the country are having anti-African or anti-white character, which means that the strong identification of the state power with political power in South Africa leads us to expect that the actions by the police in this country almost always have potential effects of racial mobilization.

Racism made it impossible for the indigenous Africans to enjoy the benefits of modernization in South Africa. The white rulers constantly discriminated against the Zulus, Xhosas and other black ethnic groups. The period between 1910 and 1947 exposed how economic racism consolidated the structures of white domination and black discrimination and exploitation. This was done through racist legislation against the black majority. These laws forced Africans to evacuate the major cities and move to remote settlements in an impoverished part of the country. In 1912, African elites rebelled by forming the African National Congress (ANC), which was meant to represent and defend black African rights. The black South Africans were deprived of their rights to own land through the enactment of the 1913 Natives Land Act. This legislation prevented blacks from producing food for themselves and from making money through agriculture. The government also regulated the job market, reserving skilled work for whites alone and denying black African workers the right to organize and form trade unions. Finally, the Pass Laws prevented blacks from moving freely between the homelands and the cities, thereby paving the ground for the introduction of apartheid.

Significant to the history of ethnic conflict in South Africa was the victory of the right-wing racist National Party (NP) in 1948 and the introduction of apartheid. The victory of the Afrikaner Nationalist Party consolidated white interests in the political and economic arena. The NP strengthened the discriminatory laws and championed the belief that Africans were inferior both biologically and culturally to whites and incapable of running their own affairs. The apartheid system served as a divide-and-rule strategy that limited black mobility and participation in socio-economic activities in the country, placing them at a structural disadvantage. Subsequent NP governments did not consider the basic needs of the African population when they created the homelands under the pretext of preserving national authority[7]. According to Mzala, the separate administration plan for the homelands was aimed at "retribalization" within the colonial framework of South Africa. It was an attempt to exclude the black majority from having a role in the administration of their own country[8]. The homelands or "Bantustans" were designed to distance the Africans from the fruits of economic development in the country and made them sources of cheap labor for white owned industries[9]. These Bantustans like KwaZulu-Natal, KwaNdebele, Bophuthatswana, and Lebowa where mainly characterized by poverty, overpopulation, underdevelopment and frustration[10].

Institutionalized racism and apartheid took control of black people's lives causing great hardships, poverty, despair and disease in the homelands. Because bad policy choices and denial of people's basic needs are seeds of conflict, the government of South Africa witnessed as a result, organized strikes by members of the banned African Nationalist Congress (ANC), and the Congress of South African Trade Unions (COSATU) with the support of the Union of Democratic Party (UDF). Violence also increased between 1976 and 1980 in the mostly black townships of Johannesburg and Soweto, where youth and school children were trying to make the townships ungovernable[11]. The brutal police repression and closure of schools forced many youths to flee the townships and join the militant wing of the banned ANC where they continued the liberation struggle. Severity of racial and ethnical boundaries is connected with the concrete economic and political boundaries within the states. Such folding boundaries become accepted as issues of historical, law and social priority. Recent history of South Africa claims that conflict often leads to braking down of these boundaries, especially when they are reinforced by the state. The defect of the solid economic and political hierarchies based on the racial or economic boundaries encourages hostility, conflicts and violence. In South Africa, after the mid 1970s, when the first modifications of the apartheid are implemented, the ethnical mobilization and violence are significantly increased. The civil protests are increased during the 1980s and 1990s. The racial segregation in housing and other sectors in society are legally mandated till 1990.

Research show that racial conflict means confrontation between members of two and more racial population: white and black Africans in South Africa, and white and African Americans in the United States of America. The racial protest is a collective action that has the public or some representatives of the Government as her auditorium, and tries to present

7 Leroy Vail, (1989) The Creation Of Tribalism In Africa, James Currey, London.
8 Mzala (1988) Gatsha Buthelezi, Chief With A Double Agenda. Zed Books Limited. London and New Jersey.
9 Ivans, Evans (1997) Bureaucracy And Race. Native Administration In South Africa. South African Institute of Racial Relations. Johanesburg.
10 Chanaiwa, David (1993) "Southern Africa Since 1945", In , (eds), Ali Mazrui and Wondji, C., General History Of Africa Since 1935, Vol. 8, Heinemann. California. UNESCO.
11 Kane-Berman, John (1993) Political Violence in South Africa, South African Institute Of Race Relations, Johanseburg. Pages: 29-31.

complaints that are experienced by the racial group. The march for civil rights represents a prototype for these actions. Still, it is useful to have in mind that the location for civil rights protests is different in the both countries, based on different laws that are referring to racial and civil disobedience. For example, in South Africa the racial protests were often held at funerals, weddings, plays and annual celebration, because these were the only legal form of group meeting for black Africans till February 1990. Opposite to this, the civil protest for human rights of the white Americans were held at governmental offices in the United States of America.

3 RACIAL CONFLICT AND THE UNITED NATIONS

Due to the fact that India and Pakistan sent appeals to the General Assembly of the United Nations for the committed discrimination toward the Hindu and Asian population, the General Assembly adopts the following resolutions that are covering:

- South Africa to modify their policies;
- United Nations members to take regulatory actions against South Africa;
- Establishment of special committees who will explore the situation and recommend actions;
- Security Council to use economical sanctions or to consider the exclusion of South Africa from the United Nations; and
- Specialized agencies to convince South Africa to modify its policies.

In 1955, South Africa refused to participate in the session of the General Assembly and refused to participate in the committee meetings. In 1970, the Assembly has doubted the legitimacy of South Africa but due to technical reasons, delegates are allowed to participate in the session. But, on 12.11.1974, the General Assembly confirmed the decision of the President and exclude South Africa from participation on the 29-th session.

The Security Council is involved in this issue in 1960, after the Sharpeville massacre, in which 250 black protesters were hurt and 69 killed for protesting for the adopted laws in South Africa. On 01.04.1960, the Security Council adopted a resolution that claims that continuing racial policies of South Africa can threaten international peace and security.

In 1962, the Security Council asked the following actions from the members states:

- To terminate diplomatic relations with South Africa;
- To close the ports in South Africa;
- Prohibition of all import and export in South Africa; and
- Denial of landing aircrafts from South Africa.

4 CONCLUSION

The racial conflicts in South Africa represent one of the biggest issues in the United Nation history. African countries today face greater challenges to peace and stability than ever before. The countries of sub-Saharan Africa, including Sierra-Leone, Ivory Coast, Liberia and the Democratic Republic of Congo, are a volatile mix of insecurity, instability, corrupt political institutions and poverty. Alarmingly, most of these countries lack the political will to maintain previous peace agreements, and thus have fallen prey to continuous armed ethnic conflict[12].

South Africa has concluded a difficult transition to democratic rule. The country bears the responsibility to steer the continent away from the repression of authoritarian government towards a path of social and economic development and good governance. The dual processes of transition and transformation need nothing less than a vibrant economy in which the basic needs of citizens are taken care of. They also require a state and society with a sense of shared destiny where racial and ethnic identities are harnessed positively as a uniting force rather than divisive factor or an impediment to nation building.

12 Monty G. Marshall and Ted Gurr, (2003) "Peace and Conflict 2003: A Global Survey Of Armed Conflicts, Self Determination Movements and Democracy".

In South Africa's transition process, Mandela's charisma helped the African national Congress (ANC) to pursue the path of negotiation, accommodation and confidence building for managing the ethnic diversity problem, though some South African whites still complain of dominant party favouritism, following ANC's second election victory of 1999. The South African people defied the pattern of their past and broke all the rules of social theory to forge a powerful spirit of unity from a shattered nation[13].

In South Africa, after a difficult and courageous political negotiation between the country's various interest groups, the state has prevented further violence by developing multiple democratic approaches to create a foundation for peace and security. The architects of the new South African constitution crafted an impressive document aimed to heal the wounds of the past and establish a society based on social justice, fundamental human rights and rule of law. The constitution guarantees freedom of association, languages and religion and includes a bill of rights.

The government has also created affirmative action packages for disadvantaged groups, which emphasise "management of diversity". They are meant, among other things, to address the structural racism created by the apartheid state. The structure of the South African government was constitutionally changed to make way for a government of national unity. Power-sharing mechanisms were included in the constitution to prevent the ethnic or racial domination of any group. The composition of the new government confirms a trend towards accommodation and tolerance, which also helped to legitimise the government.

The constitution dismantled the homelands. This act signified the end of apartheid. As mentioned above, the conditions in the black reservations were inhuman. Poverty was endemic and social amenities and jobs were scarce. The neglect of the homelands and townships made the people vulnerable to ethnic entrepreneurs and warlords who were fighting for power and economic resources. Following the dismantling of the ethnic homelands, the constitution provided for the creation of nine provinces in place of the former four provinces that existed during apartheid. This decision aimed to distribute power between sub-national units. The provinces enjoy relative autonomy, thus helping to de-escalate conflict. The next step taken towards peaceful conflict management was the establishment of the Truth and Reconciliation Commission (TRC) chaired by Arch-bishop Desmond Tutu, which helped to heal the wounds inflicted by the apartheid system. It also helped to inculcate a commitment to accountability and transparency into South African public life.

With the final step the ANC government took was meant to address the roots of economic inequalities. The ANC introduced an ambitious plan of action called the "Reconstruction and Development Programme" (RDP). The RDP was aimed at encouraging disadvantaged groups, especially blacks, to participate equally with others in business.

13 Waldmeir, M. Holman (1994) "A Powerful Spirit A Unity".

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Biosorption of Zn (II) ions from aqueous solutions by water hyacinth (*Eichhornia crasippes*): Equilibrium and Kinetic studies

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ABSTRACT: The biosorption characteristics of Zn (II) ions were investigated. Experimental parameters affecting the biosorption process such as pH, contact time, biomass dosage, initial metal ion concentration, and temperature were studied in batch adsorption experiments. Langmuir and Freundlich isotherm models were applied to the adsorption data .The biosorption capacity for *E. crasippes* was found to be 16.50 mg g^{-1}. The data was also subjected to pseudo-first-order and the pseudo-second-order kinetic models.

KEYWORDS: Biosorption, Water hyacinth (*E. crassipes*), Heavy metal ions, Isotherms, Kinetics.

1 INTRODUCTION

The need to immobilize the heavy metals released into the environment by and partially lost trough anthropogenic activities must be top on our research agenda now. This is because it is well established that dissolved metals in the environment pose a serious threat to human and environmental health. Heavy metals in water have been a major preoccupation for researchers for many years due to their toxicity towards aquatic life, human beings and environment (Ibrahim *et al*, 2010).The heavy metals have a wide range of effects on fauna and flora, some of which are life threatening as they lead to damage of the essential body systems. Zinc though essential in low concentrations is known to have negative effects such as depression, lethargy, neurologic signs such as seizures and ataxia and increased thirst in humans (Barakat, 2011).

There is therefore urgent need to remove the heavy metals already immobilized and if possible recover them for recycling purposes. This is because they do not biodegrade unlike organic pollutants, making their presence in industrial effluents and drinking water a public health concern. The conventional techniques of heavy metal removal which include chemical precipitation, reverse osmosis, ion exchange are not only expensive but also easily subject to fouling. They also lead to generation of secondary sludge which is sometimes more problematic to treat apart from the inability to remove high volume low concentrations of heavy metals. Adsorption has come out strongly as an alternative technique with activated carbon being the main adsorbent for the removal of heavy metal ions from water and waste waters is costly (Gautam *et al.,* 2014).

In order to meet the ever stringent regulations and to protect and preserve the integrity of our environment there is therefore need to come up with effective and cheap technologies that will help in mitigation of the effects of these heavy metals in the environment.

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The objective of this study was to investigate the application of *E. crasippes* an invasive weed species which has potential to successfully colonize, spread, and subsequently displace vegetation and disrupt ecosystems (Holm, 1977) (Hohm et al, 1977) as an adsorbent for Zn (II) ions removal from aqueous solutions.

The effects of several physico-chemical parameters such as pH, adsorbent dosage, contact time, initial metal ion concentration and temperature that affect adsorption were investigated. Equilibrium isotherm models and kinetic models were applied to the data obtained for a better understanding of the adsorption process.

2 MATERIALS AND METHODS

2.1 BIOMASS PREPARATION

E. crassipes plants were harvested from Winam Gulf, Kisumu bay at Kisat and Hippo point of L. Victoria, Kenya. The collected biomass was washed several times with tap water to remove adhering dirt. The washed biomass was then cut into roots, shoots and stems and the parts dried separately for 2 weeks .The dried brown plant biomass were then transported to the University of Nairobi laboratories were they were further dried and later ground and sieved to various particle sizes(<75µm, >75< 300 µm, >300< 425 µm and > 425 µm). The material was washed again using distilled water, then dried in an oven for 48 hours at 70ºC then stored in plastic containers awaiting biosorption experiments.

2.2 CHEMICALS

All chemicals used in the present work were of analytical grade. The stock solution of Zn (II) ions was prepared in 1.0 g L^{-1} concentration using 4.4200 g of ZnSO4.7H_2O (Sigma Aldrich) then diluted to appropriate concentrations .The pH of the solutions was adjusted using 0.1 mol L^{-1} HCl and 0.05 mol L^{-1} NaOH solutions.

2.3 ANALYSIS OF METAL IONS

The concentration of Zn (II) ions in the biosorption media was determined using Atomic absorption Spectrophotometer (CTA 2000 and Varian Spectr AA), equipped with air acetylene burner. The hollow cathode lamp was operating at 4 mA. Analytical wavelength was set at 213.5 nm.

2.4 BIOSORPTION EXPERIMENTS

Biosorption experiments were conducted at room temperature (26 ºC) by agitating a given mass of biosorbent with 20 mL of metal ions solution of desired concentration in 100 ml polypropylene containers using an orbital shaker at a speed of 200 rpm for 20 min except for contact time experiments. The effect of solution pH on equilibrium biosorption of metal ions was investigated under similar experimental conditions between 2.0 and 7.0.

After the adsorbate has had the desired contact time of interaction with the adsorbent, the samples were filtered using Whatman no. 42 filter paper and the residual concentration analyzed using CTA- 2000 AAS. However experiments involving effect of contact time used filter paper no 2.For studies on effect of temperature the adsorption studies were carried out at 25, 30, 40, 50, 60 and 70 ºC.

The amount of biosorption (q) was calculated by using the equation below.

$$q = (\frac{C_o - C_e}{m})V \quad (1)$$

The biosorption efficiency, A %, of the metal ion was calculated from:

$$A\% = (\frac{C_o - C_e}{C_o}) \times 100 \quad (2)$$

Where **Co** and **Ce** are the initial and final metal ion concentrations (mg L^{-1}) respectively. **V** is the volume of the solution (L) and **m** is the amount of biosorbent used (g).

3 RESULTS AND DISCUSSION

3.1 EFFECT OF pH ON METAL BIOSORPTION

Hydrogen ion concentration is one of the important factors that influence the adsorption behavior of metal ions in aqueous solutions. It affects the solubility of metal ions in solution, replaces some of the positive ions found in active sites and affects the degree of ionization of the adsorbate during the process of biosorption (Volesky, 2007). This is because it affects solution chemistry and also the speciation of the metal ions.

The effect of initial pH on biosorption of Pb (II) ions onto *E.crasippes* was evaluated in the pH range of 2.0 to 7.0. Studies in pH range above 7.0 were not attempted as there is precipitation of lead (II) hydroxides. From the figure 1 it could be seen that Pb (II) ions adsorption increased as the pH increased. At low pH values, protons occupy the biosorption sites on the biosorbent surface and therefore less Pb (II) ions can be adsorbed because of electrostatic repulsion between the metal cations and the protons occupying the binding sites.

When the pH was increased, the biosorbent surface became more negatively charged and the biosorption of the metal cations increased drastically until equilibrium was reached at pH 5.0 - 6.0. At pH of >6 .0 there is formation of hydroxylated complexes of the metal ions and these complexes compete with the metal cations for the adsorption sites hence a reduction in the effective metal cations removal. Therefore adsorption experiments at pH above this were not considered. Similar results were reported (Amboga *et al,* 2014).

3.2 EFFECT OF BIOSORBENT DOSAGE

The number of available binding sites and exchanging ions for the biosorption depends upon the amount of biosorbent in the biosorption system. This is attributed to the fact that it determines the number of binding sites available to remove the metal ions at a given concentration. The dosage also determines the adsorption capacity of the biosorbent with an increase in mass reducing the biosorption capacity as the mass increase from 0.125 g to 2.5 g per 20 mL of adsorbate. The effect of biomass dosage on adsorption of Zn (II) ions is indicated in figure 2. An increase in the % adsorption is attributable to an increase in the number of binding sites for the metal cations .Similar results were recorded in the literature for other adsorbents. However the mass could not be increased infinitely as at some point all the solution is sequestered leaving no residual solution for concentration determination.

3.3 EFFECT OF INITIAL METAL CONCENTRATION.

The initial concentration remarkably affected the uptake of Zn (II) ions in solution. The efficiency of Zn (II) ions adsorption by *E.crasippes* at different initial concentrations (20-600 mg L^{-1}) was investigated as shown in figure 3. At a lower concentration, the adsorption sites take up the available Zn (II) ions much quickly due to less competition among the metal ions for the available binding sites which are fixed in this case. However, as the concentration increases the competition for the limited binding sites sets in as the binding sites become saturated.

3.4 EFFECT OF CONTACT TIME

Contact time is an important parameter for any successful use of the biosorbents for practical purposes. Effect of contact time on adsorption of Zn (II) ions was investigated keeping the biomass in contact with the metal ion solution for different time periods between 0 to 60 minutes. The adsorption of Zn (II) displayed a triphasic pattern with rapid initial uptake in the first 5 minutes, then a slowed down followed by a plateau.

It was noted that as adsorption proceeds, the sorbent reaches saturation state, at this point the sorbed solute tends to desorb back into solution (figure 4).Eventually, the rate of adsorption and desorption are equal at equilibrium. When the system attains equilibrium, no further net adsorption occurs. The time taken to attain equilibrium is very important for process optimization. The rate of adsorption is very fast at first and over 95 % of total biosorption of Zn (II) ions occurs in the first 5 minutes and thereafter it proceeds at a slower rate and finally no further significant adsorption is noted beyond 20 minutes of contact time. The very fast adsorption makes the material suitable for continuous flow water treatment systems.

3.5 EFFECT OF TEMPERATURE

Temperature of the medium affects the removal efficiency of pollutants in aqueous solutions. This is because a change in temperature in turn affects the solubility of pollutants and also the kinetic energy of the adsorbing ions. Therefore the effect of temperature on adsorption of Zn (II) ions was investigated and the data is shown in figure 5.The results indicate that the % adsorption is not affected by temperature changes. However when the concentration is increased the reaction is slightly affected by temperature changes hence a reduction in the % adsorption. This can be attributed to the fact that with increase in temperature of the solution, some binding sites are damaged, the attractive forces between the biomass surface and Zn (II) ions are weakened thus decreasing the sorption efficiency. This could be due to increase in the tendency for the Zn (II) ions to escape from the solid phase of the biosorbent to the liquid phase with increase in temperature.

3.6 BIOSORPTION KINETICS

Kinetic study provides useful information about the mechanism of adsorption and subsequently investigation of the controlling mechanism of biosorption as either mass transfer or chemisorption. This helps in obtaining the optimum operating conditions for industrial -scale batch processes (Anayurt *et al*, 2009).

A good correlation of the kinetic data explains the biosorption mechanism of the metal ion on the solid phase. In order to evaluate the kinetic mechanism that controls the biosorption process, the pseudo-first-order models were applied for biosorption of Zn (II) ions on the biosorbent. The Lagergren pseudo- first –order rate model is represented by the equation:

$$\log(q_e - q_t) = \log q_e - \frac{k_1}{2.303}t \quad (3)$$

Where q_e and q_t are the amounts of metal adsorbed (mg g^{-1}) at equilibrium and at time t respectively, and k_1 is the rate constant of pseudo-first-order biosorption (min^{-1}).The qe and rate constant were calculated from the slope and intercept of plot of $\log(q_e - q_t)$ against time t.

The pseudo-second-order equation assumes that the rate limiting step might be due to chemical adsorption. According to this model metal cations can bind to two binding sites on the adsorbent surface.The equation can be expressed as shown below

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^{\,2}} + \frac{1}{q_e}t \quad (4)$$

Where k_2 is the rate constant of the pseudo-second- order adsorption (g $mg^{-1}min^{-1}$).If the adsorption kinetics obeys the pseudo-second-order model, a linear plot of t/q_t versus t can be observed as shown in figure 6 (a) and 6 (b).

3.7 BIOSORPTION ISOTHERMS

For optimization of the biosorption process design , its imperative to obtain the appropriate correlation for the equilibrium data.Biosorption isotherms describe how adsorbate interacts with the biosorbent and the residual metal ions in solution during the surface biosorption.The isotherms also help in determination of adsorption capacityof the biosorbent for the metal ions((Foo and Hameed, 2010). The data on Zn (II) biosorption was fitted with the Langmuir and Freundlich isotherms.

The Langmuir isotherm assumes monolayer coverage of the adsorbate onto a homogeneous adsorbent surface and the biosorption of each cation onto the surface has equal activation energy.The Langmuir isotherm can be exppressed as :

$$\frac{C_e}{q_e} = \frac{1}{q_{\max} b} + \frac{C_e}{q_{\max}} \quad (5)$$

Where q_{max} is the monolayer capacity of the biosorbent (mg g^{-1}), and b is the biosorption constant (L mg^{-1}).The plot of ce/qe versus ce should be a straight line with a slope of $1/q_{max}$ and intercept of $1/q_{max}$ b when the biosorption follows Langmuir equation.

The Freundlich equation can be expressed as :

$$\log q_e = \log K_F + \frac{1}{n}\log C_e \quad (6)$$

where K_F and 1/n are the Freundlich isotherm constants related to biosorption capacity and biosorption intensity respectively.n describes the heterogeneity of the adsorbent surface and its affinity for the adsorbate(Chen et al., 2003).A higher value of n (or a smaller value of 1/n) indicates a stronger bond between the adsorbate and the adsorbent thus values of n larger than unity indicate a strong bond which implies favourable adsorption(Sari et al., 2009). If the equation applies then a plot of log q_e versus log C_e will give a straight line of slope *1/n* and intercept as K_F.The experimental data was evaluated using Langmuir and Freundlich isotherms and results are displayed in 7 ((a) and 7 (b).

4 FIGURES

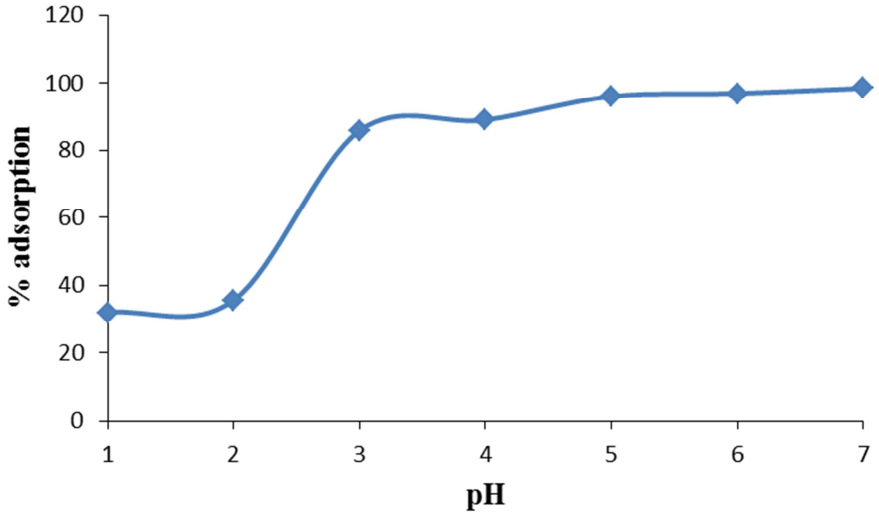

Figure 1 : Effect of pH on adsorption of Cu(II) ions onto E.crassippes

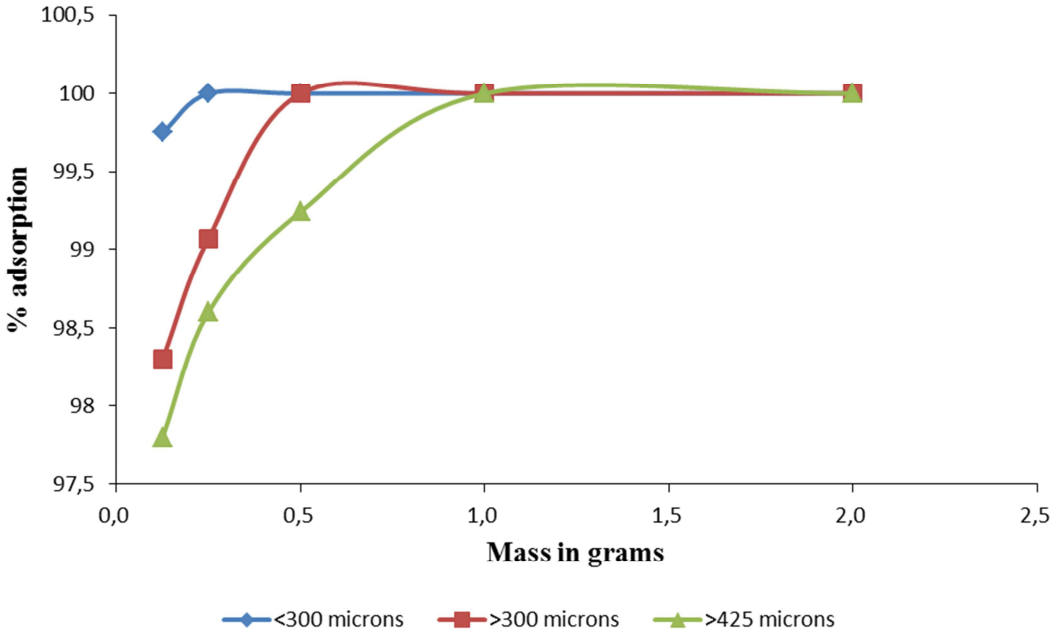

Figure 2: Effect of biomass dosage and particle size on adsorption of Cu (II) ions

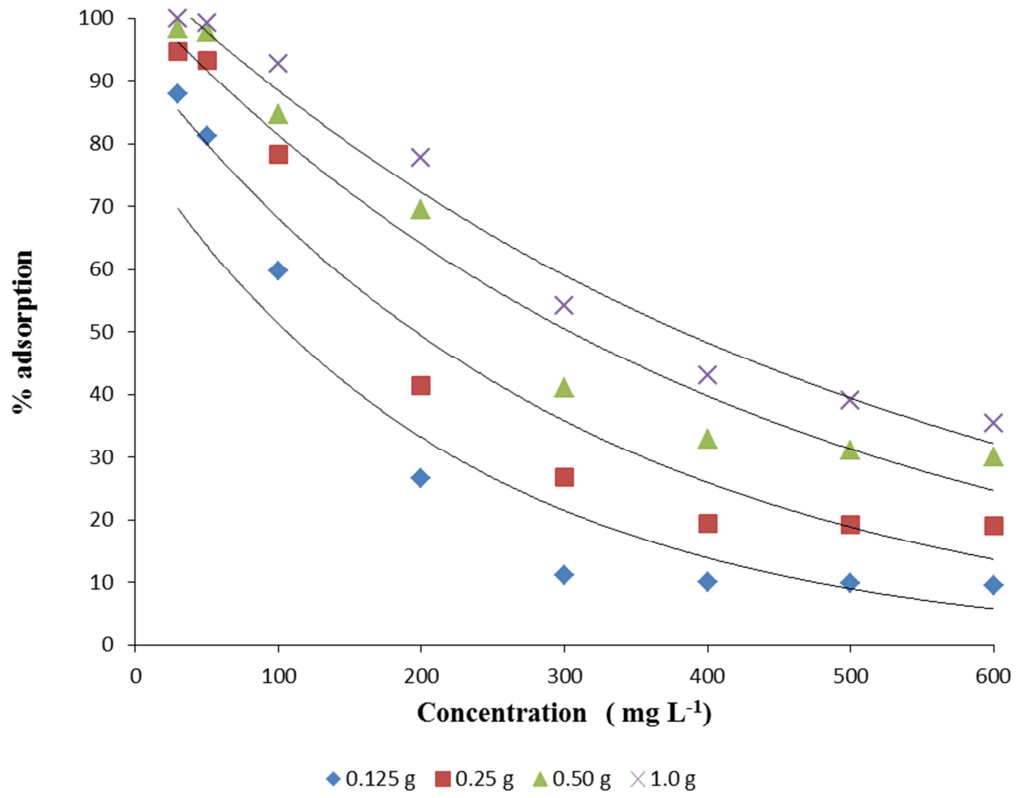

Figure 3: Effect of initial concentration of Zn (II) ions on adsorption by E. crassipes

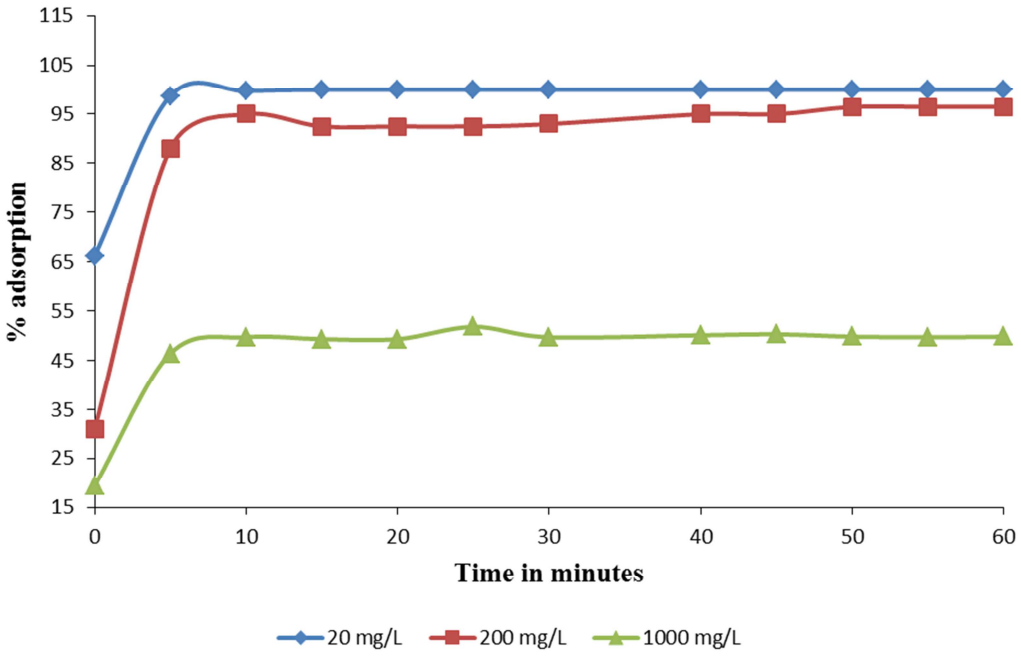

Figure 4: Effect of concentration and contact time on adsorption of Zn (II) ions by 0.5 g of E. crassipes

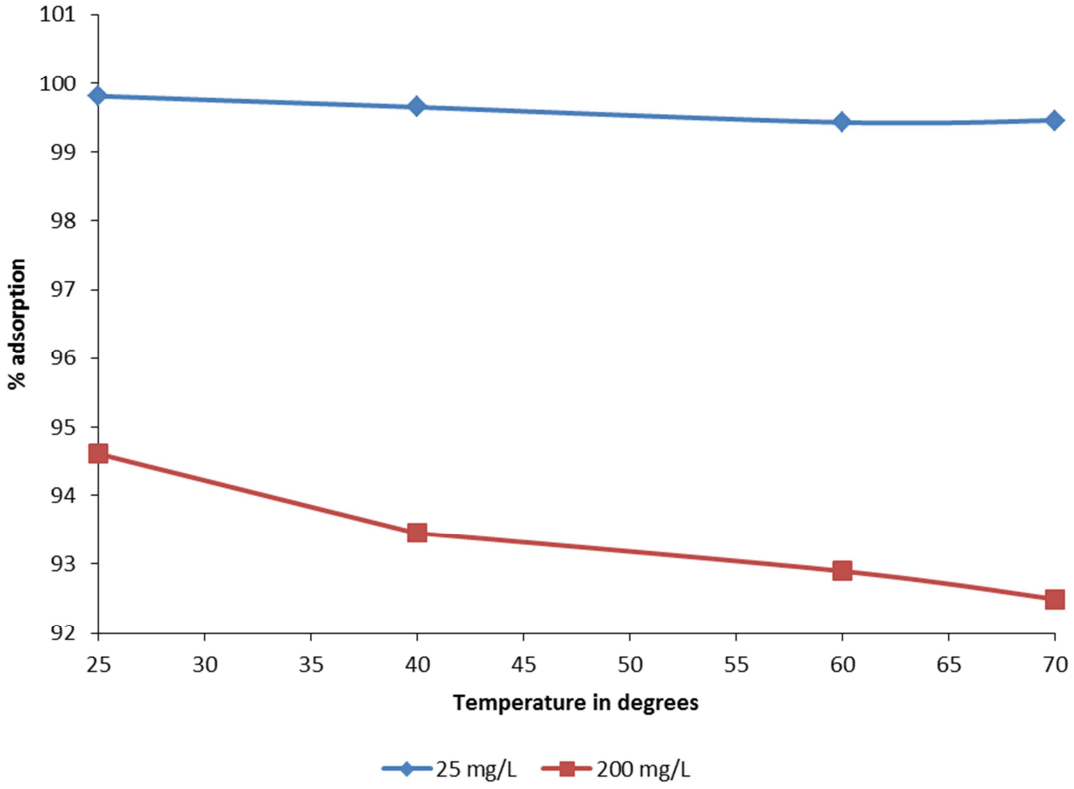

Figure 5: Effect of temperature on % adsorption of Zn (II) ions by 0.5 g of E. crassipes

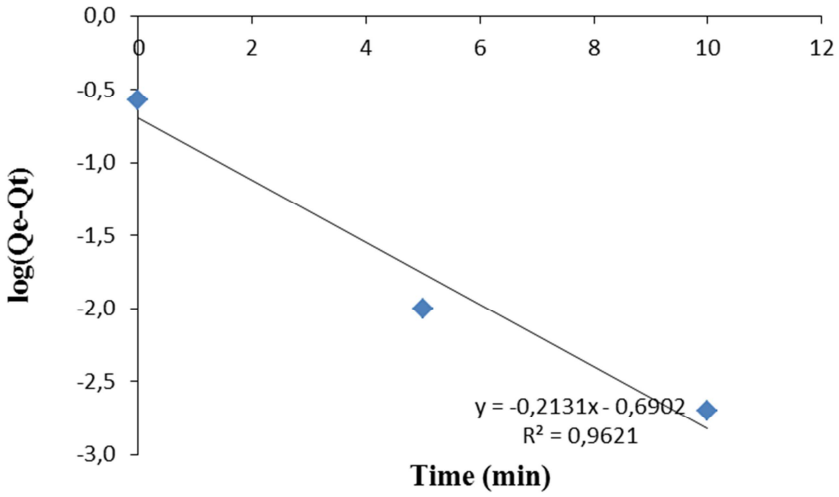

Figure 6(a): Pseudo-first-order plot for adsorption of 20 mg/L of Zn (II) onto E. crassipes

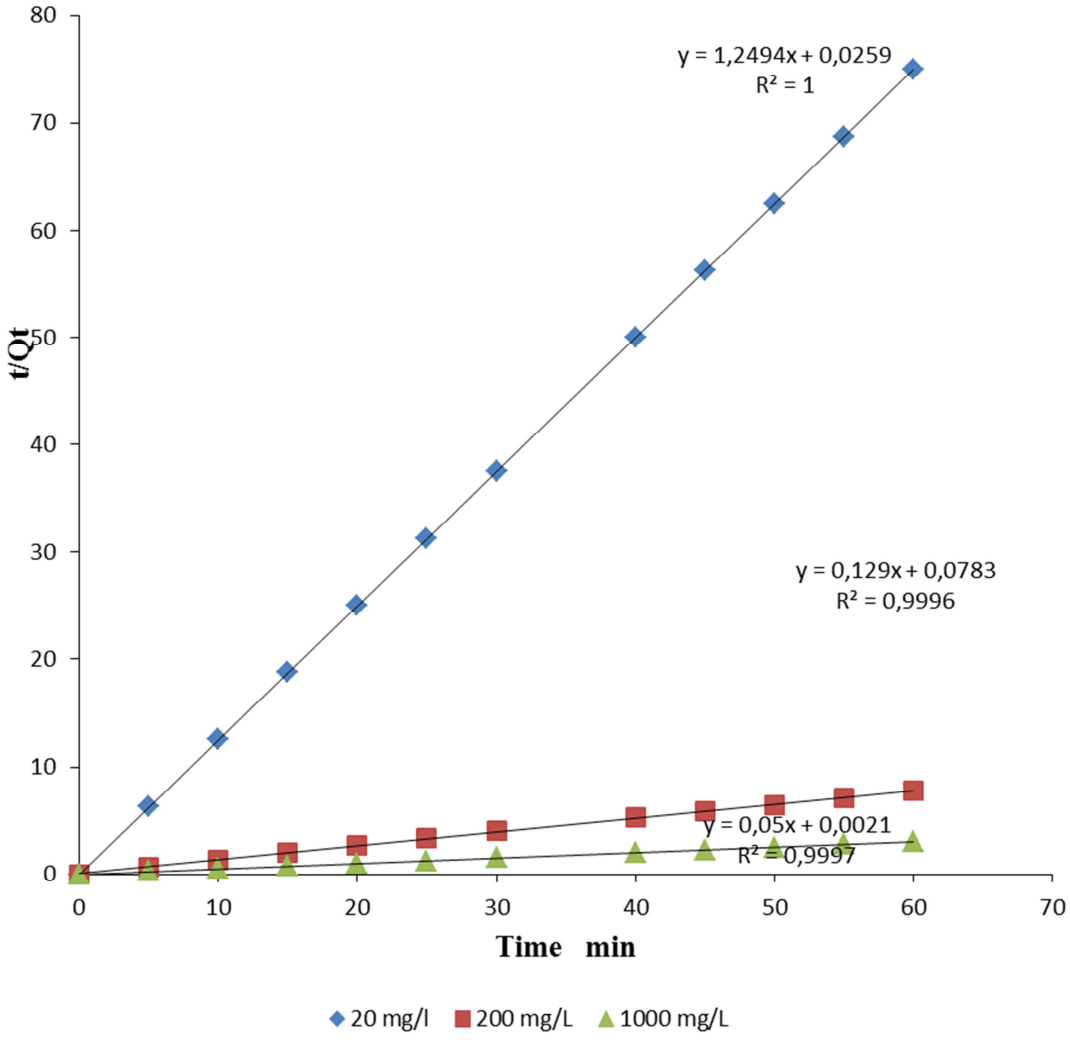

Figure 6(b): Pseudo-second- order plots for Zn (II) ions adsorption by E.crassipes.

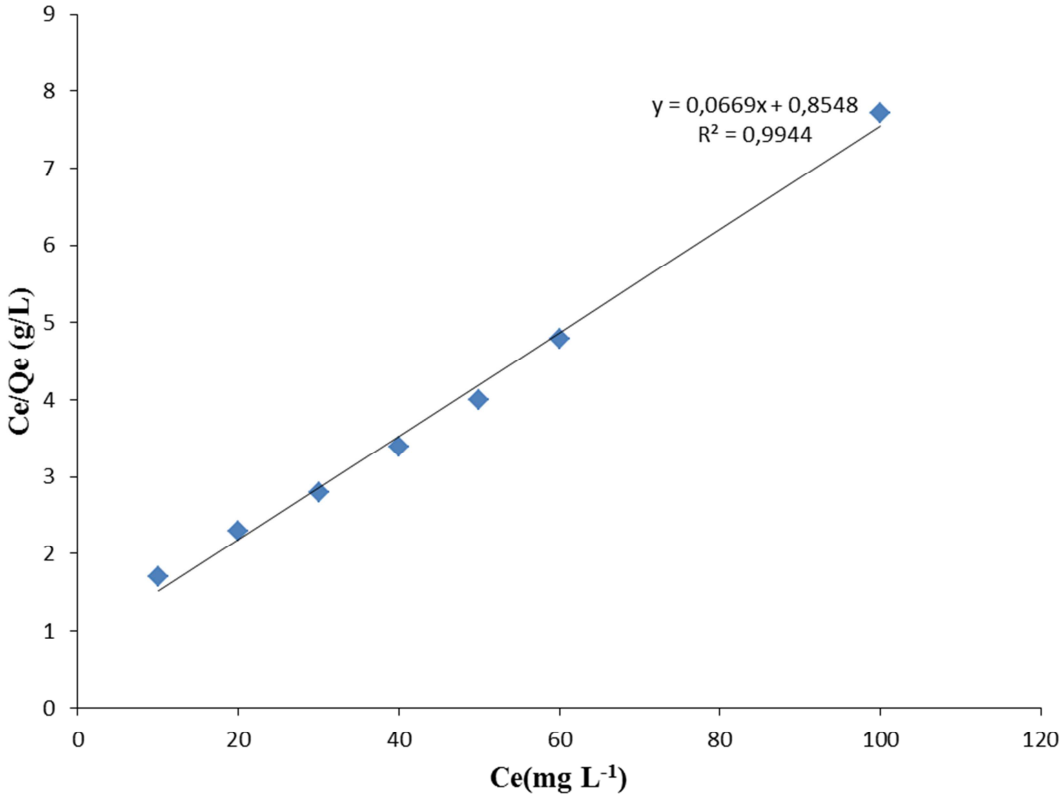

Figure 7(a): Linearized Langmuir isotherm for adsorption of Zn (II) ions by E.crasippes

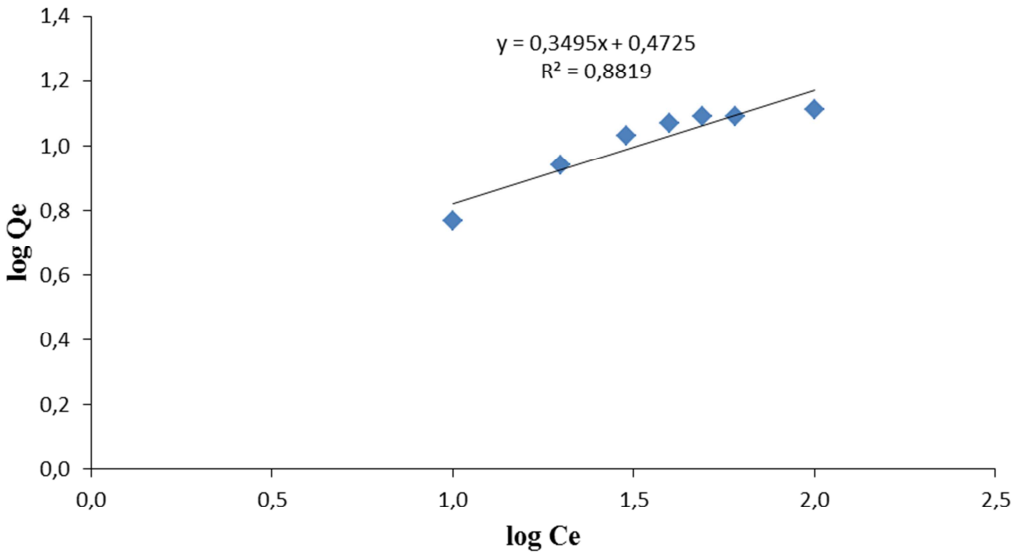

Figure 7 (b) : Freundlich isotherm for adsorption of Zn(II) onto E. crassipes

5 CONCLUSION

This study demonstrates that *E.crasippes* is a promising adsorbent for the removal of Zn(II) ions from aqueous solutions. The adsorption process was affected by various physico-chemical parameters such as contact time, pH, initial concentration of the metal ions, shaking speed and temperature.The kinetic study revealed that the adsorption data obeyed the pseudo-second-order model better than the pseudo-first-order model given the higher correlation coefficient(R^2). It can therefore be

concluded that *E.crasippes* is an effective alternative biomass for the removal of Zn (II) ions from wastewater because the material has a high adsorption capacity, naturally and abundantly available at a low cost.

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Comparative of Islanding Detection Passive Methods for Distributed Generation Applications

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ABSTRACT: One of the important protection characteristics in online distributed generation is to identify the islanding operation. And in accordance with standards of Distribution network in power system, this identification must take in less Than 2 seconds. There are several Methods in Micro grids islanding detection. Islanding detection technique may generally be divided into remote and local techniques. In remote, The detection algorithm is on the grid side, in local the detection is on the DG side. Local Techniques consisting of active and passive and hybrid methods. Passive methods have been studied in This paper. The most commonly used passive islanding detection techniques are presented in This paper. This paper aims to compare these methods with their non-Detection zone and speed of detection. The comparison can help researchers determine the best method for their product.

KEYWORDS: Distribution Generation, islanding detection, Micro grid, Passive method.

1 INTRODUCTION

Recently by introducing and increasing the penetration of distributed generation (DG), electricity restructuring and also the need of reducing greenhouse emissions Micro Grids have emerged. A Micro Grid (MG) can be defined as a Low-Voltage Networks comprising distributed generation resources(micro turbines, fuel cells, solar photovoltaic modules, small wind turbines and synchronous generators) plus its loads and storage devices (flywheel and capacitors) and it can provide both power and heat to local loads. MG is normally connected to Medium Voltage networks. In emergency mode micro grid can operate autonomously i.e. disconnected from upstream MV network. The most challenging issue of micro grids is power islanding, which is defined as "a condition in which a portion of utility system that contains both loads and distributed energy resources remains energized while isolated from remainder of utility system[1]. Islanding is either intentional or unintentional, the former is for maintenance and load shedding and the latter is because of fault and equipment failure. Unintended Islanding operation has several drawbacks including inadequately grounded system depending on the transformer connections[2], line worker safety risks, and significant variation in voltage and frequency, distributed resources damaging due to out-of-phase reclosing, tripping the line due to out of synchronism[3]. According to IEEE Std. 1547-2003 the anti-islanding relay must immediately disconnect the DG, in less than 2 seconds of the establishment of a power island[1]. Several methods have been proposed for islanding detection. In general islanding detection methods can be divided into two

main groups: 1) remote methods and 2) local (active, passive and hybrid) methods. This classification is shown in Figure 1. Remote methods such as Power line communication, supervisory control and data acquisition, transfer-trip are based on communication between the grid and the DGs. They don't have a non-detection zone (NDZ) and also they have better reliability than local methods but they are more expensive to implement and uneconomical especially for small DG systems. Local methods are based on the measurement of DG output parameters. They classified into three categories: active, passive and hybrid. In active methods small external perturbation are injected locally into the system. In normal operation these Perturbation doesn't cause a significant Deviation in the operating conditions due to the presence of the utility. In the absence of the utility, however small deviations will be amplified, so it becomes easy to detect the islanding conditions. Since active methods inject abnormal inputs into the DG output, this degrades the power quality and it would be undesirable for the utility and its customers. In fact, the system responses of These perturbations are used to detect islanding conditions. If the active and reactive power imbalance in the islanded system is small, active methods will detect islanding conditions. It Means that these methods have very small NDZ. Passive methods are based on Monitoring system parameters such as voltage, current, frequency, harmonic distortion, etc. They make their decision to trip without directly interacting with system operation. Hybrid methods include a combination of an active and a passive techniques. It will overcome the short comings of both active and passive techniques. The active technique is used only when the islanding is suspected by the passive technique [3-5].The most significant advantage of Passive islanding detection is that it doesn't influence the power quality. The passive methods do not affect the waveform of high voltage. Only passive technique has the ability to be used in both anti islanding Protection Strategy and MG operation modes (disconnection from upstream network). So this paper aims to provide useful information in passive islanding detection techniques.This paper is organized as follows: section 2 represents most type of passive techniques, section 3 provide a comparison analysis between the passive methods. Finally some conclusions are represented.

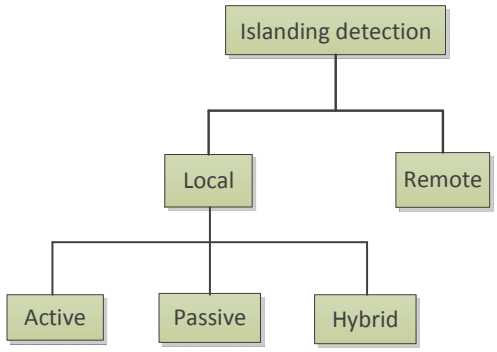

Fig1: Classification of islanding detection technique

2 PASSIVE ISLANDING DETECTION METHODS

The main philosophy of passive methods is to monitor the DG output parameters because when MG is isolated from the main grid the system parameters are start to vary dynamically. In following subsections some of passive islanding detection methods are presented.

2.1 UNDER VOLTAGE/ OVER VOLTAGE

Traditional voltage relays are commonly used. they measure the voltage magnitude at the DG side and trip the generator if the voltage have been abnormal during a certain time. The relay can respond to over and under voltage circumstances. In Principles the method relies on reactive power imbalances between production and consumption, which occurs after loss of mains. This leads to a change in voltage level, which can be measured locally[6].

$$Q_L = Q_{DG} + \Delta Q$$

There is relatively large NDZ therefore traditional relays are used as a secondary or backup protection relays.

2.2 UNDER FREQUENCY/ OVER FREQUENCY

A frequency relay makes its decision based on the frequency of voltage at the DG terminal. They are based on the frequency change introduced in island. If the frequency rises above (over frequency) or drops below (under frequency) predetermined thresholds, the relay will trip and DG will be isolated from the main grid [6].

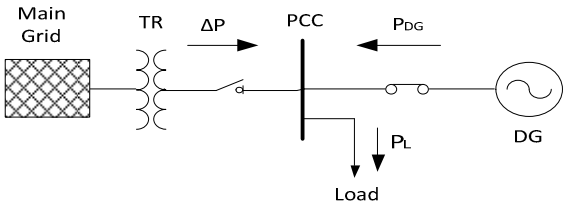

Fig2: System representation for anti-islanding methods

$$P_L = P_{DG} + \Delta P \qquad (1)$$

Equation (1) describe the power balance of the system. If P_L=P_{DG} there is no active power mismatch (ΔP=0) between the DG and Main Grid. It is worth to mention that the active power is directly proportional to the frequency. If the power imbalance in the islanded system is small, The frequency will change slowly so these relay can't detect islanding successfully, So it have a large NDZ.

2.3 RATE OF CHANGE OF FREQUENCY

Rate Of Change Of Frequency (ROCOF) is today the most commonly employed Loss Of Main (LOM) detection method because it is very simple and cheaper than that of other methods. ROCOF relays rely on the assumption that when islanding occurs, there is an imbalance between the generation and load in the formed island. Immediately after islanding, the resulting power imbalance will cause the frequency to change dynamically. The rate of change of frequency can be calculated from swing equation of the synchronous generator, which is given bellow:

$$\frac{df}{dt} = \frac{1}{2\pi}\frac{d\omega}{dt} = \frac{f_0}{2H}\Delta P \qquad (2)$$

Where ΔP is power mismatch at the DG side, H is the generator inertia constant for DG system, f_0 is the system nominal frequency, ω is the generator speed.

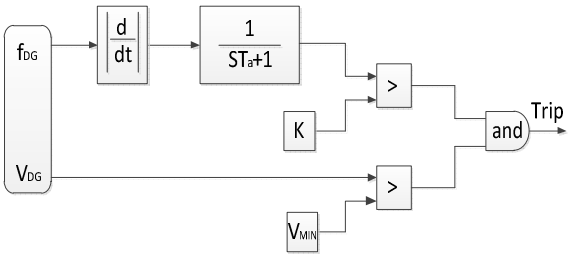

Fig3: ROCOF relay model

ROCOF relay model is illustrated in Fig 2 in which T_a is the time constant of the filters. If the output of low pass filter is larger than the relay setting and also the magnitude of the terminal voltage is larger than the minimum voltage setting, the ROCOF relay send a trip signal to the DGs Circuit Breaker. ROCOF relay method is highly reliable when there is large power mismatch but it may require an active power imbalance higher than 15% to detect islanding suitably[7-9].

2.4 VOLTAGE VECTOR SHIFT RELAY

If the MG becomes islanded, the generator will begin to feed a larger load (or smaller) because the current provided by (or injected into) the power grid is abruptly interrupted. Thus, the generator begins to decelerate (or accelerate). The increase (decrease) in current causes to change the DG terminal voltage(V_T). Consequently, the difference between V_T and generator internal voltage (E_I) is suddenly increased (or decreased) and the terminal voltage phasor changes its direction. as shown in Fig4. VS relay is very fast in comparison to other method such as ROCOF but it is sensitive to network faults and it has large NDZ i.e. for the setting of 6° it may require an active power mismatches more than 30% Sn to detect islanding situation[10, 11].

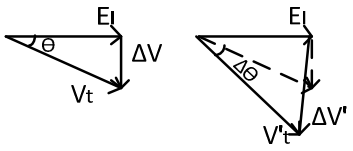

Fig 4: DG terminal voltage vector shift

2.5 PHASE JUMP DETECTION METHOD

Phase jump detection (PJD) method are based on monitoring the phase differences between the main grid voltage and DG current. In the presence of main grid, DG current is synchronized with the main grid voltage through a phase locked loop. When Mg is disconnected from main grid, the phase angle will change and it will exceed the predetermined threshold. The phase criterion for PJD is presented by:

$$\tan^{-1}\left[R\left(\omega_0 C - \frac{1}{\omega_0 L}\right)\right] \leq \theta_{th}$$

where *R*, *C* and *L* are respectively load resistance, capacitance and inductance. ω_0 is main grid voltage frequency.

The advantage of this method is its easy implementation, however the threshold selection cause difficulty in islanding Detection because the phase can be affected by certain loads such as motor loads or simply by presence of load that can not produce phase angle change. Also, this method can not detect islanding when the load power factor is near unity. Fig.5 shows the operation of voltage when it is disconnected from main grid[12].

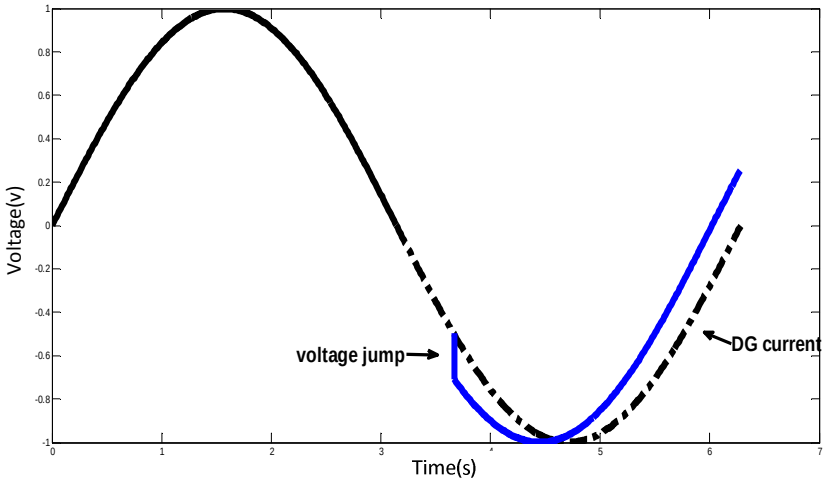

Fig5: Phase jump method Operation

2.6 VOLTAGE UNBALANCED AND TOTAL HARMONIC DETECTION

The principal of this method is to detect total harmonic distortion of the terminal voltage at the DG side. In normal operation main grid can be considered as a stiff voltage source which providing sinusoidal voltage waveform. when main grid is disconnected, the voltage harmonic will increase due to interaction between high impedance of islanding load and harmonic current produced by inverter. If the THD becomes higher than the certain threshold islanding condition can be detected successfully. This method have advantage that it does not have an NDZ when there is power balance in MG because it doesn't rely on active and reactive mismatches at the instant of islanding. But this Methods is similar to other methods which are suffering from determining appropriate threshold for islanding detection, because non-linear loads may cause voltage distortion to be high so it can be detected as islanding condition. Furthermore linear load doesn't affect THD voltage significantly so it can be hard to detect islanding[13]. In [2] a new islanding detection based on measuring voltage unbalance and change in the voltage total harmonic distortion from all the phase components are presented. This method is able to detect very fast and selectively islanding situations in a perfect power balance without NDZ. It also intelligently utilizes the available fault detection information with islanding verification logic.

2.7 RATE OF CHANGE OF ACTIVE POWER

This method is based on measuring the rate of change of power, dP/dt, at the DG side. There will be a significant change in dP/dt before and after islanding situations. The instantaneous three phase DG output power are illustrated by:

$$P_g = V_a i_a + V_b i_b + V_C i_C$$

Where V_a, i_a, V_b, i_b, V_C, i_C represent the sampled values of line currents and phase voltages measured at the generator's terminals. This algorithm monitors and integrates the changes in output power, ΔP_g and then compares it with predetermined thresholds which is defined by:

$$\sum_{n=-tx}^{n=0} (\Delta P_g)_n > K_s$$

Where n is sampling instant, tx is the length of measuring window and K_S is tripping threshold. The advantage of dP/dt is that they are economical but it cannot detect islanding properly under all LOM situations. For example, output power of some renewable sources are changing with time so finding an appropriate threshold for this method is difficult[8, 14, 15].

2.8 RATE OF CHANGE OF FREQUENCY OVER POWER

This method monitors the change of df/dP_L. This method has the merit of islanding detection even in situations that dP_L is small, because the value of df/dP_Lcan be large enough to be detected by relay. it also more reliable and has lower NDZ than ROCOF relay. This method have two different threshold so settings of these threshold would be rather difficult[15].

2.9 COMPARISON OF RATE OF CHANGE OF FREQUENCY (COROF)

COROCOF is based on measuring change of frequency such as ROCOF but at two location, i.e. main grid and DG side. COROCOF differentiate between rate of change of frequency due to LOM and network perturbations. At main grid the ROCOF is measured and if the value exceed the limits a block signal will transfer to the DG. At DG side the ROCOF will also be determined. When DG has not received any blocking signal and the value of rate of change of frequency has exceeded the threshold the Relay will send trip[16].

Due to much computational work the practical implementation of this method is very difficult.

2.10 RATE OF CHANGE OF PHASE ANGLE DIFFERENCE (ROCOPAD)

ROCOPAD method monitors the voltage and current signals at the DG side and estimating the phasors (amplitude, phase and frequency). Then the phase angle difference must be calculated and compared with the threshold. ROCPAD is obtained as follow:

$$ROCOPAD = \frac{\Delta(\delta_V - \delta_i)}{\Delta t}$$

Where δ_V and δ_i are voltage and current phase angles. The ROCPAD relay can successfully detect islanding condition even under active power balances in Mg. they also have fast response[17].

2.11 INTELLIGENT BASED METHOD

In these approach various system parameters that could affect islanding can be measured locally. Some important parameters are change of voltage, change of frequency, ROCOF, ROCOP, ROCOFOP, change of harmonic distortion, change of power factor and etc. These techniques use data-mining technology such as neural networks, support vector machines and decision tree to extract information from the large data sets which are obtained by network off-line simulations during predetermined events. These are more accurate methods to detect islanding in multi-DG system and has the ability to optimize the threshold values. Their NDZ are small and has faster operation time. However it involves much computational works so the implementation of this technique may be time consuming[18-20].

2.12 WAVELET TRANSFORM-BASED METHOD

Wavelet transform provide information about time and frequency of a waveform and it is efficient method for analysis of transient signals that are non-stationary data. Recently wavelet transform-based method have been used for islanding detection. In this method voltage and current are monitored and then the energy coefficient of these transient signals are extracted by wavelet transform. If these values exceed certain thresholds the protective relay will detect islanding conditions. Fig.6 shows the basic model of the transient-based islanding detection technique.

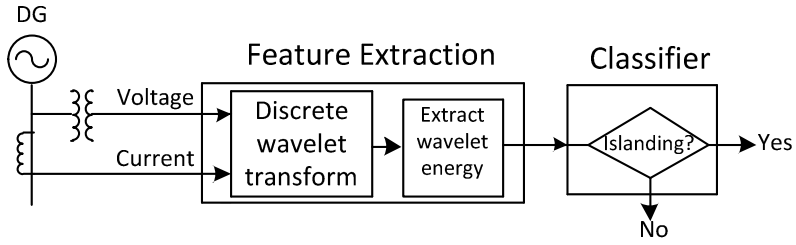

Fig.6 basic model of wavelet transform-based method

Wavelet transform-based has the privilege of being fast and reliable. However it is associated with high computational process. Reference [21]proposed a method using wavelet transform and S-transform in order to extract features for detection of islanding and power quality disturbances. The results show that wavelet degrades significantly under noisy signals, while ST is considered to detect the disturbances correctly under both noise free and noisy scenarios[22, 23].

2.13 ESTIMATION-BASED METHOD

The basic idea of this method is to estimate the voltage, current and frequency of signal in order to draw out necessary features. Reference [24] uses a fast gauss-newton algorithm for islanding detection. The algorithm can estimate current and voltage parameters accurately in a recursive manner for realistic power system even in the presence of significant noise. It also use data mining approach to classify estimated features.In [25] a statistical signal-processing algorithm known as estimation of signal parameters via rotational invariance techniques is utilized to extract features from power system voltage and frequency waveforms. It reduce the NDZ but in small voltage and frequency deviation it takes long time to detect islanding. Also the complexity of computational process for this algorithm is high.

Table 1 . comparison of passive islanding detection method

Technique	Concept	NDZ	Speed
Under/Over Voltage	Voltage Change	Large	Low
Under/Over Frequency	Frequency change	Large	Low
Rate of change of frequency	Frequency variation over time	Smaller than OF/UF	Faster than OF/UF
Voltage Vector shift	Terminal voltage vector change	Larger than ROCOF	Faster than ROCOF
Phase jump detection	Phase voltage change	Large	Low
Voltage unbalance and total harmonic detection	Measuring voltage unbalance and THD	Small	Faster than OF/UF & OV/UV
Rate of change of active power	Active power variation over time	Large	Faster than OF/UF & OV/UV
Rate of change of frequency over power	Frequency variation over power variation	Large	Faster than OF/UF & OV/UV
Comparison of rate of change of frequency over power	Comparing DG ROCOF with the main grid ROCOF	Smaller than ROCOF	Faster than ROCOF
Rate of change of phase angel difference	Change of phase angel between voltage and current	Small	Fast
Intelligent based method	Change in various parameters	Very small	Very fast
Wavelet transform-based method	Energy coefficient extraction	Almost Zero	Very fast
Estimation-based method	Parameter estimation	Very small	Fast

Tufts-Kumaresan signal estimation method [26] are used to detect islanding condition. This method uses a non-iterative algorithm for the estimation of the damping factor and oscillation frequency of DGs. This method is non-recursive and can estimate the signal parameters even in noisy status. It also has small NDZ. All of estimation based method are reliable, accurate, do not affect the system power quality but they suffer from high complexity in computation. Passive anti islanding classification is showed below. There is no exclusive passive method for islanding detection which will work successfully for all kinds of systems. It depends on the Type of DG systems to be protected. Also the most effective factors are time and the non-detection zones which can help the design engineer to choose the best method. Table 2 compare the speed of detection and the Non Detection Zone of different passive methods. It also illustrate

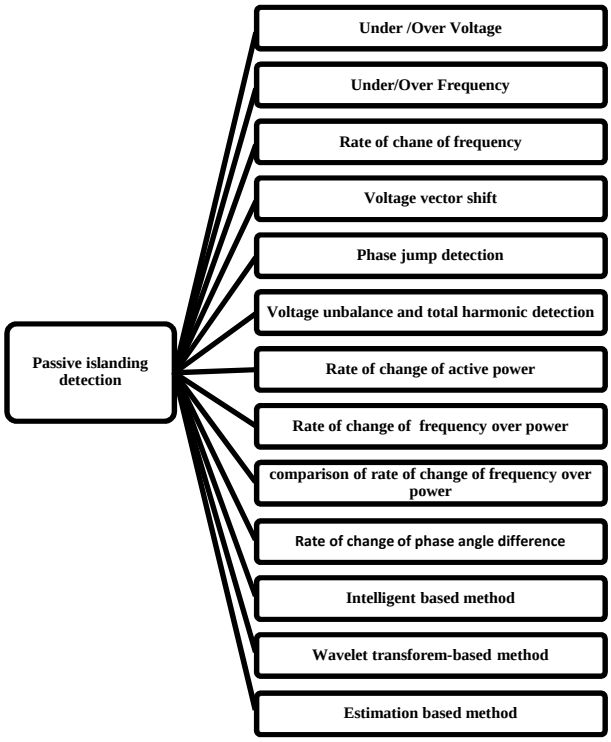

Fig7. Classification of passive islanding detection method

3 CONCLUSION

The main purpose of this paper was to review of different passive anti islanding methods. This paper compares different passive anti islanding methods. These methods can be used for all types of DG technology. They have the advantages of being cheap and easy to implement, using locally measured signal and making trip decision without impacting in system power quality. The drawbacks of this local method are that in some cases it has large non detection zones, in cases that NDZ are small the method is much more complicated and needs more computational process. The results shown in this paper indicate that the proposed methods has good performance.

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A New Islanding Detection Method For Inverter-Based Distribution Generation Power System Using Impedance Unbalancing And Total Harmonic Distortion Of Current

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ABSTRACT: One of the important protection characteristics in online distributed generation is to identify the islanding operation. And in accordance with standards of distribution network, this identification must take in less Than 2 seconds. A novel islanding detection method for an inverter-based distribution generation power system is proposed in this paper. The inverter-based distribution generation power system includes a dc power source and a grid-connected DC/AC inverter. The grid-connected DC/AC inverter acts as a virtual capacitor as the frequency is slightly lower than the fundamental frequency of utility voltage. Hence, the proposed method can immediately detect the islanding operation. This method is combination of previous methods therefore its operation is more suitable. The results of simulation done by MATLAB program, shows the suitable operation of this method well. It is observed that method is highly effective in islanding detection, including different islanding and non-islanding conditions in the initial test system and standard inverter-based distribution generation power system with wide variations in operating parameters.

KEYWORDS: Islanding Detection Method, Inverter-Based Distribution Generation Power System, Impedance Unbalancing, Harmonic Distortion, Current.

1 INTRODUCTION

Nowadays, in most of the countries, most of the energy is supplied by fossil fuels. But in this way, we are faced with many problems such as environmental pollution and finite fossil energy. Countries use renewable energy for supply needed energy to solve these problems. Renewable energies mostly include solar energy, wind energy, energy from waste, biomass and flowing water. At the present time the goal of Europe is to supply 12% energy consumption through renewable energy in 2012. Most of distributed generations in power systems are renewable energy. Depending on the type of distributed generation, they are can be either AC or DC. But in general, most of these distributed generations are connected to the network by power electronic converters [1, 2].However, distributed generations have effects in the network; one of these effects is islanding phenomenon. Islanding mode occurs when one or more DG separately and without connection to the network, supplies local loads. This phenomenon often is unwanted. This phenomenon will cause problems such as risk for maintenance crew, damaging consumers' devices because of unstable voltage and frequency and happening imbalance while reconnecting to the network. Therefore according to the IEEE1547 standard, islanding operation must be recognized and disconnected in 2 seconds [3-5]. So far many methods have been proposed to detect the islanding state. These methods can be divided into two main groups: active and passive [4]. Active methods include:

- Impedance measurement method [6]
- Analysis of the frequency range [7]
- Methods of changes in voltage and reactive power level [8]
- Interharmonic method [9]

And the passive methods can be highlighted:

- Voltage and frequency relays [10]
- frequency changing rate relays($^{df}/_{dt}$)
- rate of output power changes[10]
- imbalanced voltage and total harmonic distortion of current(voltage)[9]

THD method may go wrong in some cases that start-stop mode occurs in network but islanding mode haven't happened therefore disconnect the network. In impedance measurement method the decision will be made very quickly because only measuring the impedance is done and sometimes may be wrongly diagnosed. In this paper, a new method based on a combination of the previous methods is proposed to detect an islanding condition and this method has a high speed because it uses the passive and active methods based on measurements. Also it prevents misdiagnosis from islanding state and system disconnection mistake. This paper is organized as follows. In the next section discussed case will be studied. An algorithm will be proposed in third section to detect the islanding state. The result are presented and analyzed in the fourth section. Finally, the conclusions are presented in fifth section.

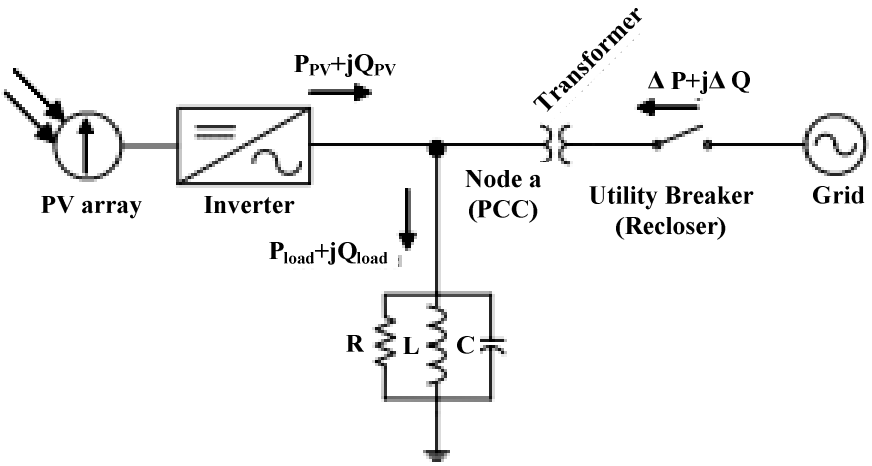

Fig 1:sketch of distributed generation system for detecting anti Islanding

2 MODEL DEVELOPMENT

Single-line diagram of the system being studied is shown in Fig 2. In this system, DG is shown by a DC source and a voltage source converter (VSC) which is connected to power system and local load through a low-pass filter. The total impedance of the low-pass filter is displayed by R_t and L_t . The system parameters are described in Table 1.

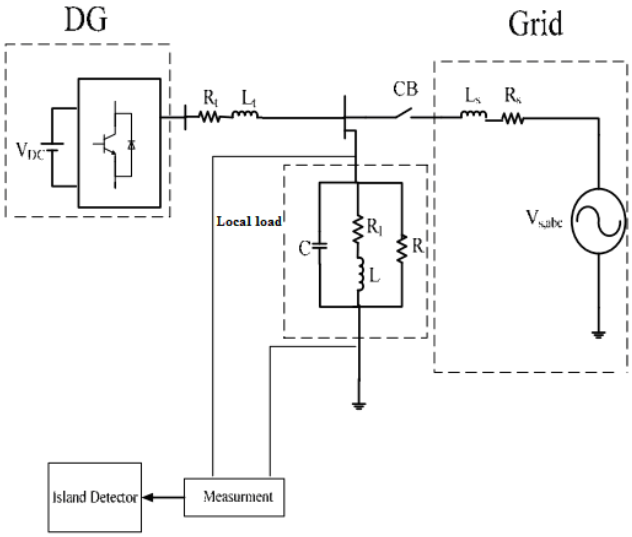

Fig 2: The power system being studied including distributed generation and network

Table 1. System 's parameters

PARAMETER	VALUE
R	76.176 Ω
L	111.9 mH
C	62.855
R_s	1 Ω
L_s	10
R_t	1.5
L_t	300
F_0	60
PWM carrier frequency	1980
DC voltage	1500
Nominal gird frequency	60

When the circuit breaker is closed as shown in the figure, distributed generation with local load is connected to the power system and generation power is injected into the system by DG. But when the circuit breaker is opened, islanding conditions occur and DG with local load creates an islanding state and independently of national network, requisite power of local load will be provided by distributed generation. In this situation islanding state must be recognized and generation must entirely be cut off and after connection to the network, generation is restarted. A measurement device is located in both side of local load to distinguish the islanding condition. The output of the measurement device ends in a central processor so measured signals are processed and in islanding state, decision is quickly made to cut off the system

3 PROPOSED ALGORITHM TO DETECT THE ISLANDING STATE

In changing rate method, we measure impedance of load. When changing of measured impedance in one period is greater than its set value, trip signal is sent to circuit breaker. Relay setting is done based on independent performance of distributed generation units and without the presence of network. Presence of network doesn't affect relay setting. The problem of this method is wrong operation in some situation such as switching mode. And because decision in this method is very fast, as a result relay operates and system is disconnected wrongly. Loading Changes in islanding mode leads to changes in current (voltage) harmonics. So, the total harmonic distortion (THD) can be used as a parameter to determine the islanding state. The current THD in moment t is obtained from equation (1).

$$THD_t = \frac{\sqrt{\sum_{h=2}^{H} I_h^2}}{I_1} \times 100$$

I_h is rms value of hth harmonic and I_1 is the main component of measured current at time t. In this paper, a new method based on the two previous methods is proposed to detect an islanding condition. Fig 3 shows the flowchart of the proposed method. In this paper, first the THD of current is measured any moment. If the measured value is less than the determined threshold value, system continues to operate. But if the measured value goes above this threshold value, the value of dz/dt is checked. And if its value exceeds of the set threshold value, islanding mode is diagnosed and stop command is sent.

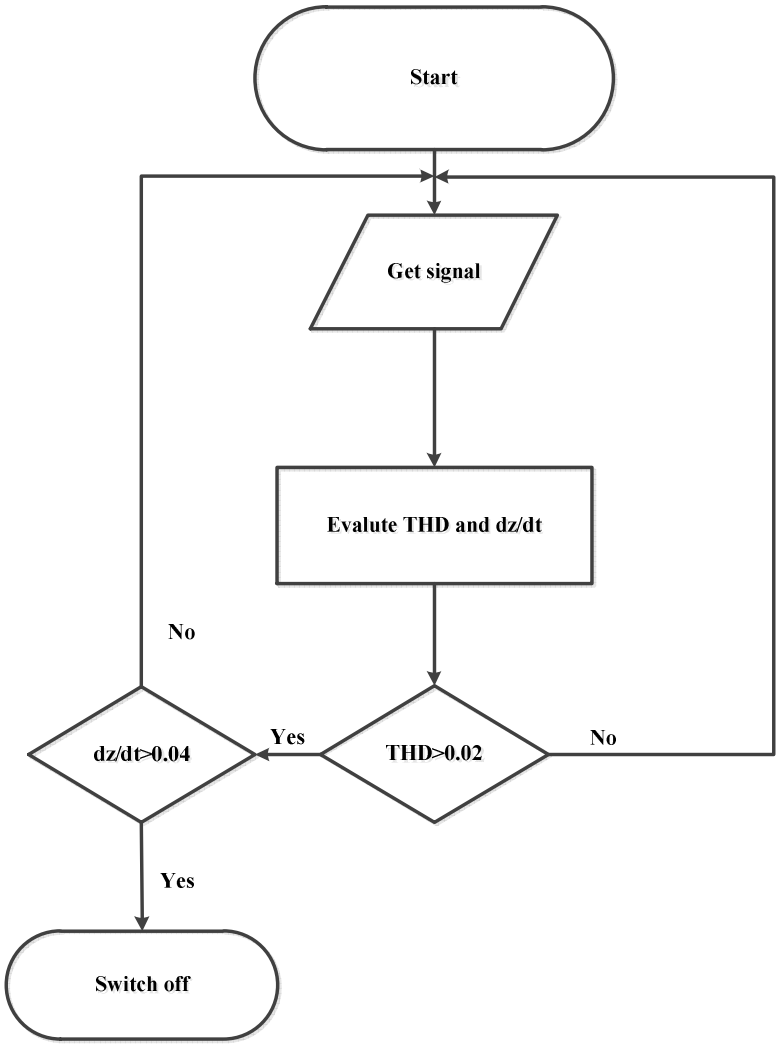

Fig 3: The flowchart of the proposed algorithm for detecting Islanding

4 SIMULATION RESULTS

In this section the results of proposed method are presented for various loads.

4.1 NON-NOMINAL LOAD

In this case, local load have non-nominal values. In connection (to network) state, network absorbs 910kw (0.5Pu) active power from distributed generation and absorbs 400Kvar (0.16Pu) reactive power from load as well.

At the first circuit breaker is closed and the system is connected to the network. At t = 1.2 sec, CB is opened and distributed generation and local load are isolated from the network and islanding state is created. Figure 4 shows the voltage waveform of phase A, which has remained relatively constant. Fig 5 and Fig 6 display THD of voltage and THD of current respectively. According to the figures, it is clear that at t = 1.2 seconds THD values are increased rapidly and their value is greater than 0.025. In this situation it is possible for islanding state to occur therefore $^{dz}/_{dt}$ should be checked. Fig 7 shows $^{dz}/_{dt}$ of signal. According to waveform, it is determined that the size of the waveform $^{dz}/_{dt}$ is higher than 0.04. Therefore islanding state is diagnosed and system should be shut down and generation should be stopped. In Fig 8, the impedance and Phasor of the system in accordance with frequency are shown in terms of the non-nominal load.

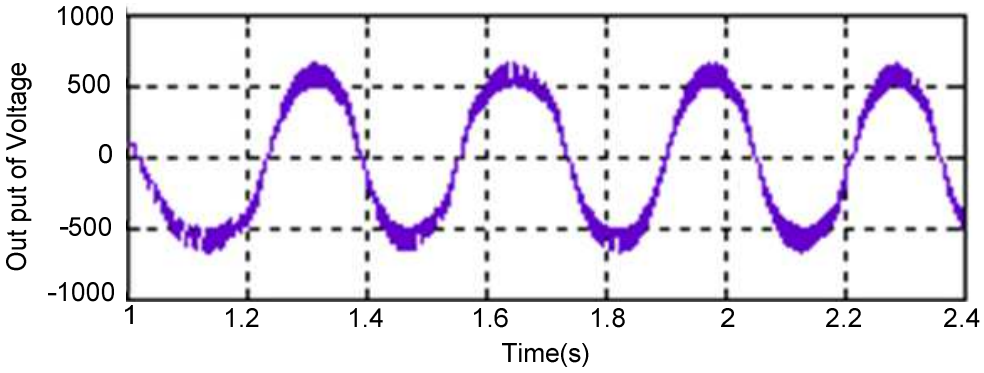

Fig 4: voltage waveform of phase A at the non-nominal state

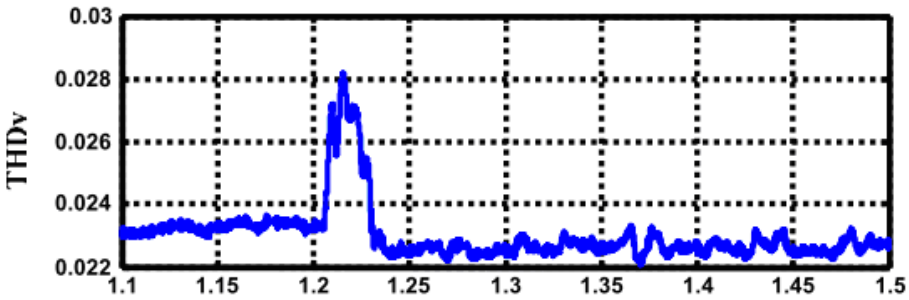

Fig 5: Changes of THD of voltage at non-nominal load on the islanding conditions

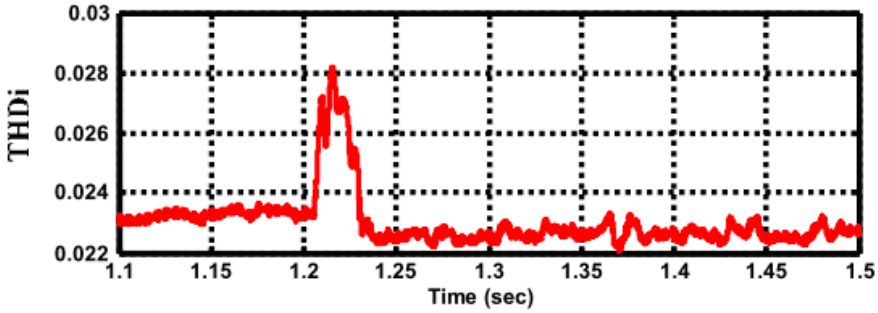

Fig 6: Changes of THD of current at non-nominal load on the islanding conditions

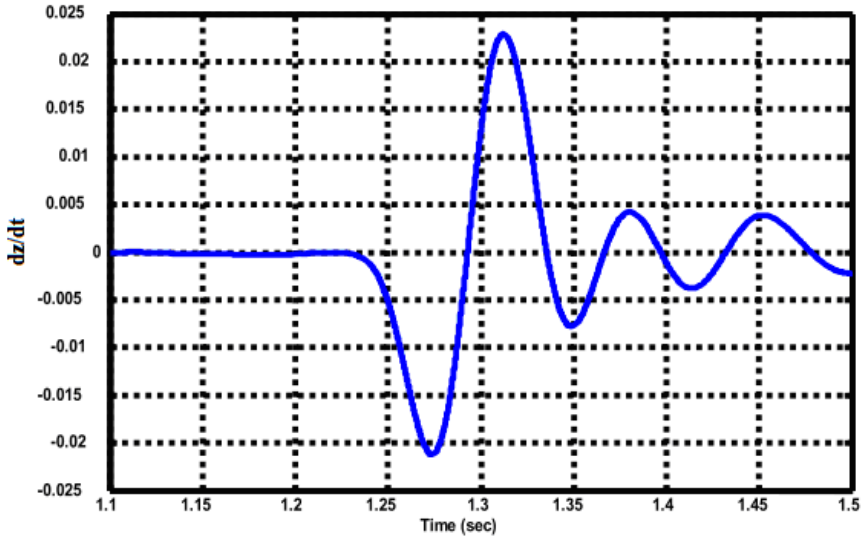

Fig 7: The rate of impedance changes in non-nominal conditions

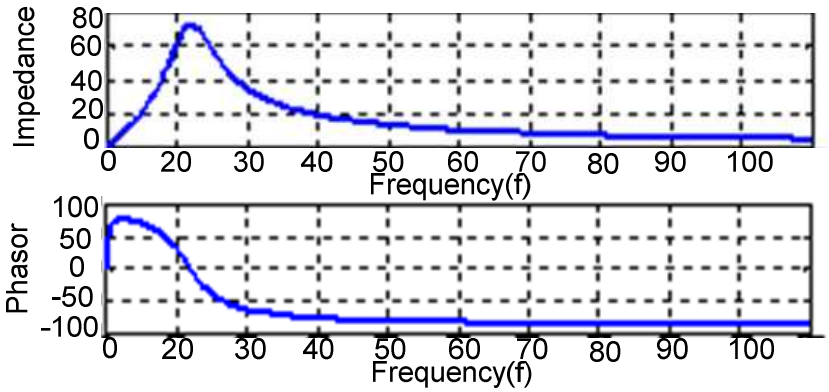

Fig 8: changes of impedance and phasor in accordance with frequency

4.2 NOMINAL LOAD

In this section, the local load values are nominal values of load and power cannot be exchanged between the network and distributed generation. At t = 1.0 sec, CB is open and the system turns to an islanding state. Fig 9 and Fig 10 display THD of voltage and THD of current respectively. THD values go higher than 0.025 at islanding moment and changing rate of impedance must be evaluated then must be decided about the islanding situation. Fig 11 shows the changing rate of impedance. According to the figure, $^{dz}/_{dt}$ at t = 1.09 s is higher than 0.04. So it can be claimed that the islanding has happened.

The IEEE standard is considered like the previous section, and the islanding has been diagnosed before 2 seconds.

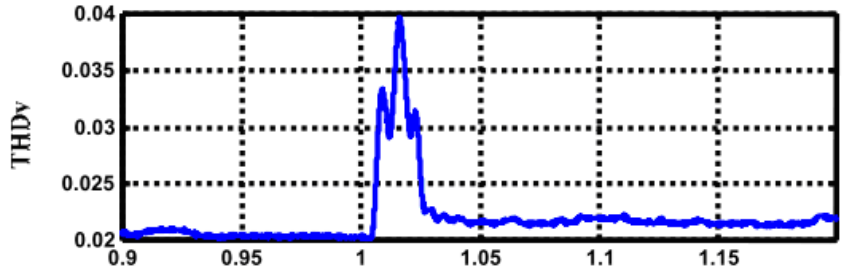

Fig 9: Changes of THD of voltage at nominal load on the islanding conditions

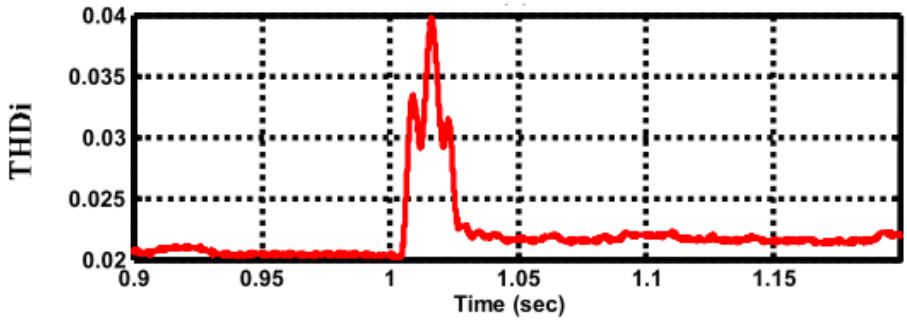

Fig 10: Changes of THD of current at nominal load on the islanding conditions

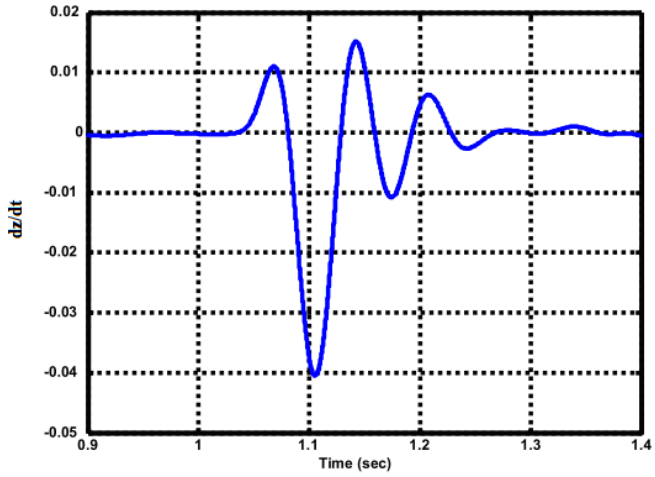

Fig 11: The rate of impedance changes in terms of the nominal

4.3 STARTING THE ENGINE AND SWITCHING THE CAPACITOR BANK

In this section, the performance of the algorithm is evaluated for different switching modes, to demonstrate that the proposed algorithm cannot be wrong at switching times and islanding is recognized well. At first the system works in the state of connected to the network. At t=1.5 sec an induction motor with (P=1.5 KW and P.F=0.75, lag) starts. At t=1.8 sec a capacitor bank with reactive power Q=1 MVAR is switched and connected to the network. And at t = 2.2 sec islanding state occurs and the system is isolated from the network. Fig 12 shows the voltage phase A in this case. According to the voltage waveform it is clear that voltage has changed a little. Fig 13 and Fig 14 show THD of voltage and THD of current in this state. As shown in Fig 14, at t=1.5, t=1.8 and t=2.2 sec THD values are higher than 0.025. Then in these moments, it should be examined whether an islanding state or switching state is done

According to Fig 15 showing the changing rate of impedance, it is determined that the value of $^{dz}/_{dt}$ is higher than 0.02 just at t = 2.2sec. So we can understand that the islanding state is at t=2.2 sec and other events except islanding state have happened in other moments (t=1.5 and t=1.8).

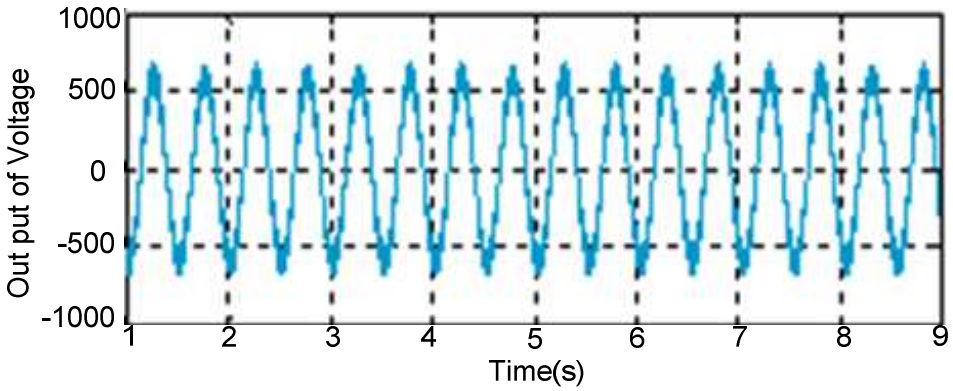

Fig 12: Voltage waveform at the switching conditions

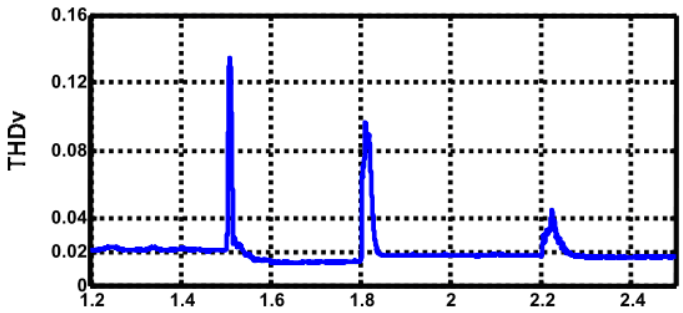

Fig 13: Changes of THD of voltage in islanding and switching state

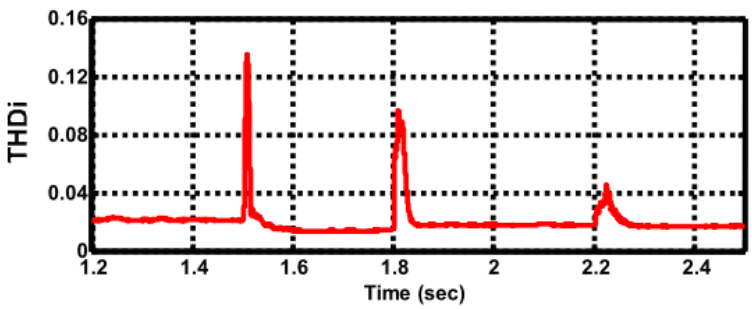

Fig 14: THD waveforms for current in the switching conditions

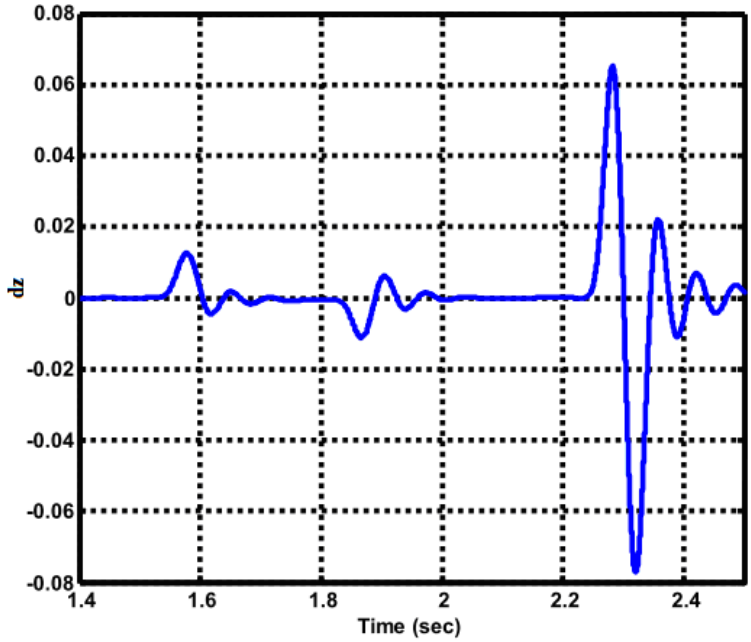

Fig 15: The rate of impedance changes in accordance with time for switching condition

5 CONCLUSION

In this article a new combined method was proposed for detecting islanding conditions for distributed generation. The results shown in this paper indicate that the proposed method has good performance. Because, in situations that previous methods go wrong, new method simply detects the situation and adopts more appropriate decision to disconnect systems.

Following results have been performed based on simulation:

1. In this method, there is no injection in inverter current so there is no unwanted reactive power.
2. The proposed islanding detection method is having a high speed.
3. Simulations have been performed using MATLAB software in real environment.
4. In this method we do not have non detection zone (NDZ).
5. Studied system is similar to standard with the difference that is used local loads are assumed to be unbalanced.

Conventional active detection methods are not able to detect the island with the aim to keep it stable. Because they try to leave electrical parameters such as voltage and frequency from their rating value. So in micro grids, island should be detected by using passive or remote methods. We should note that the detection time of 2 seconds which is referred to in standard is not appropriate and detection time must be less than this value. The proposed method which is in group of active methods is capable for use in micro grids.

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Early Seedling Growth Status of Threatened Medicinal Tree Species *Couroupita guianensis* Aubl. in District Meerut, (U.P.) India

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ABSTRACT: *Couroupita guianensis* is a highly valued species for the humans, soils management, environment and forestry. The tree is found some parts of India but now it is threatened species many areas of the country. Hence, there is an urgent need for conservation of this tree species. The present study was carried out in District Meerut for the period March 2014 to June 2014. The matured, seeds of *C. guianensis* were collected from **Acharya Jagadish Chandra Bose Indian Botanic Garden** Shibpur, Howrah Kolkata, West Bengal. A total 50 seeds were sown in 5 pots containing soil, manure 3:1 ratio. The germination starts seven days after sowing in the month of March. Complete germination within 18 days during the end of March 2014.The total germination percentages were observed 95 % . Germination, seedling growth, number of leaves parameters were recorded at March to June (2014). The results indicate that the status of germination, saplings growth and development of *C. guianensis* is fairly rapid. I had recorded three months growth of *C. guianensis* tree species Mean 22.7 cm. after germination period in soil of Meerut district. It is concluded that the aim of the present study is to spread awareness towards the conservation and established of the threatened unique tree *C. guianensis* in Meerut district. The study benefited to environment and forest management in those areas, where the plant is now not found. The present study of the scope in the future various fields such as conservation of threatened tree species, adaptation tree species, pharmacology and environment management.

KEYWORDS: *C. guianensis*, Threatened, Germination, Conservation, Meerut.

INTRODUCTION

The widespread loss and degradation of native forests is now recognised as a global environmental crisis. From 2000-2005, global forest area declined by around 20 million ha/yr (Hansen *et al.,* 2010), with undisturbed primary forest declining by an estimated 4.2 million hectares (or 0.4%) annually (FAO, 2010). The loss and degradation of forest ecosystems resulting from human activity are major causes of global biodiversity loss (UNEP, 2009; Vie *et al*., 2009). Clearance of forest for agriculture, mining, urban and industrial development all contribute to the loss of forests and tree species in the wild. Management activities within forests, including burning, logging and overgrazing also impact on forest structure, functions and processes and can additionally contribute to the loss of tree species. ***Couroupita guianensis***, is a large tropical tree species belongs to the family Lecythidaceae is common name cannon ball tree. The leaves are upto 20 cm long and are simple with serrated margins. Its flower raceme is cauliflorus with beautiful reddish and pink flowers, 7 to 15 cm long,which are stunningly fragrant. The tree bears, large globes woody fruits directly on the trunk and main branches, which are 15 to 25 cm in length and look like big rusted cannon balls. The tree play a fundamental role in maintaining the basic ecosystem functions and the quality of life on earth. The tree is indispensable to human and animals for his life. *C. guianensis* is a medicinal tree which is endowed with curative properties including anti- fungal, anti - biotic, anti - septic, anti-malaria. The leaves and flowers of *Couroupita guianensis* showed anti-oxidant activity. (Stalin G *et al*., 2012).The trees are used to cure colds and stomach aches. Juice made from the leaves is used to cure skin diseases, and shamans of South America have even used tree parts for treating malaria. The inside of the fruit can disinfect wounds and young leaves ease toothache. The leaves of *Couroupita guianensis* possess the herbal hand wash formulation (Minakashi G Joshi *et al*., 2008). In Ayurveda, it's used extensively as an anti- inflammatory medicine. The volatile oils from the flowers show anti-bacterial and anti-fungal

properties. It is one of the ingredients in the many preparations which cure gastritis, scabies, bleeding piles, dysentery, scorpion poison and many more. Leaves are used as fodder for cattle & deer. The tree very important role for various fields such as Backyard planting; Boundary marker; stabilization; Commercial planting; Erosion control: Large roadside tree; environment management; Shade tree; Specimen tree; urban greening; Wild grafting (Orwa *et al*., 2009). One-fourth of the plant species listed by the U.S. Endangered Species Act include reintroduction as a component of their recovery plan (Kramer *et al*., 2011.) *C. guianensis* tree species not found in Meerut district. However, Meerut's soil is more fertile and has a warm subtropical climate and becomes very cold and dries in winters from December to mid February while it is dry and hot in summers from April to June. During extreme winters, the maximum temperature is around 12^0 and minimum 3^0 to 4^0 Celsius. Summers can be quite hot with temperatures rising up to 42^0 to 44^0 Celsius range. *C. guianensis* is perceived as very important tree species for local populations, forestry, biodiversity and environment management. *C. guianensis* is easily germination from seed, the rate of growth is fairly rapid at April to June 2014 in Meerut. The tree is found some parts of India but it is not found many parts of country. Hence, there is an urgent need for conservation threatened tree species which is required in Meerut and many other adjacent districts. The present research work consisted in defining conservation and early growth status of tree species *C. guianensis.* This tree species should be carried out, in order to ensure that future generations can benefit from it. which can be used for the welfare of the mankind.

MATERIAL AND METHODS

The present study was carried out at B – 16, Jwala Nagar, Ambedkar Chowk in District Meerut for the period March to June 2014 in pots. The matured and healthy seeds were collected from **Acharya Jagadish Chandra Bose Indian Botanic Garden** Shibpur, Howrah Kolkata West Bengal during the first week of March 2014. The total 50 seeds were sown in 5 pots containing soil: manure ratio 3:1. Germination commenced seven days after sowing and total 95% germination was observed within 18 days in the end of March from date of sowing. Saplings growth parameters such as seedlings growth, number of leaves were recorded at April, May, June 2014.

RESULTS

The result shows that the total seeds germinated 95 % at the end of March 2014 within 18 days. Seedlings height Mean was recorded at April to June 2014. Seedlings height Mean 8.9 cm., 15.93 cm., 22.7 cm., at April, May, June 2014.The plant height and number of leaves was recorded at April to June 2014. Respectively growth of all stages of *C. guianensis* is fairly rapid in Meerut District. All results clear in the table 1. 2. and figures 1-7. The plants were growing 22.7 cm. at April to June 2014 after germination period. Ramakirshnan 1972, Gomez - Pompa & Vezques-Yanes 1974, Harper &White 1974 reported that the germination and seedling establishment are two very critical phase in the life history of tree species Composition of Trees Grown Surrounding Water Springs at Two Areas in Purwosari Pasuruan, East Java (Soejono., 2012). Status and Cultivation of Sandalwood in India USDA Forest service (Shobha N. Ral .,1990). For those of us associated with arboreta and botanical gardens, we are in a position to address the challenge of saving the world's threatened tree species. We need to do more than just include them in the plant collections of our gardens. Effective tree conservation may require a finessed combination of different kinds of ex situ and in situ actions, ecological restoration and plant reintroduction, and socio-economic and regulatory considerations to truly secure them from threat (Sara Oldfield and Adrian C. Newton 2013). According to the Red list of Threatened Plants (UNEP, 1995), 19 species are already extinct and 1236 species are threatened. Of these, threatened 41 taxa are possibly extinct in the wild, 152 are endangered, 102 are vulnerable, 251 are rare, and 690 are indeterminate (D Ramprasad *et al*., 2012). As a consequence, many tree species are threatened and disappear more and more from their natural ecosystems. The present study focuses on the threatened tree species *C. guianensis* established in Meerut district.

Table – 1
SEED GERMINATION PERCENTAGE OF couroupita guianensis

MARCH						
Days	3	6	9	12	15	18
Germination (%)	_	-	30	45	80	95

Table 2.
The plant height, AND number of leaves at three months after germination period

Months	Plant Height Mean (cm.)	No. Of leaves (three plants)
April	8.9±0.15	5, 4, 3
May	15.93±0.05	18, 15, 14
June	22.7±0.26	33, 31, 28

Fig. 1. Flower of C. guianensis

Fig. 2. Fruits bearing on C. guianensis

Fig. 3. Seeds collected by Yashwant Rai from Kolkata

Fig. 4. View of germinate seedling in Meerut

Fig. 5. Growth status of C. guianensis seedlings at April 2014 in Meerut

Fig. 6. Growth status of C. guianensis seedlings at April, May 2014 in Meerut

Fig. 7. Growth status of C. guianensis seedlings at April, May, June (90 days) 2014, in Meerut

CONCLUSION

It is concluded that the aim of the present study is to spread awareness towards establishment and conservation of threatened tree *C. guianensis* in those areas where the plant is now rarely found. This research work will also prove to be of immense usefulness for the conservation of threatened tree species in the forest. Since this plant is beneficial for humans in many ways, therefore it is required that wide propagation and conservation of this plant should be carried out, in order to ensure that future generations can benefit from it.

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The removal of phosphates from laundry wastewater using alum and ferrous sulphate as coagulants

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ABSTRACT: Phosphates are derived from a wide variety of sources including the atmosphere, agriculture, urban drainage domestic and industrial wastewater. Domestic and industrial wastewater such as from laundry and dry cleaning services release high concentration of phosphates through detergents used into the land and water environment. This work was aimed at studying the removal of phosphates from laundry wastewater using alum and ferrous sulphate as coagulants for treatment. Samples of wastewater were collected from two laundry companies in Lagos State, Nigeria. The physicochemical parameters measured were pH, total dissolved solids, total solids, total suspended solids, biochemical oxygen demand (BOD), chemical oxygen demand (COD), COD: BOD and phosphate removal. Using ferrous sulphate and aluminium sulphate as coagulants, the phosphates were precipitated from the waste water samples. The results obtained from locations A and B were pH (9.10 and 10.20), total solids (800.00 and 900.00 mg/l), total suspended solids (200 and 400 mg/l), total dissolved solids (600 and 500 mg/l), biochemical oxygen demand (276.70 and 134.00 mg/l), chemical oxygen demand (716.00 and 664.00 mg/l) and phosphate removal (26.0 and 30.0%) respectively. These results were compared with the Federal Environmental Protection Agency limits (FEPA, Nigeria) and found to be higher than the recommended standards. Thus, these results suggested adverse effects on the environment and impairment of the health of aquatic life where such waste water is being discharged. In conclusion, the use of alum in phosphates removal from laundry wastewater provided better results than ferrous sulphate.

KEYWORDS: Phosphate removal, detergent, laundry wastewater, coagulants, eutrophication.

1 INTRODUCTION

Industrialization is of special significance to a nation for socio-economic reasons such as improving the quality of life and general living standard of the population, provision of employment and infrastructural development [1]. However, industrialization is associated with pollution (water, land and air), environmental degradation, depletion of resources and threat to human health due to exposure to hazardous substances from industrial effluents and erosion [2]. Human beings have affected water quality over the years in many ways such as sewage disposal, toxic contamination through heavy metals and pesticides, run-off from agriculture and urbanization [2]. Municipal wastewater consists of wastewater from homes, commercial establishments and surface or ground water that enters the sewage system [3]. Phosphorus is introduced into the aquatic environment in different chemical forms and the most frequent soluble forms of phosphorus are orthophosphate (H_2PO_4 and HPO_4^{2-}), metaphosphate (or polyphosphate) and organically bound phosphate [4]. Phosphate is a common

constituent of agricultural fertilizers, manure, organic wastes in sewage and industrial effluents. Phosphorus is an essential element for plant life but when in excess in water, it can speed up eutrophication (i.e. a reduction in dissolved oxygen in water bodies caused by an increase of mineral and organic nutrients) of rivers and lakes [5]. The increased load of phosphates in the environment as a result of human activities has been a matter of concern for more than four decades [18] but the primary issue has been to what extent additional phosphorus has contributed to the eutrophication of lakes, ponds and other bodies of water. Chemical treatments through the addition of alum or lime to precipitate out phosphates in wastewater have proved to be effective in removing about 95% of phosphates originally present in wastewater [7]. In Nigeria, there is an urgent need to provide simple method of phosphate reduction in domestic and industrial effluents in order to conform to acceptable standards before disposal into water bodies. Therefore, this work was carried out to study the removal of phosphates from laundry wastewater using alum and ferrous sulphate as coagulants.

2 SAMPLE COLLECTION

Two wastewater samples (containing detergents) from two laundry companies in Surulere and Ikotun, Lagos state, Nigeria were collected, analyzed and treated. The samples were collected in water-washed and labelled plastic containers. Physicochemical parameters such as pH, total dissolved solids (TDS), total solids (TS), total suspended solids (TSS), biochemical oxygen demand (BOD), chemical oxygen demand (COD) and phosphate removal were determined from the waste water samples and recorded. A portion of the sample meant for biochemical oxygen demand (BOD), chemical oxygen demand (COD) and phosphate removal were analyzed within 3 hours of collection while the remaining samples were refrigerated at 4^{o}C. The pH was determined using a Mettler-Toledo pH meter. The electrode was rinsed with the samples, immersed and pH value displayed was recorded. Total solids, total suspended solids and total dissolved solids were determined using oven-drying and gravimetry methods. Biochemical oxygen demand (BOD) was determined by iodometric titration. Chemical oxygen demand (COD) was determined by chemical oxidation. Phosphate removal was determined by ascorbic acid-molybdate method after pre-treatment processes (turbidity removal, pH adjustment and phosphorus precipitation) were initially carried out.

3 RESULTS AND DISCUSSION

3.1 PHYSICOCHEMICAL PARAMETERS OF THE WASTE WATER SAMPLES

The physicochemical parameters of the wastewater samples are presented on Table 1. The pH values obtained for samples A and B were 10.20 and 9.10 respectively. Both samples were alkaline. The pH value obtained for sample B was found to be within the stipulated Reference [8] allowable limit of 5.50-9.50 while the pH value of sample A was found to be above the allowable limit for wastewater before being discharged into surface water. pH values less than 7 is acidic and highly detrimental to aquatic macro-invertebrates and fishes. pH is among the physicochemical factors influencing the growth of bacteria in waste stabilization ponds [9]. Also, pH value is also an important factor for efficient removal of phosphorus using alum or other salts, as the solubility of their precipitates varies with pH. For alum, minimal solubility occurs in the pH range of 5.0 to 7.0 and for ferric in the range of 6.5 to 7.5 [10]. The optimum pH for phosphorus removal using alum ranges from 5.5 to 6.5, but in typical wastewater, it ranges from 6.0 to 9.0. Ferric chloride is more effective in removing phosphorus when the pH ranges from 4.5 to 5.0 with typical values of 7.0 to 9.0. The total suspended solids (TSS) values obtained for samples A and B were 200 mg/l and 400 mg/l respectively. The total suspended solids values obtained were very high and this revealed that there were suspended particles in the water samples analyzed which invariably decreased the transparency and showed that the samples were highly polluted. The total suspended solids values for both analyzed samples were higher than the Reference [8] allowable limit of 15 mg/l for wastewater. The results obtained were in line with the work of Reference [11]. High level of dissolved and suspended solids in the water system increases biological and chemical oxygen demand which depletes the dissolved oxygen levels in the aquatic systems [12;13]. Sample A had a biochemical oxygen demand (BOD) value of 276.70 mg/l and chemical oxygen demand (COD) value of 716.00 mg/l while sample B had a BOD value of 134.00 mg/l and COD value of 664.00 mg/l. The BOD and COD values obtained on analysis of the wastewater samples were found to be higher than the Reference [8] limit (BOD = 50.00 mg/l and COD = 250.00 mg/l) for wastewater before discharge into surface water. According to Reference [14], these levels of BOD and COD could constitute potential pollution problems to the water bodies since they contain organic compounds that will require a larger quantity of oxygen for degradation. The COD: BOD ratio for the samples under consideration were found to be less than 10.00 mg/l and indicated that the compounds in the analyzed samples were relatively degradable, a possible depletion of the dissolved oxygen in the receiving river and possess a potential effect on aquatic life. Thus, the BOD correlated positively with the COD

for both samples (correlation coefficient, r = 0.7896). For correlation coefficient near zero, there is no linear correlation between the variables. Correlation measures the goodness of fit of the equation actually assumed to the data [15]

Table 1. Physicochemical parameters of the waste water samples

Samples	pH	TDS (mg/l)	TS (mg/l)	TSS (mg/l)	BOD (mg/l)	COD (mg/l)	COD/BOD	% P removal
A	10.20	600.00	800.00	200.00	276.70	716.00	2.60	26.0
B	9.10	500.00	900.00	400.00	134.00	664.00	5.00	30.0
FEPA limit	5.50-9.50	NS	NS	15.00	50.00	250.00		5.00

TDS- Total Dissolved Solids, TS-Total Solids, TSS-Total Suspended Solids, BOD- Biochemical Oxygen Demand, COD- Chemical Oxygen Demand, P- Phosphorus, NS-Not Stipulated

3.2 COAGULANTS AND PHOSPHORUS REMOVAL

The relationships between the amount of coagulant and the percentage phosphorus removed in both samples A and B are presented on Tables 2 and 3. When 0.0013 g of $Al_2(SO_4)_3.18H_2O$ (alum) was added to sample A, 26% phosphorus was removed and when the amount of coagulant added was increased to 0.0025 g, 30% phosphorus was removed. When 0.0038 g of coagulant was added, the percentage phosphorus removed was then reduced to 26%. However, when $FeSO_4.7H_2O$ (ferrous sulphate) was used as the coagulant of interest, the percentage phosphorus removed reduced progressively both for samples A and B. These amounts of phosphorus removed after the addition of coagulants as seen in Table 2 were lower than the Reference [8] limit of 5.00 mg/l for wastewater. According to the report of Reference [16], the decrease in phosphorus removal efficiency after optimum dosage was due to the restabilization of colloidal suspension and further increase in the amount of the coagulants resulted in ineffective and decrease in the efficiency of the coagulant. There is also the possibility of a second reaction after the precipitation of soluble phosphorus known as hydrolysis. In this reaction, aluminium forms aluminium hydroxide floc, which also assists in the precipitation of aluminium phosphate floc as well as other solids in the water. Also, alkalinity, temperature, pH and presence of other substances such as colloidal matter affected the efficiency of the coagulants [17].

3.3 EFFECTS OF PH AND AMOUNT OF COAGULANT

The variations in the pH after coagulation and the amount of coagulant are also presented on Tables 2 and 3. A decrease in the amount of coagulant resulted in a corresponding decrease in pH after adjustment. On further decrease of the amount of coagulant ($Al_2(SO_4)_3.18H_2O$) added, the pH further reduced but pH remained almost constant when $FeSO_4.7H_2O$ was used as coagulant. At pH greater than 8, the ions of the coagulant become soluble and hence, the amount of phosphorus removed decrease [18]. Upon increasing the amount of coagulants, the pH was more important than its initial pH before addition of coagulants. The effect of pH on the amount of residual phosphorus can be explained by the change of orthophosphate compound with pH [19]. Phosphate removal as aluminium or iron phosphate depends on water. After alum or $FeSO_4.7H_2O$ was added into the water sample, the pH of the solution decreased due to the fact that part of the alum was precipitated as the hydroxide forms and hydrogen ions were formed. However, below a pH range of 5.5, the aluminium ions are soluble and do not participate in the hydration reaction necessary to make alum effective as a coagulant. Also, the formation of insoluble aluminium phosphate is not possible as it is soluble below pH of 6 and above pH of 8 [10]. On the other hand, when the pH level of the water is above 8 after the addition of alum, aluminium ions again become soluble and the efficiency of the coagulation is decreased [18].

Table 2. Percentage phosphorus removal and pH variation during phosphorus precipitation with alum

Sample	pH	pH adj	P1 (mg/l)	Coag (g)	pH coag	P2 (mg/l)	P removal (g)	% P removal
A	10.20	7.30	8.71	0.0013	8.10	6.47	2.23	26.0
	10.20	7.10	9.84	0.0025	7.90	6.93	2.91	30.0
	10.20	7.50	9.85	0.0038	7.80	7.32	2.52	26.0
B	9.10	7.10	0.90	0.0013	7.80	0.69	0.21	23.0
	9.10	7.20	1.00	0.0025	7.80	0.70	0.30	30.0
	9.10	7.10	1.00	0.0038	7.70	0.75	0.26	25.0

P1- initial phosphorus concentration before coagulation P2- residual phosphorus concentration after coagulation pH ad,j-pH after adjustment pH coag.-pH after coagulation Coag.-amount of coagulant added

Table 3. Percentage phosphorus removal and pH variation during phosphorus precipitation with ferrous sulphate heptahydrate

Sample	pH	pH adj.	P1 (mg/l)	Coag. (g)	pH coag.	P2 (mg/l)	P removal (g)	% P removal
A	10.20	7.50	10.06	0.0013	8.30	7.03	3.03	30.0
	10.20	7.80	10.14	0.0025	8.20	7.64	2.50	25.0
	10.20	7.90	10.15	0.0038	8.20	7.99	2.16	21.0
B	9.10	7.20	0.92	0.0013	7.80	0.70	0.23	25.0
	9.10	7.10	1.03	0.0025	7.80	0.78	0.25	24.0
	9.10	7.10	1.03	0.0038	7.70	0.84	0.19	19.0

P1- initial phosphorus concentration before coagulation P2- residual phosphorus concentration after coagulation pH adj.-pH after adjustment pH coag.-pH after coagulation Coag.-amount of coagulant added

3.4 COMPARISON OF THE EFFECTS OF THE TWO COAGULANTS

A comparison of the effects of the two coagulants (Tables 2 and 3) show that $Al_2(SO_4)_3.18H_2O$ elicited better phosphate removal in both samples than $FeSO_4.7H_2O$ indicating that the former is a better coagulant for the phosphorus removal in wastewater. This is due to the low metal (aluminium) to phosphorus ratio required for the formation of a precipitant. Also, the benefit of using $Al_2(SO_4)_3.18H_2O$ in wastewater treatment include the wide pH range where aluminium phosphate remains insoluble between pH of 2 and 9. Unless the precipitant is exposed to extremes of either acidic or basic conditions [17].

4 CONCLUSION

The phosphorus removal by $Al_2(SO_4)_3.18H_2O$ and $FeSO_4.7H_2O$ were found to be highly pH dependent with an optimum pH of 7.90 to 8.20. At this pH, $Al_2(SO_4)_3.18H_2O$ dosage of 2.91 mg/l removed 30.0% of the total phosphorus while $FeSO_4.7H_2O$ dosage of 2.50 mg/l removed 25.0% of the total phosphorus in sample A. A better phosphorus removal was achieved when the sample pH was adjusted to 7. However, phosphorus removal according to the results obtained in this study was not affected by changing and varying mixing period because phosphorus removal is relatively fast. The dosages of $Al_2(SO_4)_3.18H_2O$ and $FeSO_4.7H_2O$ and pH played important roles in phosphorus removal and the removal efficiency increased with increasing pH. The results obtained showed that the use of $Al_2(SO_4)_3.18H_2O$ (alum) as a coagulant demonstrated better results in phosphorus removal than $FeSO_4.7H_2O$.

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Rose: A Pinter's Character in Plato's Cave

Pinter's *The Room* and Plato's *Allegory of the Cave*

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ABSTRACT: Plato's *The Allegory of the Cave*, Book VII of *The Republic* and Pinter's *The Room* (1957) show not only much similarity but also fundamental differences. This paper analyzes the similarities between *Rose*, Pinter's character and the shackled prisoners in Plato's allegory. Both works have the same beginning and the same ending. In the two works Both Plato and Pinter share the existentialist point of view that man is a stranger in the world. In addition, both works are introducing the idea of art for truth's sake and consequently art for life's sake. The play has nearly the same plot structure of the Allegory and Rose, the protagonist of the play becomes "A Pinter's character in Plato's cave".

KEYWORDS: Plato, Pinter, existentialism.

Harold Pinter (1930-2008) wrote several works throughout his theatrical career that share a common plot structure in which the protagonist of the play begins and ends his/ her life in a room which resembles the cave in Plato's *Allegory of the Cave*. In a note at an early London production of *The Room* and *The Dumb Waiter* at the Royal Court in 1960 Pinter wrote: "there is no hard distinction between what is true and what is false. A thing is not necessarily either true or false; it can be both true and false" (Ganz, 3). This distinction between what is true and what is false is the main theme in most of Pinter's plays, as well as in Plato's *Allegory of the Cave*.

In addition, in a radio interview with Kenneth Tynan, Pinter was asked about his characters, he said:

> I'm dealing with these characters at the extreme edge of their living, where they are living pretty much alone. … Before you manage to adjust yourself to living alone in your room … you are not terribly fit and equipped to go out and fight the battles … which are fought mostly in abstractions in the outside world
>
> (qtd in Esslin, 34).

Reading his plays, specially the *comedies of menace*, it is evident that Pinter's characters do not share in the battles of the outside world. Rather, they retreat to their rooms and stay in an illusionary safety and stability the rest of their lives. These characters confined within the walls of their rooms are the main preoccupation in Pinter's drama, and their lonely lives are liable to different literary, social, political, and philosophical interpretations.

This paper aims at analyzing the similarities between *Rose*, Pinter's character in *The Room* (1957) and the shackled prisoners in Plato's *The Allegory of the Cave*, Book VII of *The Republic*, focusing specifically on the image of the room/cave and its residents in the play to better understand how the dramatic setting functions. Both spaces; Plato's cave and Pinter's room manifest themselves as shelters for their inhabitants. They represent focal points in the stories and mark the turning points where extraordinary transformations might take place. In addition, their settings are spaces whose boundaries are limited to the womb/ tomb lines as people start and have their lives ended in these spaces.

The paper also points out the similarities between Pinter's room and Plato's cave showing the relation between characters and settings. The paper shows that both Pinter's protagonist and Plato's prisoners share the labyrinths of illusion, and they only conceive of these labyrinths in terms of the many false impressions that occur in their settings. It also emphasizes that the common background between Pinter and Plato is their conception of humanity as subject to an

overpowering reality of illusion. Whereas Plato is preoccupied with the manners of perception inside and outside the cave, Pinter is preoccupied with how the outside looks from inside his room. Like Plato's cave prisoners, Pinter's Rose has imprisoned herself within the walls of her room and is ignorant of her status in life. Therefore, this paper aims at showing these similarities and little differences in the two works.

For the accomplishment of this aim, it is worth referring, first, to *The Allegory of the Cave*. In the manner of a dramatic dialogue Plato introduces Socrates addressing Glaucon, Plato's brother, telling him the allegory which represents the idea of truth and philosophical education. The Allegory pictures people as dwelling in dark underground cave, and are in chains. These people are thus in a state of ignorance and lack of enlightenment, and are imprisoned (Crome, 6).

Behind the prisoners there is a wall that separates the prisoners from a set fire. That fire reflects the shadows of the people who pass across a pathway behind the wall. The prisoners perceive the shadows on the walls as the only reality in their life. One of the prisoners is unwillingly freed and forced to go out of the prison and face the sunlight and the outside reality of life and beings. There, he suffers all types of pain and is unable to open his eyes in the sunlight. After a while, the unshackled prisoner becomes accustomed to the sunlight, the daily life and the real people, and he knows the seasons and the reality of life. He remembers his fellow prisoners and feels it his duty to go back to the cave to enlighten them and tell them about the lies they hold as truths. The shackled prisoners do not believe him, react violently, and kill him.

Plato explains the prisoners' situation saying that "the prison-house is the world of sight, the light of the fire is the sun, and … the journey upwards to be the ascent of the soul into the intellectual world." In *Pathmarks*, Martin Heidegger explains the situation saying that "the vault of the cave represents the dome of the heavens. People live under this dome; assigned to the earth and bound to it … in this cave-like dwelling they feel they are in the world and at home" (McNeill, 161). The light of the fire is man-made, and the illumination coming out of it is a human delusion and a symbol of total alienation from the outside world. Having passed outside the cave, the sunlight is not man-made; rather it is the reality that man tries to avoid because it is painful both to the eye and to the soul.

In *A Modern Worldview From Plato's Cave*, Bryce Haymond comments on the allegory trying to reach its meaning. He says:

> The cave therefore, represents the world, while the prisoners are the people who inhabit the world. The shadows that the prisoners see are everything that people see in the present world, with its objects, environments, events, and so on. As a result, Plato interprets the physical world as only an illusion – an imperfect representation of a perfect Form. The chains might represent human ignorance (8).

The story then, does not present truth, but portrays the human situation and Man's search for/ denial of the truth. Hence, we, as the Allegory's readers, are implicated in it. It is an attempt to push us towards truth taking hold of those who are resistant to what it says (Crome, 8).

What is notable in The Allegory is the assertion that the prisoners in the cave are, in Socrates' words, "like ourselves" (Denton, 338), or as in Heidegger's translation, "they are very much like us" (22). In the Allegory Socrates assures that "the allegory depicts precisely the everyday situation of man, who, in so far as he does not possess any standard other than everydayness, can not see its strangeness" (Heidegger, 22). If we, as readers, become able to recognize in ourselves a likeness to the prisoners, as we consequently deny what Socrates says, in so doing, we cease to be what we were. In the Allegory, Plato want us to see ourselves reflected, externalized, and reject what we see, but then we cease to be what is reflected and therefore, change (Crome, 8).

That likeliness does not belong to Plato's time only; rather "it is historically present … as the all- dominating fundamental reality … of the ever- advancing world history of the planet in this most modern of modern times" (McNeill, 176-77). The story recounted in the Allegory provides a picture of the real events in the history of the West whether in the past, present, or the future.

According to Bryce Haymond, "Plato's concepts, and particularly his depiction of our situation in the world in his Allegory of the Cave, are reflected today in modern pop culture, including … literature. … This may explain why humanity remains fascinated with the concept of leaving the cave" (3). In literature, the plays of Harold Pinter are the best example of the search for truth and reality that are meant by Plato in his Allegory. In his plays, specially *The Room*, Pinter plays the role of the philosopher who delivers his ideas to the audience, who tries to liberate his characters by "laying hold of them violently and dragging them away. This is admittedly what Plato himself dictates" (Van Deurzen, 195). But in both cases, man is resistant and his denial is completely violent.

Plato presents the Allegory in four stages (Heidegger, 28), and it is notable that each stage has a resonance in Pinter's play. In his Noble Lecture Pinter expresses his view towards modern man which echoes the situation of the cave prisoners, specially in the first stage of the Allegory. He says: "you don't need to think. Just lie back on the cushion. The cushion may

be suffocating your intelligence and your critical faculties but it's very comfortable" (7). According to Plato, in the cave people are satisfied with their torture and do not question their critical situation. Rather, they are "in the habit of conferring honors among themselves on those who were quickest to observe the passing shadows" (Denton, 340). Pinter notices the same about human beings, he says: "one sometimes forgets that tortures become easily bored they need a bit of laugh to keep their spirit up" (The Noble Lecture, 3), and these ideas are previously confirmed in his plays which express humanity's illusion and alienation.

In *The Room* Pinter is able to produce exact pictures of alienation in the American society; man's alienation from himself, from his fellow men, and from the world in which he lives (Pappenheim, 3). Roger Copeland analyzes the elements of Pinter's drama as follows:

> [In Pinter's plays] the essential ingredients rarely change: A room, safe enclosed space of some sort. Characters who feel not only secure, but at home in that space. An unexpected visitor whose very presence evokes a sense of dread, of inexblicable threat—a fear that seems at first, unfounded, even paranoid. Then … an invasion begins; and the boundaries between inside/outside, familiar/unfamiliar, safe/unsafe, self/other to blur (22).

Such description completely fits with Socrates' description of the prisoners' condition in the cave; the same setting, the same characters, and the same attitudes and conceptions regarding the world, life, and the truth. This is emphasized again by Pinter himself, a year after writing *TheRoom*. In 1958 he wrote: "you have asked me to discuss the lines I myself am working on … Given a man in a room and he will sooner or later receive a visitor … A man in a room who receives a visit is likely to be illuminated or horrified by it. The visitor himself might as easily be horrified or illuminated" (qtd in Weales, 607 and in Esslin, 40). This horror/illumination is first reflected in *The Room*.

The Room (1957) is Pinter's first play, written when he was twenty seven and was first produced in the same year by the Drama Department of Bristol University. When asked about the source of his plays Pinter said: "I went into a room and saw one person standing up and one person sitting down, and few weeks later I wrote The Room" (qtd in Hinchliffe, 80). In this one act play, Pinter "creates figures that live in isolation in a menacing world. They don't revolt against a hostile abstract world. Instead, they look for shelter, be it physically defined, as a room" (Rahimipoor, 2011, 593).

THE FIRST AND SECOND STAGES:

Like Plato's Allegory, *TheRoom* is set in a bed sit. Two persons inhabit it, a couple, Rose and Bert. Rose never leaves the room which she considers her entire world, and Bert works as a van driver. A couple arrives and inquires if the room would be vacant soon, and Rose becomes nervous because she has no intentions to leave the room. Then Mr. Kidd, the landlord arrives and tells Rose that someone is waiting in the basement, eager to deliver her a message. With the entrance of the stranger, who is a blind Negro named Riley; Rose starts to be anxious and violent. Basically, Riley's entrance irritates Rose, but later on it is Bert who reacts violently and kills him. The play ends with Rose crying that she has become blind.

Resembling the first stage of the Allegory, the room, setting of the play, "is comfortable, representing as it does, her only security … Also no one bothers her"(Hinchliffe, 41). Rose tells Bert: "this room's all right for me … If they ever ask you, Bert, I'm quite happy where I am. We're quite, we're all right. … And we're not bothered. And nobody bothers us." But when the stranger, the outsider, comes to deliver her a message, the play becomes totally pinteresque "about people bothering people who want to keep themselves, who find communication too alarming" (Hinchliffe, 41).

In an interview with John Sherwood in the BBC, March 1960, Pinter tried to give a summary of *The Room*. He said:

> This old woman [Rose] is living within a room which, she is convinced is the best in the house, and she refuses to know anything about the basement downstairs. She says it's damp and nasty and the world outside is cold and icy, and that in her warm and comfortable room her security is complete. But of course it isn't; an intruder comes to upset the balance of everything, in other words points to the delusion on which she is basing her life
>
> (qtd in Esslin, 35-6).

This refers to the beginning of the play when Rose tells Bert: "it's very cold out, I can tell you, it's murder" (91). But with the progression of events it becomes clear that "murder" is not outside. Rather, as in the Allegory, "murder" is basically inside the walls of the room/ cave in which the character confines herself.

In his analysis of the atmosphere and setting of the play, Martin Esslin points out that "a warm room surrounded by a cold and hostile world is, in Pinter's case, already itself a dangerous situation" (61). It is also notable that Rose violently denies the fact that the room, her room, is going to be vacant, which means her insistence to remain in her illusion away from the reality of the outside world, just like Plato's prisoners who are satisfied with their residence in the cave. Thus Pinter is introducing the common thread in his plays which is "the opening sense or illusion of security, which is defined in each play as a function of the protagonist's sense of identity, his knowing who he is" (Berkowitz, 83).

Hence, Pinter makes his setting a microcosm of the world. In this setting there are only, as in Plato's cave, existential anxieties; unknown fear with unknown reasons (Kohzadi, et-al, 1690). In both settings, man encounters all types of alienation and is not really secure. This is clear in Rose's assertion to Bert that "this is a good room, you've got a chance in a place like this" (95), and then in her reaffirmation to Mr. Kidd when she says: "well, Mr. Kidd, I must say this is a very nice room. It's a very comfortable room" (98). Most notable is the fact that Rose is like Plato's prisoners in the cave, they take the shadows in front of them as truth or Plato's "unhidden." "There is no question they can raise about the truth of that truth" (Heidegger, 20). They are unaware that their truth is only a self reality they have created by themselves, and they perceive these shadows/self realities as the only truth in their life. Pinter affirms this idea in his Noble Lecture when he points out that "when we look into a mirror we think the image that confronts us is accurate. But move a millimeter and the image changes – we are looking at a never-ending range of reflections. But sometimes a writer has to smash the mirror – for it is on the other side of that mirror that the truth stares at us" (12), and this exactly what both Pinter and Plato try to do with their characters/prisoners.

Rose plays a double role in her room. Partially, she symbolizes the prisoner who feels pain when confronted with the truth of the outside world in the second stage of the Allegory; and then she perfectly symbolizes the shackled prisoners who refuse any intruders or confusion about their real being. Kohzadi, et-al explains this likeliness in the following quotation that is quoted at length:

> Let alone, Rose would be content simply to exist, feeling confidence in the flimsy security of her own created world presented by the comfortable and cozy room she lives in. But Rose is not let alone; life for her, as the play proceeds, becomes a succession of anxieties and restraints imposed upon her by the other selves or by her own hidden dreads. These hidden dreads are the results of the struggle of the self with other selves which disturb her being by showing the reality of non-being. The first disturbing factor is the inexplicable world outside (1690).

Rose completely ignores the outside world because she knows nothing other than her room/cave. She tells Bert: "I've never seen who it is. Who is it? Who lives down there? … But whoever it is, it can't be too cosy" (92). In this case, she is reminiscent of the dialogue between Glaucon and Socrates in the Allegory. Glaucon asks Socrates saying "how could they see anything but the shadows if they were never allowed to move their heads?" and Socrates replies: "to them, I said, the truth would be nothing but the shadows of the images" (Denton, 339). Most emphatically, "the prisoners have no relationship to themselves and each other; they see only shadows of themselves" (Heidegger, 22). Bert and Rose also have no relationship to each other. The only thing that unites them is the room/cave in which they live and hide from the world.

Rose is a prisoner of her room, totally alienated and delusional. According to Plato, to be prisoned and delusional "is the absence of circumspection and insight, where man is in every respect removed from truth, where he has no familiarity" (Heidegger, 28). Bert plays the role of the puppeteers in Plato's cave. He seems to understand Rose's state of ignorance. He delivers her the image of the physical world which is fake or an illusion to the real thing, just as in Plato's cave the puppeteers "thrive on tricking to keep the prisoners under a leash of ignorance. … we can posit that they may be anyone in the world who may be keeping mankind from knowledge of the true reality" (Haymond, 8). Thus, Rose's room becomes a trap, a prison, a wall that blocks her access to the outside world.

THE THIRD STAGE:

The third stage in the allegory is absent in Pinter's play, and this is a fundamental difference between the two works. In Plato's Allegory, the third stage involves one of the prisoners' realization of the truth and his understanding of the essence of life and beings outside the cave. But In Pinter's play neither Bert nor Rose understands or even has the intentions to understand the hidden reality of life outside the room. Consequently no one of them plays the role of the unshackled prisoner in the Allegory. This difference does not prevent the actions of the play from passing to the fourth stage of the Allegory and having the same end just as it has the same beginning.

THE FOURTH STAGE:

The fourth stage is illustrated in the play by the arrival of the strangers whom Rose does not welcome and reacts to violently. The only difference in this stage is that the intruder, the messenger of truth, comes late after some introductions. First, Mr. Kidd comes to Rose's room and the conversation between them becomes a series of attacks and counter-attacks. Like Plato's unshackled prisoner, Mr. Kidd seems very perceptive regarding Rose's vulnerabilities and tries to remind her of her situation as only a tenant of the room (Kohzadi, et-al, 1692).

Then, Rose's vulnerability and anxiety are again revealed with the intrusion of the Sands. But this can not be compared with her feelings when Mr. Kidd returns to tell her that there is a man in the basement waiting to see her. With his entrance to the room, it is obvious that the man, Riley, has come to make Rose aware of the "delusion on which she is basing her life" as Pinter cites in Esslin, p.36.

Now, the arrival of the blind Negro – symbolic of the freed prisoner who has just come from sunlight to the darkness of the room – represents the fourth stage of the Allegory. "And now is there anything surprising in one who passes from divine contemplations to the evil state of Man, when they returned to the den they would see much worse than those who had never left it" (Denton, 342). And this may be the reason of Riley's blindness. He might be blind just because he has spent a long time in the basement and then enters Rose's room with its human darkness.

The character of Riley is liable to many interpretations. "The Negro is not merely feared but also desired by Rose [as every man has a hidden instinctual tendency towards truth and light] and the play explores both fear and curiosity, change and resistance to change" (Hinchliffe, 44). Most critics define Riley as an omen of Rose's near death, and this is asserted again in Plato's Allegory. It is an omen of a death, but not Rose's, it is Riley's death that will happen in the room as death takes place in Plato's cave. As Socrates points out, "Men would say of him that up he went and down he came without his eyes; and that it was better not even to think of ascending; and if anyone tried to loose another and lead him up to the light, let them only catch the offender, and they would put him to death" (Denton, 341).

In *A Room and Some Views: Harold Pinter*, John Russel Taylor quotes Pinter's comment on the character of Riley. Pinter says: "I don't think there's anything radically wrong with the character in himself, but he behaves too differently from the other characters" (Ganz, 105-06). This recalls Plato's unshackled prisoner who, after perceiving the sunlight, essence of truth, behaves differently from the other prisoners. That is why Riley is considered a source of menace to the room's residents/prisoners, and the play is dealt with as a comedy of menace.

In addition, in his article; *The World of Harold Pinter*, Ruby Cohn comments on Pinter's victims and villains in his first four plays. According to his point of view, Riley is a villain/victim in The Room (Ganz, 78). In the play, the villain/ messenger is also a victim. He is mysterious because he comes from the outside world which the characters in the room can not see. Then, Riley is not a Pinteresque villain, but the villain is the one that keeps the victim confined within the room/cave. In the room the villain is Bert, the patriarchal figure, head of the system. This is evident as he attacks Riley because Riley symbolizes truth and the awakening while Bert "would hold [Rose] a willing prisoner" (Ganz, 125).

Thus, Riley is perceived as Plato's unshackled prisoner who tries to preach his fellows and help them see the hidden truth behind the walls. Like the prisoner, Riley "speaks to Rose always tenderly, never insidiously; Rose's insults and Bert's attack seem undeserved" (Ganz, 125). If Riley is to be linked to the cave's prisoner, he is a victim twice: first when he is left a prisoner in the basement as Plato's is left in the cave, and secondly when he tries to enlighten Rose, the prisoner of the room, and is attacked violently in denial to what he says. Moreover, in an interview with Cary Perloff, Pinter describes Riley as "Rose's savior, arriving to release her from her imprisonment with Bert," and he comments on Riley's knowledge of Rose's life by saying: "I think releasing her from imprisonment is all right, but it's an imprisonment she doesn't know she's enduring" (Perloff, 25).

Echoing the reaction of Plato's prisoners, Rose insists on her delusions, and her reaction is completely aggressive:

> Riley: I have a message for
>
> Rose: you've got what? How could you have a message for me, Mister Riley,… well, why don't you give it up as a bad job? Get off out of it … you're not only a nut, you're a blind nut and you can get out the way you come (114).

Then, she yells at him as "she touches his eyes, the back of his head and temples with her hands" (115). It is clear that this is "the action of a blind person rather than a seeing one" (Hinchliffe, 43), the thing which refers to her total illusion and alienation.

Then, to end the fourth stage of the play/Allegory, Bert, Rose's fellow resident, attacks Riley and kills him:

> Riley: Mr. Hudd, your wife—
>
> Bert: Lice
>
> He strikes the Negro, knocking him down, and then kicks his head against the gas stove several times. The Negro lies still. Bert walks away.
>
> Rose stands clutching her eyes.
>
> Rose: Can't see, I can't see
>
> Blackout
>
> Curtain (116).

Rose's final blindness is the natural result of refusing to listen to the message, a message of awakening that is brought to her room/ cave. This means her inability to see the light of truth forever. Rose and Bert are like "the people in the cave

[who] are so passionately attached to their view that they are incapable of even suspecting the possibility that they take for the real what might have the consistency of mere shadows" (McNeill, 162). They, then, refuse to look at reality in the room/cave or the reality outside it which represents the highest truth of human beings.

In that fourth stage, Pinter creates his unusual "atmosphere of menace and silence, as though that were the sum total of human condition" (Pryce-Jones, 31). His closed room hides "terror stricken beings, clinging to the last remnants of security and happiness … [Rose] lives isolated from any contact with the outside world … her isolation follows lack of communication with others," so she fails to communicate with Riley who symbolizes that other (Sahai, 10).

In the light of this analysis of both Pinter's *The Room* and Plato's *Allegoryof the Cave* it safe now to conclude that Plato's Allegory has a resonance in Pinter's play. Consequently, Pinter's, like Plato's, are characters who suffer from xenophobia and seek refuge within the four walls of a room/prison. William Baker stresses the same idea when he says that "there is certainly xenophobia in the room" (42). The characters are doomed to stay forever in their prisons, and the only action they can do –according to Pinter in an interview with Lary Bensky, published in The Paris Review – is to "walk out of a door, or come in through a door, and that's all about they can do" (9).

It turns out that liberation fails in Pinter's play just as it does in Plato's Allegory. Liberation is violent and "attaining what is now unhidden involves violence … resistance, such that the one to be freed is forced up along a rugged path" (Heidegger, 32). Characters in the play and in the Allegory are persistent upon darkness. They do not have enough courage to endure the suffering and pain resulted from adaptation to reality, and the fail to have "genuine liberation" (Heidegger, 33). A violent step is needed to be taken towards them. This violent step is to make them aware of the potential untruth of their recent lives. It is important for the character/prisoner to realize what the shadows are (Powell, 42), then she/he will be ready to accept the change. Both Plato's Allegory and Pinter's play express the concepts of truth and absolute reality as Socrates explains to Glaucon and as seen in the demonstration of Rose's character and life (Hunt, et-al, 156).

Pinter, like Plato, has found that humanity is trapped in a cave like world and it must be freed to experience the truth. Like the significance of Plato's cave, Pinter's room "can be seen on multiple levels. The aching of the human soul for something more in this world, or the intuition that there is something missing in our existence" (Haymond, 38). Inside the room it is like a world without philosophers, without the realists, and outside is the world or the light of reality. So in the room it is like Plato's cave and outside is the world which is inexplicable to the characters/prisoners. Moreover, Pinter's characters are people like us as "we are all in this, all in a room" (Esslin, 35).

The essence of Pinter's strategy in functioning the setting of *The Room* might be introduced as follows: "if you really want to tug the rug out from under your audience's perceptions, it helps to begin with a real rug. For Pinter knows that the deepest terrors, the profoundest mysteries, hover in and around the most realist- looking of details," and here, the most realist looking of details as perceived by the character and by the audience is the closed room with solid walls (Copeland, 25). Pinter seems to be saying in his "claustrophobic room" that if you want to free humanity from suffering and oppression, start there, in the room (Dorfman, 54).

Pinter shares Plato the existentialist point of view that man is a stranger in the world. *The Room* presents much of the themes that are popularly associated with existentialism namely "alienation," "the absurd," "anxiety," and "nothingness" (Stanford Encyclopedia of Philosophy, 3). In his play, Pinter is preoccupied with what James A. Herne calls "Art for truth's sake" that emphasizes humanity and its appellation of truth that is not always beautiful (Meserve, 127). To see the difference between what is false and what is true is Pinter's aim through his drama. Pinter points out that "most of what we are told is false, and the truth is on the whole, hidden and has to be excavated and presented and confronted, all along the line," and this is exactly what Pinter does in *The Room* (Causac, 36).

It is meaningful now to say that the two works; *Allegory of the Cave* and *The Room* are set in the same cave, and Rose in *The Room* is another prisoner in Plato's cave. The two works show not only much similarity but also fundamental differences. Both works share the first and second stages of the Allegory as man is chained with ignorance and torture without being aware of his miserable state. The fourth stage in the Allegory is also echoed in the play to show human resistance to all attempts of enlightenment and awakening. Both works have the same beginning and the same ending. They start within enclosed walls and end with murder in the same setting.

Rose shares Plato's prisoners the same attitude and point of view towards life. Both are claustrophobic and xenophobic. They are quiet and stable as much as they are alone in their shelters, but once they encounter any strangers – the messengers of truth – they turn into violence and become murderers.

In the two works Both Plato and Pinter share the existentialist point of view that man is a stranger in the world. Both works illustrate existentialist themes of nothingness, alienation, anxiety, and the absurd, and the philosophers'/artists' efforts to drag humanity out of this circle. In addition, both works are introducing the idea of art for truth's sake and consequently art for life's sake.

The considerable difference between the two works is the absence of the third stage of the Allegory from Pinter's play. In the third stage one of Plato's prisoners realizes the truth of life and is awakened from his past illusion, and becomes the messenger of truth. But in Pinter's play the messenger is not one of the room's prisoners, and Rose does not have the courage to step out of the room's door. But this absence of the third stage does not prevent the play from having nearly the same plot structure of the Allegory and Rose, the protagonist of the play becomes "A Pinter's character in Plato's cave".

NOTES

[1] Plato, 'The Myth of the Cave', in Lesely Denton (ed.), 75 *Reading: An Anthology,*3rd edn. (McGrow 1991), 341. (All the subsequent quotations from the Allegory will be taken from this edition).

[1] Harold Pinter, 'The Room', in *Title 17,* (U.S: F 4717, 1960), 92-3 www.Neiu.edu/~/circill/f 4717.pdf (All the subsequent quotations from the play will be taken from the same edition).

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The Limit of Clustering in Geographical Innovation, a case study of the Lagos Region, Nigeria

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ABSTRACT: Regional clusters, the geographical bounded concentration of firms are the best environment for stimulating innovation and competitiveness of firms. This paper therefore underscores the limit or inhibiting factors of industrial cluster in geographical innovation, using the Lagos region as a case study. Primary data were collected through the administration of one hundred and three questionnaires, in the twelve industrial estates (total sampling). The paper has reveals tremendous cluster benefits in form of Transportation economies, Power economies, Raw material purchase/supply, Collaboration in research and development, labour economies, security, telecommunication economies, joint ports and Shipping as well as access to financial institution economies. Apparently, cluster can lead to unlimited and amazing technological development of a region, thereby facilitating diffusion and innovation creation. Despite the astounding advantages emanating from cluster development, the research has found out that its performance in economic development could be limited, hindered or inhibited. The paper further revealed, inadequate water supply and transportation, incessant power supply, research and development inadequacy, security, personal reasons, sales promotion, inaccessible financial institution as well as government policy as inhibiting factors which limit the role of clustering in facilitating crucial geographical innovation.
It is therefore recommended that industrial cluster should be strengthened and encouraged through government investment in the industrial sector, making the location factors to be liberal, ensuring the adequacy of facilities in the industrial estates, giving tax holiday to younger investors, relaxing the laws governing the importation of some raw materials. This will have positive impact on productions and industrial expansion.

KEYWORDS: Industrial cluster, Technological innovation, Economies, Lagos region, Competitiveness.

INTRODUCTION

Agglomeration has traditionally been viewed as central to cluster development, in which geographical proximity has facilitated crucial externalities, particularly those relating to the generation and diffusion of tacist knowledge through the creation of an innovative environment surrounding the industry.

Regional clusters may be used as a catch-word for older concepts like industrial districts, specialized industrial agglomerations and local production systems. A regional cluster may be defined as a geographically bounded concentration of interdependent firms. According to Reference [1] “a cluster should have active channels for business transactions, dialogue and communication”. Without active channels even a critical mass of related firms is not a local production or social system and therefore does not operate as a cluster. It is argued that regional clusters are the best environment for stimulating innovation and competiveness of firms as stipulated in [2]. It has been argued in [3] that concentration is the most striking feature of the geography of economic activities and has its benefits. So having production and resources already concentrated in a region gives a region a competitiveness advantage. Clusters are specialized in a small number of industries, reflecting the mere general point that economic, entrepreneurial and technological activities in specific industrial sectors tend to agglomerate at certain places, according to [4]. Building the regional cluster is even perceived by some as the

way to compete globally, as economic "specialization is (seen as) the only way to overcome the `globalization trap` that is outrunning the risk of being out competed across the board" according to [5]. Indeed, the role which space and distance play in determining the nature and behaviour of the economy is the central departure point which defines the urban and regional economic paradigm. Here, the spatial corollary of aspatial increasing returns to scale is economies of clustering, and the spatial corollary of aspatial decreasing returns to scale is diseconomies of clustering.

It must be noted, however, that once an agglomeration of firms becomes established, progressively more external economies are created through a cumulative process. The propensity to agglomerate (locationally) increases further either when transactions include small-scale, irregular, under standardized, or contact-intensive activities that have high unit linkage costs, or when firms seek to reduce demand fluctuations by improving their customer base through location clustering, as in [6]. Existence of externalities and increasing returns to scale in production is the most important explanatory factor for geographic concentration of firms. Although, the literature has identified two types of externalities the negative and positive externalities, as in [7]. Externalities are costs and benefits of transactions that are not reflected in prices. Pollution is the most commonly used example of a negative externality. Reference [7] first developed a conceptual framework to distinguish two different types of externalities according to how they are mediated.

CONCEPTUAL ISSUES/ LITERATURE REVIEW

The success of some regional clusters has focused attention on the creation of external economics and on the role of knowledge intensive, local environments in stimulating the competitiveness of network of firms. Competition is increasingly seen to occur between clusters, value chains or network of firms rather than just between individual firms. It is also argued that regional clusters are the best environments for stimulating innovation and competitiveness of firms, according to [8]. The first stage in cluster development often involves new firm spin-offs leading to a geographical concentration of firms in nearly the same production stage. The agglomeration is followed by local competition that is an essential driver of innovation and entrepreneurship.

Based on Reference [9], concept of an industrial cluster facilitated a different and more instrumental approach. Clustering is more or less seen as an independent, partial process with its own laws of development, where the laws of successful clusters can be reverse-engineered in order to imitate the success stories as stipulated in [10]. According to Reference [11] companies gain competitive strength in regional cluster because of a better access to specialized and experienced employees, supplier, specialized information and public goods, and by the motivating force of local rivalry and demanding customers. It is the case of external economics strengthened by proximity. In spite of the original contextualization of industrial clusters within a framework of national competitive advantage by Porter, it is the concept of local competitive advantage, which has dominated discussion of cluster development over the past decade. In part, this is due to the longer tradition of research on localizing competitive advantage which linked aspects of the cluster concept specific process and it's embedding in local business networks to spatial considerations. Despite all the advantages that are enjoyed as a result of industrial cluster, it also has negative effects. The negative effects of clustering especially that of congestion, may reach a point where industries start moving away, a process referred to as deglomeration. No matter how bad the situation is, some industries can not move away because of industrial inertia.

THE STUDY AREA AND THE METHODS

The Lagos region covers metropolitan Lagos made up of fifty-seven local government areas among which are, Ikeja, Apapa, Mushin, Ikorodu, Epe and Badagry to mention just a few. This region which is situated along the south west of Nigeria, approximately between latitudes $6^0$27' and $6^0$37' north of the equator and longitudes $3^0$15' and $3^0$47' east of Greenwich meridian, with a land area of about 1,088km^2, covers about 32 percent of the land area of Lagos state. About 20 percent of this area is made up of Lagoons and mangrove swamps. Perhaps it is the strategic position of the Lagos region within the country, which explains why industrial concerns and trading companies, such as United African Company (UAC), Union Trading Company (UTC), Patterson and Zochonis (PZ), have their head offices, located in this region. In addition, major financial centres such as the Nigerian Stock Exchange and the head office of major banks, insurance companies and other financial institutions are located in this region. The Lagos region has two seaports, Tincan and Apapa. The two ports handle about 60 percent of Nigeria's total export excluding crude oil and about 70 percent of imports. Major terminals for both road and rail routes are located in the Lagos region. The strategic location of the Lagos region is further strengthened by the presence of the most important airport. The Lagos state population figure for the 2006 national population census was 8,048,430

The first stage in the collection of primary data involves the reconnaissance survey which was carried out, covering all the twenty industrial estates/areas and outlying firms in the Lagos region. In each of the industrial estates/areas, all the industrial establishments were identified. The purpose of identifying all firms in each estate and other industrial centres was to ensure that none of the industrial establishments was left uncovered during the survey. The questionnaire was designed to elicit information on such issues as the industry group (line of activity), the location (address/industrial estate/area), clustering of firms and the limiting factors. All the firms identified during the reconnaissance survey were covered in the questionnaire administration. The questionnaire was administered such that firms in each of the industrial estates/areas and the outlying firms were visited one after the other. In each case, the questionnaires were left with the industrialist/designated officer to complete. One hundred and three questionnaire were administered in twelve industrial estates; one questionnaire in each of the firm. This connotes that all the firms in the industrial estates were successfully covered in the questionnaire administration, which was administered. All the questionnaires were retrieved.

RESULTS AND DISCUSSION

Table 1.1, indicates that 103 firms exist in the estates. The distribution of these firms varied from one industrial estate/ to another. There were 13(12.6%) in Apapa, 3(2.9) in Matori, 7(6.8%) in Agbara, 24 (23%) in Ikeja, 14(13.6%) in Ilupeju, 3(2.9%) in Ijora, 7(6.8%) in Iganmu, 10(9.7%) in Oshodi/Isolo, 2(1.94%) in Ogba, 4(3.94%) in Ikorodu, 9(8.7%) in Oregun, 7(6.8%) in Surulere/Mushin. This analysis shows that the number of agglomeration firms varied across the estates; however, there were none in Gbagada, Agidingbi, Oyediran/Yaba, Ilasamaja, Lagos South-West, Akowonjo, Kirikiri, Abesan/Ipaja. The twelve industrial estates covered were the core areas of industrial activities in Lagos states. The location of each of these firms is shown in Figure 1.1, while the lists of these firms is provided in Table 1

Table 1 Distribution of firms

S/No	Industrial Estate/Area	Number of Firms	Percentage of Total
1	Apapa	13	12.6
2	Matori	03	2.9
3	Agbara	07	6.8
4	Ikeja	24	23
5	Ilupeju	14	13.6
6	Ijora	03	2.9
7	Iganmu	07	6.8
8	Oshodi/Isolo	10	9.7
9	Ogba	02	1.94
10	Ikorodu	04	3.94
11	Oregun	09	8.7
12	Surulere/Mushin	07	6.8
Total		**103**	**100**

Field Survey, 2013.

CLUSTER BENEFITS AMONGST FIRMS IN THE LAGOS REGION

Table 2, reveals the 103 (100%) firms indicating a saving due to clustering enjoyed. As a result of joint transportation, 27 (26%) firms realized between 21 and 30% savings, whereas 36(35%) firms realized <10% savings due to joint power supply. Also, as a result of joint raw materials purchase/supply, 5 (4.9%) enjoyed between 61 and 70%, while due to collaboration in research and development, 5(4.9%) enjoyed between 71 and 80% savings. Furthermore, as a result of joint labour, 43(41.7%) firms enjoyed <10%, 9(8.7%) realized between 71 and 80% savings. Another, 65(63%) firms realized <10% savings, as a result of joint water supply.

Moreover, due to joint waste treatment, 50 (48.5%) firms realized <10% savings, 3(2.9%) enjoyed between 61 and 70% benefits. Also, 37 (35.9%) firms realized <10% savings, while 5(4.9%) realized between 61 and 70% as a result of joint security. Another, 76 (73.8%) firms realized <10% benefits due to joint telecommunication. Due to joint ports and shipping,

49(47.6%) firms realized between 31 and 40% savings, whereas due to access to financial institution, 9(8.7%) firms each enjoyed between 81 and 90% and <10% savings.

The dominant economies enjoyed is the access to financial institution, Joint telecommunication was the least.

Table 2 The Cluster Benefits (savings) Enjoyed by Firms

% Savings	Joint transport		Joint power supply		Joint raw materials P/S		Collaboration R &D		Joint Labour		Joint Water Supply		Joint waste treatment		Joint security		Joint telecomm		Joint port & shipping		Access to financial institution	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<10	25	24.3	36	35	34	33	41	39.8	43	41.7	65	63	50	48.5	37	35.9	76	73.8	49	47.6	09	87
11-20	16	15.5	09	8.7	05	4.9	07	6.8	13	12.6	09	8.7	10	9.71	12	11.7	09	8.7	15	14.6	14	13.6
21-30	27	26	30	29.1	13	12.6	02	1.94	10	9.71	20	19	10	9.71	10	9.71	10	9.71	10	9.71	19	18.4
31-40	10	9.71	10	9.71	20	19.4	19	18.4	08	7.8	6	6	13	12.6	14	13.6	06	5.8	02	1.94	12	11.7
41-50	09	8.7	06	5.8	19	18.4	16	15.5	09	8.7	2	1.94	09	8.7	10	9.71	02	1.94	08	7.8	10	9.71
51-60	7	6.8	06	5.8	06	5.8	08	7.8	08	7.8	1	0.97	07	6.8	12	11.7	-	-	07	6.8	15	14.6
61-70	6	5.8	04	3.9	05	4.9	4	3.9	03	2.9	-	-	03	2.9	05	4.9	-	-	09	8.7	10	9.71
71-80	2	1.94	01	0.97	1	0.97	5	4.9	09	8.7	-	-	01	0.97	02	1.94	-	-	03	2.9	05	4.9
81-90	1	0.97	01	0.97	-	-	1	0.97	-	-	-	-	-	-	1	0.97	-	-	-	-	09	8.7
91-100	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	103	100	103	100	103	100	103	100	103	100		100	103	100	103	100	103	100	103	100	103	100

Source: Author's Analysis, 2013

Clustering Economies Variables

Y_1 Joint Transportation (Percentage Savings accruing from joint transportation (transportation economies)

Y_2 Joint Power supply (Percentage Savings accruing from joint use of power (power economies)

Y_3 Joint Raw Material Purchase/Supply (Percentage Savings accruing from joint Raw materials purchase (input economies).

Y_4 Collaboration in Research and Development (Percentage Savings accruing from joint R & D)

Y_5 Joint Labour Supply (Percentage Savings accruing from wage rate (Labour economies i.e reduction in the cost of Labour).

Y_6 Joint Water Supply (Percentage Savings accruing from joint water supply measured as a percentage reduction in the cost of water supply).

Y_7 Joint waste treatment (Percentage Savings accruing from joint waste treatment)

Y_8 Joint Security (Percentage Savings accruing from joint security services).

Y_9 Joint Telecommunication (Percentage Savings accruing from joint telecommunication).

Y_{10} Joint Ports & Shipping (Percentage Savings accruing from joint ports and shipping)

Y_{11} Access to Financial institution (Percentage Savings accruing from access to financial institution).

The Analysis of Variance carried out in testing the hypothesis (i.e. clustering economies do not vary significantly amongst firms, as depicted in Table 3 shows that the result was significant at 5% level (0.000<0.05). Therefore, null hypothesis H_0 above is rejected, which means the acceptance of the alternative hypothesis H_1, connoting that Agglomeration Economies vary significantly amongst the firms. This result tends to confirm Ciccone's (1991) assertion that agglomeration of firms comes about as a result of potential benefits (especially lowering of costs) accruable to firm's close together in space.

Table 3 Summary of the Analysis of Variance (ANOVA) for the Benefits of Clustering

	Sum of Squares	Df	Mean Square	F-Cal.	F-Tab
Between Groups	100142.756	10	10014.276	34.917	1.84
Within Groups	224277.491	782	286.800		
Total	324420.247	792			

Source: Author's analysis, 2013

Table 4 Location limit of clustering

Location factors	**Responses**				
	SA	**A**	**UND**	**DA**	**SD**
Nearness to raw materials	32	25	23	18	15
Market facilities	16	20	22	19	26
Transportation	62	10	15	13	3
Water supply	55	17	16	11	4
Labour	18	21	23	28	13
Power supply	67	20	8	5	3
Government policy	58	18	13	8	6

Source: Author's Analysis, 2013

Table 3 reveals the responses relating to the location limit of clustering. The General Mean Weight Value and the Mean Weight Value or the cut off point for this grouped responses were calculated. It was found that only four factors, out of the seven listed were accepted as significant location (factors) limit of clustering, while other factors were insignificant (Table 4).

Table 4 The summary of location factors

Factors	**Total weight value**	**Mean weight value**	**Decision**
Nearness to raw materials	330	3.20	Rejected
Market facilities	290	2.82	Rejected
Transportation	424	4.12	Accepted
Water supply	417	4.05	Accepted
Labour	312	3.03	Rejected
Power supply	452	4.39	Accepted
Government policy	423	4.11	Accepted

GMWV =25.72/7 = 3.67

Source: Author's Analysis, 2013

Table 4 reveals that transportation, water supply, power supply and government policy were accepted because their respective Mean Weight Values of 4.12, 4.05, 4.39 and 4.11 are greater than the General Mean Weight Value of 3.67. Other factors are counted insignificant because of their Mean Weight Values which are lesser than the General Mean Weight Value. This further lends credence to the fact that only four factors are germane in the clustering limit.

Table 5 Limitation by advantages offered by locating within the Estates

Estate advantages	Responses				
	SA	A	UND	DA	SD
Subcontracting	30	22	10	30	11
Sales promotion	26	29	11	20	17
Security	27	18	15	18	25

Source: Author's Analysis, 2013.

Table 5 reveals the responses relating to the estates advantages limit of clustering .The general mean weight value and the mean weight values or the Cut off points for these grouped estates advantages were calculated and summarize. Apparently, all the three factors listed have their Mean Weight Values greater than the General Mean Weight Value and were subsequently accepted as being significant. This connotes that subcontracting, sales promotion and security significantly contributes to the limit of clustering in the Lagos region (Table 6).

Table 6 Summary of Decisions On Estates Advantages

Estates advantages	**Total weight value**	**Mean weight values**	**Decision**
Subcontracting	335	3.25	Accepted
Sales promotion	338	3.28	Accepted
Security	313	3.04	Accepted

GMWV =9.53/3 =3.15

Source: Author's Analysis, 2013.

Table 6 depicts that the estates advantages; subcontracting, sales promotion and security, have their Mean Weight Values of 3.25, 3.25, 3.28 and 3.04 respectively, these values are higher than the General Mean Weight Value, and are therefore significant contributors to clustering limit.

Table 7 Limitation by Other Factors

Other factors	**Responses**				
	SA	A	UND	DA	SA
Research development	38	32	12	13	08
Personal reasons	33	29	10	18	13
Cheap land	25	17	12	28	21
Port and shipping	20	23	26	15	19
Access to financial institution	45	20	18	12	08

Source: Author's Analysis, 2013.

Table 7 reveals the responses relating to the limit of clustering by other factors. The general Mean Weight Value (GMWV) and the Mean Weight Value (MWV) or the cut off point for this grouped responses were calculated. Three, out of the five listed factors were accepted as significant (table 8)

Table 8: Summary of Decision on Limitation by Other Factors

Other factors	Total weight value	Mean weight value	Decision
Research and development	388	3.77	Accepted
Personal reasons	360	3.50	Accepted
Cheap land	306	2.97	Rejected
Ports and shipping	315	3.24	Rejected
Access to financial institution	391	3.80	Accepted

GMWV = 17.28/5 = 3.46

Source: Author's Analysis, 2013.

From table 8 above, research and development, personal reasons and access to financial institution were accepted because their respective mean weight values of 3.77, 3.50 and 3.80 are greater than the General Mean Weight Values of 3.46, thus evidently signifying to significant clustering limit.

SUMMARY AND CONCLUSION

The research has examined the limit of clustering in geographical innovation of the Lagos region. The research revealed the immense benefit of clustering in the form of various economies enjoyed by firms through maximum proximity locations. Economies such as transportation, power, labour, raw materials purchase/supply, research and development, security, water supply, telecommunication as well as access to financial institution are enjoyed by firms.

The paper revealed three groups in relation to the limit of clustering. The location factors constituted the first group. Seven location factors were considered to be germane, these are; nearness to raw materials, market facilities, transportation, water supply, labour, power supply and government policy. The Mean Weight Values of these factors were determined, it was found that only four factors; transportation, water supply, power supply and government policy were major contributors to the clustering limit. Advantages derived by firms in each of the estates constitute the second group, three factors were identified; subcontracting, sales promotion and security. The Mean Weight Values reveal all the three factors as being significant. The third groups (other factors) are; research and development, personal reasons, cheap land, ports and shipping and access to financial institutions. Three of these factors; research and development, personal reasons and access to financial institution are found to be significant, because their respective Mean Weight Values are higher than the General Mean Weight Values. The limit of industrial cluster constitutes a barrier to industrial, advancement, expansion and upliftment.

Industrial cluster can lead to amazing technological development of a region, thereby facilitating diffusion and innovation creation which will immensely contributes to the economic welfare and improved standard of living. The industrial estates needs to be created and equipped with facilities, because industrialization in this modern world is a determinant of national power, thus, any country that failed in this aspect, will find it difficult to perform effectively in other aspects of the economy.

Clustering if encouraged, will lead to increase economies, these clustering of firms should be made viable, encouraged and strengthened through government investment in the industrial sector. Government should strive to intervene by ameliorating the clustering limit to facilitate industrial expansion, so that the multiplier effect could be maximally exploited. This could be achieved through the liberalisation of location factors, ensuring the adequacy of facilities in the industrial estates, giving tax holidays to the younger investors, relaxing the laws governing the importation of some raw materials, as this will have positive impact on productions.

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Binary Oxide Photoelectrode with Coffee Natural Dye Extract for DSSC Application

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ABSTRACT: SnO_2 (x)- ZnO(1-x) binary system with two different SnO_2 composition (x= 3, 5 mol%) were prepared by solid state reaction at high temperature employed as photoanode for dye sensitized solar cell(DSSC) fabrication. SnO_2-ZnO binary oxide was characterized by X-ray diffraction(XRD) and UV-VIS Spectroscopy to examine their structure and optical properties. High performance carbon electrode was prepared onto glass and used as counter electrode. Coffee powder was used as natural dye-sensitizer. The improvement in device efficiency was achieved by larger SnO_2 composition. The overall power conversion efficiency increased from 0.18% for SnO_2:ZnO (3:97mol %) device to 0.26% for a device with SnO_2:ZnO (5:95mol %) photoanode.

KEYWORDS: Binary oxide, XRD, DSSC, conversion efficiency, fill factor.

1 INTRODUCTION

A dye-sensitized solar cell (DSSC, DSC) is a low-cost solar cell belonging to the group of thin film solar cells [1,2]. It is based on a semiconductor formed between a photo sensitized anode and an electrolyte, a photoelectrochemical system. The DSSC has a number of attractive features; it is simple to make using conventional roll-printing techniques, is semi-flexible and semi transparent which offers variety of uses not applicable to glass-based systems, and most of the materials used are low-cost[1-5]. In the fabrication of DSSCs, the choice of the metal oxide material and the transparent electrode is crucial to obtain efficient light harvesting, charge separation, and extraction. TiO_2 has been widely studied for efficient DSSCs [6-8], and a power conversion efficiency of 11% was reported [9]. Moreover, ZnO nanoparticles were investigated for DSSCs [9-15]. DSSCs fabricated using ZnO nanoparticles have achieved the second highest efficiency after TiO_2 [12-16]. Another crucial parameter in the fabrication of DSSCs is the sensitizing dye. Due to the dye significant role, considerable interest has been directed towards the development and improvement of new families of organic dyes and of metal complexes[11-15]. These complexes have a number of interesting features such as good absorption, long excited lifetime, and highly efficient metal-to-ligand charge transfer. The disadvantages of these complexes are high cost and sophisticated preparation techniques. Therefore, alternative organic dyes such as natural dyes have been studied intensively[13-18]. The main features of natural dyes are their availability, environmental friendly and low in cost[16-18]. In this research, SnO_2-ZnO binary oxide transparent films were prepared by spin-coating technique. Structure, optical and photovoltaic properties of SnO_2:ZnO binary oxide photoelectrode with the coffee natural dye extract (DSSC) was studied.

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2 EXPERIMENTAL PROCEDURE

SnO_2 and ZnO were separately observed by XRD to examine their purification. SnO_2(x) and ZnO (1-x) (x = 3, 5 mol%) were mixed and ball-milled for 20 h to get homogeneous powder . It was mesh-sieve with 3-step mesh to choose the small scale and uniform powder. It was annealed at 800 °C for 1 h and SnO_2-ZnO composite powder was successfully formed. Flow chart of experimental procedure for SnO_2- ZnO binary oxide powder was shown in Fig 1. After that SnO_2- ZnO binary oxide powder, 3 ml of methoxyethanol ($CH_3OCH_2CH_2OH$) was stirred with magnetic stirrer and these SnO_2-ZnO binary oxide solution was refluxed at 100°C by water bath for 1 h. After cool down at room temperature SnO_2-ZnO binary oxide paste was formed. Finally SnO_2-ZnO binary oxide paste was coated on glass substrate by spin coating. The flow chart of experimental procedure for SnO_2-ZnO binary oxide film was shown in Fig 2.

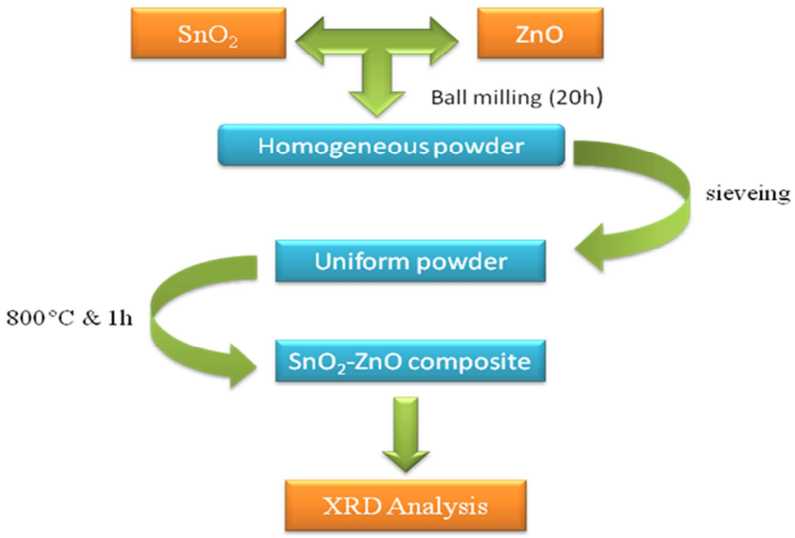


Fig 1 Flow chart of experimental procedure for SnO_2- ZnO binary oxide powder

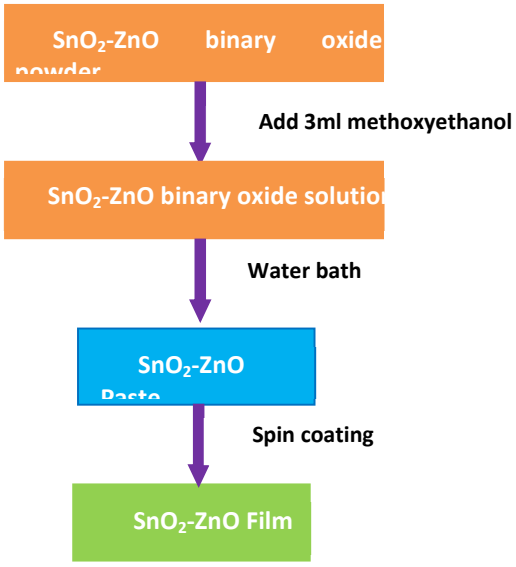


Fig 2 Flow chart of experimental procedure for SnO_2- ZnO binary oxide film

2.1 PREPARATION OF NATURAL DYE-SENSITIZER

Coffee seeds were used as natural dye-sensitizer in this work. Firstly, coffee seeds were ground in grinding machine and obtained the coffee powder. The powder was squeezed by blander for fine powder formation. And then, acetone was added into specimen for coffee solution and it was sieved by filter paper. After sieving, coffee solution was annealed with heat controller at 100 °C for 20 min. After cooling, it was sieved with the filter paper and coffee solution was obtained. Flow chart of experimental procedure for coffee natural dye sensitizer in pH level 5 was shown in Fig 3.The UV-Vis Spectroscopy was used to examine the optical properties of coffee solution. Fig 4 showed absorption properties of coffee dye extract solution. It could absorb near visible region and the optical band gap values obtained was 4.09 eV.

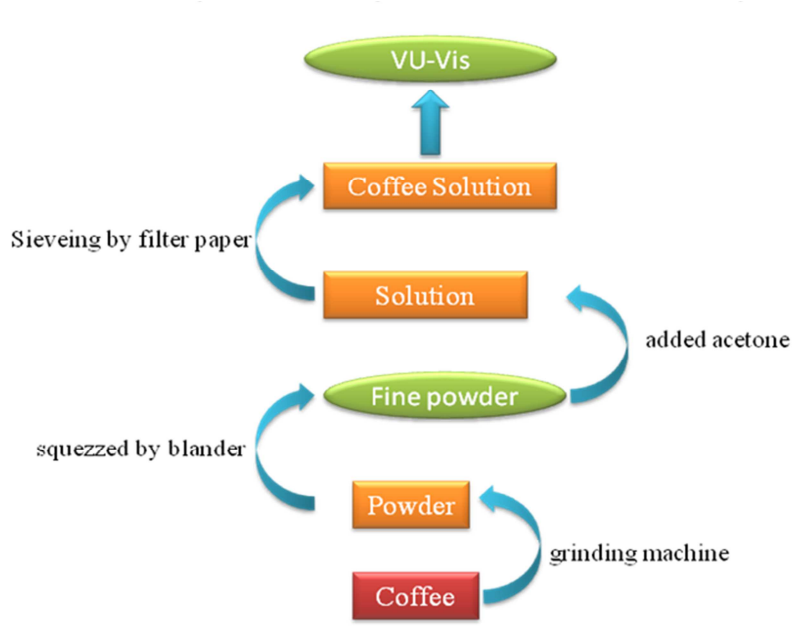


Fig 3 Flow chart of experimental procedure for coffee natural dye-sensitizer

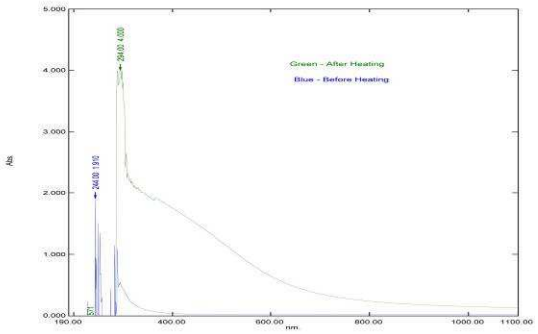


Fig 4 Absorption spectrum of coffee dye extract in pH level 5

2.2 PREPARATION OF DSSC (DYE-SENSITIZED SOLAR CELL)

The black carbon was dispersed into the mixture solution of water and ethanol. After dispersion, carboxymethyl cellulose was also added and adhesive carbon paste was formed. It was coated onto glass substrate and annealed at 80 °C for 30 min. The glass plate was dried on the hot plate for 30 min. By this time, the coffee solution was put in the dish. The SnO_2-ZnO

binary oxide coated slide should have soaked in this solution for 1 h and 30 min. It was dried on the hot plate for 1 h at 100°C, the slider was ready for use. Iodine solution was prepared for electrolyte. Carbon coated glass plate was placed the face downward on the SnO_2-ZnO binary oxide coated glass plate. The two glass plate must be slightly offset. Binder clips were used to keep the two slides together. One drop of a liquid iodine solution was then added between the slides. Capillary action will strain the entire inside of the slides. In this study, the cell was measured both the voltage and current output of the cell under halogen lamp.

3 RESULTS AND DISCUSSION

3.1 XRD ANALYSIS

Fig 5 (a-b) showed the XRD spectrum of SnO_2-ZnO binary oxide powder at 3:97 mol% and 5:95 mol%. The upper site of XRD profile was represented the observed SnO_2-ZnO spectrum while the lower site indicated the JCPDS (Joint Committee on Powder Diffraction Standard). All of diffraction peaks were consistent with hexagonal wurtzite structure for ZnO and tetragonal structure for SnO_2.Thus ZnO and SnO_2 were examined to be composite binary oxide form at both compositions. Table 1, showed the value of lattice parametre, bond length, hexagonality and crystallite site data of SnO_2-ZnO binary oxide powder.

Table 1. Lattice parametre, Bond Length, Hexagonality and Crystallite site data of SnO_2:ZnO Binary Oxide Powder

Specimen	Lattice Parametre		Bond Length (Å)	Hexagonality (c/a)	Crystallite size (nm)
	a (Å)	c (Å)			
SnO_2:ZnO (3:97 mol %)	5.74	4.27	3.64	0.74	70.31
SnO_2:ZnO (5:95 mol %)	5.45	4.36	3.36	0.79	63.94

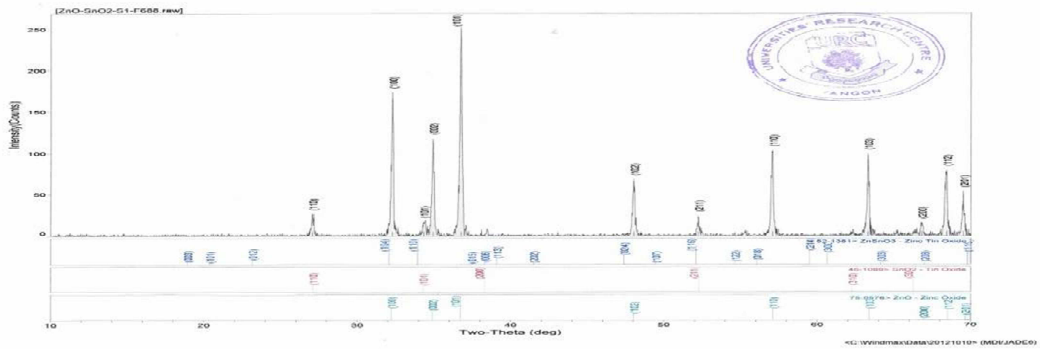


Fig 5 (a) XRD spectrum of SnO_2:ZnO (3:97mol %) binary oxide powder

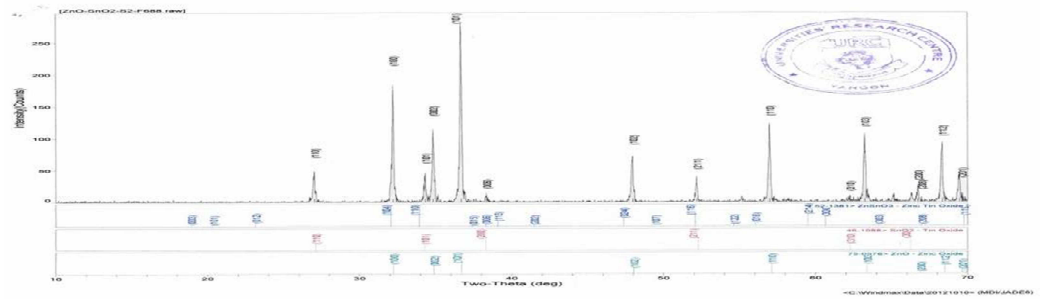


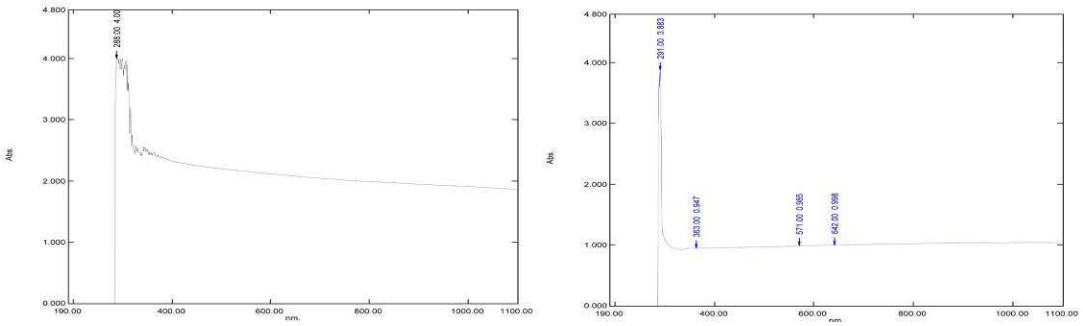
Fig 5 (b) XRD spectrum of SnO_2:ZnO (5:95 mol%) binary oxide powder

3.2 OPTICAL PROPERTIES

Fig 6(a-b) illustrated the absorption spectra for SnO_2-ZnO binary oxide films. The absorbance was over 60% in the visible region for all samples. It could be seen from figure that absorption edge near 300 nm. The absorption edge shifted to longer wavelength as the various SnO_2-ZnO compositions. The optical band gap values obtained were summarized in Table 2.

Table 2. Optical Band Gap of SnO_2-ZnO binary oxide

Specimen	Optical Band Gap (eV)
SnO_2:ZnO (3:97 mol %)	3.91
SnO_2:ZnO (5:95 mol %)	4.08



(a) (b)

Fig 6 Absorption spectrum for SnO_2:ZnO(a) 3:97 mol % (b) 5:95 mol % binary oxide films

3.3 PHOTOVOLTAIC PROPERTIES

Fig 7 (a-b) , showed the I-V curves of SnO_2-ZnO binary oxide photoelectrode DSSC cells under illumination(8104 lux). The summarized photovoltaic parameters for the two DSSCs were listed in Table 3.

Table 3 Photovoltaic parameters of SnO_2-ZnO photoelectrode with coffee dye sensitizer extract

Specimen	I_{sc} (mA)	V_{oc} (mV)	FF	η(%)
SnO_2:ZnO (3:97 mol %)	0.08	54	0.75	0.18
SnO_2:ZnO (5:95 mol %)	0.06	105	0.73	0.26

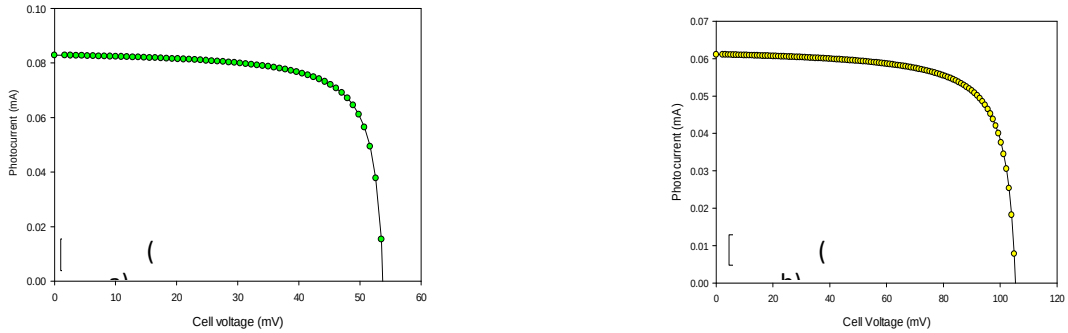


Fig 7 I-V curve of SnO_2:ZnO (a) 3:97 mol% and (b) 5:95 mol% binary oxide DSSC

4 CONCLUSION

SnO_2-ZnO binary oxide transparent films were prepared by spin-coating technique. From the results of powder analysis, SnO_2-ZnO binary oxide fine powder was formed at given temperature. The optical band-gap of SnO_2-ZnO binary oxide photoelectrode was same as the coffee dye extract for SnO_2-ZnO (5:95 mol %). Therefore, the efficiency of SnO_2-ZnO (5:95 mol %) was examined to be larger than that of SnO_2-ZnO (3:97 mol %). It might be attributed to the larger amount of SnO_2 into ZnO. The results showed that SnO_2-ZnO and coffee natural dye exhibited a promising application in the preparation of dye sensitized solar cell.

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Study of *Gelidium sesquipedale* overexploitation effects on *Sargassum muticum* proliferation of in El Jadida area, Morocco

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ABSTRACT: The proliferation of harmful algae in a marine environment is practically linked to human activities that are to be by overexploitation or pollution. Characteristics of the brown alga *Sargassum muticum* promote her ability to adapt and endure the harsh conditions in different parts of its distribution. This study indicates that the overexploitation of the red algae *Gelidium sesquipedale* causes an imbalance in the marine environment will be colonized by invasive alga *S. muticum*. Therefore, we must act quickly and rationally manage natural seaweed fields to avoid the invasion of the environment by harmful species.

KEYWORDS: harmful algae*,* human activities, invasion, pollution.

1 INTRODUCTION

Biological invasions in coastal marine habitats have been recognized as one of the main causes of biodiversity decline and changes in native populations, community dynamics, and major ecosystem processes (Grosholz 2002).

In certain number of marine sites, a higher biomass and more frequent harmful algae coincided with dramatic declines in commercial stocks of other species very important economic interest. We quote here the example of *Gelidium sesquipedale* (Clemente) Thuret which quantities collected decline each year leaving space either case to the new Japanese *Sargassum muticum* (Yendo) Fensholt species.

The Japanese seaweed *Sargassum muticum* was accidentally introduced into African waters and discovered for the first time in coastal waters Doukkala at African level (Sabour & al, 2013).

Algal blooms are a natural phenomena regulated by a certain number of environmental factors. However, overfishing accentuates the problem of harmful algal blooms by weakening the growth of other algae species. In association with abiotic factors, collectors' algae influence the development of algal biomass. Thus, when the activity is accentuated by poaching or increased fishing, harmful algal blooms easily. At present, the adverse effects of overfishing on the life cycle of algae contaminate coastal ecosystems, causing problems of coastal water quality and habitat loss.

The general objective of this research is to provide information needed to understand the linkages between Harmful Algal Blooms (*Sargassum muticum* case) and overexploitation of algae (*Gelidium sesquipedale* case) and present scientific evidence that the red algae overuse could contribute to the worsening of harmful algal blooms.

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2 MATERIALS AND METHODS

2.1 *SARGASSUM MUTICUM* DESCRIPTION

Sargassum muticum (Yendo) Fensholt is a Japanese seaweed class Phaeophyceae. In her country, it is present on the coast bathed by the warm waters of the current "Kuroshio" south and east "Tsushima" west (Critchley, 1983) and in China Sea. It is located on semi-beaten quiet mode, at the infralittoral superficial. The first proliferation observed (Sabour & al., 2013) on the Moroccan Atlantic coast in the coastal Doukkala.

Like all algae of the genus Sargassum, *Sargassum muticum* is fixed by a basal disc and carries air-carrying vesicles pedicelled. The frond has a complex morphology resembling that of higher plants (Fig. 1). Seaweed has one or more principal axes from which primary and secondary branches are born. Of these branches, there foliaceous organs sometimes with a rib nickname, cylindrical containers pruned tip and pedicellate, aerocystes, pedicelled and spherical vesicles located in the lateral position.

Its systematic classification is as follows: Class: Phaeophyceae, Subclass: Cyclosporeae, Order: Fucales, Family: Sargassasseae, Genre: Sargassum, Species: muticum.

2.2 STUDY AREA

This part of research was conducted in the area of Sidi Bouzid Moroccan Atlantic coast.

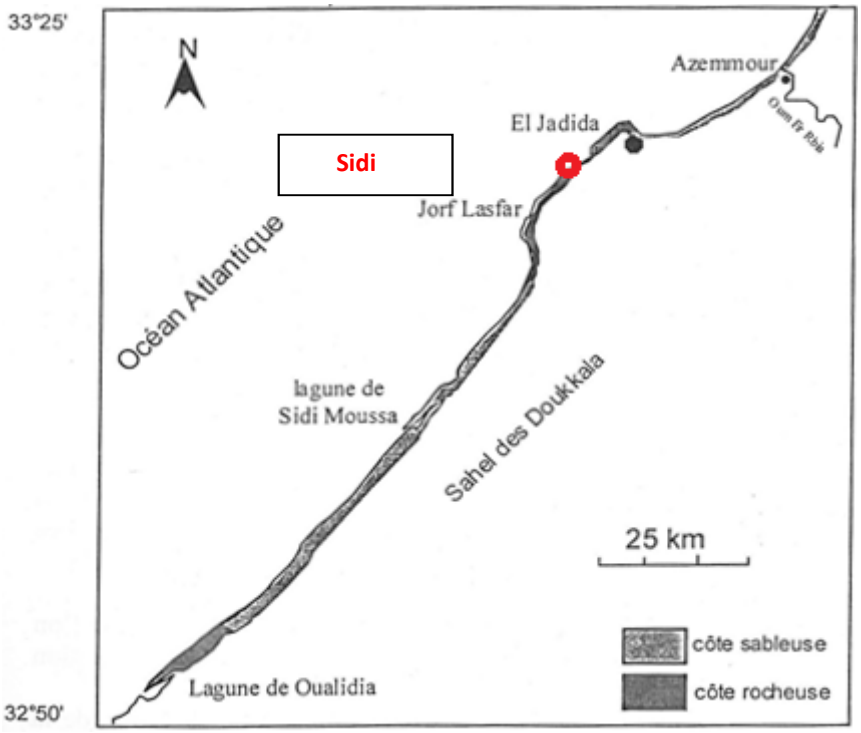

Fig. 1. Location of sampling site

2.3 SAMPLING METHODS

Sampling of this kind was carried out along an annual cycle from January 2013 until December 2013. We file randomly on a different point quadrat covering the entire study site. Determining the coordinates of each sampling point was determined by GPS (Garmin 72) and a photo was taken for verification of coverage of the species *Sargassum muticum* and *Gelidium sesquipedale*.

2.4 PARAMETERS STUDIED

During this research we determined the abundance of *Sargassum muticum* species in the study station. The study of the ecology of this species has also been started in this part of research.

The parameters taken into account are the index of overall algal cover (% of plant cover occupied by the reference species) (RR) according to the scoring grid below (Table 1). The principle of this grid is based on the disappearance of the reference species under the effect of increasing of eutrophication level and on species richness. At the monitoring station, each color corresponds to a state defined by the level of eutrophication, bad to very good for a given species.

Table 1. Classification grid of recovery algae index present in the quadrats

Percentage	Cover index	Qualification
0-5%	1	**Bad**
5-25%	2	**Mediocre**
25-50%	3	**Medium**
50-75%	4	**Good**
75-100%	5	**Very good**

-**Very good**: the reference species dominate (≥ 75%), opportunistic algae blooms may be present very locally. Diversity is satisfactory.

-**Good**: the reference species dominate (50-75%), opportunistic algae proliferate locally with the possibility of exceptional anoxic crises. Diversity is satisfactory.

-**Medium**: the reference species no longer dominate (between 5 and 50%) but are present, opportunistic species proliferates locally with local but recurrent anoxic crises. Diversity is satisfactory.

-**Mediocre**: the reference species are very poorly represented (<5%), opportunistic species do not dominate continuously but their abundance can lead to general anoxia. Diversity is reduced.

-**Bad**: the reference species are absent, only opportunistic species can grow with general and recurrent anoxic crises. Species richness is low.

3 RESULTS

3.1 MORPHOLOGY

The *S. muticum* plant, illustrated in Figure 2, is attached to the substratum by a perennial, conical, discoid holdfast up to 5 cm diameter. Occasionally smaller plants may be found attached to, or fused into, the holdfast of an adult plant. Germlings can settle simultaneously and their holdfasts can fuse, and one plant may become dominant and retard the development of the other plants by shading.

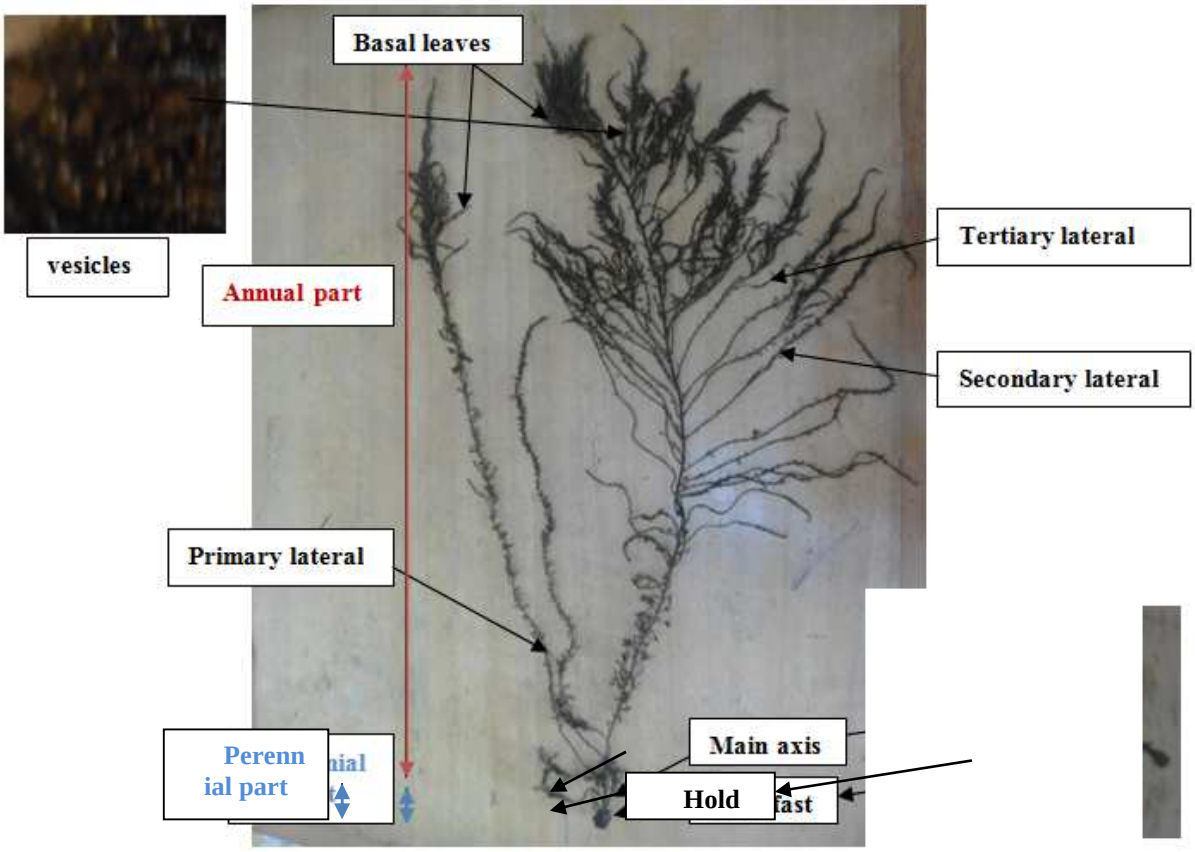

Fig. 2. The plant structure of Sargassum muticum. (Nomination by Wernberg M., & al., 1998)

Thallus is more than 1 m high. Holdfast complanate discoid in shape, up to 1,5 cm diameter. Stem solitary on the hodfast, upriht, terete, 2-3 mm in diameter, up to 2 cm high, usually unbranched, sometimes once or twice branched in the upper part. Several main branches issued spirally from the terminal part of the stem. Main branch angular 2 mm wide. Lateral branches numerously developed. Leaves arranges spirally with a phyllotaxis of 215 on the main branch. Its leaves on lower part long of the main branch obovoid to long elliptical usually 2-3 cm and 3-4 mm wide. with entire or slightly serrulate margin. Midrib absent (Belsher T., 1989).

It's leaves on the upper part of the branch becoming smaller, cuneate or sometimes slightly hemiphyllous, with dentation in distal part. Cryptostomata Scattered on leaves and vesicles. Vesicles shortly stipitate. spherical or pyriform in shape up to 3 mm in diameter, with round or mucronate apex. Vesicles formed abundantly on lower part of lateral branches. Plant monoecious. Male and female conceptacles mixed in an androgynous receptacle. Receptaclie terete, shortly stipitate, tapering upwards, 10-12 mm long and 1 mm in diameter. Maturation period is in winter to early summer. This species grows on rocks rather protected from wave action in a zone from lower intertidal to upper subtidal (Belsher T., 1989).

3.2 *SARGASSUM MUTICUM* COVERAGE VARIATION

The figure below shows that the coverage (%) of *S. muticum* in the site of Sidi Bouzid reaches a maximum during June and it decreases from July. However, a very significant increase was noticed in the coverage of this species from August.

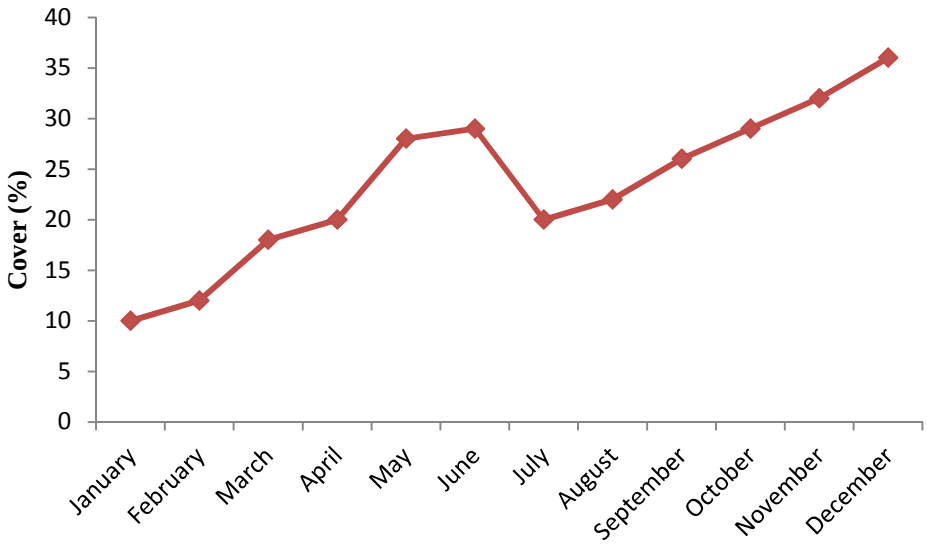

Fig. 3. Monthly change Sargassum muticum coverage

There is a very significant increase in this species coverage in August and September. This meant that there was correlation between the exploitation of *Sargassum muticum* and *Gelidium sesquipedale*.

3.3 CHANGE IN *GELIDIUM SESQUIPEDALE* COVERAGE

The evolution of *Gelidium sesquipedale* coverage in Sidi Bouzid site shows that it is high during April, May and June, then relapse during the collection of marine algae (July, August and September).

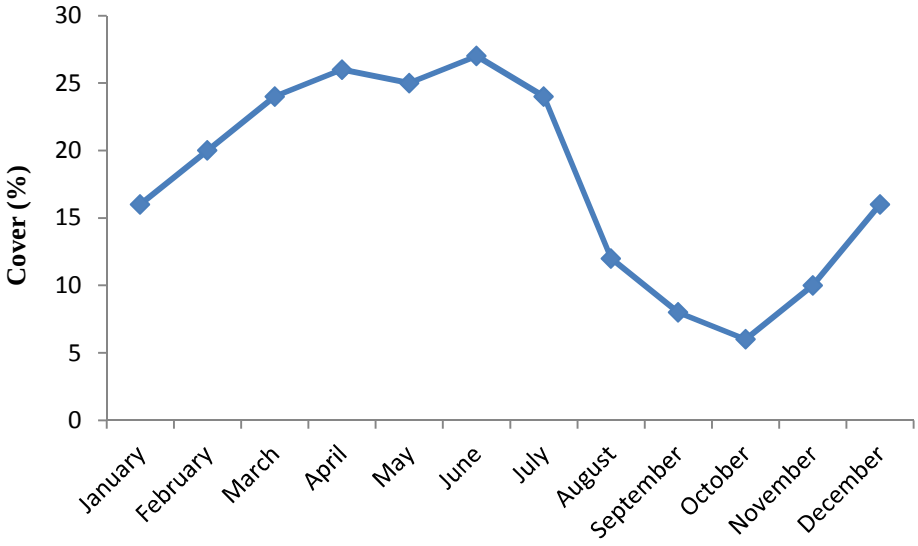

Fig. 4. Monthly change Gelidium sesquipedale coverage

3.4 COMPARISON BETWEEN *G.SESQUIPEDALE* AND *S. MUTICUM*

From the graph below, the decrease in coverage *G. sesquipedale* during and after the licensing campaign for the collection of this species promotes increasing coverage in *S. muticum*.

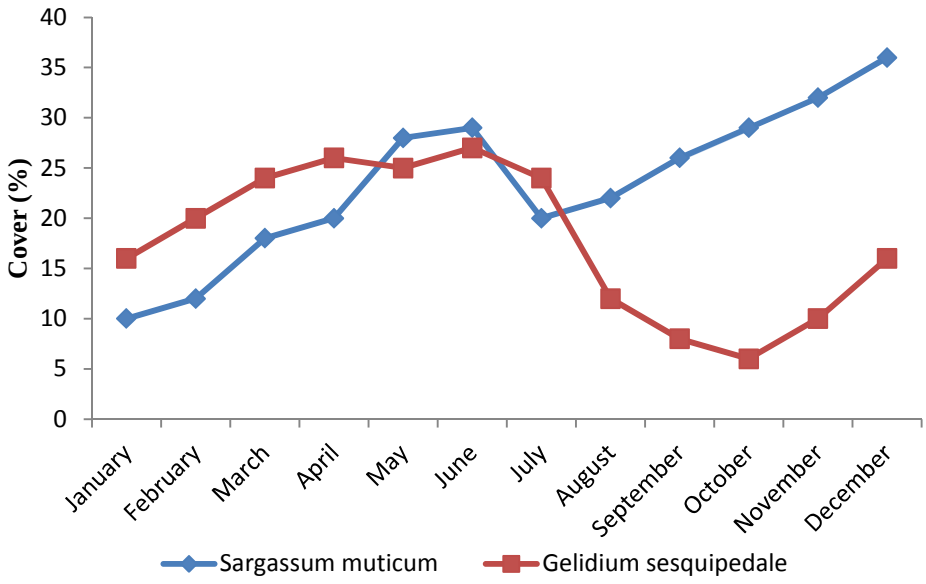

Fig. 5. Monthly coverage of Gelidium sesquipedale and Sargassum muticum in Sidi Bouzid station

4 DISCUSSION

The exploitation of *Gelidium* began to El Jadida in 1949, especially for the species *G. sesquipedale* that was abundant rejected wreck by the sea or on the rocks of mediolittoral. Today, during harvest periods, these are some thousands of needy trackside dwellers and hundreds of boats which carry an algal biomass exceeding 14000 tones defined by MPM (2010), generating a turnover exceeding 30 million dirham.

This species has an interesting agar yield of around 25-30% of the dry weight. It is the only Moroccan marine life; the law tries to protect the intense destructive exploitation. Today, it appears that the intrusion of Japan *Sargassum* in the area of predilection of *Gelidium* may represent a real threat to the latter. This is what we can call duel to the death; where *Gelidium sesquipedale* would hardly be able to push in its natural environment.

Various original morphological characters of *Sargassum muticum* were highlighted: free frond clustering, with marginal proliferations of the stud or branches from the trunk. These characteristics raise the problem of the determination of this polymorphic species. Fertile branches detached from the thallus may remain up to three months, even in difficult conditions of salinity and preserve their germination potential. Furthermore, *Sargassum muticum* has the opportunity to multiply vegetatively. Indeed, seaweed can regenerate a new frond from a single fragment with a meristem or a perennant basal disk. This vegetative propagation is related to the production of the apex phytohormones to the frond base. Dispersal of *Sargassum* may therefore be short distance through the zygotes and long distance through the fertile branches and vegetative multiplication. The presence of the dispersion promotes floats (Loraine I, 1989).

A study conducted by Levavasseur (1988) compared the pigment composition and photosynthetic activity of *Sargassum muticum* with other algal species present in our communities. The main results are as follows:

-In the spring at least, *Sargassum muticum* has a chlorophyll a among the highest; it seems that the fast-growing algae contain more chlorophyll than slow growth.

-In addition, *Sargassum muticum* would be less sensitive than other algae in summer photo-destruction of pigments.

-*Sargassum muticum* has a significant photosynthetic activity. The presence of aerocystes allows fronds grow well in the middle and even spread to the water surface, which allows them to capture the maximum of light energy.

The perennial holdfast, main stalk and basal leaves have the ability to regenerate rapidly when fronds are lost by natural senescence, physical damage or grazing, particularly in warmer waters (Davison D.M., 1996). If a primary lateral is damaged, one of the secondary laterals can effectively replace it. Herbivorous grazing damage has been observed to initiate the rapid maturation of the secondary lateral (Withers & al., 1975). Abscised laterals can continue to grow and become fertile while

free-floating (Fletcher, 1975; Tsukidate, 1984). If receptacles are damaged, they can also regenerate and the process is most rapid in mature, zygote bearing receptacles (Hales & Fletcher, 1992).

Sargassum muticum semble donc être parmi les algues dont les potentialités physiologiques sont les plus aptes à assurer une forte productivité photosynthétique.

S. muticum is tolerant of a wide range of temperatures, 5 - 30^{o}C (Norton, 1977). It can survive short periods of freezing temperatures (Norton, 1977). High water temperatures are favorable for growth and this encourages southward spread while lower water temperatures tend to limit its spread north (Norton, 1977). It is tolerant of a wide range of salinities, 6.8 – 34 ‰, but at reduced salinities, growth rates are reduced (Norton, 1977). The ideal growth conditions are thought to be a temperature of 25^{o}C and a salinity of 34 ‰ (Eno & Clark, 1995).

So with all these features, *Sargassum muticum* can develop in different environments even under difficult conditions. According to our results, the overexploitation of *Gelidium sesquipedale* promotes the location of *Sargassum muticum* in areas of *G. sesquipedale* reduced abundance. We have shown that the *S. muticum* maximum coverage was reached after increasing collection of *G. sesquipedale* during July, August and September (the period allowed for collection).

Sargassum muticum colonizes the lower part of the intertidal zone to the mean low water springs in sheltered areas where water remains at low tide. It attaches to solid substrates in place or mobile: rocks, pebbles, shells. In the Thau lagoon, for example, she has three habitat types: hard subtrats, shellfish growing tables (pillars, ropes, shells). Soft bottoms where it binds to harsh elements such as dead shells, pieces of plastic or scrap (Boudouresque & al., 1985). In Sidi Bouzid, *S. muticum* is fixed on rocks in sheltered areas at low tide. After a few months, *S. muticum* deprives other species of food and growth in the region of its hooking and it may even be a cover avoiding any passing light to other species.

Upwelling phenomena present in Sidi Bousid also promote the rapid growth of *Sargassum muticum*. This species competes with *Gelidium sesquipedale* for food, as *S. muticum* is a hardy species to the harsh conditions that favor its rapid growth over *G. sequipedale*.

But one may wonder why *Sargassum muticum* does not proliferate as much in its original environment, in Japan. In fact, the average length is 1.20 m in Japan while it can go up to more than 10 m on the Atlantic coast. The internodes between two branches are shorter and less long secondary branches in Japan (Loraine I., 1989).

One can think of a phenomenon of competition between species, an equilibrium not being reached in France is being established in Japan, but other factors may be involved. This is why the physical and chemical characteristics of water have been a comparison between the Bay of Mangoku-ura Japan and the Thau lagoon (David, 1985). The temperature criteria and meet the salinity requirements of *Sargassum muticum* in both cases, temperatures being slightly more favorable to Thau and salinity somewhat more favorable in Japan. But nitrogen levels are still significantly higher than in Japan, especially for NH_4 and NO_2. Chemical analysis of composition shows that a Japan alga has nitrogen twice. This could be the nitrate nitrogen which constitutes a limiting factor of Japan *Sargassum muticum* NH_4 and NO_2 not being assimilated (David, 1985).

In Morocco, all the conditions listed above are present and especially in the coastal upwelling where Doukkala recognized at Sidi Bouzid gives an immense richness with nutrients by upwelling from the bottom to the area rich in mineral element. Also, pollution is a major cause for *S. muticum* rapid growth.

5 CONCLUSION

Following this study, the overexploitation of *Gelidium sesquipedale* promotes attachment and growth of harmful algae *Sargassum muticum*. The different characteristics of *Sargassum muticum* gave a clearer understanding the success than meets this alga on our shores. We can mention a few points that are all favorable to its growth factors:

-Very rapid growth,

- A high reproductive capacity with an effective sexual reproduction and the possibility of vegetative propagation,

- An effective dispersion by fertile branches or not with floats, a great capacity for attachment to any single mobile solid object,

- A good photosynthetic activity.

Therefore, we must make a great attention to *G. sesquipedale* exploitation to avoid the proliferation of harmful algae in the Moroccan Atlantic coast. Since the *S.muticum* invasion is at its beginning, an effective fight against this species.

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Expense items: test on items generating inflation

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ABSTRACT: This study aims to spot the inflation – generating expenses. The expenses items are represented by series of prices statistical indexes. We are going to determine the series of gaps on these prices indexes. We will afterwards study the data- generating process in the context of the ARCH model and the V-GARCH model. We will find out the following items (food, clothes and transports) as inflation- generating items.

KEYWORDS: White noise, ARCH model, V-GARCH process, generator, inflation, statistical index.

1 INTRODUCTION

We will study the series of prices statistical indexes in the category of expenses items. The test, achieved on these series, enables us to spot inflation-generating items.

2 CHOICE OF THE MODEL

We will study the series of prices statistical indexes within the expenses items. These series may bring out temporal or instantaneous dependencies. Therefore, we will study these series of observations in the context of a V-GARCH model. The expenses items studied are the following:

Expenses items	item i
Food	1
Housing	2
Clothes	3
Health care	4
Transport	5
Leisure and education	6

In the category of expenses items, we will determine series of gaps of prices statistical indexes:

$y_t = p_{t,i} - p_{t,m}$.

m=o, i.

- $p_{t,i}$ indicates the price index in the expenses item i.

- $p_{t,0}$ represents the consumption prices index.

The variations of the new series, y_t , enable us to compare the trajectories of both series,

$$p_{t,i} \text{ and } p_{t,0}$$

The series y_t is submitted, in terms of values and signs, to an instantaneous variability.

In this context, the series studied, varies in risky way, at the proximity of fixed parameter:

$$y_t = b_i + \mathrm{e}_t$$

i=1, 2,…, 6.

$$\mathrm{E}[\mathrm{y}_t] = b_i$$

The inflation-generating process is described by these gaps between

$$p_{t,j} \text{ and } p_{t,m}$$

In another way, the series y_t is not following the normal distribution.

The skewness and kurtosis coefficients do not indeed belong to the proximity of the reference values:

$$\begin{cases} s^* = 0 \\ k^* = 3 \end{cases}$$

If

$$X \sim N(m, \sigma^2) : \begin{cases} s^* = 0 \\ k^* = 3 \end{cases}$$

Because

$$\mu_i = E\left[(X-m)^i\right]$$

$$= \begin{cases} \sigma^{2s} \prod_{j=1}^{s} (2j-1) & \text{si} \quad i = 2s \\ 0 & \text{otherwise} \end{cases}$$

$$s^* = \frac{\mu_3}{\left[\mu_2^3\right]^{0,5}}$$

$$k^* = \frac{\mu_4}{\mu_2^2}$$

Then:

The series represents:

- Leptokurtic aspect,
- A quite high asymmetry coefficient, which is a sign of non-linearity.

As a matter of fact:

Expenses items	1	2	3	4	5	6
s^*	0.25	-1.08	0.58	1.05	0.94	-0.14
k^*	2.32	4.52	3.64	9.32	3.52	2.16

We will take these series of gaps between $p_{t,j}$ and $p_{t,m}$ as patterns in the category of the six expenses items.

Then, we will study in the context of ARCH pattern, the series of observations, y_t :

$$\begin{cases} y_t = b_i + e_t \\ V\left[e_t / e_s \ , \ s < t\right] = c_0 + \sum_{i=1}^{q} c_i e_{t-i}^2 \\ \qquad\qquad = \mathrm{h}_\mathrm{t} \ . \end{cases}$$

The parameters c_i explain the weight of the past in the conditional variance of disturbances.
The model enables us to spot the inflation-generating items. We will, here, realize the ARCH test:

$$\mathrm{H}_0 : c_1 = ... = c_q = 0$$

$$H_a = H_0^c \quad .$$

H_0^c indicates the complementary of H_0 .

We will, afterwards, realize the following test:

$$\mathrm{H}_0^{\mathrm{i}} : b_i = 0$$

$$H_a^i : b_i \neq 0$$

i=1, 2,…, 6.
This means to test:

$$\mathrm{H}_0^{\mathrm{i}} : y_t = e_t$$

$$H_a^i : y_t = b_i + e_t \quad .$$

Then, under $\mathrm{H}_0^{\mathrm{i}} : b_i = 0$, the series y_t is following a process of white noise.

It is then the chocks symmetry hypothesis in the prices series.
This hypothesis comes out to spot the series following a process of white noise in the category of expenses items.
The alternative hypothesis enables us to spot the inflation-generating expenses if:

- $b_i \succ 0$

- b_i is significantly different of zero.

As a matter of fact, this model enables us to spot the inflation-generating items thanks to the sign and significance on the parameter, b_i .

We will, afterwards, that study these series of gaps in the context of the V-GARCH model.

$$y_t^* = p_{t,j} - p_{t,0}$$

$$y_t^{**} = p_{t,j} - p_{t,i}$$

The series available may bring out temporal or instantaneous dependencies.

$$\begin{cases} y_t = b_0 + e_t \\ V\left[e_t / e_s \ , \ s < t\right] = H_t \end{cases} \quad .$$

$$y_\mathrm{t} = \begin{bmatrix} y_t * \\ y_t ** \end{bmatrix} \quad .$$

$$b_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}$$

$$e_t = \begin{bmatrix} e_t * \\ e_t ** \end{bmatrix}.$$

The choice of the V-GARCH model is dictated by the two first conditional moments of the process studies:

$$E\left[e_t / e_s, s\langle t\right] = 0$$

$$V\left[e_t / e_s, s\langle t\right] = E\left[e_t e_t^{'} / e_s, s\langle t\right]$$

$$= H_t$$

$\mathrm{H_t}$ is a square matrix of order N. It is the matrix of the conditional covariances of the disturbances.

We will here study the signs of the parameters b_{10} and b_{20} .

The expenses item j is an inflation-generating item if :

- $b_{10} \succ 0$
- The parameter b_{10} is significantly different from zero.

In this context, we will spot the item j as an inflation-generating item:

- $b_{10} \succ 0 : p_{t,j} \geq p_{t,0}$
- $\begin{cases} b_{20}\langle 0 : p_{t,j} \leq p_{t,i} \\ b_{20}\rangle 0 : p_{t,j} \geq p_{t,i} \end{cases}$

As a matter of fact, the expenses item j can be a first or a second- class inflation generator.

We will then realize the test of significance on the parameters b_{10} and b_{20} :

$$H_0^s : b_{s0} = 0$$

$$H_a^s : b_{s0} \neq 0$$

s=1, 2.

3 ESTIMATIONS

We will approach the data- generating process with a whole class of models:

3.1 ARCH(Q) MODEL

$$\begin{cases} y_t = b_i + e_t \\ e_t^2 = \mathrm{c}_0 + \sum_{i=1}^{q} c_i e_{t-i}^2 + \omega_t \end{cases} .$$

We will here achieve the test:

$$\mathrm{H}_0 : c_1 = \ldots = c_q = 0$$

$$H_a = H_0^c$$

The disturbances are here following a process ARCH(1).

Expenses items	$\hat{b}_i$
1	2,11 (10,50)
2	-9,07 (-47,42)
3	1,84 (4,14)
4	-0,37 (-1,47)
5	0,92 (3,28)
6	-1,98 (-9,96)

The numbers in brackets are the t of Student.

The estimations are achieved on quarterly frequencies data corresponding to a period of observations between [1974 :1, 2011 :4].

$\hat{b}_i \succ 0$:

The expenses item i is an inflation-generating item.

Thus, the inflation – generating items are the following items: food, clothes and transport.

The series available are then described in terms of increase rate.

The gap between the two rates is interpreted as the gap between the rate in the expenses items i ($p_{t,i}*$) and the inflation rate ($p_{t,0}*$):

$$y_t = p_{t,i}* - p_{t,o}*$$

i=1, 2,…,6 .

$$p_{t,m}* = Log\left(\frac{p_{t,m}}{p_{t-1,m}}\right)$$

m=0, i.

The data-generating process is a conditionally heteroskedastic white noise process:

$$\begin{cases} y_t = e_t \\ e_t^2 = c_0 + \sum_{i=1}^{q} c_i e_{t-i}^2 + \omega_t \end{cases} .$$

3.2 V-GARCH MODEL

We will study, in the context of the V-GARCH model, the series of observations:

$$\begin{cases} y_t = b_0 + e_t \\ V\left[e_t / e_s \ , \ s < t\right] = H_t \end{cases} .$$

The vector of the dependent variables is then:

$$y_{\mathrm{t}} = \begin{bmatrix} y_t^* \\ y_t^{**} \end{bmatrix} \quad .$$

$$y_t^* = b_{10} + e_t^*$$
$$y_t^{**} = b_{20} + e_t^{**} \quad .$$

$$b_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} \quad .$$

-Test of significance:

We will here realize the test:

$$\mathrm{H}_0 : b_{10} = 0$$

$$\mathrm{H}_{\mathrm{a}} = H_0^c$$

The parameter b_{10} is significantly different from zero.

-Signs of parameter b_{10} and b_{20}

The expenses item j is an inflation- generating item if the parameter b_{10} has a positive sign.

The price index in the expense items j, which is $p_{t,j}$, is compared to the price index of the expense item i ($p_{t,i}$) and to the consumption prices index ($p_{t,0}$).

a. Let us assume that: $b_{20} \leq 0$

$$\begin{cases} \hat{b}_{10} > 0 \\ \hat{b}_{20} < 0 \end{cases}$$

The signs of the two parameters studied lead us to a double liaison:

$$\begin{cases} p_{t,j} - p_{t,0} \geq 0 \\ p_{t,j} - p_{t,i} \leq 0 \end{cases} .$$

Then :

$$p_{t,0} \leq p_{t,j} \leq p_{t,i} \quad .$$

The expenses items j is a second-class inflation-generating item.

b. $b_{20} \geq 0$

If $b_{20} \geq 0$: $p_{t,0} \leq p_{t,i} \leq p_{t,j}$.

The expenses item j is a first-class inflation-generating.

This model enables us to spot food, clothes and transport as inflation-generating.

The choice of estimations is dictated by the signs of parameters b_{10} and b_{20}.

The observations on the two interest variables, y_t^* and y_t^{**}, are conditionally the values of these parameters:

$$y_t^* = p_{t,j} - p_{t,0}$$

$$y_t^{**} = p_{t,j} - p_{t,i}$$

Expenses items		j	
		3	**5**
i	**1**	$\hat{b}_{10} = 1.61$ (3.54) $\hat{b}_{20} = -1.55$ (-2.28)	$\hat{b}_{10} = 4.10$ (9.47) $\hat{b}_{20} = 0.45$ (1.00)
	3		$\hat{b}_{10} = 1.78$ (4.05) $\hat{b}_{10} = 1.78$ (4.05) $\hat{b}_{20} = 1.54$ (2.00)

The numbers in the brackets are the t Student.

The results enable us to spot the first of the second-class inflation-generating expenses items.

(*) $p_{t,0} \leq p_{t,j} \leq p_{t,i}$.

$$(**) \quad \begin{cases} p_{t,0} \leq p_{t,1} \leq p_{t,5} \\ p_{t,0} \leq p_{t,3} \leq p_{t,5} \end{cases}$$

The item 5 is a first-class inflation-generating item.

4 CONCLUSION

We have hence realized series of gaps between series of prices statistical indexes in the category of expenses items. Then we have studied the data-generating process in the context of ARCH and V-GARCH models. The test on these series of observations enables us to spot food, clothes and transport as inflation-generating items. These items can be a first or a second-class inflation generating items.

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Effects of Exotic Eucalyptus Plantation on the Ground and Surface Water of District Malakand, Pakistan

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ABSTRACT: Vegetation plays a significant role in determining ground and surface water of an area. The present study was aimed to investigate the impacts of exotic Eucalyptus plantation on the ground and surface water in district Malakand (34.50° N, 71.75° E) Pakistan. Two villages (Kot and Totai) were selected randomly for data collection with a sample size of 25% of the population representing each village. The methods used were questionnaire survey, interviews, water table and discharge rate measurement. The results of the study indicated that 64% springs have been dried out so far in village Kot and 75% in village Totai due to high uptake of water. Eucalyptus plantation has adverse effects on ground and surface water. It was found that Eucalyptus has deepened the water table by 0.762m (0.833 yards) per year in both villages as a result the average depth of water table has reached 20.116 m (22 yards) in village Totai and 15.544 m (17 yards) in village Kot. As a result, some springs have become seasonal depending on rainfall. Results of the current study suggest that ground water and surface water resources should be monitored regularly to determine the protection and regeneration of natural forests and better utilization and improvement of marginal and degraded lands. Moreover introduction of new plant species to an area should be made after careful observation of climatic conditions of the area and keeping in mind the possible effects of these species on the environment.

KEYWORDS: Springs, Discharge rate, surface water, ground water, Eucalyptus, Khyber Pakhtunkhwa.

1 INTRODUCTION

According to global standards, forests should comprise 20-25% of total land area of a country. However, in Pakistan forests cover an area of about 4.2 million hectares, which is equivalent to 4.8 percent of the total land area of Pakistan [1] and it is decreasing due to due to continuous cutting of forest trees and commercial overexploitations. The forest cover is unable to meet the growing demand for wood and wood-based products in Pakistan which is the seventh most populous country in the world and the fourth in Asia with an annual population growth rate of 2.1% [2]. To meet the wood consumption demands of increasing population, to increase the forest cover and to support the wood dependent industries, 40 species of Eucalyptus were introduce in the late 19s in Pakistan [3]. In Punjab about 200 million trees were planted mostly on irrigated land, of which Eucalyptus is 2.2%. Similarly in Khyber PakhtunKhwa (formerly known as NWFP) province 80 million trees were raised on farmlands, of which Eucalyptus was 2.7 % [4]; [5]. Among the introduced Eucalyptus species E. camaldulensis was the most wide spread species and adaptable under all agro-ecological zones. Eucalyptus plantations are effective in reducing groundwater level because of high rate of transpiration and evaporation [6]. Zahid et al., [7] concluded that Eucalyptus uses more water than native species Acacia, Albizzia and Azadirachta. Engel et al., [8] showed that E. camaldulensis utilized ground water (67% of its total water use) as well as water from upper vadose zone, which is the source

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of supply to ground water. The increased water use by Eucalyptus depletes ground water and may lead to desertification [9]. In contrary Joshi and Palanisami [10] studied the adverse impacts of growing Eucalyptus in Kolar district of Karnataka state in India. They showed that 20 years of continuous plantation of Eucalyptus in private and public lands deepened the water level in freshly dug bore wells to 260 m, as compared to the mean depth of water level in bore wells (177 m) in 21 villages of Kolar district. The distance between Eucalyptus plantation and freshly dug bore wells had negative correlation with the depth of water table. When wells were located within a distance of 1 Km from Eucalyptus plantations, the water in bore well was reduced by 35 to 42 percent during 3-5 years. The Social Forestry Project in Malakand district was also started in February, 1987 with the objectives that it will contribute to raise the standard of living in the project area by improving the productivity and use of the hill and marginal lands. Till June 2000 large-scale plantations of Eucalyptus camaldulensis were carried out in the Malakand-Dir region on an area of 22,071.29 hectares (54,497 acres) yielding over 14.723 million Eucalyptus trees in addition to other plant species [11].

Malakand district is now suffering from many environmental problems like low water table, micro climate change, soil erosion and dry springs. The key and worth-mentioning contributing factor to the above mentioned problems is Eucalyptus putting livelihood opportunities at grave stake as livelihoods of the people are primarily dependent on water and soil. The objective of the study was to investigate impacts of Eucalyptus plantation on ground and surface water.

2 MATERIALS AND METHODS

2.1 SITE DESCRIPTION

The study was conducted in district Malakand (34.50° N, 71.75° E) Pakistan. The soil of Malakand District is loamy and moist, and is irrigated by the river Swat. Total forest area of Khyber Pakhtunkhwa is 4650561 acres in which Malakand District is contributing 101181 acres in the form of Protected Forest, Communal, Private Plantation and Miscellaneous [12].

2.2 QUESTIONNAIRE SURVEY

Stratified random sampling technique was used to satisfy the results of the study. The whole universe was divided into two strata based on population, education, income, Eucalyptus plants abundance and distribution. From each stratum 25% random sampling was carried out to ensure the authenticity of the results. The questionnaire covered various aspects like impacts of Eucalyptus on the ground water, springs, post and pre scenario of the Eucalyptus, behavior of the people towards Eucalyptus, water table depth, tree distribution, and commercial value of trees in the study area [13].

2.3 DISCHARGE RATE MEASUREMENT

From each village three springs were selected randomly. The discharge rate of springs was measured by diverting the flow through a small opening and the time was noted using a stop watch to fill a container of known volume (300mL and 1L). For large springs, an ordinary tape was used to measure the average width and depth, and multiply this cross-sectional area by the current speed (Q = VA). To estimate the speed, a floating object was thrown into the spring and the time was noted to travel a known distance. Past discharge rate was predicted by taking the marks remained on rocks, an ordinary tape was used to measure the average width and depth, the speed of water was assumed according to the topography of the spring [14].

2.4 SPRINGS POSITION

Global Positioning System (GPS, Garmin with 12 channels) receiver was used to find out the exact position of the selected springs in the study area [15].

2.5 WATER TABLE MEASUREMENT

Water table was measured using an ordinary tape, reaching it down to the water level in wells.

3 RESULTS AND DISCUSSION

3.1 IMPACTS OF EUCALYPTUS ON THE GROUND WATER

The data showed that Eucalyptus has adverse impact on ground water it has lowered the water table by 0.762 m (0.833 yards) per year in the study area. The water table in village Totai has become deeper up to 20.116m (22 yards) while in village Kot the water table got deeper to 15.544m (17 yards). The water table was at depth of 4.572 m (5 yards) before Eucalyptus plantation in village kot but now because of the excessive uptake of water by Eucalyptus plantation the depth of water table has significantly increased to 20.116m (22 yards) (see Fig. 1). On the other hand in village Totai the depth of water table was 3.657m (4 yards) before Eucalyptus which has increased now to 23.774 m (26 yards). The worse water scarcity was observed in 2006-2007 in both villages when wells were dug up to 6.400 m (7 yards).

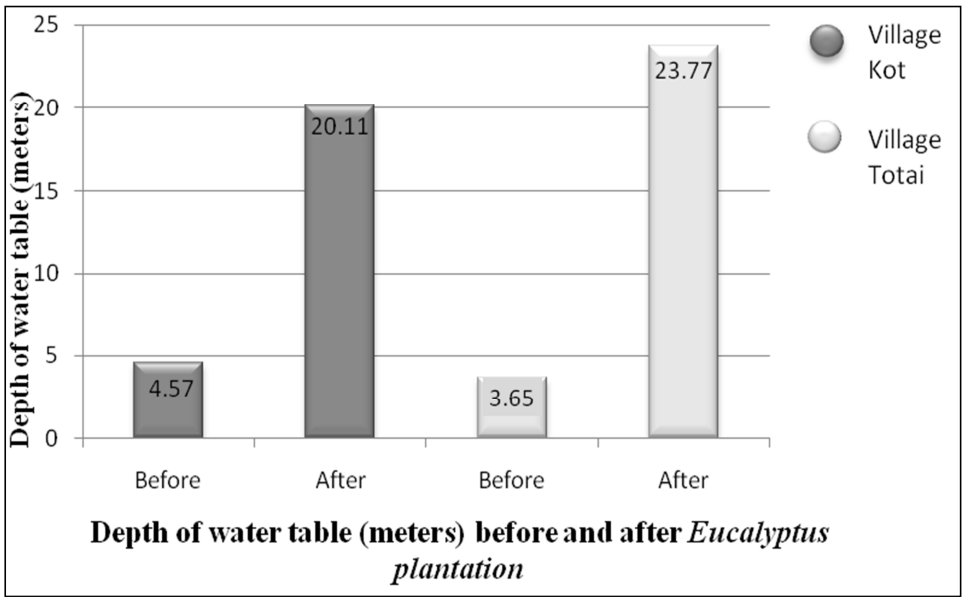

Figure.1 Depth of water table in meters before and after Eucalyptus plantation

Note: 1 yard= 0.9144m or 3ft

3.2 IMPACT OF EUCALYPTUS PLANTATION ON SPRINGS

The expansion of Eucalyptus plantations raises concern over their effect on local water resources [16]. Aforestation can also have the less desirable effect of reducing water yield of an area [17]: [18]. According to Rodríguez-suárez et al., [19] when a meadow pasture is changed to a forestry plantation of Eucalyptus. The annual maximum depth of the water table increased at 2- 2.5 mm/day, while at the same time the catchment discharge rates during summer decreased. The data revealed that 64% springs have been dried out so far in village Kot. There were 22 natural springs before Eucalyptus (as shown in fig. 2) which are reduced to 8 springs and many of them have become seasonal. On the other hand there is a 75% reduction in spring's numbers in village Totai. Before Eucalyptus plantation there were 40 natural springs which are reduced to 10.

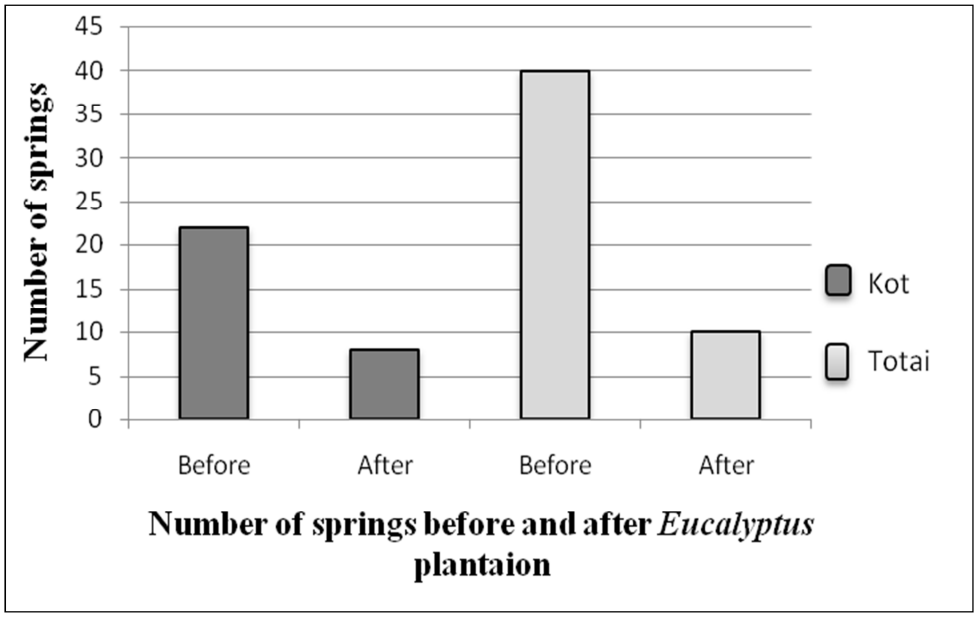

Figure. 2 Impact of Eucalyptus plantation on springs.

3.3 IMPACT OF EUCALYPTUS PLANTATION ON DISCHARGE RATE OF SPRINGS

Eucalyptus has a special root system consists of a shallow rooting system beneath the soil surface and deep tap roots that penetrate deep into the soil reaching the water table. The shallow roots are used to absorb surface soil moisture these extend horizontally to more than 3 to 5 meter. The tap roots can grow up to 9 meters into deeper soil layers to take up groundwater from aquifers. In dry period Eucalyptus shift their water uptake to the deep roots this makes them able to survive and even grow during dry periods [20]. Because of this root system Eucalyptus plantation has adversely affected the discharge rate of natural springs in both villages. Of the three selected springs in village Kot (Figure 3), the discharge rate of first spring has redused to 2.2L/s from 5L/s. The discharge rate of second spring was 1.5L/s which is completely dry now. While spring third has reduced to 0.5L/s from 2L/s. In village Kot 14 springs have been dried out so far and the number of dry springs is incresing at a very fast rate. Hassan and Khan [21] stated that Eucalyptus has caused 80% decreased in the discharge rate of springs in Udigram village Swat, Pakistan from 1995-2000.

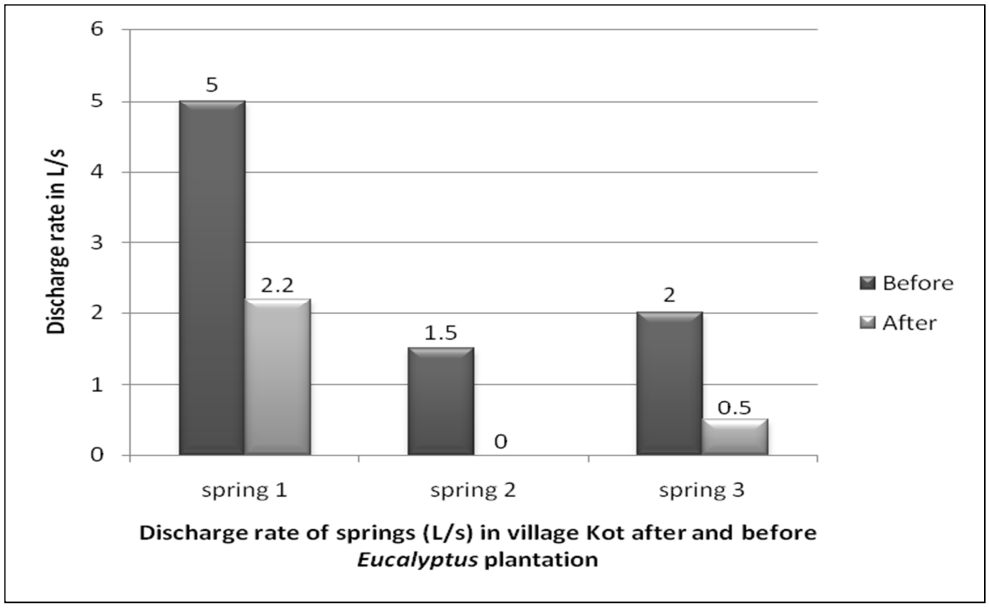

Figure.3 Discharge rate of springs (L/s) in village Kot.

Spring 1 GPS location (N 34o32.386, E 71o43.980)

Spring 2 GPS location (N 34o29.357, E 71o42.829)

Spring 3 GPS location (N 34o29.241, E 71o46.784)

In village Totai the impact of Eucalyptus plantation on springs is much more. The data showed that 30 springs have been dried out. Of the selected springs (as shown in fig.4), spring first has reduced from 3L/s to 0.3L/s while spring second and third with past discharge rate of 1L/s and 1.5L/s are completely dry now.

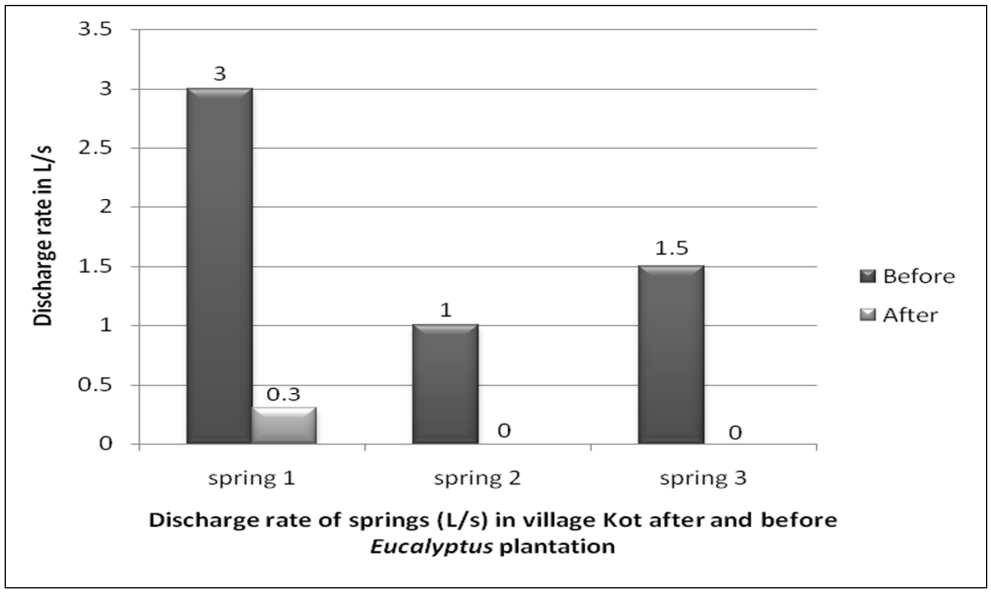

Figure.4 Impacts of Eucalyptus plantation on discharge rate of springs in villgae Totai.

Spring 1 GPS location (N 34o33.702, E 71o44.489)

Spring 2 GPS location (N 34o32.377, E 71o42.966)

Spring 3 GPS location (N 34o32.386, E 71o43.980)

4 CONCLUSION

The results indicate that introduction of Eucalyptus species plantation has adverse impacts on surface and ground water in district Malakand. Eucalyptus has been debated for decades because of its adverse impacts like soil erosion, dryness of springs, lowering water table, competition with crops, micro climate change, affect soil fertility, and consumption of much ground water associated with its high growth rate. Ground water and surface water resources should be monitored regularly to determine the conservation and regeneration of natural forests and better utilization and improvement of marginal and degraded lands. Moreover introduction of new plant species to an area should be made after scientific observation of climatic conditions of the area and keeping in mind the possible effects of these species on the environment. Caution need to be exercised while planning large scale transfer of lands into Eucalyptus plantation.

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Stock Market Indexes: A random walk test with ARCH (q) disturbances

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ABSTRACT: We will here study the stock market indexes, in the context of a random walk test with ARCH (q) disturbances. This model based on these theoretical predictions has been valuated from the Tunis Stock market data. The coherence of the parameters signs and the statistical relevance of the estimations are validating the choice of the conditionally heteroskedastic random walk model.

KEYWORDS: white noise, index, random walk, ARCH (or GARCH) model.

1 INTRODUCTION

We will, here, study the series of the stock market quotations. The choice of the topic is dictated by considerations originating, a priori, in the economic theory and the availability of the series of observations.

2 THE CONDITIONALLY HETEROSKEDASTIC RANDOM WALK MODEL

We will, here, achieve a random walk test. We will assume that the data-generating process is a random walk process, that is to say:

$$y_t = y_{t-1} + e_t$$

The disturbances e_t are checking the following hypotheses:

$$E[e_t] = 0$$

$$E[e_t e_{t-s}] = \begin{cases} \sigma^2 & \text{if} \quad s = 0 \\ 0 & \text{otherwise} \end{cases}$$

The first interpretation of the random walk hypothesis is dictated by the conditional expectation, that is to say:

$$E\left[y_t / y_{t-1} \right] = E\left[y_{t-1} + e_t / y_{t-1} \right]$$
$$= y_{t-1}$$

Then, the best prediction of the stock market quotations corresponds to its past value.

The choice of a random walk process means that in average, the change of quotation is zero.

This second interpretation is described in terms of the conditional expectation of the increases of the series:

$$E\left[y_t - y_{t-1} \middle/ y_{t-1} \right] = E\left[e_t \middle/ y_{t-1} \right]$$
$$= 0$$

We will achieve, as a first step, the conditionally heteroskedastic random walk test:

$$\begin{cases} y_t = y_{t-1} + e_t \\ e_t^2 = c_0 + \sum_{i=1}^{q} c_i e_{t-i}^2 + \omega_t \end{cases}$$

$$\text{Then, as, } y_t^* = y_t - y_{t-1}$$
$$= e_t :$$

We will, here, study the data-generating process as a conditionally heteroskedastic white noise model:

$$\begin{cases} y_t^* = e_t \\ e_t^2 = c_0 + \sum_{i=1}^{q} c_i e_{t-i}^2 + \omega_t \end{cases}$$

We will, here, achieve the white noise test in the series studied:

$$y_t^* = y_t - y_{t-1}$$
$$= e_t$$

$$\text{Then, } E\left[y_t^* \right] = E\left[e_t \right]$$
$$= 0$$
$$E\left[y_t^* y_{t-s}^* \right] = E\left[e_t e_{t-s} \right]$$
$$= \gamma(s)$$

$$\gamma(s) = E\left[y_t^* y_{t-s}^* \right]$$
$$= \begin{cases} \gamma(0) & \text{if } s = 0 \\ 0 & \text{otherwise} \end{cases} .$$

Then:

$$\rho_s = \frac{\gamma(s)}{\gamma(0)}$$
$$= \begin{cases} 1 & \text{if } s = 0 \\ 0 & \text{otherwise} \end{cases} .$$

y_t^* Is a white noise if $\rho_s = 0$, $s = 1,2,...$

Then, we will achieve a white noise test in the series y_t^* :

$$H_0^i : \rho_i = 0$$
$$H_a^i : \rho_i \neq 0$$

$i = 1,2,...$

Under $H_0^i : \rho_i = 0$, the data-generating process is a white noise.

This propriety of the process studied enables as to get interested to the future values of the stock market indexes series:

$$E\left[y_{t+1} \middle/ y_t \right] = y_t$$

As the matter of fact, the prediction to the time t of the process studied corresponds to the current value.

The statistics associated to this test are then:

$$t_{\hat{\rho}_i} = \frac{\hat{\rho}_i - \rho_i}{\hat{\sigma}(\hat{\rho}_i)}$$
$$= T^{1/2}[\hat{\rho}_i - \rho_i]$$

Under $H_0^i : \rho_i = 0$, $T^{1/2}\hat{\rho}_i \approx N(0,1)$

$$\hat{\rho}_i = \frac{\hat{\gamma}(i)}{\hat{\gamma}(0)}$$

$$\hat{\gamma}(i) = \frac{1}{T-i}\sum_t \hat{e}_t \hat{e}_{t-i} .$$

We will reject $H_0^i : \rho_i = 0$ if $\left| t_{\hat{\rho}_i} \right| > t_{\alpha/2}$.

If $\alpha = 0{,}05$, $t_{\alpha/2} = 1{,}96$.

The hypothesis $H_0^i : \rho_i = 0$ validates the white noise hypothesis.

We will, here, achieve a second white noise test:

$$H_0 : \rho_1 = \ldots = \rho_s = 0$$
$$H_a = H_0^c$$

The alternative hypothesis indicates the complementary of H_0.

The statistic associated to this test is then:

$$Q = T\sum_{i=1}^{s} \hat{\rho}_i^2 .$$

Under $H_0 : \rho_1 = \ldots = \rho_s = 0$, $Q \approx \chi_\alpha^2(s)$.

We will determine the value of the Ljung –Box statistic, Q^* :

$$Q^* = T(T+2)\sum_{i=1}^{s} \frac{1}{T-i}\hat{\rho}_i^2 \quad .$$

Q^* is following a Khi –square distribution with s degrees of freedom.

3 PROPRIETIES OF THE SERIES STUDIED-TESTS

3.1 PROPRIETIES OF THE SERIES STUDIED

The series of the stock market quotations is subject to an instantaneous variability.

We will study the series available, p_t, over the period, [1997, 2008].

The data constitute the daily frequencies.

i. Inference statistics

We will, at a first step, determine the moments of order one and two, the minimum and the maximum, the of skewness (s) and kurtosis (k) parameters …:

	p_t	y_t
m	1146,25	0,0005
Median	1031,85	0,0002
Minimum	449,64	-0,05
Maximum	2346,11	0,04
σ	473,10	0,0077
s	0,64	0,08
k	2,64	6,24
N	2742	2742

We will study, as a second step, in terms of rate increase, the stock market series:

$$p_t^* = Log\left(\frac{p_t}{p_{t-1}}\right).$$

We will compare the skewness (s) and the kurtosis (k) coefficients to the parameters values associated to a gaussian process: $s = 0$ and $k = 3$.

The values of these coefficients, corresponding to $s = 0{,}08$ and $k = 6{,}24$, do not belong to the reference values of a gaussian process.

As a matter of fact, the series of the stock market quotations is not following a normal distribution.

The value of kurtosis, which is quite high, expresses the leptokurtic aspect of the series studied.

The coefficient s does not belong to the proximity of zero. This hypothesis is significant of non-linearity.

ii. The graphic study:

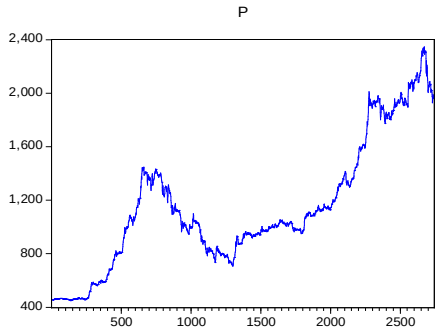
The series of the stock market quotations, p_t is not, a priori, stationary (Graph a).

In the other hand, the series p_t^* is stationary (Graph b).

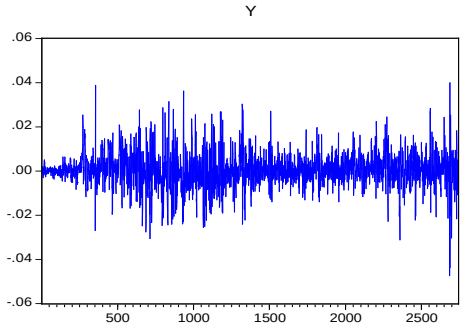
The graphic representation of this series is expressing the regroupings of volatility:

The values of this series, with unpredictable signs are followed by values with the same signs.

The variability of the series persists in time. These predictions are validating, a priori, of an ARCH model hypothesis, representative of a data-generating process.



Graph a



Graph b

3.2 TESTS

We will, here, achieve a whole range of tests: a stationarity test, a normality test,

i. Stationarity test

	ADF	$\boldsymbol{p-p}$
$\boldsymbol{p_t}$	$\boldsymbol{I(1)}$	$\boldsymbol{I(1)}$
p_t^*	$\boldsymbol{I(0)}$	$\boldsymbol{I(0)}$

The series of the stock market quotations p_t is not stationary.

The series p_t^* is stationary. Then, the series p_t is $I(1)$.

ii. Normality test

Test 1 : Jarque –Béra test:

We will, here, achieve the test: $H_0 : \begin{cases} s = 0 \\ k-3 = 0 \end{cases}$

$H_a = H_0^c$.

The statistics associated to this test are then:

$$J-B = \frac{T}{6}\left[s^2 + \frac{1}{4}(k-3)^2 \right].$$

Under $H_0 : \begin{cases} s = 0 \\ k-3 = 0 \end{cases}$ $: JB \approx \chi_\alpha^2(2)$.

$\boldsymbol{s}$ and $\boldsymbol{k}$ indicate the skewness and the kurtosis coefficients.

	Statistics of the test	$\boldsymbol{p}$
p_t^*	**1197,01**	**0,000000**

As $p \leq 0{,}05$, we will, here, reject:

$$H_0 : \begin{cases} s = k - 3 \\ = 0 \end{cases}$$

The series y_t is not following a normal distribution.

Test 2 : Granger –Newbold test

We will, afterwards, achieve the normality test of Granger –Newbold.

We will determine the autocorrelation coefficients of order j, ρ_j :

j	$\rho_j(y_t)$	$\rho_j(y_t^2)$	$\frac{\rho_j^2(y_t)}{\rho_j(y_t^2)}$
1	**0,313**	**0,494**	**0,2**
2	**0,111**	**0,340**	**0,04**
3	**– 0,041**	**0,215**	**0,0080**
4	**– 0,024**	**0,199**	**0,0028**
⋮	⋮	⋮	⋮
23	**– 0,015**	**0,024**	**0,01**
24	**0,031**	**0,034**	**0,0282**

The ratio between $\rho_j^2(y_t)$ and $\rho_j(y_t^2)$ does not belong to the proximity of one the series studied is not following a normal distribution. It is constitutes the general characteristic of the financial series.

It is agreed to underline that: $y_t = p_t^*$

4 ESTIMATION

In the choice of model, we realize a whole class of tests**.**

4.1 TESTS ON THE MODEL

$$y_t = b_0 + e_t$$

i. White noise test

We will, here, achieve, on the series $\hat{e}_t^2$, the test:

$$H_0 : \rho_i = 0 \qquad (\text{or } H_0 : \rho_1 = \ldots = \rho_s = 0)$$
$$H_a = H_0^c \qquad .$$

We will reject, $H_0 : \rho_1 = 0$ (and $H_0 : \rho_1 = \rho_2 = 0$). Then, $\hat{e}_t^2$ is, a priori, following a second order autoregressive process: The disturbances e_t are following an ARCH (2) (or GARCH (1, 1)) model.

ii. Test

$H_0 : c_1 = ... = c_q = 0$

$Ha = H_0^c$

We will achieve, in the context of this hypothesis, the regression of de $\hat{e}_t^2$ on the values $\hat{e}_{t-i}^2$:

$\hat{e}_t^2 = c_0 + \sum_{i=1}^{q} c_i \hat{e}_{t-i}^2 + \omega_t$.

$ARCH(q)$	c_0	c_1	c_2	F	NR^2
$ARCH(1)$	$3{,}05\times10^{-5}$ $(12{,}30)$	$0{,}48$ $(29{,}25)$		$255{,}56$	$652{,}34$
$ARCH(2)$	$2{,}62\times10^{-5}$ $(10{,}38)$	$0{,}42$ $(22{,}15)$	$0{,}14$ $(7{,}44)$	$463{,}71$	$693{,}40$

The numbers in brackets are the t of Student.

	$\overline{R}^2$	$LogL$	AIC	SIC	HQC	DW
$ARCH(1)$	$0{,}24$	$20872{,}52$	$-15{,}24$	$-15{,}22$	$-15{,}24$	$2{,}14$
$ARCH(2)$	$0{,}25$	$20891{,}86$	$-15{,}25$	$-15{,}25$	$-15{,}25$	$2{,}00$

The values of $LogL$ and $\overline{R}^2$ and the information criteria validate the hypothesis of an $ARCH(2)$ model.

We will, then, achieve the test:

$H_0 : c_2 = 0$

$H_a : c_2 \neq 0$

We will, here, determine SCR_i :

$SCR_0 = 3{,}88\times10^{-5}$

$SCR_a = 3{,}80\times10^{-5}$.

The statistics associated to this test is then:

$$F = \frac{(SCR_0 - SCR_a)/1}{SCR_a/(N-3)} .$$

This statistics is following a Fisher distribution with 1 and $N-3$ degrees of freedom.

$$F = \frac{(3{,}88-3{,}80)\times10^5}{3{,}80\times10^{-5}}(N-3)$$

$$= 57{,}66$$

$F > F_\alpha(1, N-3)$: We will reject $H_0 : c_2 = 0$.

The test validates an $ARCH(2)$ process.

At the first time, the choice of model validates the following estimations:

$\hat{b}_0$	$t_{\hat{b}_0}$	p
0,000534	**3,62**	**0,0003**

$SCR = 0{,}163294$.

$LogL(y, b_0, \sigma^2) = 9443{,}30$

$DW = 1{,}37$

$AIC = -6{,}8896$

$SIC = -6{,}8875$

$HQC = -6{,}8888$

Nous réalisons le test :

$H_0 : b_0 = 0$

$H_a : b_0 \neq 0$

Under $H_0 : b_0 = 0$, $t_{\hat{b}_0} = \dfrac{\hat{b}_0}{\hat{\sigma}(\hat{b}_0)} = 3{,}62$

as $p < 0{,}05$, we reject $H_0 : b_0 = 0$.

Dans un second temps, nous réalisons le test d'un processus $ARCH(q)$:

$$\begin{cases} y_t = b_0 + e_t \\ \hat{e}_t^2 = c_0 + c_1 \hat{e}_{t-1}^2 + \omega_t \end{cases}$$

		p
$\hat{b}_0$	**0,000184** **(1,62)**	**0,1034**
c_0	$2{,}5 \times 10^{-5}$ **(36,14)**	**0,0000**
c_1	**0,62** **(15,90)**	**0,0000**

The parameter b_0 is not significantly different from zero.

4.2 RANDOM WALK WITH DISTURBANCES GARCH(P, Q)-TESTS

We will study the statistical pertinence of estimations of the two classes of models:

i- Random walk model with disturbances GARCH (p, q),

ii- Random walk model with disturbances TGARCH (p, q).

The estimations of these models are the following:

ARCH (1) model:

$$\begin{cases} y_t = y_{t-1} + e_t \\ \hat{e}_t^2 = c_0 + c_1 \hat{e}_{t-1}^2 + \omega_t \end{cases}$$

$$\hat{e}_t^2 = 4{,}8\times 10^{-5} + 0{,}44\hat{e}_{t-1}^2$$
$$(52{,}10) \qquad (15{,}60)$$

ARCH (2) model:

$$- \begin{cases} y_t = y_{t-1} + e_t \\ \hat{e}_t^2 = c_0 + c_1 \hat{e}_{t-1}^2 + c_2 \hat{e}_{t-2}^2 + \omega_t \end{cases}$$

$$\hat{e}_t^2 = 3{,}8\times 10^{-5} + 0{,}41\hat{e}_{t-1}^2 + 0{,}20\hat{e}_{t-2}^2$$
$$(38{,}85) \qquad (14{,}45) \quad (10{,}84)$$

ARCH (6) model:

$$- \begin{cases} y_t = y_{t-1} + e_t \\ \hat{e}_t^2 = c_0 + \sum_{i=1}^{6} c_i \hat{e}_{t-i}^2 + \omega_t \end{cases}$$

	$\hat{c}_i$	$t_{\hat{c}_i}$
c_0	$\mathbf{1{,}8\times 10^{-5}}$	20,84
c_1	0,41	14,52
c_2	0,20	11,11
c_3	0,08	8,10
c_4	0,14	8,12
c_5	0,10	6,48
c_6	0,04	4,84

GARCH (p, q) model:

$$- \begin{cases} y_t = y_{t-1} + e_t \\ \hat{e}_t^2 = c_0 + c_1 \hat{e}_{t-1}^2 + a_1 h_{t-1} + \omega_t \end{cases}$$

c_0	c_1	a_1

$GARCH(1,1)$	$3{,}4\times10^{-6}$ $(11{,}72)$	$0{,}28$ $(19{,}72)$	$0{,}72$ $(61{,}82)$

TGARCH (p, q) model:

	c_0	c_1^+	c_1^-	c_2
$TARCH(1,1)$	$4{,}8\times10^{-5}$ $(51{,}32)$	$0{,}26$ $(6{,}76)$	$0{,}35$ $(5{,}42)$	
$TGARCH(1,1)$	$3{,}4\times10^{-6}$ $(11{,}30)$	$0{,}25$ $(10{,}45)$	$0{,}06$ $(2{,}12)$	$0{,}72$ $(57{,}56)$

The numbers in brackets are the t of Student.

The criterion of the maximum of likelihood and information leads us to the choice of a random walk model with disturbances ARCH (or TARCH). These criteria are determining bay the following values:

	$LogL(y,c,\sigma^2)$	AIC	SIC	HQC
$ARCH(1)$	$9264{,}60$	$-6{,}7602$	$-6{,}7538$	$-6{,}7580$
$ARCH(2)$	$9305{,}62$	$-6{,}7895$	$-6{,}7808$	$-6{,}7864$
$ARCH(6)$	$9417{,}97$	$-6{,}8715$	$-6{,}8628$	$-6{,}8684$
$TARCH(1)$	$9273{,}90$	$-6{,}7664$	$-6{,}7577$	$-6{,}7632$
$TGARCH(1,1)$	$9419{,}6$	$-6{,}8717$	$-6{,}8608$	$-6{,}8678$
$GARCH(1,1)$	$9417{,}97$	$-6{,}8715$	$-6{,}8628$	$-6{,}8684$
ARCH-M	9930,98	-7,2425	-7,2318	-7,2387

The series of stock market quotations is following a random walk process.

It is a random walk model with disturbances ARCH (or TARCH).

$ARCH(2)$	$ARCH(6)$	$GARCH(1,1)$	$TARCH(1,1)$	$TGARCH(1,1)$

c_0	$3{,}8\times10^{-5}$ $(38{,}85)$	$1{,}8\times10^{-5}$ $(20{,}84)$	$3{,}4\times10^{-6}$ $(11{,}72)$	$4{,}8\times10^{-5}$ $(51{,}32)$	$3{,}4\times10^{-6}$ $(11{,}30)$
c_1	0,41 $(14{,}45)$	0,41 $(14{,}52)$	0,28 $(19{,}72)$		
c_2	0,20 $(10{,}85)$	0,20 $(11{,}11)$			
c_3		0,08 $(8{,}10)$			
c_4		0,14 $(8{,}12)$			
c_5		0,10 $(6{,}48)$			
c_6		0,04 $(4{,}84)$			
c_1^+				0,27 $(6{,}76)$	0,25 $(10{,}45)$
c_1^-				0,35 $(5{,}42)$	0,06 $(2{,}12)$
a_1			0,72 $(61{,}82)$		0,72 $(57{,}56)$

The value of the likelihood function and the information criteria validate the random walk hypothesis with disturbances $TGARCH(1,1)$.

5 CONCLUSION

The proprieties of the series studied are conditioning the inference methods:

- The series of stock market quotations, as any financial series, is subject to an instantaneous variability. The regrouping of volatility is described by the values of the series with unpredictable signs, which are followed by values with the same signs.
- The skewness (s) and the kurtosis (k) coefficients do not validate the hypothesis of a Gaussian process.
- In the tests on the residues, we will accept the hypothesis of an autoregressive conditionally heteroskedastic process.
- The choice of the ARCH model is dictated by the proprieties of the series studied.

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Eucalyptus in Social Forestry and Sustainable Development-District Malakand Pakistan

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ABSTRACT: The study was aimed to document the suitability of *Eucalyptus* for Malakand (34.50° N, 71.75° E) social forestry project. The project was started in February 1987 with the aim to improve life style of villagers by improving the yield and use of the hillsides, and marginal lands. The methodology used was questionnaire survey; point count and line transect method. It was found that the project has not yet achieved its objectives and caused economical, ecological, and social problems in the project area. The revenue generated from *Eucalyptus* plantation remains in few hands of the community. It was found out that project is not socially acceptable, ecologically viable and economically feasible. The poor are suffering more as they are more dependent on the natural resources that are water and soil. The results showed that wheat production has been reduced from 1350 to 1100 kg per hectare. The results indicated that birds prefer native species (*Ziziphus mauritiana* 26% and *Acacia nilotica* 14.6%) over *Eucalyptus* (2.6%) for nesting. As a result *Eucalyptus* supports less bird's diversity as compared with native species. Many species of birds, cattle and other wild animals are suffering because of their dependency on water and soil. Government has to look for sustainable and environment friendly alternatives. Moreover introduction of new plant species to an area should be made after careful examination of hydrological and geological conditions of the area by keeping in mind the possible impacts on environment.

KEYWORDS: Social forestry; Revenue; *Eucalyptus*; Malakand; Bird diversity; Sustainable development.

1 INTRODUCTION

In Pakistan forests and planted trees cover an area of about 4.2 million hectares which is equivalent to 4.8 percent of the total land area [1] and it is decreasing due to a number of threats including continuous cutting of forest tress and commercial overexploitations. The forest cover is unable to meet the growing demand for wood and wood-based products in Pakistan which is the seventh most populous country in the world and the fourth in Asia with an annual population growth rate of 2.1% [2]. To meet the wood consumption demands of increasing population, to increase the forest cover and to support the wood dependent industries, 40 species of *Eucalyptus* were introduce in the late 19s in Pakistan [3]. In Punjab about 200 million trees were planted mostly on irrigated land, of which *Eucalyptus* is 2.2%. Similarly in Khyber PakhtunKhwa (formerly known as NWFP) province 80 million trees were raised on farmlands, of which *Eucalyptus* was 2.7 % [4], [5]. Among the introduced *Eucalyptus* species *E. camaldulensis* was the most wide spread species and adaptable under all agro-ecological zones. The Social Forestry Project in Malakand district was started in February, 1987 with the objective that it will contribute to raise the standard of living in the project area by improving the productivity and use of the hill and marginal lands. The project was sponsored by the Government of the Royal Kingdom of Netherland along with the government of Islamic Republic of Pakistan. Till June 2000 large-scale plantations of *Eucalyptus camaldulensis* were carried out in the Malakand-Dir region on an area of 22,071.29 hectares (54,497 acres) yielding over 14.723 million *Eucalyptus* trees in addition to other plant species [6]. Malakand district is now suffering from many environmental problems like low water table, micro climate change, soil erosion, fauna and flora loss and dry springs. The key and worth-mentioning contributing factor to the above mentioned problems is *Eucalyptus* putting livelihood opportunities at grave stake as livelihoods of the people are primarily

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dependent on water and soil. The objective of the study was to document suitability of *Eucalyptus* for Malakand social forestry project.

2 MATERIALS AND METHODS

2.1 SITE DESCRIPTION

The study was conducted in district Malakand (34.50° N, 71.75° E) Pakistan. The soil of Malakand District is loamy and moist, and is irrigated by the Swat River. Total forest area of Khyber Pakhtunkhwa is 4650561 acres in which Malakand District is contributing 101181 acres in the form of Protected Forest, Communal, Private Plantation and Miscellaneous [7].

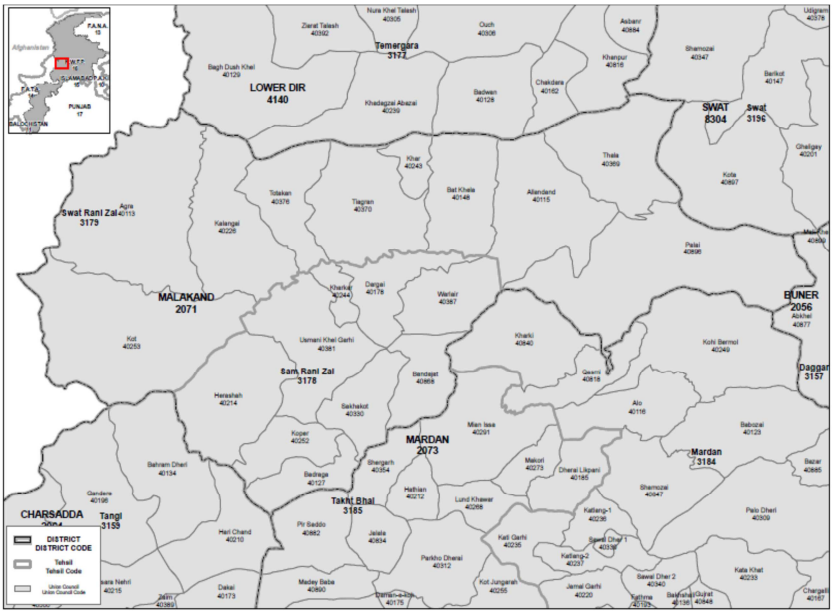

Fig. 1. Map of district Malakand [18]

2.2 QUESTIONNAIRE SURVEY

Stratified random sampling technique was used to satisfy the results of the study. The whole universe was divided into two strata based on population, income, *Eucalyptus* plants abundance and distribution. From each stratum 25% random sampling was carried out to ensure the authenticity of the results. The questionnaire covered various aspects like post and pre scenario of the *Eucalyptus*, behavior of the people towards *Eucalyptus*, people and their dependency, tree distribution, impacts on crop production and commercial value of trees in the study area [8].

2.3 BIRD'S NEST COUNTING

From each village hundred trees of *Eucalyptus*, *Ziziphus mauritiana* and *Acacia nilotica* were observed randomly in triplicate for nest counting by point count method [9].

2.4 BIRD'S DIVERSITY

A line transect of one kilometer was selected in triplicate. Line transect was accomplished by two parallel 500 meter long lines spaced at least 300 meters apart. The speed of travel was relative to the rate of bird movement to prevent individual birds from being counted more than once but not so fast as to pass a bird before it calls or sings 0.5 to 1.0 kilometer/hour [17].

2.5 GLOBAL POSITIONING SYSTEM

Global Positioning System (GPS, Garmin with 12 channels) receiver was used to find out the exact position length of the selected transect lines in the study area [10].

3 RESULTS AND DISCUSSION

3.1 WILLINGNESS TO PLANT *EUCALYPTUS*

It was find out that 85% of the respondents were not willing to plant *Eucalyptus* tree on the mountains while 10% of the residents have agreed with the plantation of the trees and 5% have shown no response in this regard. Similar results were founded by Hassan and Khan [11] 80% of the respondents were not agreeable to plant *Eucalyptus* tree on the mountains while 15% of the people were agreed to plant *Eucalyptus* trees.

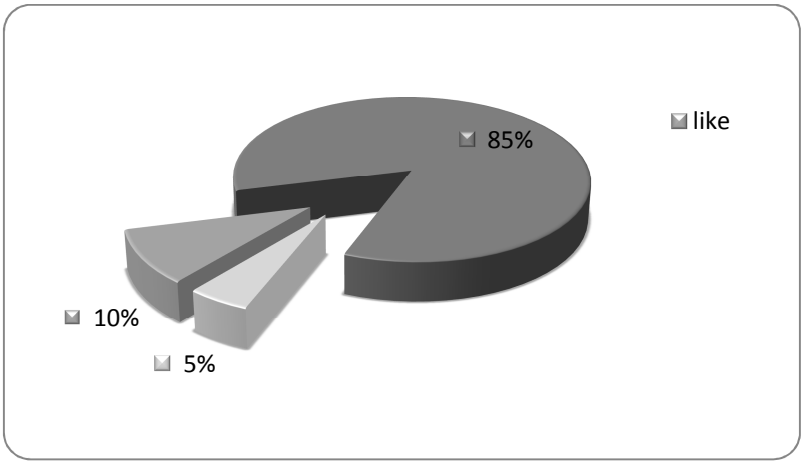

Fig. 2. Behavior of the people towards Eucalyptus plantation

3.2 *EUCALYPTUS* AS FUEL WOOD

The data indicated that 88% of the villagers are using farm wood and wild bushes as fuel wood followed by liquefied petroleum gas (LPG) 8% and animal dung 3%. One of the major species is *Dodonaea viscose* which is used as a fuel wood. Only 1% people are using *Eucalyptus* as fuel wood. These *Eucalyptus* trees are those which are cultivated by the villagers on their own personal land as no one is allowed to cut down *Eucalyptus* trees which are under social forestry project. In other words *Eucalyptus* trees are not used by the villagers as fuel wood.

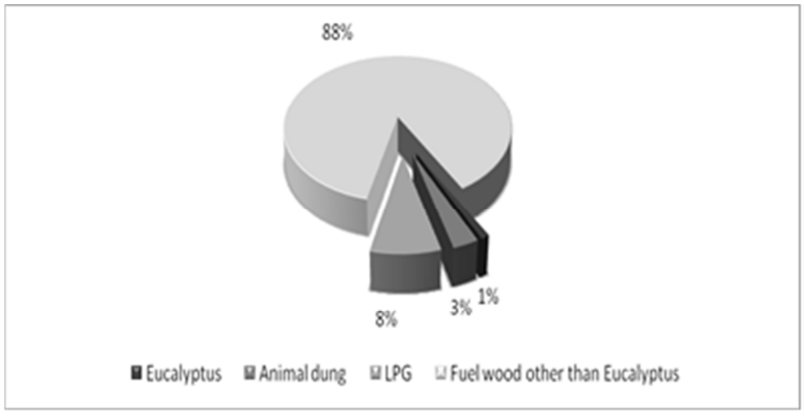

Fig. 3. Eucalyptus as Fuel wood

3.3 IMPACT ON AGRICULTURE PRODUCTION

Eucalyptus plantation also has impacts on the floral and faunal diversity of an area. *Eucalyptus* has allelochemicals and volatile compounds. These chemicals have harmful effects on the crops in the ecosystem resulting in the reduction and delaying of germination, mortality of seedling and reduction in growth and yield [12]. *Eucalyptus* competes vigorously with ground vegetation and with neighboring crops in situations where water is in short supply [13]. Similarly Blake [14] reported the inhibitory effect of *Eucalyptus* on the growth of its associated species by reducing their germination, photosynthesis and yield. According to the villagers water was in surplus for irrigation and domestic use before the *Eucalyptus* plantation. The results showed that wheat production has been reduced from 1350 to 1100 kg per hectare. The main stream in village Kot which was the main source of water for irrigation is no longer providing enough water for irrigation. People are going out of options they do not have adequate water to irrigate their fields. The cattle are also suffering as they are dependent on spring's water. Our previous study indicated that 64% springs have been dried out so far in village Kot and 75% in village Totai and many have become seasonal [15].

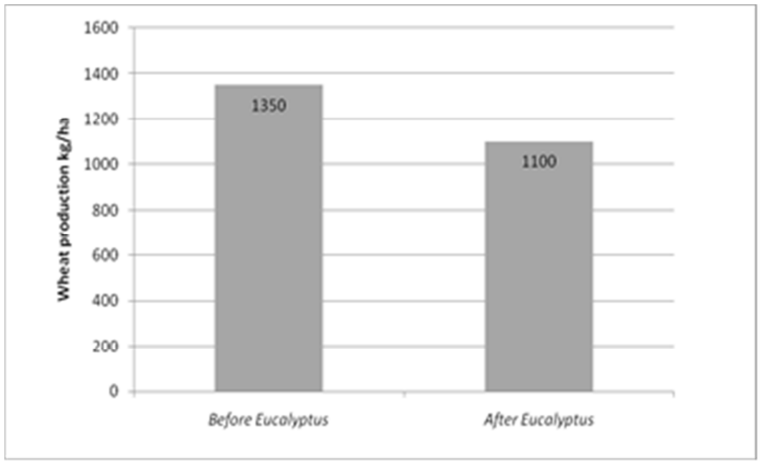

Fig. 4. Wheat production in kg/hectare

3.4 *EUCALYPTUS* AND BIRD NESTING

Eucalyptus plantation held the lowest abundance for most groups of arthropods and has negative impact on the ground arthropods [16]. *Eucalyptus* tree has smooth and flat bark; its branches are elastic and not dense like native species (*Ziziphus mauritiana, Acacia nilotica* and *Dalbergia sissoo*) etc to provide support for nesting and protection against predators. The results indicated that 26% birds preferred *Ziziphus mauritiana* over *Eucalyptus* trees for nesting. *Acacia nilotica* is preferred 14.6% by birds as compared to *Eucalyptus* 2.6 % for nesting. Birds that chose *Eucalyptus* trees for nesting are those whose nest size is 5 to 8 times larger than the bird size. Only house sparrow's (*Passer domesticus*) nests were observed in the study area, which were also vulnerable to wind storm. Large scale of monoculture plantation of *Eucalyptus* is fatal for the local fauna. Further research is needed to monitor the population of birds in the project area.

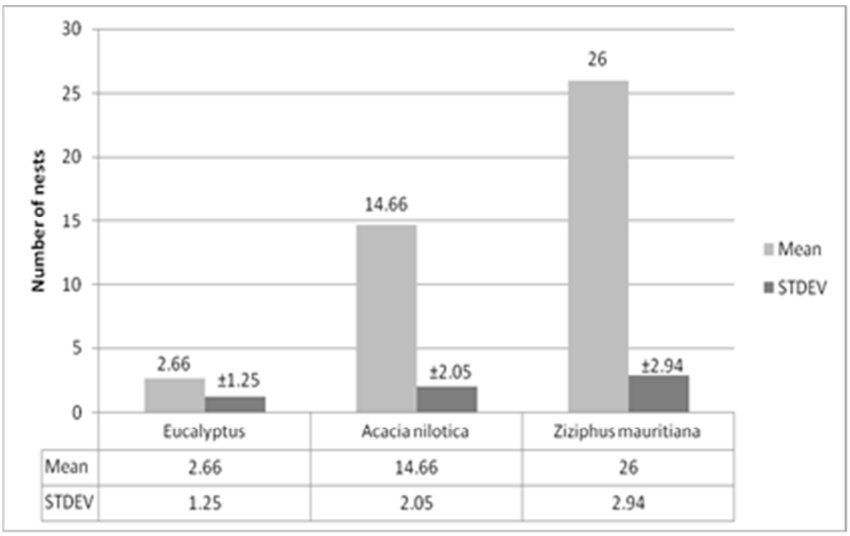

Fig. 5. Behavior of birds towards Eucalyptus for nesting

3.5 BIRD'S DIVERSITY

The results indicated that *Eucalyptus* monoculture forest has less bird diversity as compared to mixed native forest. Only three species (*Passer domesticus, Pericrocotus ethologus* and *Corvus splendens*) were found in *Eucalyptus* forest. On the other hand eleven species were found in mixed native forest. The species found were *Prinia criniger, Turdoides caudatus, Prunella atrogularis, Phylloscopus inornatus, Emberiza cia, Pycnonotus cafer, Anthus sylvanus, Pycnonotus leucogenys, Seicercus xanthoschistos, Pericrocotus ethologus* and *Corvus splendens*. The mixed forest was mainly composed of *Ziziphus mauritiana, Acacia nilotica, Dodonaea viscose, Olea ferruginea, Acacia modesta, Morus nigra, Morus alba* and *Dalbergia sissoo.*

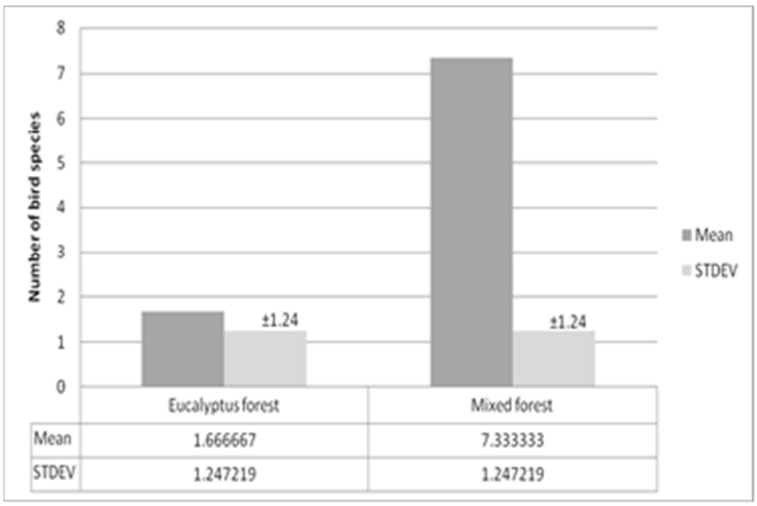

Fig. 6. Bird's diversity in Eucalyptus and mixed native forest

Table 1. Bird's diversity in Eucalyptus and mixed native forest

Forest type	Species
***Eucalyptus* monoculture**	*Passer domesticus, Pericrocotus ethologus, Corvus splendens*
Mixed forest	*Prinia criniger, Turdoides caudatus,* *Prunella atrogularis, Phylloscopus inornatus, Emberiza cia, Pycnonotus cafer,* *Anthus sylvanus, Pycnonotus leucogenys, Seicercus xanthoschistos,* *Pericrocotus ethologus, Corvus splendens.*

3.6 SOCIAL IMPACTS

Eucalyptus plantation not only has impacts on flora and fauna but also has social impacts in the project area. The mountains are owned by different villages and then by different tribes (Kota khel, Utman khel, Toghal khel, Sandi khel, Stana dar, shahanian etc). The boundaries of the mountains are not obvious that's why they often fight with each other. According to the local police station they register one FIR (first information report) per month on disputes regarding *Eucalyptus* plantation. A farmer from village Totai said that *Eucalyptus* is a social evil. The other social problem that has caused by the *Eucalyptus* is the water scarcity for irrigation. The main stream in village Kot is no longer flowing and contains a few patches of water as a result limiting the amount of water for irrigation. Our previous study indicated that *Eucalyptus* has deepened the water table by 0.762m (0.833 yards) per year in study area [15].

3.7 REVENUE FROM *EUCALYPTUS*

The mountains are owned by the villagers and distributed among different tribes. The revenue generated from *Eucalyptus* plantation is supposed to be distributed among the villagers but the data showed that 100% of the people have not got any in the form of money from *Eucalyptus* plantation so far. The revenue generated from plantation remains in the hands of few, although *Eucalyptus* trees are consuming the common resources.

4 CONCLUSION

Nature has maintained a balance on the planet earth between the living and non living environment. Species are adapted to their habitats and habitats are adapted to them. Because of the limited knowledge about the earth processes and balance we humans often make mistakes that is importing and exporting exotic species.

Eucalyptus has been debated for decades because of its adverse impacts like soil erosion, dryness of springs, lowering water table, competition with crops, micro climate change, affect soil fertility, and consumption of much ground water associated with its high growth rate.

The results indicate that the social forestry project was not based on sustainable development and has not achieved the desired objectives. *Eucalyptus* plantation has adverse economical, ecological, and social impacts. Ground water resources, surface water resources, flora and fauna should be monitored regularly to determine the protection and regeneration of natural forests and better utilization and improvement of marginal and degraded lands. Moreover introduction of new plant species to an area should be made after careful observation of climatic conditions of the area and keeping in mind the probable effects of these species on environment.

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Metallurgical study of cast aluminium alloy used in hydraulic brake calliper

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ABSTRACT: Reports of many functional deficiencies are these days rampant in many aluminium products flooding the Nigeria markets. These emanate from the local aluminium manufacturing, cottage foundry industries and much more from goods imported in the country. The study investigates the metallurgical properties of as-received and cast aluminium alloy samples used in the floating piston/calliper of the automobile hydraulic master brake cylinder. Commercially available aluminium alloy is procured from which callipers were cast and characterised. The study compares the physical properties by Hardness test, microstructural properties using high resolution metallurgical microscope, X-Ray Diffraction, chemical composition using Atomic Absorption Spectrophotometry. The as-received samples are characterised by poor metallurgical qualities such as variation in weight and density, low HBN, low tensile strength, high porosity and sand inclusions from the previous poor casting practices, hence abnormalities result under usage. The aluminium alloy was technically cast at pouring temperature higher than 750 ^{o}C using sand mould of high permeability. The casting gave higher HBN values of eutectic-AlSi structured aluminium alloy. The tensile strength calculated as approximate relationship between the hardness and the tensile strength, gave lower 329.09 Mpa and 154.78 Mpa strength for as-received samples as compared with the cast alloy having 353.58 Mpa and 226.49 Mpa tensile strength values respectively.

KEYWORDS: cast aluminium alloy, x-ray diffraction, microstructure, characterization, atomic absorption spectrophotometry.

1 INTRODUCTION

The metals sector in Nigeria is still struggling to reach its full potential particularly in the development and consumption of key metallic products as Iron, Steel, Copper, Aluminium, Tin, Lead, Zinc etc. and in exploitation of key noble metals such as gold and silver [1]. It is very unfortunate that Nigeria exports many of her resourceful minerals and metal scrap only to import the finish products from other countries. The aftermath is that Nigeria market is flooded with many substandard products among which the automotive and automobile industries (Figure 1). The use of aluminium is very prominent in the automotive and automobile industries [2]. Aluminium alloy spare parts are easily produced or imported even at lower cost than steel or any other metals which in many instances do not match many international standard practices and specifications [3, 4].

Good engineering material design and standard manufacturing practices play vital role in the proper component selection for engineering application [5]. Aluminium and its alloys are part of the major engineering materials that are indispensable for now being prominent for its light weight and corrosion resistance among other properties. For its wide areas of applications, aluminium and its alloy attract different areas of research focuses. The need for improved properties to prevent failure most especially during service is of great priority. It is observed that commercially pure aluminium contains a minimum of 99 percent aluminium and is a soft and ductile metal used for many applications where high strength is not necessary while aluminium alloys on the other hand, possess better casting and machining characteristics and better mechanical properties than the pure metal.

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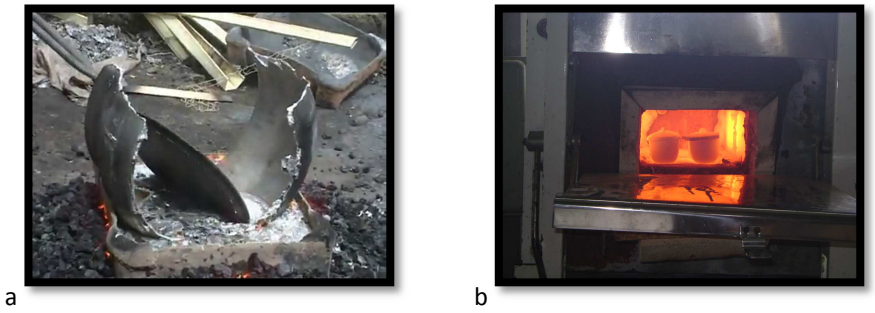


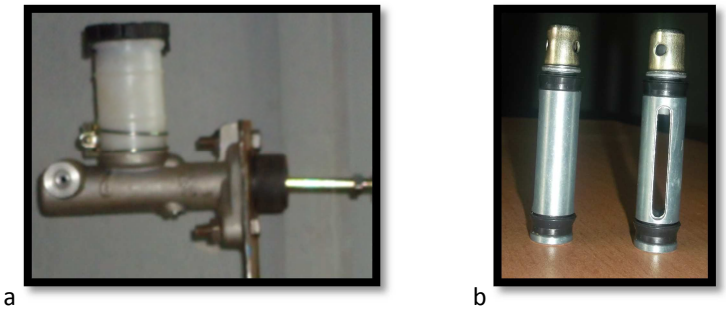
a b

Figure 1: Re-melting of aluminium in (a) an open earth-made furnace and (b) electric furnace.

Microscopic examination is performed to study the metallographic features of specimen using high magnification microscopes. These examinations may involve the optical or scanning electron microscopy. Optical microscopic examination is used to determine grain size, microstructure and inclusion type and content. XRD is used in studying the structure of alloys and in the determination of compounds that make up the alloy. X-ray diffraction analysis makes use of Braggs' law [6, 7, 8, 9].

Owing to the improved properties, the usefulness of aluminium and aluminium alloys in domestic, laboratories and industries cannot be overemphasized. This is seen around us today as at least one part of equipment or a whole machine is made from aluminium alloy [10]. From the long list of the equipments and machine parts made from aluminium, the hydraulic brake piston/calliper has been selected for this study (Figure 3).

The wear and corrosion behaviours of many alloys have been widely studied and reported in the literature [11, 12, 13, 14]. The impact of friction causing wear on the two rubbing contact surfaces cannot be under-estimated in engineering processes [15]. Many reports are available on the qualities of materials used in different machine parts and equipments used in different media. Wear and corrosion of aluminium in various media and environments such as water, acids, alkaline, bases and agro-fluids have been widely studied and published in literature [16, 17, 18, 19, 20] but much report is not available on studies previously made on wear, corrosion and the synergies between aluminium alloys and hydraulic fluids. Hence, the present work investigates the metallurgical properties of as-received and cast aluminium alloy samples used in the floating piston/calliper of the automobile hydraulic master brake cylinder (Figure 2).



a b

Figure 2: Photographs showing of (a) as received master brake cylinder and (b) floating calliper

2 MATERIALS AND METHOD

2.1 MATERIALS SOURCES

The as-received aluminium alloy samples (marked as A and C) from the new and the scrap respectively were sourced from the floating calliper of automotive hydraulic brake cylinders produced by Star Co. Ltd, Japan for Nissan Bluebird 2.0 model engine. The new aluminium alloy samples were procured from the local automobile spare part shop and designated as Sample A from which Sample B was produced. Another set of scrap of floating calliper was obtained auto-mechanic workshop, designated as Sample C from which Sample D was produced for the experiment.

2.2 METHODS

2.2.1 PREPARATION OF MOULD, CASTING AND CHARACTERISATION OF ALUMINIUM SAMPLES

Cast aluminium alloy samples were produced from the as-received samples by sand casting method. The moulding sand was prepared from fine and coarse sand particle sizes. The sand particle size distribution of moulding sand used is shown in Table 1. The sand particle size distribution controls the permeability which is the amount of air can be trapped through the sand. The coarse particle size results in high permeability while fine particles give low permeability of moulding sand. Then the moulding sand was added to the pattern and rammed properly. The moulds were prepared from two set of mixing ratios of moulding sand [a mixture of Coarse (80%) + Fine (20%) and a mixture of Coarse (20%) + Fine (80%)]. To study the effect of casting process (the pouring temperature and particle size of moulding sand) on the properties of cast aluminium alloy, a total of six specimens were produced as follows: First the molten metal was poured at temperature of 700 ^{o}C into two moulds (mould 1 and 2) having coarse (-1180+300) and fine (-300+75) particles sizes (in µm) of moulding sand respectively (Tables 2). The casting is repeated at the pouring temperatures of 750 ^{o}C for (mould 3 and 4) and 800 ^{o}C for (mould 5 and 6) as shown in Table 3. The six trial specimens were produced and the hardness values in HBN were determined from which specimen with the highest HBN was selected for further used.

Table 1: Particle size (µm) distribution of moulding sand

Sieve range (µm)	+1180	-1180 +850	-850 +600	-600 +425	-425 +300	-300 +212	-212 +180	-180 +150	-150 +125	-125 +75	-75
% distribution	1.21	3.49	7.53	10.61	11.47	14.23	13.52	13.62	11.66	8.13	2.06

Table 2: Sand mixing ratios and Particle size ranges (µm)

Set	**Sand mixing ratio**	**Sand particle size ranges (µm)**
Set 1	Coarse (80%) + Fine (20%)	-1180+300 (coarse) and -300+75 (fine)
Set 2	Coarse (20%) + Fine (80%)	-1180+300 (coarse) and -300+75 (fine)

Table 3: Effect of casting temperatures and particle sizes on BHN of trial specimens

Mould no	**Casting temperature (^{o}C)**	**Sand particle size ranges (µm)**	**(BHN)**
Mould 1	700	Coarse (80%) + Fine (20%)	62.4
Mould 2	700	Coarse (20%) + Fine (80%)	47.2
Mould 3	750	Coarse (80%) + Fine (20%)	63.1
Mould 4	750	Coarse (20%) + Fine (80%)	52.3
Mould 5	800	Coarse (80%) + Fine (20%)	65.7
Mould 6	800	Coarse (20%) + Fine (80%)	54.2

2.2.2 CASTING AND PRODUCTION OF SPECIMENS

As-received aluminium alloy samples (new and scrap) sourced from automobile cylinder respectively marked as samples A and C, were in batches weighed into a melting pot, melted and held at temperature range of 700 to 800 ^{o}C in electric furnace under a controlled atmosphere. Sample A was melted and sand cast to get Sample B while Sample C was melted and sand cast to get Sample D for the experiment.

The mould was produced from a mixture of Coarse (80%) + Fine (20%) particle size ranges of moulding sand of a relative high permeability. The molten metal was sand cast into rod of 300 mm long by 30 mm diameter, from which callipers 100 mm long by 12 mm diameter were machined (Figure 3).

Figure 3: Turned aluminium alloy before slicing

Figure 4: Sliced specimen

Other test specimens were sliced to 15 mm thick by 25 mm diameter coins for hardness tests and microstructural examination (Figure 4). Powder specimens were also produced for both as-received and cast samples for XRD studies. The cast samples obtained from sample A and C were designated as samples B and D respectively.

2.2.3 GRINDING AND POLISHING OF SAMPLES

The surface of the aluminium alloy sample were grinded and polished with different types of polishing grit which include 50/60 µm, 100/120 µm, 220 µm, 320 µm, 400 µm, 600 µm, 800 µm and 1200/2400 µm on the grinding and polishing machines at Engineering Materials Development Institute (EMDI), Akure. The polished surface was cleaned with distilled water, dried-up with cotton wool and kept in the desiccators.

2.2.4 DETERMINATION OF CHEMICAL COMPOSITIONS OF SAMPLES

The chemical compositions of aluminium alloy samples were determined using Atomic Absorption Spectrometer (AAS) Thermo series 2000 model at the Project development and design laboratory, Materials and Metallurgy division, Federal Institute of Industrial Research, Oshodi. (FIIRO), Lagos. The results of chemical composition are presented in Table 4.

2.2.5 MICROSTRUCTURAL EXAMINATION OF SAMPLES.

Microstructures of the as-received and cast aluminium alloy samples obtained from different pouring temperatures were examined under higher resolution metallurgical microscope with digital camera in the laboratory of Metallurgical and Material Engineering Department of Obafemi Awolowo University, Ile-Ife. The sections and surfaces were examined under x800 magnifications. The micrographs are presented in Figures 5 to 8.

2.2.6 THE HARDNESS TESTS OF ALUMINIUM ALLOY SAMPLES.

The hardness of samples was determined using Brinell Hardness Testing Machine at the Department of Metallurgical and Material Engineering, Obafemi Awolowo University (OAU), Ile-Ife. The test was conducted by pressing a tungsten carbide sphere 10 mm in diameter into the test plate surface for 10 seconds with a load of 1500 kg, and then the diameter of the resulting depression is measured. An average of four BHN values was measured out over an area of the specimen surface. On a typical plate each test would result in a slightly different number. The BHN is determined using equation 1.

$$HBN = F/ [\pi D/2(D-\sqrt{D^2-D_i^2})] \quad (1)$$

Where BHN = the Brinell hardness number
F = imposed load in kg
D = diameter of the spherical indenter in mm
D_i = diameter of the resulting indenter impression in mm

The results of hardness tests of six trial specimens (Table 2) and the four selected samples used in the study are presented in Table 4. The tensile strength of the all the samples is calculated as an approximate relationship between the hardness and the tensile strength as TS (MPa) = 3.55 x HBN (for HBN ≤ 175) where HBN is the Brinell hardness number of the material as measured with standard indenter and load.

2.2.7 X-RAY DIFFRACTION ANALYSIS OF SAMPLES

The powder of each sample produced for XRD was studied under higher resolution x-ray using X-Ray Mini-Diffractometer MD-10 model with digital facilities in the laboratory of the Centre for Energy Research and Technology (CERT) of Obafemi Awolowo University, Ile-Ife. The grain sizes of the particles of as-received and cast aluminium alloy were examined by XRD. The diffractograms of morphology are shown in Figures 9 and 10.

3 RESULTS AND DISCUSSION

3.1 PREPARATION OF CAST ALUMINIUM ALLOY SAMPLES AND CHARACTERISATION OF THE SAMPLES

The mechanical (hardness, strength, toughness etc) and metallurgical properties could be enhanced by proper management of casting process and other controlling factors. The pouring temperature for aluminium alloys usually ranges from 675 to 790 °C, although thin-wall castings can be poured at temperatures as high as 845 °C. From the casting of the trial specimens (Table 3), it was obtained that when the grain size of sand was fine, the hardness was increased very rapidly from 700 ^{o}C to 750 ^{o}C but increasing slowly from 750 ^{o}C to 800 ^{o}C because at high temperature the crystal of molten metal start to burn and gases escaped out which are entrapped in the cast specimen. But from coarse sand, the hardness increased by more rates at pouring temperature from 750 ^{o}C to 800 ^{o}C than 700 ^{o}C due to fast cooling rate at higher grain size of sand. The aluminium alloy samples were characterised by AAS to ascertain the chemical composition of the materials. The micro-structural examination was carried out to reveal the micro structure of the alloy and to compare the similarities and differences between the grain sizes and structures of as-received and cast samples. The hardness values are compared as means of identifying their behaviour under friction with respect to their composition and micro-structure. With these, some reasons for their corrosion and wear behaviours are understood.

3.2 CHEMICAL ANALYSES OF ALUMINIUM ALLOY SUBSTRATES

The results of chemical compositions of As-received Aluminium alloy and Cast aluminium alloy substrate used in this experiment are presented in Table 4. As-received aluminium alloy sample A was sourced from un-used spare calliper; sample B was cast from sample A. Sample C was sourced scrap of callipers obtained from automobile repair shop from which sample D was produced by casting.

The chemical compositions of sample A (control sample) and cast aluminium alloy (sample B) used in the experiment in Table 4 shows that 98.87 %Al, 0.38 %Si, 0.40 %Mg, and 0.23 %Fe were present in the sample A, that 98.44 %Al, 0.32 %Si, 0.29 %Mg, and 0.16 %Fe were present in sample B while equal amount of 0.001 %Mn, 0.01 %Cu, 0.001 %Zn, 0.001 %Cr and 0.001 %Ti were present in both sample A and B.

From the melting and casting process, there is reduction in the amount aluminium, silicon, magnesium and iron content of Sample A during the process of melting and casting to produce Sample B and likewise Sample C to Sample D. This is because at higher temperature the crystal of molten metal start to burn and gases escaped out according to Mahipal et al, 2013[21]. Also, holding the molten alloy at high temperature resulted in some of the metal and some alloying elements (such as Si, Mg, and Fe) oxidised and dissolved into the slag. Equal amount of 0.001 %Mn, 0.01 %Cu, 0.001 %Zn, 0.001 %Cr and 0.001 %Ti were present in both as-received and cast aluminium alloys. The Atomic Absorption Spectrometry (AAS) shows silicon and magnesium as principal alloying elements as applicable to wrought aluminium alloys of 6000 series. The cast samples contain Silicon, copper and Magnesium which may characterise the standard designated 3xxx.x group of cast aluminium alloy. This type of Al-alloy is easily machined and can be precipitation hardened but not to the high strength that can be reached by 2000 and 7000 series.

There is greater silicon content in Sample C compared with the Sample A but there is reduction in the Aluminium content of Sample B, C and D as compare to Sample A. Close similarities are obtained from the chemical compositions and optical microscopy of sample A and B and the scrap based alloys sample C and D. The casting process reduces the %composition of Al, Si, and Fe obtained in the cast alloy (sample B) produced from sample A from un-used calliper while there is corresponding decrease in the %composition of Al, Si, Mg and Fe; and increase in the %composition of Mg, Mn and Cu in the scrap base cast alloy. Comparing sample A and C, the much differences in the composition of the major alloying metals (Si, Mg, Cu, Zn and Fe) results from the diversities in the chemical composition differences of the base materials from which the callipers were produced by the manufacturers. Also, there are significant changes in the HBN values resulting fro the casting process.

Table 4: Chemical composition, HBN and strength of aluminium alloy samples

Elements	Sample A	Sample B	Sample C	Sample D
Al	98.87	98.44	98.39	97.43
Si	0.38	0.32	0.72	0.46
Mg	0.40	0.29	0.36	0.41
Fe	0.23	0.16	0.26	0.24
Mn	0.001	0.001	0.001	0.002
Cu	0.10	0.10	0.12	0.18
Zn	0.001	0.001	0.002	0.001
Cr	0.001	0.001	0.001	0.001
Ti	0.001	0.001	0.001	0.001
Average BHN	92.7	99.6	43.6	63.8
Strength (MPa)	329.09	353.58	154.78	226.49

3.3 MICRO-STRUCTURAL EXAMINATIONS OF ALUMINIUM ALLOY SAMPLES

The micro-structural examinations carried out revealed the microstructures of the alloy and compare the similarities and differences between the grain sizes and structures of as-received and cast samples (Figures 5, 6, 7 and 8). The microstructure obtained from as-received and cast aluminium alloy samples studied under higher resolution metallurgical microscope with digital camera under x800 magnifications are shown in Figures 5 to 8. This is reflected in the results of the hardness tests and tensile strength obtained on the aluminium alloy samples in Table 4.

The grains in sample A and C are coarse compare to the fine grains in sample B and D and because of the fineness and closeness of the grains, the sample will be more prone to corrosion. The cast sample are characterised by inclusions from casting sand as revealed in the X-ray diffraction study. The lumpy grains may be attributed to inclusions interacting with the grains during the solidification process. However, the grain sizes could be refined under a controlled artificial aging process. But this can be relieved by cooling, passing through natural aging as the grain size will be coarse but will have higher corrosion resistance but lower hardness as compared to when it is refined by artificial aging.

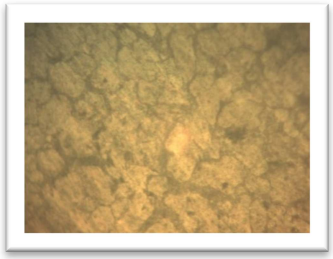


Figure 5: Micro-structure of sample A under magnifications of x800

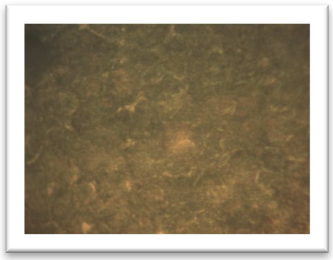


Figure 6: Micro-structure of sample C under magnifications of x800

Figure 7: Micro-structure of sample B magnified at x800

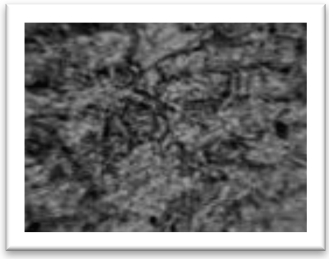


Figure 8: Micro-structure of sample D magnified at x800

3.4 HARDNESS AND STRENGTH OF SAMPLES

The results of the hardness tests of Aluminium alloy samples were determined using Brinell Hardness Testing Machine. Table 4 reflects average BHN obtained hardness tests of four point tests of As-received aluminium alloy and Cast aluminium alloy which agrees with the ASTM B647-84 (2006), B648-78 (2006) and B724-00 (2006) international standards practices. From the results of the hardness tests, sample B has lower BHN than sample A, while BHN in the sample D is greater than sample C due to the higher alloying effect of silicon, magnesium and iron in Sample D as shown in the Table 4. The aluminium alloy technically cast at pouring temperature higher than 750 ^{o}C using a mould of high permeability of moulding sand gave higher HBN values with eutectic-AlSi structure aluminium alloy which is agreement with [21]. The grain size of cast aluminium alloy had been modified by faster rate of cooling and higher permeability of moulding sand.

Tensile strength of the all the samples is calculated as an approximate relationship between the hardness and the tensile strength, TS (MPa) = 3.55 x HBN (for HBN ≤ 175), where HBN is the Brinell hardness number of the material as measured with a standard indenter and load.

The tensile strengths were calculated as 329.09 Mpa, 353.58 Mpa, 154.78 Mpa and 226.49 Mpa for samples A, B, C and D respectively. Sample D will be able to withstand higher stress compare to Sample C. There is a great reduction in the hardness and strength of Sample A when cast to give Sample C. This is as result of the grains forming larger grains during the casting process. The same effect is seeing in the casting of Sample B to give Sample D. With higher hardness property exhibited by cast alloy, the cast sample will be of more abrasion/ wear resistance than the as-received sample.

3.5 X-RAY DIFFRACTION STUDY

The peaks in the above diffractograms were obtained from the result of the analysis being interpreted by 'Search and Match Method'. Each of peak value was compared with the database of the standard values of compounds under this radiation. The difference between the peak value of the results got and the standard values in the database is not more than 0.03. This method is based on Bragg's law which states that $n\lambda=2d\sin\theta$: where n-order of reflection, d-inter granular space and λ- wavelength. In addition to this, the grain sizes of compounds in the Al-alloy samples is determined by using Scherrer equation which is given by; $D= 0.9\lambda/\Delta (2\theta) \cos\theta$. Where D is the grain size, Λ is the wavelength; (2θ) is diffraction angle. The diffractograms of surface morphology are shown in Figures 9 and 10.

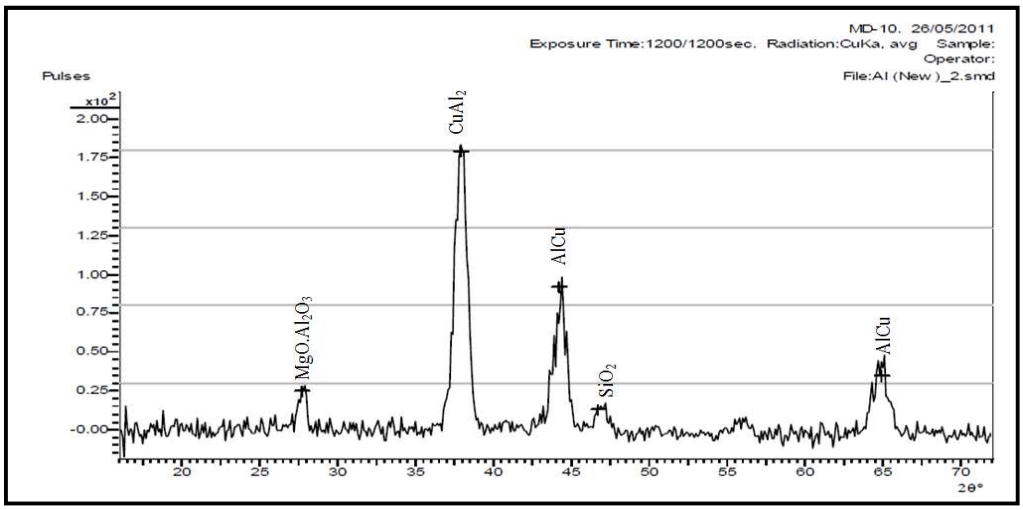


Figure 9: XRD analysis of As-received aluminium alloy sample

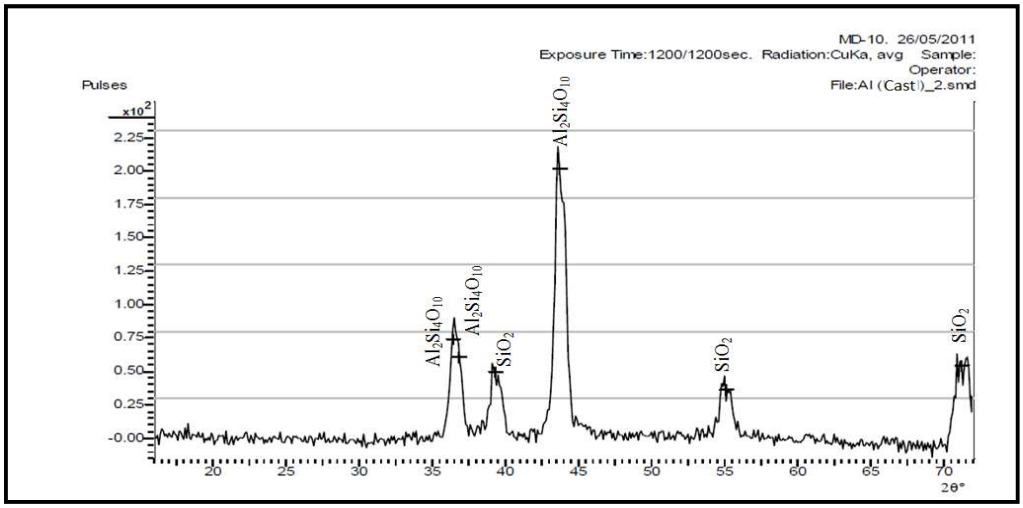


Figure 10: XRD analysis of cast aluminium alloy sample

3.5.1 XRD ANALYSIS OF AS-RECEIVED ALUMINIUM ALLOY FROM SAMPLE A

From Figure 9, the following peak values were shown at the diffraction angle (2θ); (i) 27.69° (ii) 37.86° (iii) 44.20° (iv) 46.70° (v) 64.80°. By the Search and Match method, the given closest values in the database, the phases of compounds found to be present are: Tetragonal crystal structure $MgO.Al_2O_3$ (Magnesium Aluminium Oxide) with the diffraction angle (2θ) of 27.68°, Tetragonal crystal structure $CuAl_2$ (Aluminium copper) with 37.8674°, Monoclinic structure AlCu (Aluminium copper) with 44.1875°, Monoclinic structure SiO_2 (Silicon Oxide) with 46.71° and AlCu (Aluminium copper) with 64.7793°. The grain sizes D of compounds in the Al-alloy samples is calculated using Scherrer's equation, for first peak D=0.05Å, second peak, D=0.14Å, third peak grain size=0.24 Å, fourth peak grain size=0.60Å and fifth peak grain size=0.1Å

3.5.2 XRD ANALYSIS OF CAST ALUMINIUM ALLOY FROM SAMPLE B

In Figure 10, the diffraction angle (2θ) from the results of XRD analyses are: i. 36.35°, ii. 36.78°, iii. 39.25° iv. 43.66° v. 55.00° vi. 71.17° were found to be of closest search match to i. 36.3582° ii. 36.8058° iii. 39.2411° iv. 43.6492° v. 55.0069° and vi. 71.1864°.

In which the following phases of compounds and crystal structure were detected at different peaks: $Al_2Si_4O_{10}$ (Aluminium silicate) at diffraction angle (2θ) of 36.3582° with Triclinic crystal structure, $Al_2Si_4O_{10}$ (Aluminium silicate) at 36.8058° with Triclinic crystal structure, SiO_2 (Silicon Oxide) at 39.2411° [Monoclinic crystal structure], $Al_2Si_4O_{10}$ (Aluminium silicate)

43.6492^{o} [Triclinic crystal structure], SiO_2 (Silicon Oxide) at 55.0069^{o} [Tetragonal crystal structure] at SiO_2 (Silicon Oxide) at 71.1864^{o} of Hexagonal crystal structure.

At a constant wavelength, the grain sizes of compounds in the Al-alloy samples calculated using Scherrer's equation: for the first peak D = 0.04Å, for second peak, D = 3.38Å, third peak grain size = 0.6Å, fourth peak grain size=0.34Å, fifth peak grain size = 0.14Å and the sixth peak grain size = 0.11Å

Generally, the results are characterised by poor metallurgical qualities such as variation in weight and density, low HBN, low tensile strength, high porosity, irregular microstructure and casting defects such as sand inclusions resulting from the poor casting practices.

Improved, long lasting contact surfaces interaction of aluminium alloy product with hydraulic fluid such as brake fluid (to reduced wear and corrosion) could be achieved by surface coating such as electroplating or electroless plating [5, 23, 24, 25]. The moderate magnesium quantity in aluminium alloy examined, makes it less flammable and this will contributes to its use in automobiles. Further more, Al-alloy has little casting quality to produce Al-alloys because of its silicon content, though Al-alloy with higher silicon content will possess better casting quality. Al-alloy can however be forged to produce products such as floating piston in automobile master break cylinder which usually comes in contact with un formulated types of hydraulic oils available today. Brake fluids must not corrode the metals used inside components such as callipers, master cylinders, etc. They must also protect against corrosion as moisture enters the system. Additives (corrosion inhibitors) are added to the base fluid to accomplish this. The absorption of moisture into the fluid increases the tendency for corrosion. Most automotive professionals agree that glycol based brake fluid should be flushed, or changed, every 1-2 years [26].

4 CONCLUSION

The study has been carried out to investigate the metallurgical properties of Al-alloy sourced from the floating piston in automobile hydraulic master brake cylinder. Based on above findings on this Al-alloy substrate, the following conclusions are reached. The samples are characterised by poor metallurgical qualities such as variation in weight and density, low HBN, low tensile strength, high porosity, irregular microstructure and casting defects such as sand inclusions resulting from the poor casting practices. Al-alloy resistance to corrosion could be improved by casting but with corresponding reduction in the tensile strength. Cast aluminium alloy will only be useful in areas where low strength and good corrosion resistance are needed as in the case of piston/calliper in the automobile master break cylinder [28,29]. Nevertheless, cast aluminium alloy faces the problem of ductility and uniform property. Therefore, the calliper should be forged which is believed will have more uniform properties and better ductility than castings, or else, coating method such as electroplating or electroless plating of Ni and surface heat treatment [23, 24, 27] could be applied to reduced wear and corrosion.

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Effects of polishing grades and Saccharin-550 additive on copper electroplating on NST60Mn and NST50-2 steels

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ABSTRACT: Cathodic protection is still one of most useful methods of corrosion control applicable to metal surfaces. Copper is often applied on steels for its good adhesion and improved appearance. Organic additives to plating baths improve the throwing power, levelling and brightening of the film. Hence the effects of surface polishing grit and Saccharin-550 additive on copper plating of steels were studied. Two standard NST60Mn and NST50-2 steels were electroplated in acid-sulphate bath using saccharin-550 as additive. Copper film thickness reduces as surface polishing grit increased with or without additive. The film properties improve as the substrate surface improves, with the most stable, metallic, lustre and adhesion obtained on 400µm and 600µm finishes without additive. Increasing saccharin-550 concentration from 0.1g/l to 0.5g/l improved film quality. Lower 0.1g/l saccharin-550 concentration produced higher thickness but poor brightening. Optimum plating parameters were obtained at 2V, 200g/l $CuSO_4.H_2O$, 600µm SFG and 0.5g/l saccharin. The density of copper plates is increased while porosity is reduced. The coat becomes more tenacious and protective in nature, and deposited in form of metal sheet rather than the powdery form. Types of steel do not control Cu-deposition but rather the polishing grade of steel surface.

KEYWORDS: Surface polishing grit, Saccharin-550, levelling agent, brightening, copper-plating, carbon steel.

1 INTRODUCTION

The theories of electro-deposition are based on the previous works done by Michael Faraday in 1833 on electrolysis [1]. Electroplating involves the deposition of more protective metal on a metalised surface by passing electric current through the solution of the metal to be deposited, while the coating metal is made the anode and the surface is the cathode [2]. It is electrochemical deposition (of metals or alloys) that involves the reduction of metal ions from aqueous, organic, or fused salt electrolytes. In its simplest form the reaction in aqueous medium at the cathode follows the equation:

$$M^{n+} + ne^- = M \quad (1)$$

$$M = M^{n+} + ne^- \quad (2)$$

This occurs with a corresponding anodic reaction. The anode material can be the metal to be deposited and in this case the electrode reaction is electro-dissolution that continuously supplies the metal ions [3]. For a copper-plating on steel process, the chemistry of the reaction can be represented as

$$Cu^{2+} + Fe = Cu + Fe^{2+} \quad (3)$$

Copper is commonly used in coating of steel surface for use as the earthen rod due to its high conductivity and adhesion to the steel surface. The shape of the work piece and the bath throwing power determine the plate thickness. For this purpose, a few micron thickness layers is necessary. It is often applied for good adhesion and improved appearance. [4,5]. Though copper coating on steel have good resistance to corrosion, but once the base metal is exposed by a pin hole or

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scratch, a strong voltaic effect is set up at the breaks beneath the coating and this results in peeling away of the coat. Copper coating for a decorative reason is always prevented from oxidation by top coating with clear lacquer. High throwing power baths are often used such as sulphate and fluoborate-acid baths, cyanide and pyrophosphate alkaline baths [6].

A variety of low carbon steels (such as ST30LC, NST44) and mild steels medium (NST50-2), medium carbon steels (NST60Mn) and high carbon steel are produced in Nigeria [7,8.9]. These are used in many areas such as wire drawing, steel rolling and machine parts and machine tools fabrication to mention a few. Steels are characterized by high strength and high workability, but are like other metals susceptible to corrosion when used. The improved service requirement of steel can be achieved by the measures such as heat treatment; coating such as painting, metallising and electroplating; regular lubrication and so on which offer a long lasting protective measure on the machine part under services [10,11,12,13]. Coating and plating as finishing operations are carried out to obtain a good characterized surface finish of the materials for effective corrosion resistance, heat reflection, wear resistance and decorative value [14]. The coating thickness and adhesion are very important. The thickness varies from hundredth of micron to millimetres. There is control of the uniformity in the coating thickness. Some salts are added to increase the brightening and levelling of electroplate, thereby improving the porosity and appearance such as dextrin, lactic acid and saccharin are added to cadmium on steel plating baths [15].

Of recent, Hartikainen et al, 2012 [16] assessed the impact of Cu and Zn on fungi and the growth of 18 taxonomically different saprtrophic fungi such as ascomycete, zygomycete and basidiomycete and their production of oxidative enzymes on 0-400 mkg^{-1} Cu or Zn. It was reported that for all the methods, Cu was found to be more toxic than Zn for all tested fungi, showing that microbial functioning of soil is more vulnerable to Cu than Zn.

Also with trend of increase in price of metals in the world market, the use of pure copper materials as earthen rod is been replaced in practice with copper plated steels in many of the West Africa sub-region. With the view of solving the problem of microbial growth which facilitate high corrosion rate in buried plated metallic materials, perfect adhesion and uniform deposition of coating metal (metal plate) to the substrate has to enhanced and assured. Hence in the present study, the effects of addition of saccharin-550 (a compound of Ortho-sulfobenzoic Acid Imide) as the levelling and brightening additive for improved properties of copper film on steels in acid–sulphate bath were investigated on five degrees of surface polishing grits (SPG) and two varieties of steels (NST50-2 and NST60Mn) which popularly dominate Nigeria steel markets for earthen rod production.

2 MATERIALS AND METHOD

2.1 MATERIALS

The materials used in this study were NST50-2 and NST60Mn steels samples of dimension 100 mm x 100 mm x 150 mm obtained from Osogbo Steel Rolling Mill, Osogbo. The chemical composition of the steel is shown in Table 1. Saccharin 550 insoluble Vardayini's Steamer Brand of Saccharin 550 with molecular formula $C_7H_5NO_3S$ was procured from chemical store and used for the experiment.

2.2 METHODS

Saccharin-550 was pis used as levelling and brightening additive. The chemical compositions of the samples were determined at the Universal Steels, Ogba Ikeja, Lagos by optical emission spectrometry using AR430 metal analyser. The results are presented in Table 1.

Table 1: Chemical composition (%) of as-received carbon steel samples

Elements	Fe	C	Si	Mn	P	S	Ni	N_2
NST50[2]	98.3	0.24	0.18	0.40	0.40	0.04	-	0.01
NST60 Mn	97.7	0.35	0.3	0.9	0.04	0.25	0.10	-

2.2.1 PREPARATION OF CARBON STEEL SAMPLES

Steel samples were cut to smaller dimension of 40 mm x 15 mm x 5.5 mm thick. The samples surface were smoothened by hand filing with 0.8 mm, 0.6 mm and 0.4 mm hand files and finally polished on the ELE polishing machine (EL 78/260) using five degrees of sand paper grits (60μm, 120μm, 320μm, 400μm and 600μm).

2.2.2 SAMPLES SURFACE PRE-TREATMENT OPERATION

The surface cleaning were carried out by brush cleaning and washing in emulsifying solution made from 1:1 kerosene and detergent at 50 ±5^{o}C for 10 mins, followed by water rinsing for 1 mins at 70 ±5^{o}C, alkaline-washing in 1% NaOH solution operating at 45 ±5^{o}C for 2 mins to degrease the surface, followed by acid-washing in 13% HCl at 50 ±5^{o}C for 1 min with intermittent water rinsing at 27 ^{o}C between every stage. The initial weight of the specimen was determined on weight meter

2.2.3 PREPARATION OF COPPER ELECTROPLATING BATH

The acid copper sulphate electrolyte used was formulated based on the patent right of Gupta et al, 1990 [17]. HDPE plastic container was used as the bath containing the prepared formulated electrolyte. Pure copper electrode (anode) rod was carefully selected and prepared based on the B224-04 and B115-00(2004) ASTM Standards.

2.2.4 PLATING REAGENTS AND OPERATING CONDITIONS

The copper electroplating bath (Figure 1) was set up under the following conditions; the acid sulphate bath comprises of three initial plating solutions: 200g/l $CuSO_4.5H_2O$, 50g/l H_2SO_4, 1.0g/l phenol as inhibitor, operated at 50 ±5 ^{o}C bath temperature, current density (c.d) = 1A/dm^2, 95% current efficiency. 120 mm maximum electrodes separation, 25 minutes for constant time experiments, Voltage was kept constant at 2V using 0.1A. The surface polishing grade is varied from 60μm to 600μm. Saccharin concentration was varied from 0.1g/l to 0.5g/l.

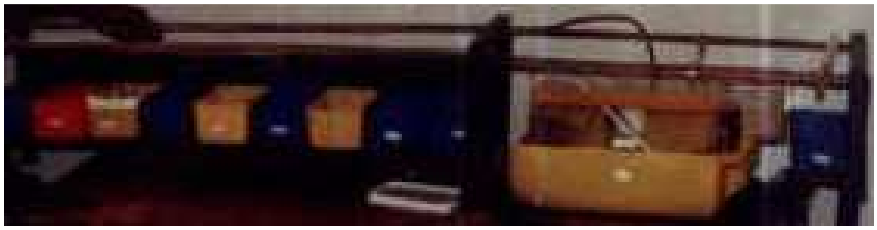

Figure 1: Laboratory set up for copper plating experiment

2.2.5 POST PLATING OPERATION

The plated steel was seal rinsed in water at 80 ±5^{o}C for 1 min, dried in air and kept in the dry saw dust.

2.2.6 COPPER FILM WEIGHT AND THICKNESS DETERMINATION

The final weight of cathode is measured. The copper film weight-gain is determined from the difference in the final and initial weights. The results are presented in Tables 2 to 10. Also, the initial dimensions were subtracted from the final dimensions of the electroplated samples. The values obtained from weight difference and from dimension difference were used in evaluating both the actual weight deposited per unit area and the thickness of deposition. Mathematically expressed as Equations 4 and 5:

$$W_D = W_2 - W_1 \quad (4)$$

$$A_D = A_2 - A_1 \quad (5)$$

where W_1= initial Weight of sample before electroplating,

W_2 = final Weight of sample after electroplating,

W_D = Electrodeposited weight,

A_1 = initial surface area of sample before electroplating.

A_2 = final surface area of sample after electroplating.

The actual electrodeposited weight in g/cm2 was calculated from Equation 6;

$$(W_D/A_D) = (W_2-W_1)/(A_2-A_1) \quad (6)$$

The thickness of electrodeposited copper film was also calculated as Equation 7;

$T_{Cu} = W_D / (A_D \times \rho_{Cu})$ (7)

Where ρ_{Cu} = density of copper given varied from 8.3 to 9 g/cm^3 [18]

The thickness of the metallic Cu-film was measured using micrometer screw gauge and while for powdery film, the electro-deposition thickness per hour has also been determined from the Equation 8

$T = (CD \times W \times CE) / 235 \times \rho_{cu}$ (8)

Where CD = current density, W = weight of metal deposited, CE = current efficiency and ρ_{cu} = copper metal density. The results are presented in Tables 3 to 7; 9, 11 and 13

2.2.7 VISUAL OBSERVATION AND SURFACE EXAMINATION

The electroplated samples were observed for physical appearance as colour, brightness, transparency, texture and tenacity and were reported in Tables 2 to 7, and 9.

The surface examination of the copper electroplated samples was carried out using digital camera at ×100 magnification in Plates 1 (a and b). Also the thin film of copper-electroplated sample and as-received substrate was carried out under an optical metallurgical microscope with digital camera at magnification ×160 (Plates 2, 4 and 5).

3 RESULTS AND DISCUSSION

3.1 DETERMINING THE OPTIMUM PLATING PARAMETERS

Table 2: Plot of applied voltage against copper film weight and film thickness

Applied voltage (V)	Film weight (g)	Film thickness (mm)	Appearance of plating
1	0.07	0.018	Pink and smooth
2	0.09	0.023	Pink and transparent
3	0.15	0.038	Red and smooth
4	0.41	0.104	Deep red and rough
5	0.75	0.190	Brownish red and powdery

Table 3: Plot of plating time against copper film weight and film thickness

Plating time (mins)	Film weight (g)	Film thickness (mm)	Appearance of plating
5	0.24	0.061	Pink, bright and metallic
10	0.41	0.104	Pink, bright and metallic
15	0.45	0.114	Pink, bright and metallic
20	0.50	0.126	Pink, bright and metallic
25	0.53	0.134	Pink, bright and metallic

Table 4: Plot of electrolyte concentration against copper film weight and thickness

Concentration (g/l)	Film weight (g)	Film thickness (mm)	Appearance of plating
200	0.05	0.013	Pink, bright, metallic and smooth
210	0.12	0.030	Pink red, metallic and smooth
220	0.21	0.053	Red, metallic and rough
230	0.25	0.063	Deep red colour and rough
240	0.31	0.077	Deep red colour and rough
250	0.35	0.089	Deep red colour, rough and porous

Table 5: Plot of electrode separation against copper film weight and film Thickness

Electrode separation mm	Film weight (g)	Film thickness (mm)	Appearance of plating
140	0.05	0.013	Pink red, metallic and smooth
120	0.08	0.020	Red, metallic and fairly smooth
100	0.12	0.030	Red, fairly smooth, peeling
80	0.17	0.043	Deep red colour and rough
60	0.18	0.046	Brownish red, rough and powdery

3.2 EFFECT OF SURFACE FINISHING GRADES ON COPPER DEPOSITION WITHOUT ADDITIVES

The effects of five surface-finishing grades of steel samples studied on the copper film weight and film thickness in sulphate bath. Figures 2 shows copper-plating on steel using improving surface finishes ranging from 60 to 600µm polishing grades. No additive was used. From the results, the film weight gain and thickness reduce as the surface-finishing grades increased. The physical appearance (colour, porosity, lustre and adhesion) improves as the surface improves.

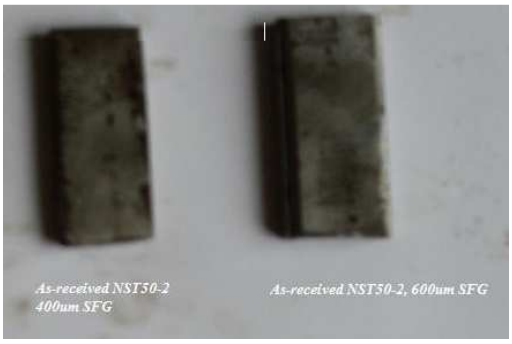

Plate 1: (a) Macroscopic views of as-received 600µm polished steel substrates.

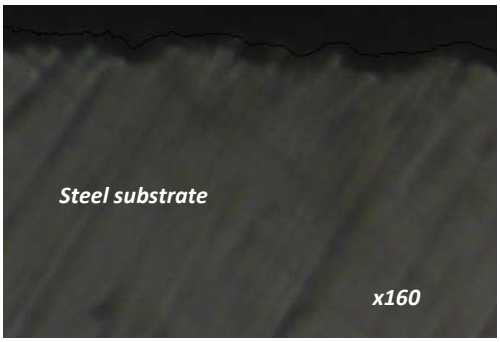

Plate 2: Microscopic views of as-received 600µm polished steel substrates

Table 6: Effect of SFG on copper film weight and film thickness (without additive)

Polishing grade (µm)	Film weight (g)	Film thickness (mm)	Appearance of plating
60	0.14	0.035	Deep red colour and rough
120	0.16	0.041	Deep red colour and rough
320	0.14	0.035	Deep red colour
400	0.10	0.025	Red colour
600	0.06	0.015	Pink colouration and smooth

Observation shows that the most stable plating was obtained from the 600µm surface finishing grade. There were unstable, rough deposits on the 320, 120µm and 60µm grades, while the deposition on 400µm and 600µm finishes were of

metallic lustre and better adhesion characteristics. The result shows that a very thin layer (μm) of copper film was deposited on the steel cathode.

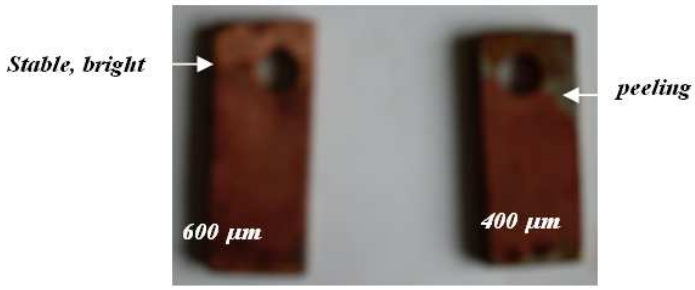

Plate 3: Photographic views of copper film on 600μm and 400μm polished substrates.

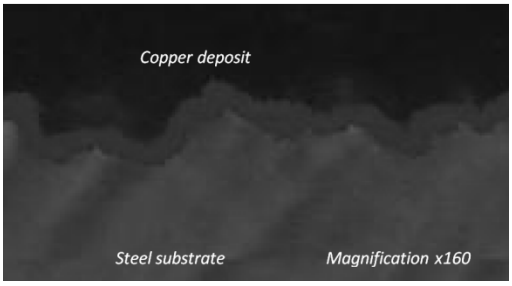

Plate 4: Optical microscopic view of copper film on 600μm polished substrate.

3.3 EFFECT OF SURFACE POLISHING GRITS ON COPPER DEPOSITION WITH ADDITIVES

The results of the effect of organic brightening agent (saccharin 500) on the film weight gain and the film thickness using five surface finishing grades are presented in Figures 3 through 5. These organic additives are used to improve on the throwing power of acid-sulphate electrolyte and the brightening of the copper plating.

3.3.1 EFFECT OF INCREASING SPG AND SACCHARIN 550 CONCENTRATION ON DEPOSITION

Figure 3 shows the results of increasing the concentration of saccharin 550 additives used as organic brightener on copper-plating on five surface finishing grades of steels in an acid-sulphate bath. There was reduction in film weight gain and thickness as the surface polishing grits SPG increased. Observation shows that, the increasing saccharin-550 concentration from 0.1g/l to 0.5g/l shows improvement on the physical appearance of the plating. At lower concentrations 0.1g/l saccharin-550, there was a high film weight and thickness value but poor brightening characteristic of the plating. The addition 0.5g/l saccharin 550 to the bath gave stable plating on all the surface finish grades. The trend of curves revealed that there was reduction in copper film weight for all surface-finishing grades used as the concentration of saccharin 550 increased. The deposition on the 600μm finish grade was very thin, bright, protective and stable. Thus, the combination of 600μm SPG and 0.5g/l saccharin produced the most stable plating suitable enough for corrosion prevention.

Table 7: Effect of SFG on copper film weight (with saccharin additive)

Concentration (g/l)	Film weight (g) and appearance of copper deposit using 60µm	120µm	320µm	400µm	600µm
0.0	0.14	0.16	0.14	0.10	0.06
appearance	powdery	rough, metallic	rough red	rough brown	rough red
0.1	0.21	0.22	0.36	0.38	0.13
appearance	powdery	mixed deposit	rough red	rough red	rough red
0.2	0.14	0.16	0.16	0.16	0.02
appearance	rough red	rough red	dull red	dull red	red, peeling
0.3	0.15	0.11	0.14	0.13	0.02
appearance	rough red	rough red	rough red	dull	red, peeling
0.4	0.11	0.07	0.07	0.09	0.03
appearance	rough, red	red-pink	red-pink	red-pink	bright pink
0.5	0.09	0.04	0.03	0.03	0.02
appearance	peeling	bright pink	dull pink	very bright	very bright

Copper film thickness is plotted against five surface polishing grits SPG varied from 60 to 600 µm. The copper film weight (g) reduces as the surface-finishing grade increased. Close values of copper deposition (weight gain) were obtained from the use of 0.5g/l saccharin on 120~600µm finish grades.

In the saccharin based electrolytes, the plating stability increased with increasing SPG.

The physical observation shows that, the organic additives gave stable plating with lower film thickness values on 600µm SFG.

Table 8: Effect of SPG on copper film thickness (with saccharin additive)

Saccharin (g/l)	Film thickness (mm) using 60µm	120µm	320µm	400µm	600µm
0.0	0.036	0.041	0.036	0.025	0.015
0.1	0.053	0.056	0.091	0.096	0.033
0.2	0.036	0.041	0.033	0.041	0.005
0.3	0.038	0.028	0.036	0.033	0.005
0.4	0.028	0.018	0.018	0.023	0.008
0.5	0.023	0.041	0.008	0.008	0.005

Using saccharin, the 600µm surface-finishing grade produced the least copper film weight and thickness with best physical appearance and plating stability. Generally, the organic additive used, yielded better and improved results in terms of brightness and adhesion, though less quantities of cu film (weight and thickness) was produced. Hence, the overall results show that with the use of 0.5g/l saccharin 550, very thin film could be obtained from 120~600µm SFG. Plate 5 illustrates the optical macrographs of copper film on (a) 60µm, (b) 120µm, (c) 320µm and (d) 600µm polished steel substrates. More porous films are obtained on rough surfaces.

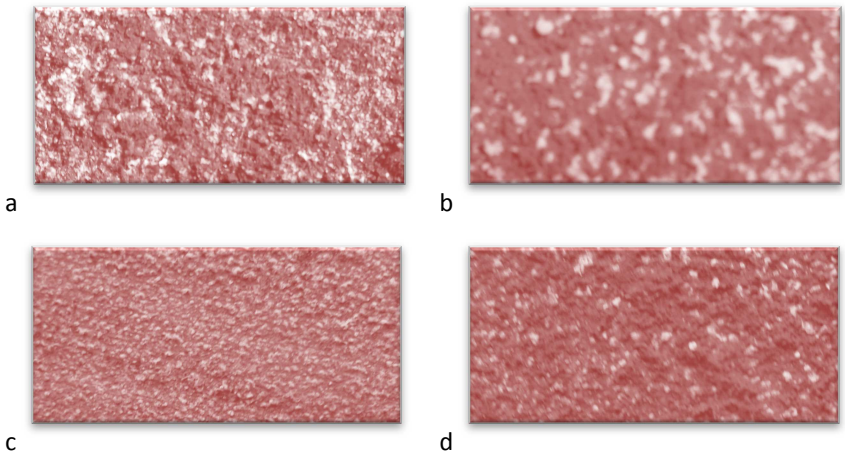

Plate 5: Optical macrographs of copper film on (a) 60µm, (b) 120µm, (c) 320µm and (d) 600µm polished steel substrates.

The addition of increasing organic additives increases the solution resistance to current flow as understood from the equation M=ZVt (1/R) based on Ohm's law and Faraday's laws. It is known that I =V/R, where 1/R is equal to conductance of solution. Hence, with much quantity of additive in solution large quantity of current I have to be drawn into the cell before substantial quantity of Cu could be plated on steel.

It is known that most organic additives are reagents with large molecular composition. They are not as conducting in solution as copper sulphate or H_2SO_4 aqueous solutions. Hence, their addition on large quantity may reduce solution conductance to certain extent.

Mayana et al, 1989 [15] reported the addition of dextrin and lactic acid as levelling and brightening agent on cadmium plating on steel. The density of copper plates is increased while porosity is reduced. The coat becomes more tenacious and protective in nature, and deposited in form of metal sheet rather than the powdery form. From the result, it becomes more evident that, with increasing surface finish grade value, (Smoother surfaces), less quantity of Cu is deposited on steel surface. The rougher surfaces have more crevices and pits, which increase the total surface area of steel obtainable (Cathode).

3.3.2 DETERMINATION OF EFFECT OF SFG AND STEEL COMPOSITION ON COPPER PLATING.

The results of copper film weight and film thickness (Tables 9 and 10) on five surface finishing grades of $NST50^2$ and NST60Mn steels are compared in Fig. 5. The plating was done using the optimum plating values of V=2V, 200g/l $CuSO_4$ for 10 minutes.

The trend of both $NST50^2$ and NST60Mn curves show that the film weight and film thickness decrease with increasing SFG from 60-600µm while observation revealed that plating become more stable from 400 to 600µm SFG. Both curves show a decrease in film weight and thickness for SFG from 60 to 320µm and from 400 to 600µm. From 320 to 400µm, $NST50^2$ maintained a constant film weight and thickness values while on the NST60Mn curve, the film weight and thickness increased with SFG. The little difference in Cu-deposition on the steel surfaces might have been influenced by some other imperfections (scratches etc) rather than the composition of the steel. Hence, it is evident that the level (degree) of surface smoothness has more pronounced influence on deposition rather than the steel types. Best Cu-plating was obtained for the two types of steels when 400 and 600µm grades were used showing that better degree of copper adhesion would be enhanced on very smooth steel substrate. The plating is sufficient enough to offer protection against corrosion of both steels when copper plated and intended to be used as earthen rods.

Table 9: Effect of SFG on copper film weight on NST50-2 and NST60Mn steels

teel type	Film weight (g) using					Remark
	60µm	120µm	320µm	400µm	600µm	
NST50-2	0.09	0.05	0.03	0.03	0.02	
appearance	peeling, red	bright pink	red-pink	very bright	very bright	Good as from 120µm
NST60Mn	0.08	0.05	0.02	0.03	0.02	
appearance	red	bright	bright	very bright	very bright	All good

Table 10: Effect of SFG on copper film thickness on NST50-2 and NST60Mn steels

Steel type	Coat thickness (mm) using surface finish grades				
	60µm	120µm	320µm	400µm	600µm
NST50-2	0.018	0.013	0.008	0.008	0.005
NST60Mn	0.016	0.013	0.005	0.008	0.005

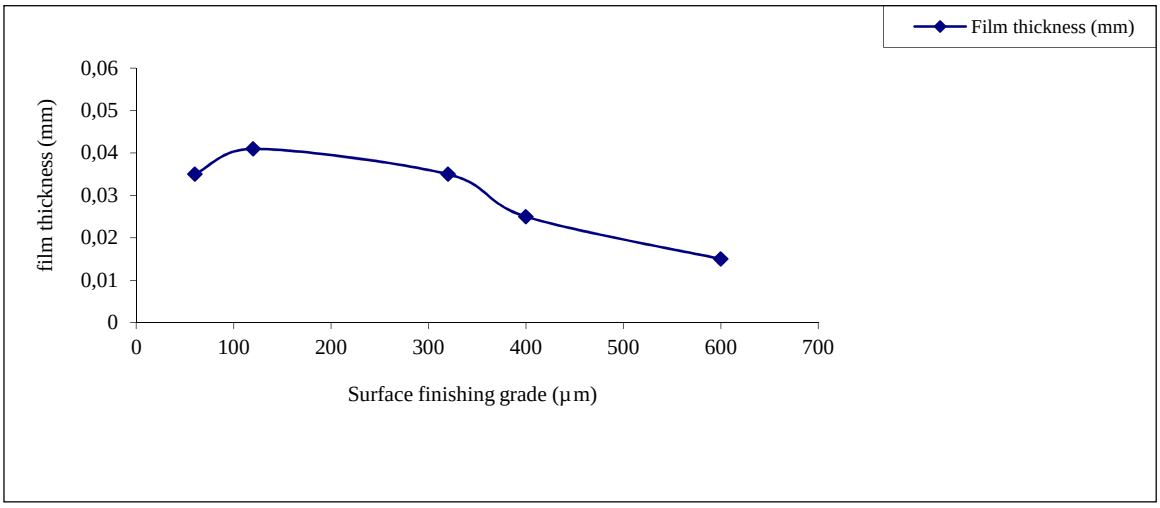

Figure 2: Effect of SFG on copper film thickness (in bath without additive)

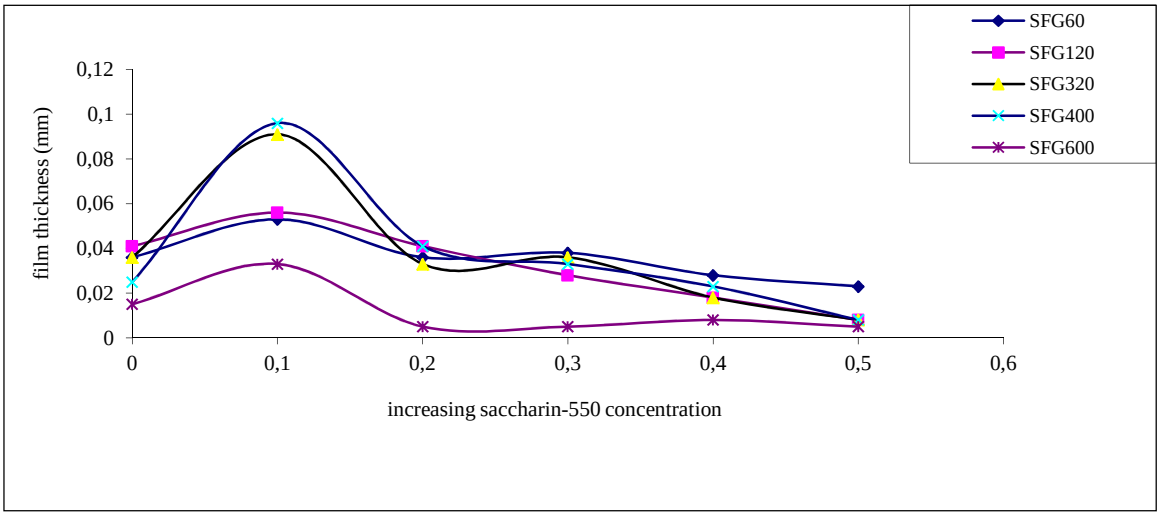

Figure 3: Effect of varying SFG and saccharin concentration on film thickness on NST50-2

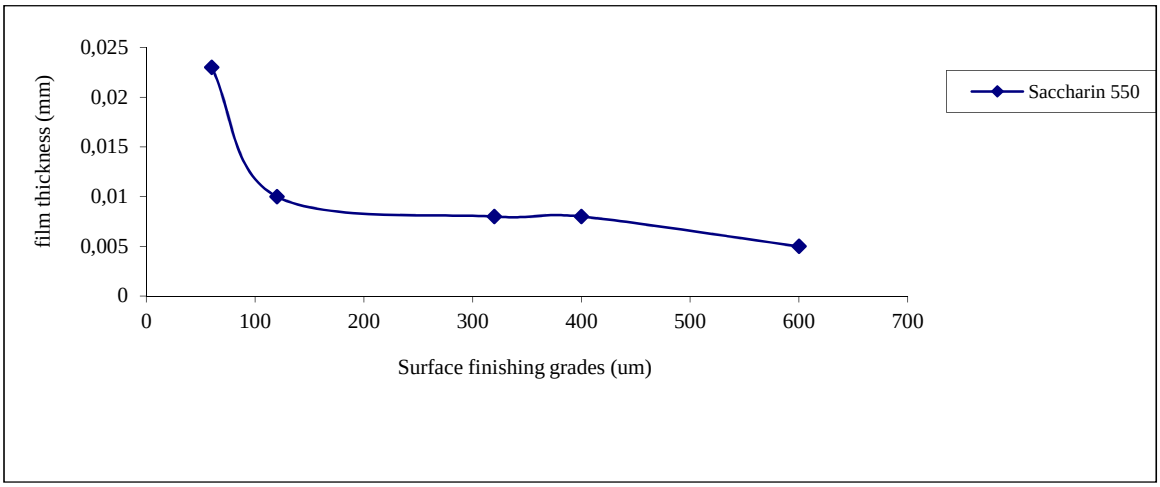

Figure 4: Effect of SFG on film thickness on NST50-2 steels (with 0.5g/l saccharin)

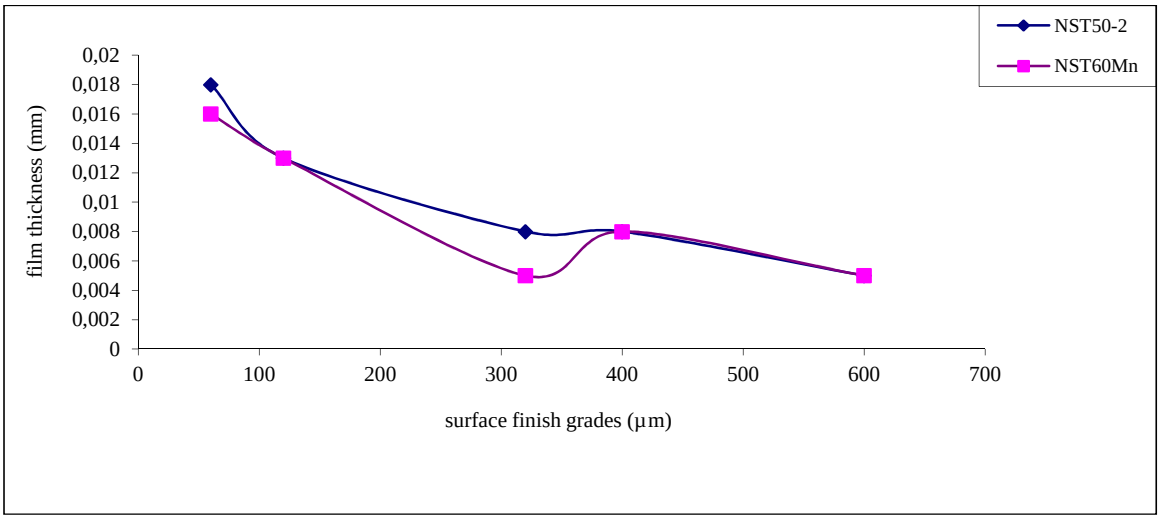

Figure 5: Effect of SFG on film thickness on NST50-2 and NST60Mn (with 0.5g/l saccharin)

4 CONCLUSION

NST50 and NST60Mn Steels were coated using copper by electroplating process. The optimum plating parameters for copper plating on steel substrates were obtained at 2V applied voltage, 200g/l $CuSO_4.H_2O$ electrolyte concentration, 120mm minimum electrodes separation, 600µm surface finishing grade and 0.5g/l saccharin concentration (used as organic brightening agent).

Copper film thickness reduces as surface polishing grades increased with or without additive. The film properties improve as the substrate surface improves, with the most stable, metallic, lustre and adhesion obtained on 400µm and 600µm finishes without additive. Increasing saccharin-550 concentration from 0.1g/l to 0.5g/l improved film quality. Lower 0.1g/l saccharin-550 concentration produced higher thickness but poor brightening. Optimum plating parameters were obtained at 2V, 200g/l $CuSO_4.H_2O$, 600µm SFG and 0.5g/l saccharin. The density of copper plates is increased while porosity is reduced. The coat becomes more tenacious and protective in nature, and deposited in form of metal sheet rather than the powdery form. The types of steel used do not show much pronounced effect on Cu-deposition but rather by the grade of smoothness of surface finishing of steel material.

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