



Journal which deals with research, Innovation and Originality



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Message from IJERGS

This is the Fifth Issue of the Sixth Volume of International Journal of Engineering Research and General Science. A total of 9 research articles are published and we sincerely hope that each one of these provides some significant stimulation to a reasonable segment of our community of readers.

In this issue, we have focused mainly on the Innovative Ideas. We also welcome more research oriented ideas in our upcoming Issues.

Author's response for this issue was really inspiring for us. We received many papers from many countries in this issue but our technical team and editor members accepted very less number of research papers for the publication. We have provided editors feedback for every rejected as well as accepted paper so that authors can work out in the weakness more and we shall accept the paper in near future.

Our team have done good job however, this issue may possibly have some drawbacks, and therefore, constructive suggestions for further improvement shall be warmly welcomed.

IJERGS Team,

International Journal of Engineering Research and General Science

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Remedies for Limitations of Innovative Construction Techniques

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Abstract - In spite of many favorable energy conserving and cost effective techniques for building construction launched by various research laboratories, the usage of such techniques in the construction field is minimal / hardly significant. This paper enunciates some of the practical difficulties faced by construction stake holders in the application of any newer and innovative techniques. To overcome those difficulties the possible remedial measures are also suggested in this paper.

Keywords— Key words: Awareness, Proximity, Tax Benefits, Social Acceptance

Introduction

The following are the influencing factors of an innovative Construction technique in general.

Awareness, Structural limitations, Transfer of Technology, Nature of Materials and Methods, Proximity, Energy required, Labourers, Tax Benefits and Social Acceptance.

AWARENESS

This is required at all levels of people getting in touch with the transfer of technology from ink to trowel. Hence, the advertising agency like information centre, educational institutions to offer relevant training by suitably modifying and updating the syllabus, curricula, trade centres etc., help in this line. Nowadays local media is popularized to communicate any sort of information to all strata of community. But it is always a point that how effectively and elegantly at the same time in simple form particular information is taken to the society.

STRUCTURAL LIMITATIONS

The structural limitations of each and every technique must be made available at the rural proximity. People are ready to use thin, brittle asbestos sheet for roofing whereas hesitate to use filler slab. This is not only because of low initial cost but also the lack of knowledge on structural limitations. Similarly, planning and designing criteria of wall openings such as doors, windows, shelves, showcases etc., in the application of Rat-trap bond brick work needs a good knowledge on compressive strength of brick.

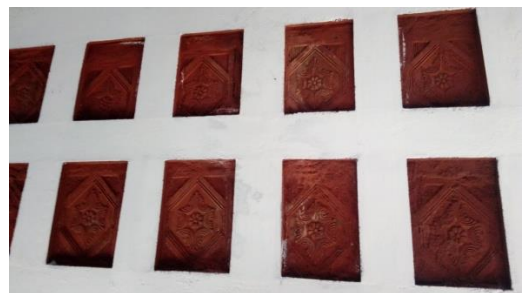
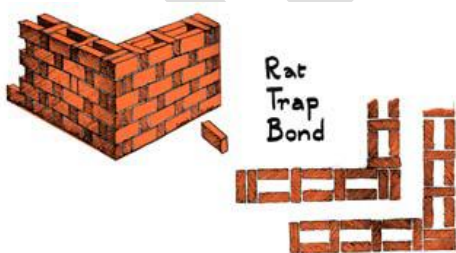


Fig.1 Schematic View of Rat-Trap Bond Brick Wall and Photograph of RCC Filler slab with Flat Tiles as Fillers

The figure 1 shows Schematic View of Rat-Trap Bond Brick wall and Photograph of RCC Filler slab with Flat Tiles as Fillers

Here, the structural limitations of Rat-Trap Bond Brick wall are 1) All bricks must be of full bricks no brick bat is suitable for this bond. 2) For brick satisfying minimum acceptable standards (compressive strength 5 to 7 MPa) the maximum clear spans of 230mm thick walls can be of 3000mm for a two parallel span of residential unit. 3) the middle wall of such two parallel spans of a residential building, can have adjoining doors opening or windows opening or door and window separated by a brick column of 375mm.

As far the RCC filler slab is concerned, 1) the minimum rib thickness is 75mm between two adjoining rows of fillers. 2) The outer most filler row should be spaced at least equal to the effective depth of the floor or roof slab for avoiding, shear failure. 3) Where ever the service lines like concealed wiring or other pipe lines are placed, extra stiffening with additional rods shall be provided for preventing stress concentration. 4) While laying concrete first the surrounding layer of concrete for each filler must be laid before laying concrete over the filler as screed concrete. 5) The performance of the slab can be improved by providing thermal reinforcement in the screed level.

TRANSFER OF TECHNOLOGY

The medium or agency through which technology transfer should take place is not a constant type. It should vary to cater the needs of all people, administrative, technical and non technical. In this stage, it is important to mention the need of interdisciplinary knowledge for all the above three categories of people. Moreover the job of extension workers is of extreme importance to offer all possible information's, suggestions from grass-root level to the administration level. Further use of audio visual aids can also help in this line to a large extent.

NATURE OF MATERIALS AND METHODS

The nature of materials used for the development of innovative technology should be of locally available and should demand fewer investments. The methods used for the development of a technology should be simple easy to understand and apply for a raw hand. To accomplish this, information on the wastes available in the existing agricultural and other industries in a particular locality is to be collected and used for innovations.

PROXIMITY

The site for process or preparation of materials, products, and components should be as far as possible very near to the actual use for the cost reduction. Our father of the nation Mahatma Gandhiji told all the item for construction of a residence must be brought from a maximum distance of 2 km, in view of minimizing the cost, that is maximizing the cost effectiveness. If such principle followed, certainly, a major portion of the cost of construction projects will be saved and in turn the national economy will be well protected.

ENERGY REQUIRED

Costly materials or more energy consuming techniques / materials have to be rejected and a judicious selection of materials is to be used. To satisfy this demand we should strictly adhere to the following order of preferences in selecting construction materials. Naturally available materials which are in direct use. 1) The waste products from other industries. 2) The materials consuming minimum energy for their final shape in the construction site. 3) As a last resort, the energy consuming materials at negligible use or minimal use.

LABOURERS

As far as labourers are concerned, to work on an unfamiliar technology, they are reluctant and demand more rates which in turn binds on uneconomical projects. Ultimately resulting in rejection of technology. To overcome this, suitable incentives / awards can be offered in encouraging the labourers who are taking part in the development and application of low cost technology. The government can issue schemes to apply the innovative techniques for the construction of shelters for labourers involved in construction fields. Free or partial wage agreement in group housing for labourers colony will go a long way to change the present trend of labourers.

TAX BENEFITS

Attractive tax benefits, supply of building materials at subsidized rates are also much useful in achieving the goal of housing for all. Middle income group and high income group people who are taking up the low cost constructions should be encouraged with higher tax benefits for having cooperated to maintain national economy.

SOCIAL ACCEPTANCE

This is the most important factor on which the total success of application of any new technique lies. The following are the major requirements of any technique to achieve social acceptance. It should suit to the local labourers and material sources. It should suit the locally available machines and equipments whether hand operated or power operated or by both. It should clear off the common man's doubt, as to whether strong enough etc., It should not offend the religious belief. Beyond all these, while the question of durability consideration strikes, the same could be very well answered by suitable audio visual aids showing the constructions performed under demonstration schemes along with the date of commencement of the structure, date of completion and also with date of last of attempt made to make maintenance etc.,

CONCLUSION

The various problems on the applications of innovative techniques and strategies to solve them are discussed. With the continuous effort of the Government and Non-Government agencies, many new techniques are coming up now a day. By proficiently using the recent innovations one can have his congenial shelter.

Acknowledgements: The authors would like to express her gratitude to the Management of Sri Ramakrishna Mission Vidyalaya and Sri Ramakrishna Mission Vidyalaya Polytechnic College, Faculty members of Civil Engineering Dept. for full co-operation to bring this paper in this shape.

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Investigation of Different Parameters of Air Cooler by Experimental Method and CFD Analysis

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Abstract— Air cooler is appliance that keeping atmosphere cold in a very cost effective manner. The basic concept of water cooling is to find medium that can reduce the temperature of the environment cool. Water has a very good ability to retain heat, in the meantime stay in liquid form. In this case, there is study about various air cooler models and select one of the model that is better and cost effective. The psychometric principles studied and compare the efficiency of the air cooler at various humidity conditions. Then we study about the evaporation rate of the water of specific quantity with different air velocity. The comparison analysis of air cooler with water and without water and how much effectiveness it is providing based on experimental studies.

Index Terms – Air cooler, Cooling pad, Mass flow rate, Humidity

INTRODUCTION

India is a tropical country in which most of the regions experience very low temperatures during the winter and very high temperatures during the summer seasons. That is, the temperature range between summer and winter seasons is very large. Hence, it is not a very pleasant experience and highly uncomfortable. Though cheaper methods of heating are available during the winter season, methods of cooling down the hot temperatures during the summer do not have wide variety of options. Air conditioners have high initial and running costs, which cannot be afforded by all the people in a developing country like India. Air coolers are relatively cheap, but provide unsatisfactory results; there is a need for developing a cheaper room cooling system. Conventional air conditioning is one of the major contributors of CFCs into the atmosphere. An alternative type of cooling, which does not expel CFCs is highly desirable as one important step in the correction of this problem. So, this is why adiabatic cooling is environmentally friendly because it is a passive cooling method that does not expel CFCs. It is 100% fresh air-cooling which even helps to clean the air it cools. With the help of Evaporative Technology swamp coolers provide cooling at cheaper than central air or larger air conditioners. A Regenerative type evaporative cooler cools air using a heat exchanger in addition to the direct evaporative method of cooling. It is observed that the overall efficiency of the system and the COP increase by about 20-25% than the normal air cooler system but the initial and maintenance costs of the system are increased due to the addition of a heat exchanger and a pump. The size of the system also increases due to the addition of more components. A multi- utility desert cooler is one in which water cooling as well as cold storage systems are attached in addition to the air cooling system. The average effectiveness was found to be 65.42% and a temperature range of 22-27° C was achieved. It can be used only in areas with high temperature and low relative humidity hence reducing its scope. Ndukwu MacManus Chinenye developed a clay evaporative cooler for the purpose of preservation of fruits and vegetables at a lower temperature and also to study the physical parameters such as cooling efficiency, cooling capacity, etc. in the system. The results showed that the evaporative cooler reduces the temperature up to 10° C and increases the relative humidity of incoming air for the storage chamber.

Problem statement

The air cooler is a cheaper technology compares to air conditioner in terms of energy efficiency and total cost. The study of air cooler efficiency and effectiveness based on the humidity is necessary because its feasibility in high humid regions have to be investigated. The other fact is the rate of water consumption in the air cooler if it is goes beyond the expected limit it will be problem for the drought ridden parts of the country.

Need of the project

The air cooler is one of the appliances used across India and the total sales is in crores of rupees and the efficiency and effectiveness of the system need to identify to increase the performance and efficiency of the system. If the air cooler system is proven very effective in this study then we can suggest people to choose air cooler due to its cost effectiveness.

Objective of the project

To study about various comparison parameters between air conditioners and air coolers

To analyze the air cooler in terms of efficiency and performance.

To compare the air cooler in geographic basis and investigate the efficiency difference

To compare the air cooler with a fan and air conditioner based on efficiency and performance

Working Principle

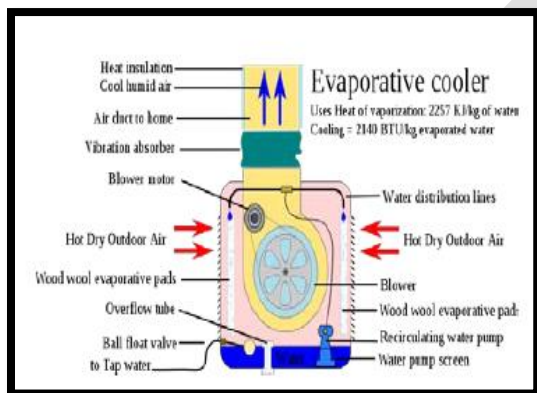


Fig. 1 Working Principle

An evaporative cooler is essentially a large fan with water moistened pads in front of it. Fan draws warm outside air through the pads and blows the now-cooled air throughout the house. Pads can be made of wood shavings. Aspen tree wood is traditional choice. They are also called as excelsior, need to be replaced every season or two, and generally cost \$20 to \$40 for a set. Small distribution lines supply water to top of pad. Water is soaked by pads and due to gravity, trickles through them to collect in a sump at the bottom of the cooler. A small re-circulating water pump sends the collected water back to the top of the pads

A large fan draws air through the pads, where evaporation drops the temperature approximately 20 degrees. The fan then blows this cooled air into the house. Small units can be installed in a window, Blowing cooled air directly into room.

Component of project

Cooling Pad

Most of the cooling pads are made up of Aspen fiber or cellulose. A cellulose pad typically needs more air and water flow than Aspen material. More evaporation can take place through a 6-inch pad than a 4-inch pad. A temperature reduction of 10 to 20 degree Celsius (50-68 degree F) can be achieved by passing hot fresh air through wetted pads.

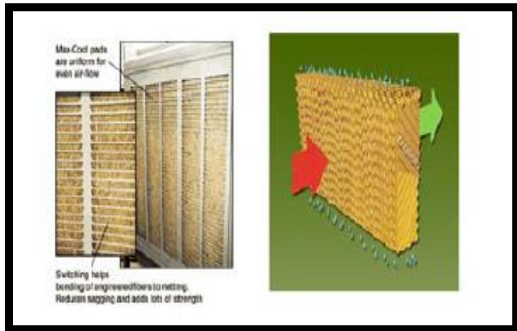


Fig. 2 Cooling Pad

Blower motor

Forced air is passed through heating or cooling elements and circulated to desired location. Air movement is provided by blower motor. Blower motor is combination of electric motor and fan. Generally a centrifugal fan with 6- to 10-inch hamster cage is used.



Fig. 3 Blower motor

Blower Fan

System of air cooling in cooler most commonly rely on forced air. Forced air is passed through cooling elements circulated to desired locations.



Fig. 4 Blower Fan

Fan efficiency is ratio between the power transferred to air stream and power delivered by motor to fan. The power of air flow is product of pressure and flow, corrected for unit consistency.

Re-circulating water pump

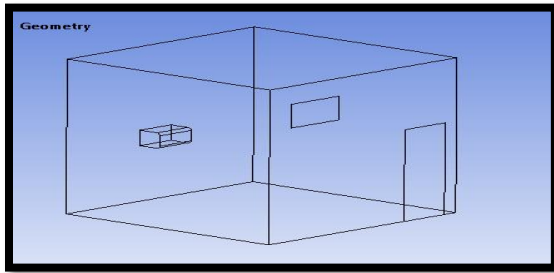
A recirculating pump draws water from the basin under pumps it through a system of sprays(or water distributors) from which water is directed onto the tube surfaces. Air is induced or forced over the wetted tube surfaces and through rain of water droplets. Evaporation is used to increase the rate of heat transfer from the tubes to the air.



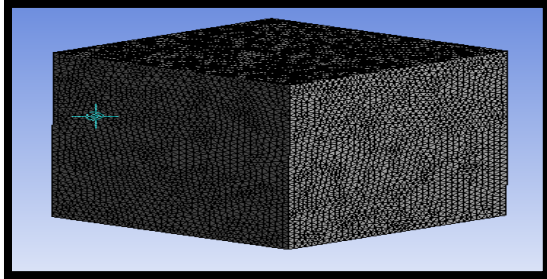
Fig. 11 Re-circulating water pump

Computational fluid dynamics (CFD) is a branch of fluid mechanics that uses numerical analysis and data structures to solve and analyze problems that involve fluid flows. Computers are used to perform the calculations required to simulate the interaction of liquids and gases with surfaces defined by boundary conditions. Ongoing research yields software that improves the accuracy and speed of complex simulation scenarios such as transonic or turbulent flows. Initial experimental validation of such software is performed using a wind tunnel with the final validation coming in full-scale testing, e.g. flight tests.

1 Room with cooler and vents

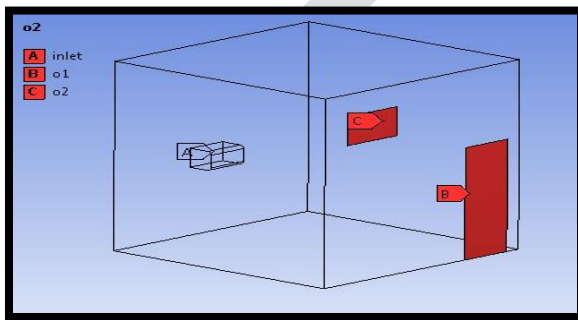


2.Mesh

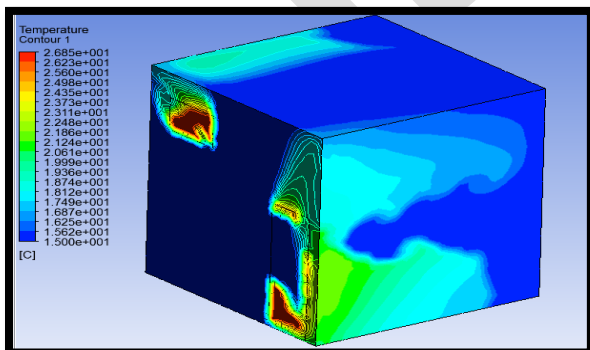


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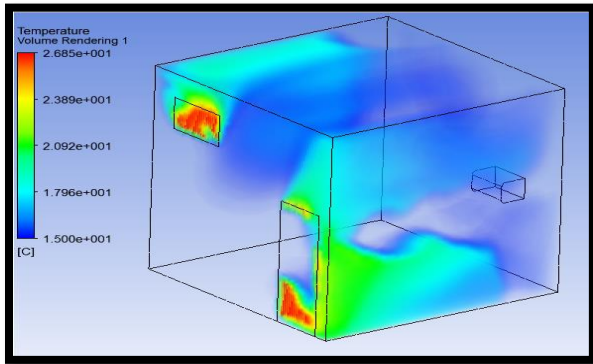
3. Named Selection



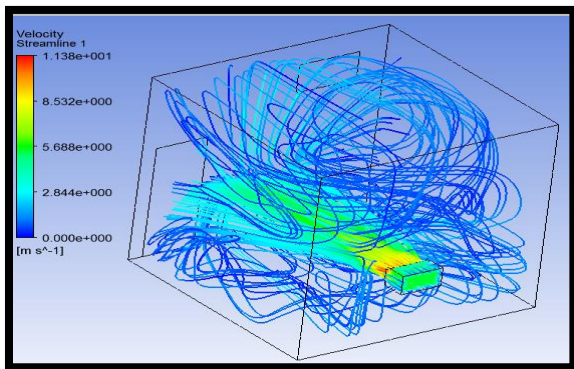
4. Mass flow rate 1kg/s



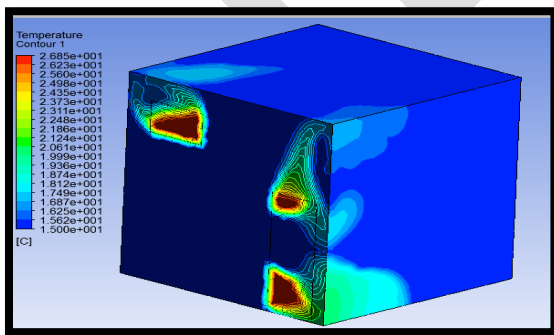
5. Volume rendering



6. Velocity

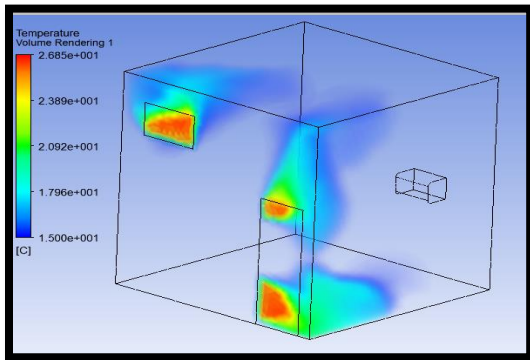


7. Mass flow rate 0.5 kg/s

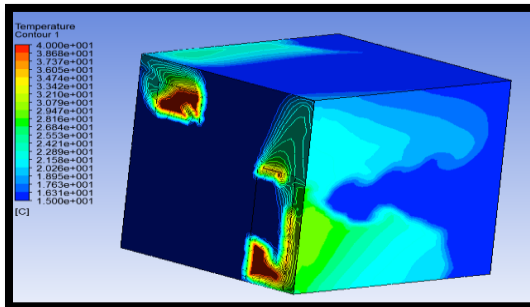


Temperature

8. Volume rendering

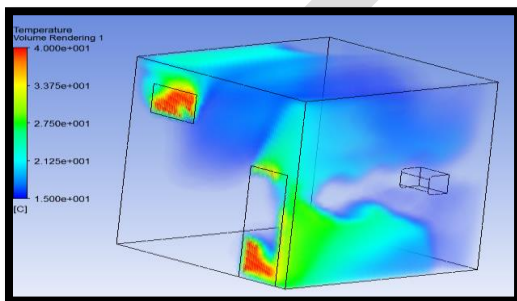


9. VENT TEMPERATURE 40 DEG

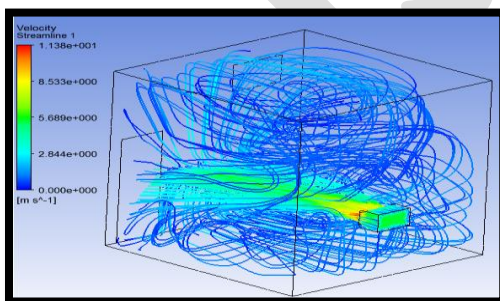


Temperature

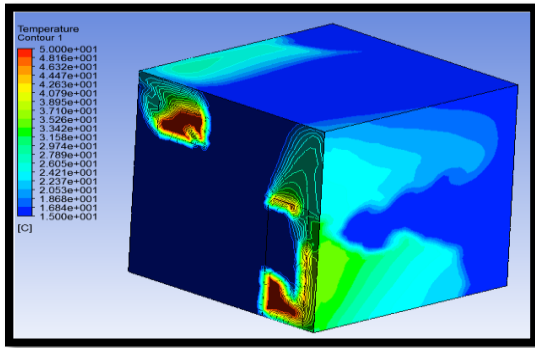
10. Volume rendering



11. Velocity

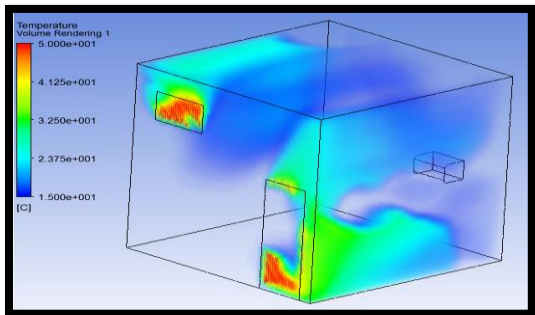


12. VENT TEMPERATURE 50 DEG

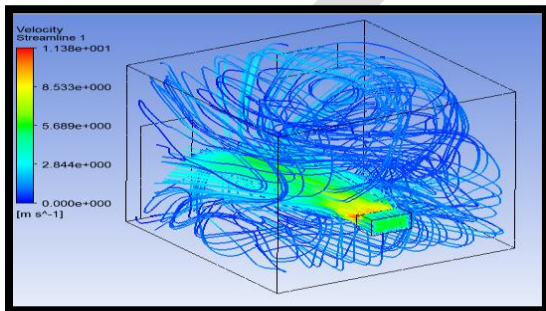


Temperature

13. Volume rendering



14. Velocity



Conclusion

With the ongoing energy crisis and pollutant emission constrains, use of evaporative air coolers are much advantages.

The difference between the outside air dry bulb temperature and the wet bulb temperature is the key factor which decides the use of evaporative coolers. Larger the difference, usefulness of evaporative coolers is better.

Cabinet type coolers are sufficient for cooling of small air volumes. For large spaces, more cabinet coolers are employed

From CFD analysis we selected accurate effective blade of Air cooler

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Advancement of high temperature and high pressure utilizing oil based drilling mud by using nanotubes

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ABSTRACT-It is imperative to comprehend the perspectives affecting oil based mud (OBM) rheology with a specific end goal to keep up a firm control over rheological properties of high temperature high pressure (HTHP) and high thickness oil based mud. This paper centers principally around the rheological properties of water-based boring liquid under high pressure and high temperature condition. This work centers around the outline, enhancement and plan of a HTHP water-based boring liquids as per the required determination, for example, rheological properties and liquid misfortune. To meet the previously mentioned boring liquid properties, the exploration was boundless to the utilization of dirt, polymers, and nanoparticles. Polymers give incredible rheological and liquid misfortune properties tooil base muds yet corrupt at high temperature. The test strategy utilized was by and large blending of oil base mud with certain detailing and after that performing mud testing. The experimentation were led by "Suggested Practice on Standard Field Procedure for Testing Drilling Fluid" API RP 13B and "Prescribed Practice 13I Standard Field Procedure for Laboratory Testing Drilling Fluid" API 13I to meet the American Petroleum Institute (API) prerequisites and acquire dependable outcomes. The principle research facility tests associated with this task are mud arrangement, static rheology test, pH and HTHP static channel press. A bentonite mud and high temperature manufactured polymers have been effectively tried at 400-degree F with great rheological and filtration properties. The base mud definition comprises of the business synthetic concoctions given by ScomiOiltools, Malaysia. The base mud plan has a steady rheology and superb liquid misfortune properties at 400 F. A thin and impermeable channel cake has been acquired with least liquid misfortune at a temperature of 400 F. Specialists have effectively utilized nanoparticles for giving amazing rheology, warm strength and liquid misfortune control. Two nanoparticles to be specific, Polypeptide nanotubes (PNT) and Aluminum Oxide were tried on the base OBM framework to break down their impacts on HTHP rheology, liquid misfortune, and channel cake quality. An exceptionally positive outcome has been acquired utilizing Polypeptide nanotubes (PNT). The utilization of PNT in OBM expanded HTHP rheology by 14% and decreased liquid misfortune by 25%. Additionally, this exploration gives answers for the issues identified with HTHP OBM improvement like mud gelation, strong listing, and low-end rheology.

Keywords- HPHT, Oil based mud, polypeptide nanotubes, rheological properties.

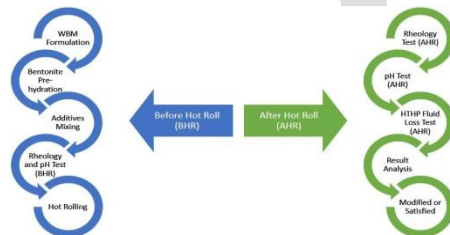
INTRODUCTION

The most dominating issue that can influence boring liquids in HTHP conditions, is the warm corruption of the oil based mud framework, and prompting changes in its properties under HTHP conditions. Oil-based mud can oppose warm corruption and withstand serious downhole condition like HTHP. In any case, oil based mud forces a negative effect on nature and it isn't financially feasible contrast with the other sort of mud frameworks, for example, OBM. Henceforth, boring into arrangements with HTHP requires an eco-accommodating OBM penetrating liquid having stable rheological and improved liquid misfortune properties [8]. The principle capacity of bentonite in OBM is to hoist thickness and diminish filtration misfortune to wellbore dividers. Bentonite can be grouped into either Ca-bentonite with low swelling limit or Na-bentonite with high swelling limit [1]. As per Shan Wenjun et al., [3], the dirt property will be enormously influenced with expanding temperature because of hydration and mixture of Bentonite earth molecule in high temperature condition. Dirt gelation process in OBM requires exceptional consideration at temperatures higher than 300 F. Bentonite focus ought not be surpassed in excess of 3 lb/bbl while defining HTHP OBM [2]. An effective HTHP well boring requires a suitable control on penetrating mud rheology. As Johann [2] expressed that "if grouping of Bentonite or dirt materials surpasses satisfactory levels and results in consistency issues, polymeric defloculants can be utilized if all else fails to control rheology." previously, high solids scattered penetrating liquid frameworks for HTHP boring contained lignosulfonate and lignite for rheology and liquid misfortune control. The customary lignite/lignosulfonate high-strong scattered muds work at alkalinity (pH 9) and

require high measurements of lignite/lignosulfonate at temperature over 360 F in light of warm debasement. Chrome lignite debasement result is CO₂ which flocculates earth and Bentonite, causing high return point and gel quality [2]. The ongoing advancement of manufactured short chain polymeric deflocculants enhanced the temperature solidness and low measurements contrasted with traditional lignite/lignosulfonates. They are temperature-stable over 400 F. Nanotechnology and surfactant has added to novel improvements in oil industry in the previous couple of decades. The rheology at HTHP condition is influenced by breaking bonds between mud particles at high temperature [6]. Nano based boring liquid extraordinarily lessens frictional obstruction between penetrate pipe and wellbore divider by framing a greasing up film at divider and pipe interface. Shale arrangement comprises of receptive dirt, which adhere to the bore and centralizer, causing balling impact. Nano based mud could be a superior decision in penetrating task in responsive shale in light of it hydrophobic film shaping trademark [12]. Because of the nearness of expansive amount of exact moment particles with high surface zone, warm conductivity, high temperature dependability, high versatility, and warm conductivity, compelling association with interior and outer surfaces of shake, nanoparticle-based penetrating liquids are foreseen to assume a key part in future and current high temperature and high pressure boring tasks [11]. Multiwall Carbon Nanotube (MWPNT) has been effectively utilized by Abduo et al., [8] to enhance HTHP rheological dependability and liquid misfortune.

II. EXPERIMENTAL PROCEDURE

The strategy is partitioned into a few stages, as appeared in Figure 1. The determinations of HTHP penetrating mud were set by the field understanding by boring liquid specialists of ScomiOiltoolsSdn. Bhd. The two stages included are before hot moving (BHR) and after hot moving (AHR). BHR comprises of Bentonite (Drill-Gel) pre-hydration for 16 hours, blending of freshoil base mud, rheology and pH test, and hot rolling. The tests required after hot moving (AHR) are same as BHR with an additional HTHP liquid misfortune test.



2.1 Drill-Gel Pre-Hydration

Pre-hydrated Drill-Gel was set up by including 35 lb/bbl of Drill-Gel and 1 lb/bbl of harsh pop to 0.97 bbl of water. The blend was mixed at fast for 30 minutes utilizing Hamilton shoreline blender. It was then kept for 16 hours at room temperature for better hydration.

2.2 Additive Mixing

The request of synthetic concoctions blended is appeared in table 1. The method for including synthetic concoctions and blending time for every substance is a vital perspective in oil base mud blending. The polymers were included gradually, and all the more blending time was given to every polymer for better hydration. A moderately higher blending time was additionally given to Drill-Bar and Drill-Gel.

2.3 Rheology Test

Rheology test speaks to the stream conduct and opening cleaning productivity of boring mud. This test is utilized to record rheology parameters like yield point (YP), plastic consistency (PV), and gel quality utilizing Fann viscometer-display 35SA. For HTHP mud the tests were done at 150 F as indicated by API models.

2.4 pH Test

pH meter was utilized to discover the pH of boring liquid. pH assumes a vital part in oil base mud and influences mud properties. Water-base boring liquids are by and large kept up in the 8 to 12 pH run for enhanced synthetic dissolvability and execution, and also for hostile to consumption of penetrating and culmination devices (Scomi).

Table 1
Chemicals used and their function

Additive	Function	Base (lb/bbl)	Base + PNT (lb/bbl)	Base+Al ₂ O ₃ (lb/bbl)
Drill fluid (bbl/bbl)	Base fluid	0.523	0.523	0.523
Caustic Soda	pH modifier	To pH 10	To pH 10	To pH 10
Soda Ash	control hardness	0.7	0.7	0.7
Hydro-Defoam HT	Foam remover	1	1	1
Hydro-Therm LV	HT Fluid Loss Polymer	6.2	6.2	6.2
Hydro-Therm R	HT Fluid Loss Polymer & Rheology modifier Polymer	1.8	1.8	1.8
Hydro-Zan	Rheology modifier	0.7	0.7	0.7
Sodium Chloride	Salinity	74.42	74.42	74.42
Hydro-Plast	HT fluid loss, shale stability	4	4	4

Hydro-Seal R	Bridging material, lubricity	4	4	4
Hydro-Sperse RS	HTHP Rheology stabilizer	2	2	2
Polypeptide nanotubes	Rheology & fluid loss improver	-	0.5	-
Aluminum Oxide	Rheology improver and H2S scavenger	-	-	0.5
Drill-Bar	Pressureing agent	Up to 14 ppg	Up to 14 ppg	Up to 14 ppg
Drill-Gel	Viscosifier and Fluid loss control	8	8	8
Magnesium Oxide	pH buffer	1.5	1.5	1.5
Ox-Scav L	Polymer extender	1	1	1
Hydro-Buff HT	Polymer extender, HT rheology Improver	1.5	1.5	1.5

2.5 Hot Rolling

Hot rolling is a procedure, which mimics a well bore mud dissemination in the research center utilizing a roller broiler and mud maturing cell. The reason for hot rolling is to check how the mud properties will change after a mud course at certain temperature. The mud tests were hot moved at 380 F and 400 F for 16 hours under 200 Psi pressure.

2.6 HTHP Fluid Loss Test

High temperature and high-pressure channel press is utilized at high temperatures and high pressures to locate the liquid misfortune. This test can be performed at unique down-gap temperature giving sensible estimations of liquid misfortune. All the HTHP liquid misfortune tests were performed utilizing Ofite HTHP channel press with strung cells (500 mL) at temperature 380 to 400 F and 500 Psi differential pressure. The paper speaks to an enhanced plan for HTHP dispersedoil base mud. The base detailing is an upgraded arrangement of polymers, earth, and dispersant with enhanced mud properties at lifted temperatures. The base is additionally enhanced by detailing with nanoparticles like Carbon Nanotube (PNT) and Aluminum oxide. The ordinary field particulars that were set up to depict the execution of the perfect liquid incorporated a Plastic Viscosity (PV) of under 50 cP, Yield Point (YP) in a scope of 18 to 30 lb/100ft² and HTHP liquid loss of under 20 ml at 380-400 oF, and 500-psi differential pressure on solidified paper. The rheological properties were estimated by API norms utilizing fann 35SA viscometer at 150 F (66 oC).

III. RESULTS AND DISCUSSION

3.1 Formulation of Base

Theoil base mud was at first detailed with Drill-Gel as viscosifier and without Hydro-Sperse RS. The rheological properties after hot moving at 380 F for 16 hours expanded to high and unsatisfactory range (over 30 lb/100ft²). The plastic consistency (PV) and yield point (YP) were too high for down to earth application (PV over 50 cP). This expansion in rheology is caused by high temperature dirt gelation marvels. Shan Wenjun et al., [3] credited this to the mud property which is significantly influenced with expanding temperature because of hydration and mixture of dirt particles under high temperature condition.

A similar plan was then blended with a polymeric deflocculant known as Hydro-Sperse RS. Hydro-Sperse RS settled the rheology by scattering the earth at high temperature. The polymer uncoiled and accomplished a straight chain setup when broken down in water because of common shock of same charged gatherings along the chain. Hydro-Sperse RS effectively enhanced the activity by fortifying earth platelet disaggregation. Un-hydrated earth platelets are collected by edge to face and up close and personal electrostatic holding as shown in Figure 2.

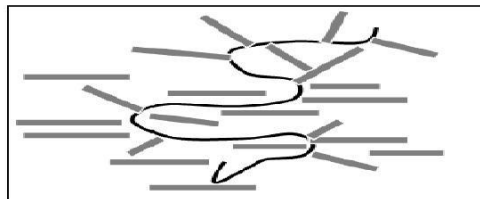
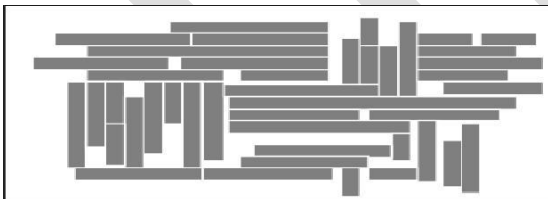


Fig. 1. Clay platelet aggregation before hydration Fig. 2. Short chain anionic polymers enhances disaggregation

At the point when water contacts polymer progresses toward becoming uncoil and adsorbs on dirt where polymer's negative charge kill positive charge of earth. This causes platelet disaggregation since polymer defeats the bond quality of the macrostructure as appeared in Figure 3. It turns out to be more powerful contrasted with untreated earth on the grounds that a bigger division of mud gets initiated for hydration [9]. The Figure 4 beneath demonstrates the rheology bends with and without Hydro-Sperse RS. Another examination in this exploration is the commitment of Hydro-Sperse RS to HTHP liquid misfortune. The ideal fixation for the most reduced liquid misfortune was derived to be 2 lb/bbl as appeared in Figure 5. This can be clarified as Hydro-Sperse RS disperse clay particles causing the formation of a thin.

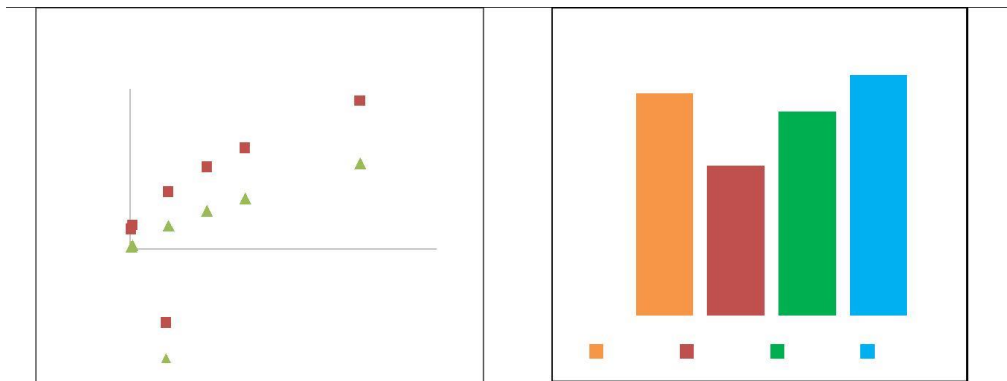


Fig. 3.Effect of Hydro-Sperse RS on Rheology after Fig. 4. Effect of Hydro-Sperse RS on Fluid loss shot rolling



Fig. 5.Barite sagging due to low LSRV

The low end rheology or low shear rate consistency (LSRV) alludes to 3 and 6 rpm dial perusing of Fann viscometer. The low wellbore annular shear rate is best approximated by 6 rpm perusing, comparable to a shear rate of 10.2 sec⁻¹. The 6 rpm perusing for boring liquids is imperative for cleaning the gap and suspend the cuttings. LSRV esteems are the primary inhibitive system for barite hanging at dynamic condition. These properties ought to be kept up inside the range for a specific arrangement of wellbore condition (Scomi). The utilization of Hydro-Sperse RS settled the rheology (PV and YP) at high temperature yet diminished the low end rheology (LSRV). The diminishing in LSRV brought about extreme drooping of solids as appeared in Figure 6. The LSRV was effectively raised by utilizing Hydro-Zan and Hydro-Buff HT. Hydro-Zan polymer is steady up to 250 F and corrupts at temperature higher than 250 F. The cooperative energy of hydro-zan and Hydro-Buff HT is clarified as Hydro-Zan proficiently balanced out LSRV until a temperature of 250 F, while over that, Hydro-Buff HT is in charge of adjustment of LSRV and generally rheology in view of its high temperature solidness. This methodology productively disposed of strong listing at high temperature. The general testing results are appeared in Table 2.

Table 2
Drilling fluid properties at 380-400 F

Drilling Fluid	Temperature (°F)	Plastic viscosity (cP)	Yield point (lb/100 ft ²)	10 sec Gel (lb/100 ft ²)	10 min Gel (lb/100 ft ²)	HTHP Fluid loss (mL)	Cake thickness (1/32 inch)
Base	150 °F (BHR)	58	45	8	32	-	-
	150 °F (AHR 380 °F)	42	17	5	6	8	3
	150 °F (AHR 400 °F)	42	21	3	6	9	4
Base + PNT*	150 °F (BHR)	62	52	9	35	-	-
	150 380 °F (AHR ₀)	53	30	4	10	6	2
	150 °F (AHR 400 °F)	48	22	4	7	8	3
Base+ Al ₂ O ₃	150 °F (BHR)	56	46	8	35	-	-
	150 °F (AHR 380 °F)	46	21	4	10	9	4
	150 °F (AHR 400 °F)	42	20	4	7	9	4

(AHR) will be closer to reality and more meaningful at these conditions. It can be seen from Figure 7 that rheology is higher for mud sample with nanoparticles. The concentration of both Polypeptide nanotubes (PNT) and Aluminum Oxide nanoparticle is 0.15% by pressure. A small concentration of both nanoparticles improved the rheology of mud at 400 F. The rheology can be broadly explained in terms of PV, YP and gel strength.

3.2 Plastic Viscosity (PV)

Drilling fluids usually consist of dispersed solids in continuous phase of fluid. PV (Plastic viscosity) is caused by mechanical friction of solids which constitute to total flow resistance. From Figure 8, it can be seen that PV increases for both samples containing nanoparticles compared to base sample. Many factors like increasing percent volume of solids, constant percent volume of solids, and decreasing particles size in drilling fluid increases plastic viscosity. Small particles size has high surface to volume ratio, which causes increased frictional drag (Scomi). The PV is higher for Carbon nanotube fluid compared to Al₂O₃ because its particle size is very small compared to Al₂O₃ and hence has a high surface to volume ratio.

3.3 Yield Point (YP)

The electrochemical attractive forces in the mud particles cause flow resistance and is termed as yield point. The surface of dispersed particles in mud can have positive, negative, or neutral charge. These charges cause electrochemical attractive or repulsive forces under dynamic condition, giving rise or drop to yield point respectively [7]. From Figure 8, it can be seen that YP of base sample is thermally stable up to 400 °F. Table 2 shows the drop in YP for all the samples after hot rolling at 380 and 400 °F. The YP or rheology for all the samples are in a stable range after hot rolling. Adding Polypeptide nanotubes and Aluminum Oxide nanoparticle further increased and stabilized the solid carrying capacity (YP). Polypeptide nanotubes efficiently increased and stabilized yield point of the base mud sample. This increase in YP is due to increasing quantity of solid particle and complex interactions among carbon nanoparticles and other additives. Al₂O₃ loses a proton in aqueous medium when pH is high and obtain a net negative surface charge [10]. This negative charge is responsible for interaction of Al₂O₃ with other charged particles and hence modify YP of the mud system. The most stable YP is given by polypeptide nanotubes compared to Aluminum Oxide and base.

3.4 Gel Strength

Gel strength is the power of forces of attraction in drilling mud at static condition. Figure 9 shows that gel strength for all the samples are in a range of 4 to 11 lb/100ft². These gels are considered as low gels and hence are desired in mud engineering perspective. High strength of attractive force cause high gelation, and vice versa. Flocculation of solids in the mud causes excessive gelation which results in high mud pump pressure to break the gel after a shutdown period. These gels are neither progressive nor high flat gels as these are undesired in the drilling industry (Scomi).

3.5 HTHP Filtration Properties

The combination of synthetic fluid loss polymers, dispersant, and clay enhanced the fluid loss properties of the base mud sample up to 400 °F. Dispersant and fluid loss polymers are negatively charged low molecular pressure polymers of short chain length. These negatively charged polymer adsorbs on positively charged clay platelets causing neutralization of charges. This creates an

overall negative charge and deflocculation occurs. The dispersion or deflocculation of clay particles result in the formation of a thin and impermeable filter cake. The formation of thin and impermeable filter cake resists excess fluid loss to wellbore formation. The synthetic fluid loss polymers used in this oil base mud system also work as secondary viscosifier. The lower fluid loss can also be explained by the fact that a viscous base fluid of mud reduces fluid loss. This proves that the used polymers are stable up to or perhaps above 400 °F. The addition of Polypeptide nanotubes to the base further enhanced the fluid loss properties. Polypeptide nanotubes not only reduced fluid loss but also filter cake thickness at high temperature and high pressure. Polypeptide nanotubes reduced the fluid loss by physically plugging the nano-sized pores of the filter cake (A.I. El-Diasty). This resulted in a thin impermeable filter cake with reduced fluid loss compared to other two samples. Aluminum Oxide did not show any improvement in fluid loss.

IV. CONCLUSION

In the present period, HTHP well boring is a standard and necessities a liquid with thermally stable rheology, liquid misfortune and other mud properties. This examination demonstrates that a traditional oil base mud framework can be upgraded by utilizing built engineered polymers, dispersants, and dirt to proficiently withstand a high temperature up to or over 400 °F. The base definition itself has streamlined rheological solidness and brilliant filtration properties at 400 °F. It is likewise reasoned that similarly helped in warm steadiness, rheological and filtration properties of oil base mud at high temperature and high pressure. Aluminum Oxide nanoparticles demonstrated a little change in rheology with a restrictive advantage of being hydrogen sulfide forager.

V. RECOMMENDATION

The additional substances related with the base enumerating are Scomi Oiltools business manufactured mixes with enhanced rheology reliability and transcendent filtration properties at ultra HTHP conditions. These novel engineered creations and itemizing can be instantly associated with by and by significant HTHP wells the world over. This oil base mud structure can be made prevalent inhibitive water base system like KCl/Polymer system, glycol or formate structure for entering responsive shale improvements. It is furthermore recommended to separate destructive or surfactant treated polypeptide nanotubes in oil base mud.

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Information Security in Big Data

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Abstract: The Era of Big data and Information security tends to both opportunity and risk management for every business activities. In Big data, Information security standpoint big data has ushered in new possibilities in terms of analytics and security solutions to protect data and prevent future cyber attacks. In Information security point of view big data is a very large data set that is mined and analyzed to find patterns and behavioral trends. In this paper we focus on process involved in data processing and overlook the security issues of big data and describes the scope of big data in business field.

Keywords: Big data, Information security, Data Encryption, Hadoop file system.

Introduction:

Big data is becoming an immensely important part of the business plan for companies in many different areas. Analyzing huge customer datasets and other kinds of data with different tools. companies save money as well as boost revenue by targeting their marketing better, designing products to better service to their customers and make better predictions. Companies that use big data, especially if that data consists of personal information of customers, are at an elevated risk of drawing hacking attempts. Developing ways to protect that data will prove to be just as important as the data itself. Information security has experienced a profound paradigm shift from traditional perimeter protection tools towards monitoring and detecting malicious activities within corporate networks. Growing role of malicious insiders in the recent large scale security breaches clearly defines that traditional approaches to information security can no longer keep up. As the security industry's response to these challenges of security, a new generation of security analytics solutions has emerged in the past few years, which are able to collect, store and analyze large amounts of security data across the whole enterprise in real time. Big Data and advanced analytics to relate security events across multiple data sources, providing early detection of suspicious activities, rich forensic analysis tools, and highly automated remediation workflows. In this paper we are discussing the level of awareness and current approaches in information security and fraud detection in organizations around the world. Big Data security analytics initiatives, presents an overview of various opportunities, benefits and challenges relating to those initiatives, as well as outlines the range of technologies currently available to address those challenges.

I. Security issues on Big data:

Big data security is a constant concern because [Big Data](#) deployments are valuable targets to would-be intruders. A single ransomware attack might leave your big data deployment subject to ransom demands. Securing big data platforms takes a mix of traditional security tools, newly developed toolsets, and intelligent processes for monitoring security throughout the life of the platform.

Big data environments add another level of security because security tools must operate during three data stages that are not all present in the network. These are

- a) data access/entry
- b) Data storage
- c) Data outcome

a) **Data Access / Entry:** Big data sources come from a variety of sources and data types. User-generated data alone can include CRM or ERM data, transactional and database data, and vast amounts of [unstructured data](#) such as email messages or social media posts. In addition to this, you have the whole world of machine generated data including logs and sensors. You need to secure this data in-transit from sources to the platform.

b) **Data Storage:** Protecting stored data takes mature security toolsets including encryption at rest, strong user authentication, and intrusion protection and planning. You will also need to run your security toolsets across a distributed cluster platform with many servers and nodes. In addition, your security tools must protect log files and [analytics tools](#) as they operate inside the platform.

c) Data Outcome: The entire reason for the complexity and expense of the big data platform is being able to run meaningful [analytics](#) across massive data volumes and different types of data. These analytics output results to applications, reports, and dashboards. This extremely valuable intelligence makes for a rich target for intrusion, and it is critical to encrypt output as well as ingress. Also, secure compliance at this stage: make certain that results going out to end-users do not contain regulated data.

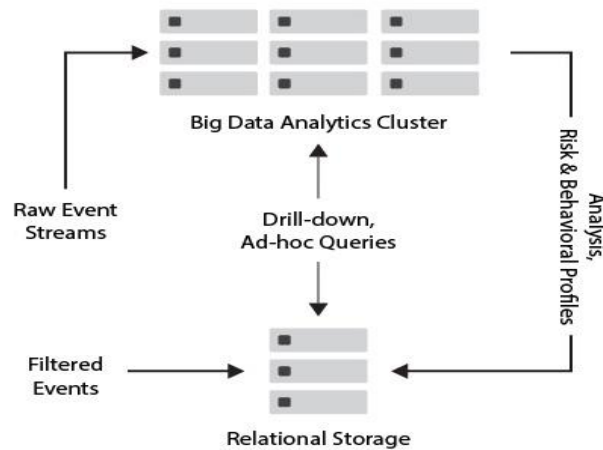


Fig.1: Data flow and Security in Bid Data

Solutions to the problem of security with privacy for big data require referring many research challenges and integrative approaches. The following are the challenges we encountered:

- i) *Data mining solutions.* These are the heart of many big data environments; they find the patterns that suggest business strategies. For that very reason, it's particularly important to ensure they're secured against not just external threats, but insiders who abuse network privileges to obtain sensitive information – adding yet another layer of big data security issues.
- ii) *Endpoints.* Security solutions that draw logs from endpoints will need to validate the authenticity of those endpoints, or the analysis isn't going to do much good.
- iii) *Real-time security/compliance tools.* These generate a tremendous amount of information; the key is finding a way to ignore the false positives, so human talent can be focused on the true breaches.
- iv) *Access controls.* Just as with enterprise IT as a whole, it's critically important to provide a system in which encrypted authentication/validation verifies that users are who they say they are, and determine who can see what.
- v) *Storage.* In big data architecture, the data is usually stored on multiple tiers, depending on business needs for performance vs. cost. For instance, high-priority "hot" data will usually be stored on flash media. So locking down storage will mean creating a tier-conscious strategy.
- vi) *Granular auditing* can help determine when missed attacks have occurred, what the consequences were, and what should be done to improve matters in the future. This in itself is a lot of data, and must be enabled and protected to be useful in addressing big data security issues.
- vii) *Distributed frameworks.* Most big data implementations actually distribute huge processing jobs across many systems for faster analysis. Hadoop is a well-known instance of open source tech involved in this, and originally had no security of any sort. Distributed processing may mean less data processed by any one system, but it means a lot more systems where security issues can crop up.
- viii) *Non-relational data stores.* Think NoSQL databases, which by themselves usually lack security (which is instead provided, sort of, via middleware).

- ix) *Data provenance* primarily concerns metadata (data about data), which can be extremely helpful in determining where data came from, who accessed it, or what was done with it. Usually, this kind of data should be analyzed with exceptional speed to minimize the time in which a breach is active. Privileged users engaged in this type of activity must be thoroughly vetted and closely monitored to ensure they don't become their own big data security issues.

II. Technologies in Big Data Security:

The Big data technologies used in the security system can find the security threat earlier. For instance big data technology can detect abnormal behavior in the network, predict the attack behavior, and analyze the source of the attack.

The following are some of the techniques used in Big data security

- **Encryption:** Your encryption tools need to secure data in-transit and at-rest, and they need to do it across massive data volumes. Encryption also needs to operate on many different types of data, both user- and machine-generated. Encryption tools also need to work with different analytics toolsets and their output data, and on common big data storage formats including relational database management systems (RDBMS), non-relational databases like NoSQL, and specialized file systems such as Hadoop Distributed File System (HDFS).
- **Centralized Key Management:** Centralized key management has been a security best practice for many years. It applies just as strongly in big data environments, especially those with wide geographical distribution. Best practices include policy-driven automation, logging, on-demand key delivery, and abstracting key management from key usage.
- **User Access Control:** User access control may be the most basic network security tool, but many companies practice minimal control because the management overhead can be so high. This is dangerous enough at the network level, and can be disastrous for the big data platform. Strong user access control requires a policy-based approach that automates access based on user and role-based settings. Policy driven automation manages complex user control levels, such as multiple administrator settings that protect the big data platform against inside attack.
- **Intrusion Detection and Prevention:** Intrusion detection and prevention systems are security workhorses. This does not make them any less valuable to the big data platform. Big data's value and distributed architecture lends itself to intrusion attempts. IPS enables security admins to protect the big data platform from intrusion, and should an intrusion succeed, IDS quarantine the intrusion before it does significant damage.
- **Physical Security:** Don't ignore physical security. Build it in when you deploy your big data platform in your own data center, or carefully do due diligence around your cloud provider's data center security. Physical security systems can deny data center access to strangers or to staff members who have no business being in sensitive areas. Video surveillance and security logs will do the same.

III. How to improve Security in Big data:

The most appropriate technique to enhance Big Data security is by informing the role played by organizations who provide the platforms and systems to access the data, by providing timely patches and security upgrades. Making security a high priority for systems puts the onus on system as well as application builders to be vigilant about security flaws, and also puts more eyeballs on the security front. With several vendors providing various solutions, you get a more precise defense against the security threats targeting Big Data applications.

Some recommendations that you can adopt to strengthen security are mentioned below:

- Do not focus all your attention on device security. Application security is of more importance.
- Keep devices and servers that contain sensitive information isolated.
- Introduce reactive and proactive protection.
- Attribute based encryption to protect sensitive information shared by third parties

Secure open source software such as Hadoop

- Offer real-time security management Collaborating with other industry peers to create industry standards, head off government regulations, and to share best practices
- Maintain and monitor audit logs across all facets of the business

Finally, Big data presents more number of opportunities for businesses that go beyond just enhanced business intelligence. Big data offers the ability to increase cyber security itself. In order to benefit from the many opportunities big data presents, companies must enhance the responsibility and risk of protecting the data.

Conclusion:

This paper introduces impact to information security from two aspects of big data. Finally, end-users are just as responsible for protecting company data. Even though many companies use their big data platform to detect intrusion anomalies, that big data platform is just as vulnerable to malware and intrusion as any stored data. Organizations must ensure that all big data bases are immune to security threats and vulnerabilities. There is a large scope for research in the security issues in Big data.

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Assessment of heavy metal contamination degree of municipal open-air dumpsite on surrounding soils: Case of dumpsite of Bonoua, Ivory Coast

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Abstract- In Ivory Coast, the majority of uncontrolled dumpsites are open-air. The aim of this work is to study the lateral and vertical distribution of heavy metals or metalloids in soils surrounding the open dumpsite of M'Ploussou Park in Bonoua, which has a wet tropical climate and located at upper topographical position. The physical and chemical parameters, such as the particle size, pH, exchangeable cations, CEC and contents of heavy metals, were studied using various analytical techniques. The vertical and lateral distribution of heavy metals or metalloids in soil samples collected from the M'Ploussou dumpsite in Bonoua were found to be in the following order: $Zn > Pb > Cr > Ni > Cd > As > Cu > Se$, regardless of the topographical position of the soil profile. Our results indicate that there are high levels of heavy metals (Cr, Pb, Cd, Zn, Ni) that exceed the CCME permissible limits in agricultural and industrial soils in both the top soil layers and in soil located below the dumpsite, probably due to the migration and infiltration of dumpsite leachate. The vertical and lateral distributions of metals or metalloids at dumping sites can pose potential ecological risks if these elevated concentrations of metals migrate into soil, plants and groundwater, where they present a danger to humans. Thus, it appears to be necessary to apply proper remediation techniques.

Keywords: assessment, heavy metal, toposequence, solid waste, open air dumpsite, M'Ploussou Park, Bonoua.

INTRODUCTION

In Ivory Coast, the rapid rate of industrialization, population growth and modernization have contributed to the generation of millions of tons of solid waste in different categories, including hazardous and non-hazardous waste. Solid wastes are heterogeneous and include plastics, electronic goods, electroplating waste, painting waste, used batteries, old clothes, syringes, needles, papers and organics materials, which are the origin of the high levels of heavy metals observed in dumpsite soil [1, 2].

The continuous accumulation of municipal solid wastes from different sources causes an undesirable enrichment of heavy metals or metalloids in dumpsite areas [3]. These toxic elements can enter soil and groundwater resources and, consequently, pose a severe environmental threat [4]. Heavy metals in the environment are non-biodegradable and are subject to bioaccumulation [5]. Thus, soil and groundwater can be vertically and laterally contaminated by the migration of leachate under waste dumpsites, where they damage the environment and human health [6]. However, the stability of heavy metal(loids) in the soil is high in contrast to other components of the environment (such as the atmosphere or water), leading to long-term or even permanent pollution [3]. Soil and water contaminated with heavy metal or metalloid attract attention because of their severe threats to the food chain, human health and soil ecosystems [7].

For this reason, it is necessary to investigate soils surrounding open dumping sites, which can be possible sources of pollutants. Thus, it appears to be important to study the lateral and vertical distributions of heavy metal(loids) in soils at the open dumpsite of M'Ploussou Park in Bonoua, which has a wet tropical climate.

Ours aims in this work are to (1) determine the nature of the toxic elements present in the dumpsite soil of the M'Ploussou Park in Bonoua, (2) follow the lateral and vertical distributions of heavy metal(loids) in the soils along a toposequence in dumpsite areas, and (3) identify the potential ecological risks for users and residents.

MATERIALS AND METHODS

Study area

The study area is situated in the southeast region of Ivory Coast at Bonoua, 60 km from Abidjan, between latitude 5°14' to 5°31' N and longitude 3°13' to 3°51' W. The dumping site is located in the M'Ploussou Park, Bonoua, at latitude 5°16' N and longitude 3°36' W (Fig. 1). This dumping site has been abandoned since 2006 with 10 years old and covers an area of 16 ha. One kind of waste (solid municipal waste) are dumped in this site: and the mean depth of the dumping site for garbage is 8 meters. The site which is situated at 5 km of dumping site at latitude 5°15' N and longitude 3°35' W were choose as a control site.

The study area is located in a tropical climate and has a mean annual rainfall of approximately 2000 mm, with a rainy season (May to July and September to October) and dry season (July to August and December to April). The average monthly temperature of Bonoua is above 20°C. The geology of the study area is dominated by sedimentary formations, especially detritic rocks. The soil of study area is classified as an arsenic ferralsol, and the dumping site is classified as a Fumic Anthroposol in the World Reference Base for Soil Resources [8].

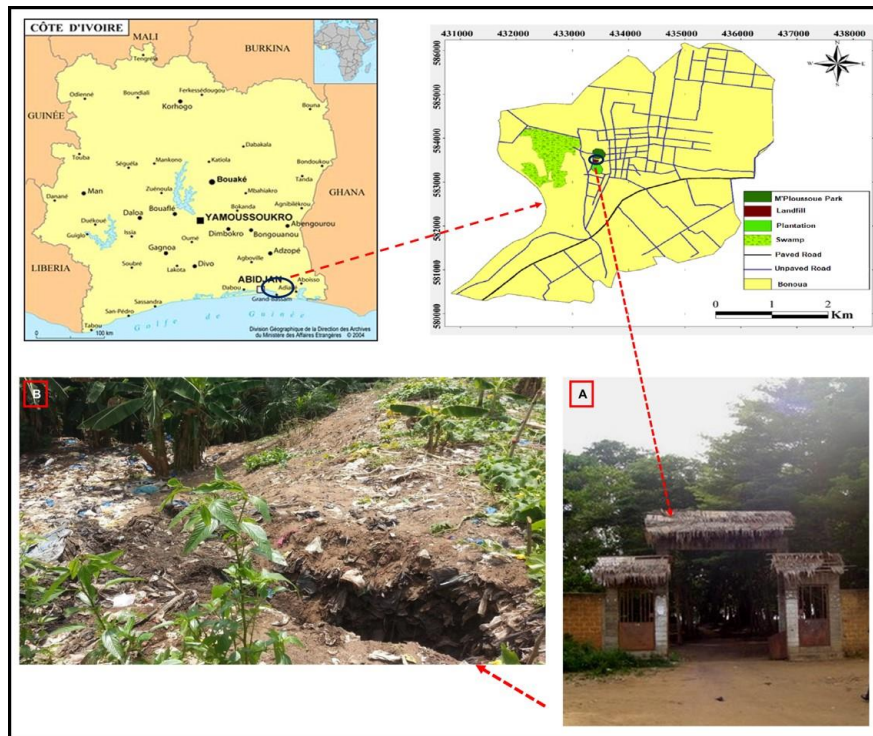


Fig.1: Localization of Study area. A- M'Ploussou Park; B – Waste deposal site

Field Procedure

A toposequence was installed on the catchment along the line of the greatest slope according to the method described by [9]. Eight soil pits, positioned along topographic segments (upper slope, middle slope, lower slope and bottom slope) with two pits per topographic segments, were georeferenced using a GARMIN GPS 72 and were dug to 1.5 meters in depth or to bedrock and then described according to the methods of [10]. The morphological parameters considered in this study include the layer thickness, main color, organic matter, size, coarse material nature, texture, structure, porosity, consistency, drainage internal, roots (abundance and orientation), transition and boundary between horizons, and structure. Soil classification was carried out according to soil resources [8]. After the description, four representative soil pits, including the dumpsite, were chosen along the toposequence for complete characterization. The position of the four pits chosen along the studied transect are presented in Table I.

Table I : Characteristics of the sampling soil pits.

Soil Pits	Topographic Position	Distance from dumpsite in (m)	Characteristics
LS 1	Upper slope (P1)	0	At center of dumpsite
LS 2	Middle slope (P2)	10	At below of dumpsite
LS 3	Lower Slope (P3)	20	At below dumpsite
LS 4	Bottom slope (P4)	30	At below dumpsite

Soil samples

Soil samples were collected from the horizons or layers for each soil profile selected. Soil samples were sieved to 2 mm to remove various types of waste (paper, used batteries, electronic goods, wood, plastic paper, straws, buckets, tin cans, sacks, clothes, glass bottles, cotton wool, food waste, leaves, fruit waste, medicine bottles, foams, ashes, water sachets, cardboard and human excreta) and were then air-dried and transported to the laboratory for various analyses.

Another soil sample from other sector was also taken as soil control to compare the quality of soil from dumping site.

Laboratory analysis

Several analyses were performed to study parameters to evaluate the soil quality. Particle size analysis was carried out by a pipette using the Robinson-Köln method, and soil textural classes were established using the textural triangle [11] (Robert and Frederick, 1995). The Walkley and Black method and Kjeldahl method were used to determine organic carbon and total nitrogen (N-total), respectively. Soil pH was determined at a 1:2.5 (w/v) (soil/water or potassium chloride solution) ratio using an electrode pH-meter [12] (Mathieu and Pieltain, 2003). The exchangeable cations (Ca^{+2} , Mg^{+2} , Na^{+} and K^{+}) and cation exchange capacity (CEC) were determined using the [13] Metson (1956) method. Heavy metals (Pb, Cd, Cr, As, Cu and Zn) were then analyzed by atomic absorption spectroscopy (ICP-OES) (Spectroblue). Analysis of the pH, exchangeable cations, CEC and contents of heavy metals were performed in the laboratory of the Institute of Ecology and the Sciences of Environment (IESE) in Paris, France. Analyses of the granulometry, C, and N were conducted in the Laboratory of Soils and Plants at the National Polytechnic Institute Felix Houphouët Boigny (INP-HB) in Yamoussoukro, Ivory Coast.

Statistical Analysis

The data were subjected to statistical analysis using 7.1 Statistica software at a 5% probability level. Significant differences between different parameters (particle size, chemical parameters, and heavy metal content) of soils collected from different toposequence positions were performed using the Student–Newman–Keuls (SNK) test at $\alpha < 5\%$ probability level.

RESULTS

Morphological characteristics of the soil along the studied toposequence in dumpsite areas

The results of each selected profile localized at different topographic positions in the waste deposal areas are presented in Fig. 2. The profiles show that the center of the waste deposal site (P1) is slightly deeper at the upper slope position (less than 50 cm depth) due to the accumulation of various types of municipal solid wastes found in profile 1 (P1), such as paper, used batteries, electronic goods, wood, plastic paper, straws, buckets, tin cans, sacks, clothes, glass bottles, cotton wool, food waste, leaves, fruit waste, medicine bottles, foams, ashes, water sachets, cardboard and human excreta (Fig. 2). The description of soil samples from profile 1 (P1) show that the soil is anthropogenic soil and is classified as Fumic Anthroposol soil according to the World Reference Base [8]. At 10 and 20 meters from the waste deposal site, at the middle (Profile 2) and lower (Profile 3) slope positions, respectively, the soils are deep (120 cm in depth) and are classified as Histic Arenite Ferralsol at the middle slope position and as Arenic Ferralsol at the lower slope position (Fig. 2). However, at the bottom slope, the soil depth decreases and groundwater appears from a depth of 30 cm. This soil is classified as Gleyic Histosol according to [8].

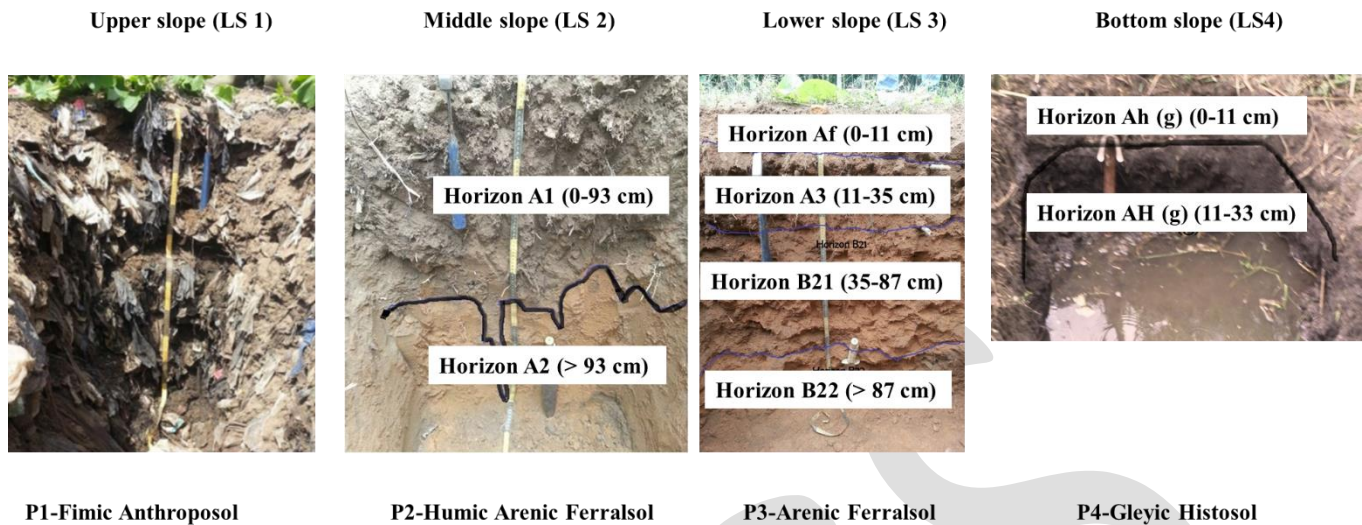


Fig.2: Soil morphological description along studied toposequence in dumpsite areas

Soil Particle Size

The soil physical properties are presented in Table II. Sand (ranging from 36% -77%) is the dominant particle size fraction of the fine earth (< 2 mm) analyzed, regardless of the slope position. Soil samples from the center of the waste deposal site and localized at the upper slope have sand as the dominant particle size fraction (77%), followed by clay (21%) and silt (2%). Along the slope position of the soil profile, the silt and clay contents significantly increase (Student's-Newman-Keuls test, 95% (Table II)), varying by 21 to 38% for clay and 2 to 26% for silt at the bottom slope. However, the sand content decreases significantly (Student's test, 95%) along the studied toposequence (Table II), where the highest contents are observed at the upper slope (77%) and the lowest contents at the bottom slope (36%).

Table II : Percentage particle size fraction (%) of the soil collected at different topographical positions.

topographical Positions	Particle Size (%)		
	Clay	Silt	Sand
Upper slope	21 ± 4 ^c	2 ± 0.1 ^d	77 ± 5 ^a
Middle slope	24 ± 3 ^b	11 ± 2 ^c	66 ± 4 ^b
Lower slope	25 ± 2 ^b	17 ± 1 ^b	58 ± 4 ^c
Bottom slope	38 ± 3 ^a	26 ± 5 ^a	36 ± 3 ^d

a, b, c values with the same letter indicate no significant difference between particles size at different slope positions along toposequence (Student's t-test, $p < 0.05$)

Chemical parameters of soil samples along slope position

The chemical characterization of the soil of each selected profile indicates that the soil sample from the center of the waste deposal site is slightly acidic to neutral with the water pH = 6.9 and potassium chloride pHKCl = 6.1 (Table III). The pH variation ($\Delta\text{pH} = \text{pH}_{\text{water}} - \text{pH}_{\text{KCl}}$) of soil samples from dumpsite soil is $\Delta\text{pH} < 1$, showing high acidity potential. Thus, the soil samples from the middle, lower and bottom slope are strongly acidic, with the water pH varying 5.1 to 5.2 and potassium chloride pHKCl varying 4.1 to 4.4 (Table III). The pH variations ($\Delta\text{pH} = \text{water pH} - \text{pH}_{\text{KCl}}$) at the middle and lower slope are $\Delta\text{pH} > 1$, showing low potential acidity, and $\Delta\text{pH} < 1$ at the bottom slope, showing high potential acidity (Table III).

Calcium (Ca^{2+}) is the dominant basic cation in the exchange complex, with a range of 0.6 -10.4 cmol.kg^{-1} , followed by K^+ (range 0.3 - 8.3 cmol.kg^{-1}), Mg^{2+} (range 0.3 - 4.3 cmol.kg^{-1}), and Na^+ (range 0.06 - 0.2), regardless of the slope position (Table III). The value of the cation exchange capacity (CEC) of the soil decreases along the topographic position with a lower value (7.9 - 25.9 cmol.kg^{-1}) at the upper, middle and lower slope and higher values at the bottom slope (43 cmol.kg^{-1}). The percentage of base saturation is higher at the upper position (a range of 74.6%), and our results show that the soils are weakly desaturated ($22\% < V < 75\%$) with a high exchange acidity (Table III) regardless of the slope position.

Table III : Mean values of pH, Cations (Ca^{2+} ; Mg^{2+} ; Na^+ ; K^+), Cation Exchangeable Capacity (CEC) and saturation base (V %) of soil samples collected at 0-30 cm depth at different slope positions along the toposequence.

Topographical Positions	pH			Cations exchangeable (cmol kg^{-1})				CEC	Saturation
	pH_{water}	pH_{KCl}	ΔpH	K^+	Ca^{++}	Mg^{++}	Na^+	(cmol kg^{-1})	V %
Upper slope	6.9 ^a	6.1 ^a	0.8	0.25	4.39	1.04	0.21	7.9	74.6
Middle slope	5.1 ^b	4.1 ^b	1	0.25	2.56	0.27	0.164	15.2	21.3
Lower slope	5.2 ^b	4.1 ^b	1.1	2.34	3.07	1.13	0.318	25.9	26.5
Bottom slope	5.2 ^b	4.4 ^b	0.8	8,31	10,4	4.28	0.74	42.8	55.4

a, b, c values with the same letter indicate no significant difference between different slope positions along toposequence (Student's t-test, $p < 0.05$)

In addition, Table IV shows that the soils from the upper slope position (dumping site) along with those from middle and lower slope positions have low levels of nitrogen (less than 1%), carbon (1-2%), C/N ratio (< 12) and organic matter (13800 - 38872 mg.kg^{-1}). However, at the bottom slope, soils have a high carbon content (13%), organic matter concentration (219600 mg.kg^{-1}), C/N ratio (> 12) and relatively high level of nitrogen (Table IV).

Table IV: Mean values of carbon, azote, organic matter and C/N ratio of soil samples collected at 0-30 cm depth at different slope positions.

Topographical Positions	Organic Matter (O.M.)			
	C (mg.kg^{-1})	N (mg.kg^{-1})	O. M. (mg.kg^{-1})	C/N
Upper slope	22600 ^b	2400 ^b	38872 ^b	9.4
Middle slope	10500 ^c	2100 ^b	18100 ^c	5
Lower slope	8000 ^d	1300 ^c	13800 ^d	6.2
Bottom slope	127700 ^a	7200 ^a	219600 ^a	17.7

a, b, c values with the same letter indicate no significant difference between C, N, or MO or C/N at different slope positions along toposequence (Student's t-test, $p < 0.05$)

Heavy metal contents of soils collected at the waste deposal site and control site soil

The Metal contents of both control and dumping site soils are presented in Table V. The mean values of all heavy metal (Cr, Pb, Cd, Zn, Ni, As, Cu and Se) detected in dumpsite soil are significantly higher at $p < 0.001$ than the mean concentration in control soil

sample (Table V). The mean values of Pb, Cr, Cd, Zn and Ni are very high in the dumping site soil, at 118 mg kg⁻¹ dry soil, 130 mg kg⁻¹ dry soil, 81 mg kg⁻¹ dry soil, 344 mg kg⁻¹ dry soil and 119 mg kg⁻¹ dry soil, respectively. In control site soil, the mean values of heavy metal are 5.4 mg kg⁻¹ soil dry for Pb, 0.23 mg kg⁻¹ soil dry for Cr and 3.2 mg kg⁻¹ soil dry for Ni (Table V). For Cd, Zn, As, Cu and Se, their values are below the limit of detection (Table V).

Table V: The mean concentration (mg.kg⁻¹ Soil dry) of some heavy metal in both studied areas

Sites	Heavy Metal (mgkg ⁻¹ dry soil)							
	Cr	Pb	Cd	Zn	As	Se	Ni	Cu
Dump	130.1±16	118±19	81±11	344±22	9.1±5	4.3±1	119±13	9.5±2
Control	0.23 ±0.01	5.4 ±0.2	nd	nd	nd	nd	3.2 ±0.3	nd

Nd: not determined, values below the limit of detection. (a, b) values with the same letter indicate no significant difference between metal concentration detected on dumpsite and control site soils (Student's test, P < 0.001)

The comparison of metal contents of dumpsite soil with different maximum acceptable level of metal for Agricultural and residential soils are presented in Table VI and indicate that Cr, Pb, Cd, Zn, Se and Ni exceed different standard recommendations (Table VI). The contents of As (9 mg kg⁻¹ dry soil) and Cu (9.5 mg kg⁻¹ dry soil) are below the recommended concentrations (Table VI).

Table VI: Mean concentration (mg.kg⁻¹ Soil dry) of some heavy metal at dumping site and maximum acceptable concentration of metal in agricultural, and residential parkland soils in different countries

Heavy metal (mgkg ⁻¹ dry soil)	Values observed in dumpsite	World Health Organization limit (WHO- limit)*	CCME soil limit** Agricultural	CCME soil limit** Residential Parkland	AFNOR soil limit***
Cr	130.1	70	64	64	70
Pb	118	100	70	140	100
Cd	81	0.35	1.4	10	1
Zn	344	300	200	200	300
Ni	119	50	50	50	50
As	9.1	40	12	12	-
Cu	9.5	100	63	63	100
Se	4.3	-	1	1	

*World Health Organization limit (WHO-limit) recommendation [44]. ** Canadian environmental quality Guidelines[26].

*** French Standards Association (AFNOR) limit recommendation [45].

Lateral distribution of heavy metals in soil profiles along the toposequence

Figure 3 depicts the lateral distribution of heavy metals in soil samples collected at a depth of 0-30 cm in each selected soil profile along the toposequence studied. The lateral distribution of heavy metals, such as Pb, Ni, Cd, Cr, Zn, Cu, As and Se, exhibits a similar

trend, where an enrichment of heavy metals in the bottom profiles and depletion in the upper soil profiles were observed. Thus, the maximum significant concentration of heavy metals is observed at the bottom slope position and the minimum significant concentration of heavy metals is at the upper slope position, with the Pb, Ni, Cr Cd and Zn contents varying from 118 to 296 mg kg⁻¹ dry soil; 119 to 212 mg kg⁻¹ dry soil; 130 to 272 mg kg⁻¹ dry soil; 81 to 124 mg kg⁻¹ dry soil; and 344 to 489 mg kg⁻¹ dry soil, respectively. These heavy metal contents exceed the recommended concentrations from Association French Normalization (AFNOR) and Canadian Council of Ministers of the Environment (CCME) (Fig. 3). Despite the heavy metal enhancement in the bottom soil profile along the toposequence, the Cu, and As concentrations are below the recommended limits (Fig. 3 and Table VI).

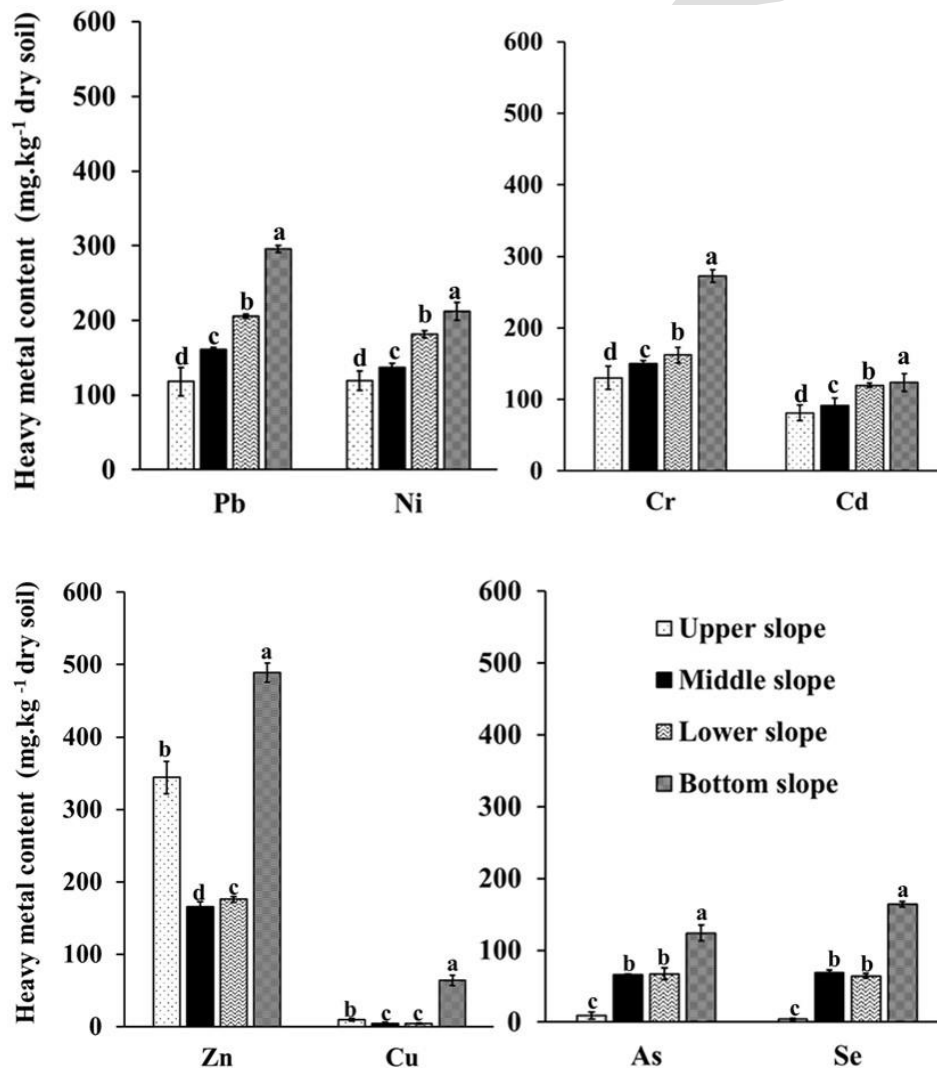


Fig.3: Lateral distribution of heavy metals (Chromium (Cr), Cadmium (Cd), Lead (Pb), Nickel (Ni), Zinc (Zn), Copper (Cu), Cadmium (Cd) and Selenium (Se)) of soil samples collected at 0-30cm depth along the studied toposequence. Histogram with the same letters (a, b, c, d) indicate no significant difference between heavy metal content observed at different topographical positions (upper, middle, Lower and bottom slope) according to the Newman-Keuls Student's test with $p < 0.05$.

Vertical distribution of heavy metals in the soil profile

The vertical distribution of heavy metals, such as Pb, Ni, Cr, Cd and Zn, display a similar trend (Fig. 4). The concentration of heavy metals (Pb, Ni, Cr, Cd and Zn) is higher in the top layers than in the deeper layers (Fig. 4) regardless of the slope position. The

maximum concentrations of Pb, Ni, Cr, Cd and Zn are observed in the top layers, with the respective mean values ranging from 161-205 mg kg⁻¹ dry soil for Pb; 137-212 mg kg⁻¹ dry soil for Ni; 149-272 mg kg⁻¹ dry soil for Cr; 91-124 mg kg⁻¹ dry soil for Cd; and 165-489 mg kg⁻¹ dry soil for Zn, regardless of the slope position. The top layers are significantly enriched in heavy metals, where their contents exceed recommended concentrations (Fig. 4 and Table VI).

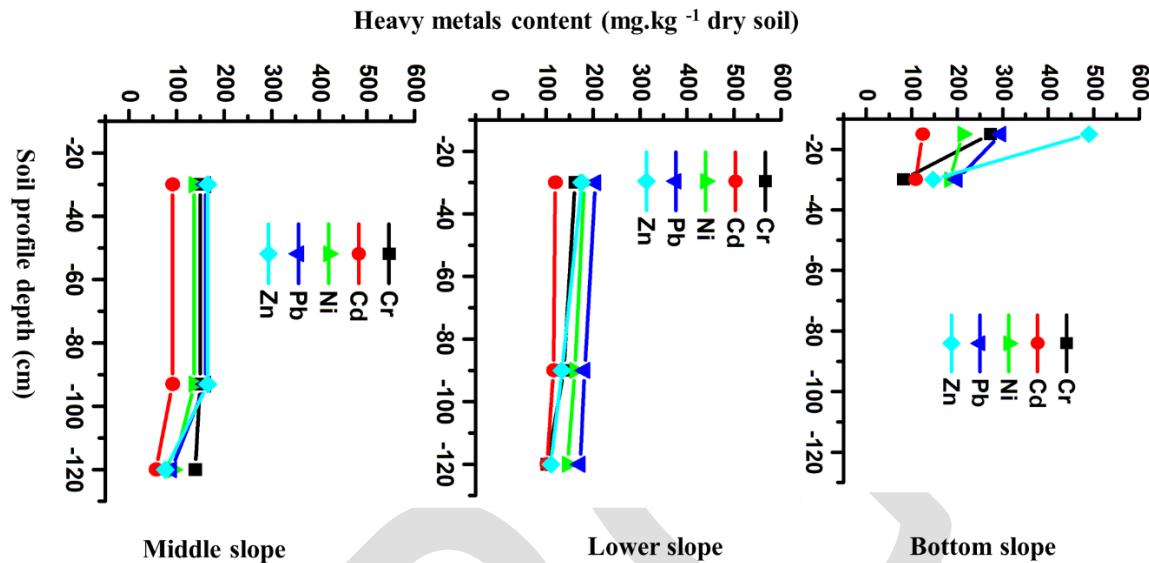


Fig.4: Vertical distribution of heavy metals (Chromium (Cr), Cadmium (Cd), Lead (Pb), Nickel (Ni), Zinc (Zn), Copper (Cu), and Selenium (Se)) in different layers of soil profiles located below the dumpsite (middle, lower and bottom slope positions)

DISCUSSION

Open dumpsites are common in developing countries, such as Ivory Coast. These practices pose serious threats to groundwater resources along with the local and surrounding soil, thereby damaging soil quality.

Impact of the open dumping site on soil properties

Soil is continuously contaminated by human activities, which often involves the accidental release of chemicals or the improper disposal of hazardous wastes. This is the case in the dumping site of M'Ploussou Park in Bonoua, which is open-air and uncontrolled. In the study area, the dumping site is located at the top of the toposequence used in this study. The soil from the waste disposal site (in the upper slope position) has a shallow depth due to the accumulation of non-biodegradable materials in the waste, such as clothes, paper, plastic paper, buckets, tin cans, sacks, glass bottles, water sachets and solid waste, over the past 10 years while the dumpsite was operational.

Analysis of the soil's physical properties indicate that the soils from the dumpsite (upper slope position) have sand as their dominant particle size fraction and that their texture is dominated by sandy-clay. This texture limits the proliferation of microorganisms and the mineralization of organic matter [14, 15].

The chemical properties of the dumpsite soil show that its pH is weakly acidic. The neutral acidity of the dumpsite soil may be attributed to the age of the waste dumping site, which is 10 years old according to [2, 16]. According to these authors, after 10 years of waste disposal, the pH levels frequently increase at dumping sites. The neutral acidity (water pH = 6.9 and pH KCl = 6.1) of the open dumpsite soil can decrease the soil micronutrient availability for plants and favor the development of metal complexation [17].

Moreover, the high quantities of organic matter observed in open dumpsite soil may be attributed to the nature of various types of

municipal solid wastes found in the study area, such as paper, used batteries, electronic goods, wood, plastic paper, straws, buckets, tin cans, sacks, clothes, glass bottles, cotton wool, food waste, leaves, fruit waste, medicine bottles, foams, ashes, water sachets, cardboard and human excreta. Other researchers attribute this high level of organic matter in the dumpsite soil to the presence of non-fermentable materials in the wastes, which tend to resist decomposition and therefore break down very slowly [18, 19]. The slow decomposition of soil organic matter, probably due to the nature of the waste, can explain the lowest capacity of exchangeable cations observed in the dumpsite soil as demonstrated by [2]. However, base saturation was rated high in dumpsite soils, reflecting the dominance of non-acid cations (Ca^{2+} ; Mg^{2+} ; Na^{+} ; K^{+}) at their exchangeable sites. The high values of nitrogen, exchangeable bases and cation exchangeable capacity recorded in dumpsite soil could be attributed to the nature and content of soil organic matter (SOM), which is a major storehouse of many nutrients in soils, including nitrogen and phosphorus [21]. Therefore, the high soil organic matter content and presence of clay in dumpsite soil can also promote exchangeable bases and the cation exchangeable capacity. For [22], this high level of organic matter favored the sorption of metal because of SOM's sorption qualities [23, 24].

Moreover, the high heavy metal content observed in open dumpsite soil than in control site soil could be attributed to the nature of various types of municipal solid wastes found in study. In fact, the continuous accumulation of different sources of municipal solid wastes, such as electronic goods, electroplating waste, painting waste, and used batteries, could be the origin of the heavy metal observed in the dumpsite soil. These results are in agreement with the findings from others researchers, which indicate that open dumpsites represents a significant source of heavy metal contamination in the environment [17, 18, 25].

The concentrations of cadmium (Cd, 81 mgkg^{-1}), chromium (Cr, 130 mgkg^{-1}), zinc (Zn, 344 mgkg^{-1}), lead (Pb, 118 mgkg^{-1}) and nickel (Ni, 119 mgkg^{-1}) in the dumpsite soil are greater than the limits recommended for agricultural soil [26] and also greater than those from the control soil which their concentration are below of the permissible level as demonstrated [27]. This result indicates that the main source of toxic element (metals or metalloids) found in dumpsite soil are not derived from the soil parent material as demonstrated [28]. The absence of heavy metal or metalloids in control soil seems show that their main source are anthropogenic. For [29], the contamination of dumpsite soil studied with lead (Pb), zinc (Zn), cadmium (Cd) and chromium (Cr) can come from the nature of wastes and also from the atmospheric deposition. The contamination of M'Ploussou Park dumpsite soil with those toxic metals or metalloid may pose risks and hazards to humans and the ecosystem through the food chain. M'Ploussou Park dumpsite soil may constitute an environmental problem if these metals migrate into the groundwater and plants.

Moreover, the soil content of Cr (130 mgkg^{-1}) in the dumpsite soil studied is much higher than the permissible limits and is also higher than that of Akouedo dumpsite soil (125 mgkg^{-1}) from Abidjan in Ivory Coast [17] as well as that of Al AIN (19.1 mgkg^{-1}) from the United Arab Emirates [25]. The Pb content (118 mgkg^{-1}) in the dumpsite soil studied was relatively higher than the Pb content from the Lome dumpsite (108 mgkg^{-1}) in Togo [18] and lower than the Pb content from the Akouedo dumpsite (1500 mgkg^{-1}) in Abidjan [17] as well as from the Yamoussoukro dumpsite (163.7 mgkg^{-1}) in Ivory Coast [30]. Similarly, the Zn soil content (344 mgkg^{-1}) in the dumpsite soil studied is above the permissible limit for agricultural soils, but lower than the Zn content from Akouedo (1164 mgkg^{-1}) in Abidjan [17] and the Yamoussoukro dumpsite (487 mgkg^{-1}) in Ivory Coast [30]. However, it is higher than the Zn content from Al-AIN (117 mgkg^{-1}) of the United Arab Emirates [24]. Additionally, the Cd content (81 mgkg^{-1}) in the dumpsite soil studied is higher than Cd content from Akouedo (11 mgkg^{-1}) in Abidjan [17], from the Yamoussoukro (4.65 mgkg^{-1}) dumpsite in Ivory Coast [30] and from Lome (37.3 mgkg^{-1}) in Togo [18]. The presence of heavy metals in the M'Ploussou Park dumpsite soil could be a serious environmental hazard from the perspective of soil pollution [31]. Otherwise, the interaction between metals and soil organic matter could have various complex consequences on the solubility, mobility and bioavailability of metals if they are leached into the surrounding areas [32]. This could create soil deterioration problems for agriculture and local residents.

Impact of the open dumpsite on surrounding soil properties along the toposequence

Research on the open dumpsite's effects on the surrounding soil properties along the toposequence showed that soil from the dumpsite (upper slope positions) was enriched in fine particles (silt and clay) and less rich in sand. The silt and clay contents increased along the downward slope, whereas the sand content decreased in the same direction. This may be attributed to the slope angle and drainage, which facilitated erosion and transportation of fine particles from the top (dumpsite soil at the upper position) to depressed areas (middle, lower and bottom slope positions). Moreover, the high levels of soil organic matter and clay further down the slope suggests the translocation of fine particles (clay and organic matter) from the waste dumpsite soil (upper slope) to the depressed areas (middle, lower and bottom slope) along the toposequence. The transportation of eroded fine particles (clay and organic matter) may be attributed to the alluvial deposition process according to [33]. In soils from further down the slope, the high clay and organic matter contents can cause a high cation exchangeable capacity, which is able to adsorb more cations and reduce leaching. For [34, 35], the presence of the fine fraction (clay and organic matter) in the down-slope soil plays a role in the retention and bioavailability of the chemical elements essential for plants. The carbon, total nitrogen, organic matter contents and C/N ratio (> 12) are high in the soil from the bottom slope position. These results are similar of those of [36], who observed a very high amount of organic matter in the bottom slope due to the relatively weak mineralization and reductive and anoxic conditions.

Furthermore, our results indicated that the pH values of the dumpsite soil at the upper slope position ($\text{pH} > 6$) was different from those ($\text{pH} < 5.5$) at the down-slope position (middle, lower, and bottom) probably because of leaching process of the cations. In fact, as the study area is located in a wet tropical rainforest with an annual rainfall of > 2000 mm, the leaching processes become intensive. These climatic conditions can promote the removal and migration of acidic cations, such as hydrogen and aluminum, in soil solutions (data not shown) toward the down-slope profiles. This result is in agreement with [37], who affirms that more basic cations (Ca^{2+} ; Mg^{2+} ; Na^{+} ; K^{+}) in soil solutions will make the soil less acidic. The presence of lower pH values (below $\text{pH} < 5.5$) in soil from down-slope positions could favor better metal mobility and availability to plants and thus affect vegetation survival [17, 38]. This study shows that the topographic position of the dumpsite affects the texture, the organic matter content and the cation exchange capacity of the surrounding soil in the dumping areas.

The average concentration of heavy metals in the collected soil sample was found to be in the following order: $\text{Zn} > \text{Pb} > \text{Cr} > \text{Ni} > \text{Cd} > \text{As} > \text{Cu} > \text{Se}$, regardless of the topographical position of the soil profile. It was observed that only Zn, Pb, Cr, Ni and Cd were higher than the CCME's permissible limits [26]. In this study, the concentrations of heavy metals (Pb, Ni, Cr, Cd and Zn) in the soil profiles were higher in the top soil layers than in the deep soil layers, regardless of the topographic position of the soil profile. This difference may be linked to the infiltration of the dumpsite leachate into the soil, which only influenced the top surface soil no matter which heavy metal was studied. Ours results indicate that the accumulation of heavy metals in surface soil does not depend on parent rocks because of their lower content in deeper soil layers. This enrichment of heavy metal in the study area soil could be attributed to human activities, urbanization and atmospheric deposition [3]. These results suggested higher ecological risks for Cr, Pb, Ni, Zn and Cd than for others metals such as and Se.

However, the lateral distribution of Pb, Ni, Cr and Cd in soil showed a higher enrichment of these heavy metals in soil profiles located below the dumpsite. This enhancement of the Pb, Ni, Cr and Cd levels in soil along the toposequence could be linked to the dumpsite leachate, which is produced in association with rain when water passes through the waste in a dumpsite and may contain a wide range of pathogens and chemical pollutants [39].

In fact, as the study area is located in a wet tropical rainforest with an annual rainfall > 2000 mm in this tropical climate; a large quantity of dumpsite leachate could be formed in the presence of precipitation and then migrate from waste into the down-slope soil profiles, contaminating the surrounding soil. [40] clearly demonstrates that the leachate flow increases linearly with increasing rainfall. In addition, it had been reported in others studies that in open dumping sites, soil and groundwater could be contaminated by leachate migration [39, 41, 42]. It appears that in the M'Ploussou Park dumpsite in Bonoua, the dumpsite leachate poses a real danger

to soil solutions through infiltration [43] and influences the vertical and lateral distribution of heavy metals (Pb, Ni, Cr, Cd and Zn), modifying the soil's physical and chemical properties. Ours results suggest that the dumpsite leachate has a significant impact on local soil as well as the surrounding area's soil quality in a wet tropical climate. Thus, the M'Ploussoue Park dumpsite at Bonoua appears to harbor potential ecological risks for all residents living within 30 m of the dumping site. Preventing soil contamination by dumpsite leachates is highly recommended.

CONCLUSION AND RECOMMENDATION

Analyses of the vertical and lateral distributions of heavy metals in soil samples collected from the solid waste disposal site of M'Ploussoue Park in Bonoua indicate that there are high levels of heavy metals (Cr, Pb, Cd, Zn, N) in the top soil layers as well as in the soil at the bottom of the slope, with contents that exceed permissible limits, suggesting a high pollution potential. Examination of the metal distribution in the soil profiles indicates the accumulation of metals in the surface soil layers is a result of human activities, urbanization or atmospheric deposition. The heavy metals in surface soil layers can migrate to plants, groundwater and surface water resources. Furthermore, our study also show that the heavy metal enrichment of soil located under the dumpsite is probably due to the migration and the infiltration of the dumpsite leachate. The vertical and lateral distributions of metals in M'ploussoue Park in Bonoua can pose potential ecological risks if these elevated concentrations of metals migrate into soil, plants and groundwater, which would lead to adverse effects on plants, animals and humans. It appears that in a wet tropical climate, the open dumpsite has a significant impact on soil and on the soil quality in surrounding areas, likely due to the dumpsite leachate produced. It is thus recommended to prevent soil contamination via dumpsite leachates. Finally, it is necessary to study this dumping site and determine the exact boundaries of the contamination area and the risk people living there. To limit heavy metal migration in plants, groundwater and surface water resources, it appears necessary to develop proper remediation techniques.

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Studies on Mechanical Properties of Bamboo/Carbon Fiber Reinforced Epoxy Hybrid Composites Filled with SiC Particulates

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Abstract - In concern with global environmental awareness, most of the engineering synthetic materials are replaced by natural fiber composites. Bamboo is attracted towards the researchers because of its bio-degradability, high tensile strength, low density and anti-bacterial properties. Many research studies have shown underutilization of these bamboo fibers as a reinforcing material in composite research and its relevant application in product development. Hence there are more possibilities of developing a economical engineering products by utilizing bamboo fibers in composite manufacturing. In the present work experimental investigation has been carried out to study the effect of Silicon carbide on bamboo/carbon fibers. The woven hybrid composite laminates were fabricated by using hand lay-up method using L-5 Epoxy resin and K-6 hardener. Bamboo fibers at different wt % are filled in epoxy resin and the effects of Silicon carbide with bamboo/carbon fibers on mechanical and physical properties are studied. On the basis of mechanical testing results, it is found that bamboo/carbon fiber mixed with silicon carbide is giving optimum mechanical properties. The addition of Silicon carbide on bamboo/carbon fibers has improved tensile, flexural strength. The water absorption tests were performed on immersing specimens into three different water conditions, namely normal, distilled and salt water. Specimen preparation and water absorption studies carried out as per ASTM standards. The micro-hardness test result shows that reinforcing SiC in matrix improves micro-hardness of composite. On the basis of overall study the Silicon carbide with bamboo/carbon fiber reinforced epoxy composites is found to be better combination and suitable for fabrication of engineering products.

Keywords - Bamboo fiber, Carbon fiber, Epoxy, Silicon Carbide, Hand layup, Mechanical property, Water absorption test

INTRODUCTION

Natural fiber reinforced composites (NFC's) material is one of the new trends in engineering materials. Cost effectiveness is the key point for manufacturing of engineering products. Availability, completely or partial recyclable and bio-degradable also plays an important role in fabricating engineering components. These NFC's are preferred in most applications due to lower environmental effects and have higher fiber content for equivalent performance, which reduces the amount of more polluting base polymers. Also its lower weight improves fuel efficiency and reduces emissions in automotive applications. Many research studies on the natural fibers such as cotton, coir, sisal, jute, banana, flex, maize, and areca, to list few, have been carried out. The main drawbacks of these natural fibers are hydrophilicity. Most of these are hydrophilic (higher moisture absorption) in nature because of hydroxyl and other polar groups in their constituents [1-4]. Currently, plenty of research material is being generated on the potential of cellulose based fibers as reinforcement for plastics. All researchers who have worked in the area of natural fibers and their composites are agreed that these renewable, abundantly available materials have several drawbacks: poor wettability, incompatibility with some polymeric matrices and high moisture absorption by the fibers [5-6]. Normally cellulose based fibers are used in fabricating natural fiber composites. To develop NFC's, it is vital to understand the chemical composition and the surface adhesive bonding properties of natural fibre. The main constituents of natural fibre include cellulose, hemicellulose, lignin, pectin, ash, waxes and water-soluble substances. Among all the natural fiber reinforcing materials, bamboo appears to be a promising material because it is relatively inexpensive, anti-bacterial and commercially available in the required form [7]. Carbon Fiber Reinforced Polymers (CFRP) is a fiber reinforced polymer made of a plastic matrix reinforced by fine fibers of carbon. Fiber carbon is a lightweight, strong, and robust material used in different industries due to their excellent properties. The mechanical behavior of bamboo/E-glass hybrid composites with Al₂O₃ used as a filler material gives the optimum tensile & flexural strength and the mechanical properties significantly influenced while using bamboo & glass fibre in such layer manner [8]. The composites reinforced with pure carbon fibers can hold the maximum tensile, flexural, impact strength and less water intake percentage, whereas the composites reinforced with carbon and banana fibers shows higher water intake percentage [9]. Bamboo composites having ability to replace petroleum based composite materials in many applications and it leads to increase consumer benefits in various sectors [10]. Bamboo fiber possesses good moisture absorption, soft feel and splendid colors as

well as anti bacterial properties. Hence these properties make the fiber popular in home textiles. Bamboo fiber can absorb ultraviolet radiation in various wavelengths; hence it can be used in wallpapers and curtains [11-12]. The main purpose of this study is usage of bamboo fibers in industries for rural development. In this paper, an effect of hybridization of bamboo/carbon fiber reinforced epoxy composites with SiC as filler material is evaluated. The results of the tests help in determining the potential applications of the bamboo/carbon fiber reinforced epoxy composites.

2. EXPERIMENTAL PROCEDURES

2.1. MATERIALS

Bidirectional Bamboo fiber mats of thickness 0.2 mm are purchased from Champs Agro Unit, Thane (W), Maharashtra, India. Carbon fibers in woven mat form of 200 gsm are supplied by Suntech Fiber Private Limited, Bangalore. Epoxy L - 12 and Hardener is K-6 are supplied by Yuje Enterprises, Malleshwaram West, Bengaluru, India. Silicon carbide was purchased from Sapna Abrasives, Bangalore, India. Table 1 and Table 2 indicate Physical properties of Bamboo fiber and Carbon fiber respectively.

Table 1. Physical properties of Bamboo fiber

Physical Property	Bamboo Fiber
Density (g/cm ³)	1.1
Elongation at break (%)	11
Cellulose content (%)	45-50
Lignin content (%)	20-30
Tensile strength (MPa)	350-500
Elastic modulus (GPa)	85-87

Table 2. Physical properties of Carbon fiber

Physical Property	Carbon Fiber
GSM	200
Orientation	Plain-woven fabric
Tensile strength (GPa)	3.4
Tensile modulus (GPa)	230
Density (g/cc)	1.8
Elongation (%)	1.5

2.2. SPECIMEN FABRICATION

An attempt has been made to fabricate composites by using bamboo, carbon and a hybrid of bamboo/carbon fiber reinforced epoxy with SiC particulates. The mechanical properties like tensile, flexural and hardness are analyzed. Water absorption behaviour is also analyzed.

2.2.1. PREPARATION OF EPOXY-HARDNER AND SiC MIXTURE

For preparing each laminates 350 g of Epoxy-Hardener mixture is taken. For preparing this mixture the ratio is 10:1 (For every 10 g of epoxy 1 g of hardener is taken). Then this mixture is stirred thoroughly for some time. Then 6% of SiC is added to the mixture for the last laminate in order to study the effect of filler material in composites.

2.2.2. FABRICATION METHOD

In this present work, hand layup method is used for fabricating composite laminates. Hand lay-up technique is the simplest method of composite processing. The processing steps are very simple. First of all, a release gel is sprayed on the mold surface to avoid the sticking of fiber to the surface. Thin plastic sheets are used at the top and bottom of the mold plate to get good surface finish of the product. Reinforcement in the form of woven mats are cut as per the mold size and placed at the surface of mold after perspex sheet has been placed over it. Then thermosetting polymer in liquid form is mixed thoroughly in suitable proportion with a prescribed hardener and poured onto the surface of mat already placed in the mold. The polymer is uniformly spread with the help of brush. Second layer of mat is then placed on the polymer surface and a roller is moved with a mild pressure on the mat-polymer layer to

remove any air trapped as well as the excess polymer present. The process is repeated for each layer of polymer and mat, till the required layers are stacked. After placing the plastic sheet, release gel is sprayed on the inner surface of the top mold plate which is then kept on the stacked layers and the pressure is applied. After curing either at room temperature or at some specific temperature, mold is opened and the developed composite part is taken out and further processed.

3. TESTING OF COMPOSITES

The mechanical properties are carried out by different instruments for the fabricated composites. Table 3 shows the laminates designations. The thickness of each layer of carbon is 0.4 mm and each layer of bamboo is 0.27 mm. As per ASTM standard, the thickness of each laminates is nearly 3 mm, So as to maintain the ASTM standard, considering 9 layers of bamboo fiber for laminate L1 (Only bamboo fiber and epoxy-hardener mixture), for laminate L2 6 layers of carbon fiber is taken (Only carbon fiber and epoxy-hardener mixture), for laminate L3 5 layers of bamboo and 4 layers of carbon fiber is taken (Mixture of bamboo/carbon and epoxy-hardener mixture) and for laminate L4 5 layers of bamboo and 4 layers of carbon fiber with 21 g of filler material (Mixture of bamboo/carbon, epoxy-hardener with SiC mixture).

Table 3. Laminates designations

Sequence	Composition
L1	B+B+B+B+B+B+B+B+B
L2	C+C+C+C+C+C
L3	B+C+B+C+B+C+B+C+B
L4	B+C+B+C+B+C+B+C+B (SiC)

3.1. TENSILE TEST

The tensile test is conducted by cutting the composite sample according to ASTM D638 (specimen dimensions is $216 \times 19 \times 3 \text{ mm}^3$). The computerized testing machine (UTM) was utilized. Composite specimens with different fiber combinations are tested, which are shown in Fig. 1. In each case, three samples are tested and the average is determined and noted. When the tensile load is applied to the specimen the system automatically calculates ultimate strength, ultimate load, and displacement and strain rate. The graph related to the above values is simultaneously plotted by the computer. The specimen is held in the grip and load is applied and the corresponding elongations are noted. The load is applied until the specimen breaks, ultimate tensile strengths are noted. Tensile stress and strain are recorded and load vs. displacement graphs are generated.

Table 4. Tensile properties of composites

Sequence	Break Load (N)	Tensile Modulus (N/mm ²)	Ultimate Tensile strength (N/mm ²)
L1	57.87	589.804	32.45
L2	9288.1	2580.73	162.94
L3	11.77	2293.97	150.48
L4	9423	1912.39	165.32

3.2. FLEXURAL TEST

The samples are cut to the dimensions as per ASTM standards for flexural testing. The test specimen geometry is width 8 mm, length 80mm, thickness 3 mm. The test is conducted at a strain rate of 1mm/minute. The test specimens are as shown in Fig. 2. Flexural test is done using a three point bend setup. The distance between the two supports are maintained at 100 mm. The ultimate load carrying capacity of the composite laminates is recorded.

3.3. HARDNESS TEST

Shore durometer hardness (Shore-D) for this research to study the hardness of the surface of the sample material. The ASTM test method designation is ASTM D2240 ($26 \times 26 \times 3 \text{ mm}^3$). The specimens are shown in Fig. 3. The Shore hardness is measured with an apparatus known as a Durometer and consequently is also known as 'Durometer hardness'. The hardness value is determined by the penetration of the Durometer indenter foot into the sample. Because of the resilience of rubbers and plastics, the indentation reading may change over time, so the indentation time is sometimes reported along with the hardness number.

3.4. WATER ABSORPTION TEST

The water absorption tests were performed on immersing specimens into three different water conditions, namely normal, distilled and salt water. Specimen preparation and water absorption studies carried out as per ASTM D570 (Specimen dimension is $30 \times 28 \times 3 \text{ mm}^3$). Specimens were immersed in normal (pH=7), distilled (pH=6.5) and salt (pH=8) shown in Fig. 4, water at room temperature, i.e., 23

°C. After specific time intervals (every 2 hours days), specimens were removed from the container, their surface moisture was removed by tissue paper. The content of water absorption by the specimen was measured using a precise digital balance machine. The percentage of water uptake is calculated by the following equation.

$$W(\%) = (W_1 - W_2) / W_1$$

W_1 = initial weight of specimen g

W_2 = specimen weight after N hours of water soaking, g

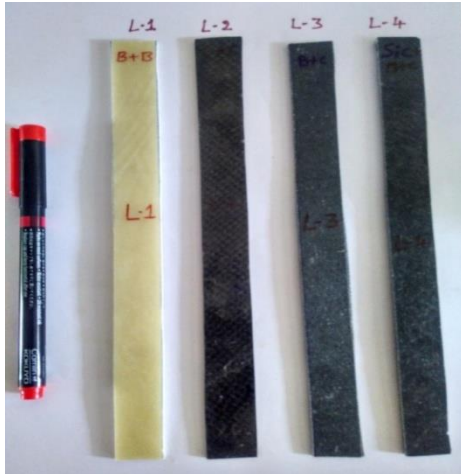


Fig. 2. Tensile test specimens

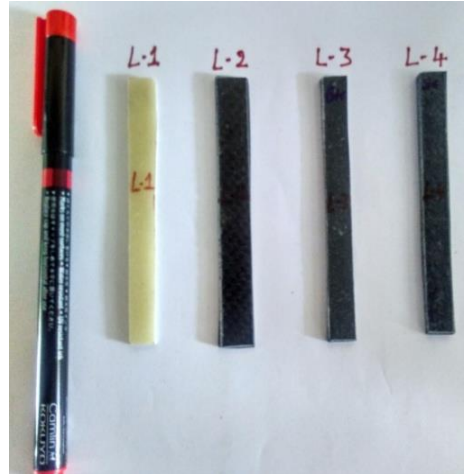


Fig. 3. Flexural test specimens

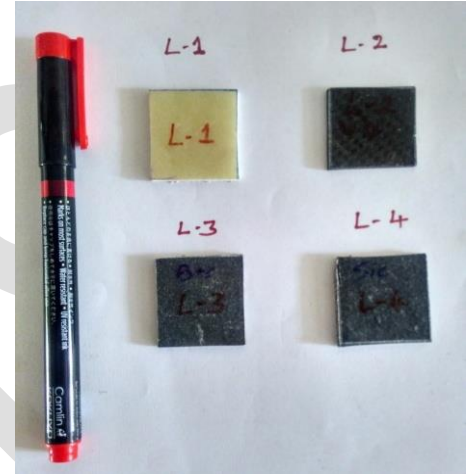


Fig. 4. Hardness test specimens



Fig. 4. Test specimens immersed in normal, distilled and salt water

4. RESULTS AND DISCUSSION

4.1. TENSILE PROPERTIES

The composites laminates L1, L2, L3, and L4 are fabricated according to ASTM standards and tested in UTM machine to obtain tensile properties. The properties like break load; tensile modulus and ultimate strength are listed in Table 4. The stress vs. strain graph is shown in Fig. 5. It is observed that the laminate L4 consisting of filler material gives the maximum tensile strength of 165.32 MPa and the laminate L1 gives the least tensile strength of 32.45 Mpa. Laminates L2 and L3 which is the combination of bamboo/carbon hybrid composites shows the better result than L1 which is the combination of pure bamboo layers. Among all the combinations, addition of filler material SiC to the bamboo/carbon hybrid composites L4 shows the better result than L1, L2 and L3.

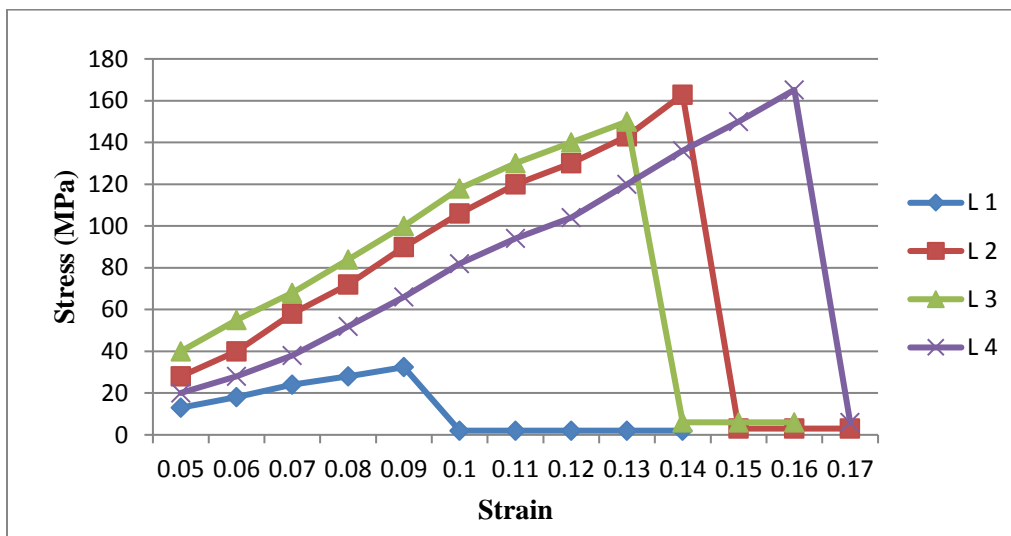


Fig. 5. Stress vs. strain graph for tensile test

4.2. FLEXURAL PROPERTIES

The flexural strength of the laminates was determined using the three-point bending machine as per ASTM D790. The load vs. displacement graph is shown in Fig. 6. The laminate L2 shows more flexural strength which is about 562 MPa. The laminate L1 shows less flexural strength of 362 MPa because it consists of pure bamboo fiber only. The laminate L3 having both natural and synthetic fibres gives a flexural strength of 381 MPa. And laminate L4 of strength 425 MPa, which gives better result next to the L2. Fig. 7 indicates the flexural strength of different laminates.

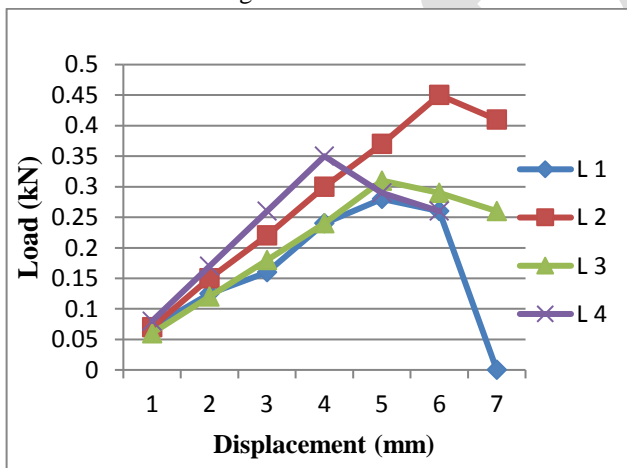


Fig. 6. Load vs. displacement for flexural strength

Flexural Strength (MPa)

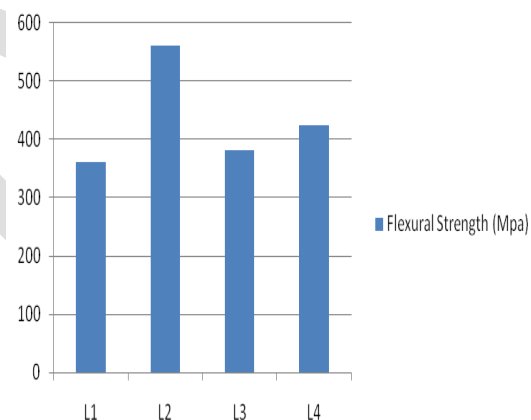


Fig. 7. Flexural strength of laminates

4.3. HARDNESS PROPERTY

In this study the hardness test has been conducted on Shore-D hardness testing instrument. It can be seen that the laminate L4 consisting of filler material as the highest hardness value among the other laminates. The hardness values for different laminates are shown in Fig. 8.

4.4. WATER ABSORPTION TEST

In water absorption studies, specimens were immersed into three different types of water conditions, which were normal, distilled and salt water to signify the real-life conditions. From the results it was observed that water absorption can be reduced by the hybridization of bamboo/carbon composites. Water absorption is shown in Fig. 9-11. Laminate L1 shows higher water absorption behaviour and pure synthetic fiber combination L2 having less water absorption capacity. Also absorption is more in distilled water because of purity of water. In salt water the salt molecules inhibit the activity of water molecules and rests on the surface of the laminate.

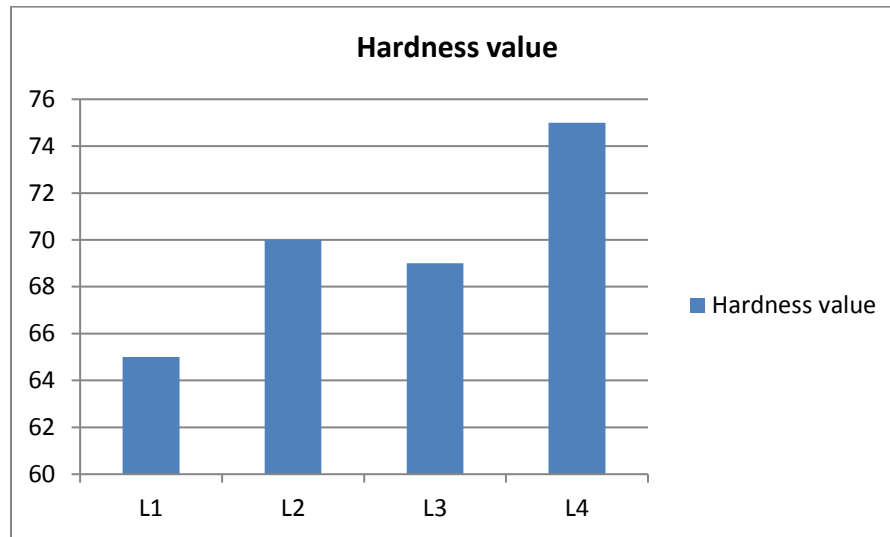


Fig. 8. Hardness value for different laminates

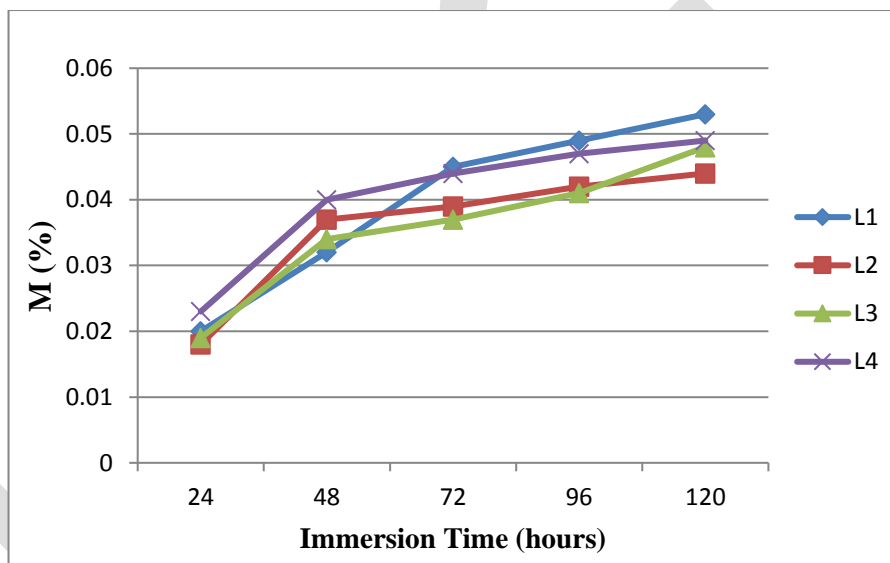


Fig. 9. Water absorption of composites in distilled water

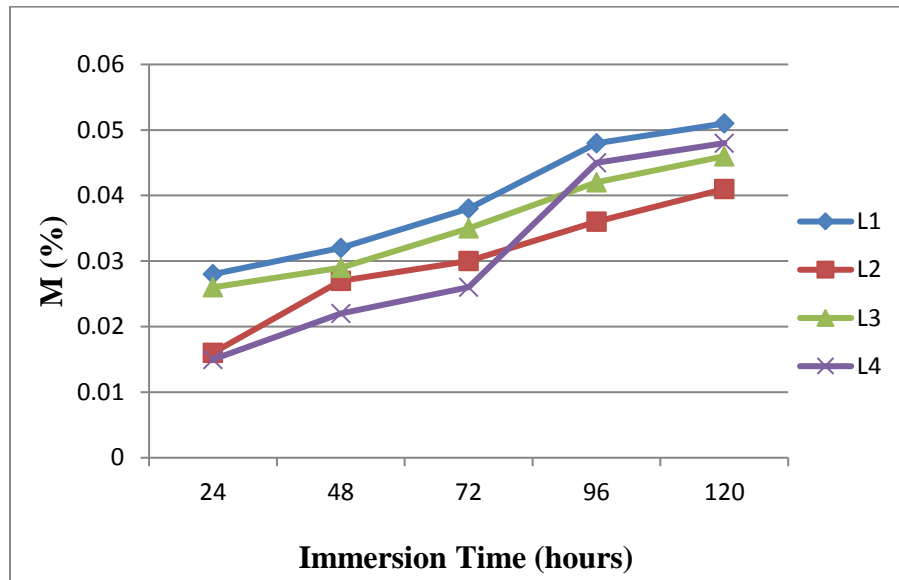


Fig. 10. Water absorption of composites in normal water

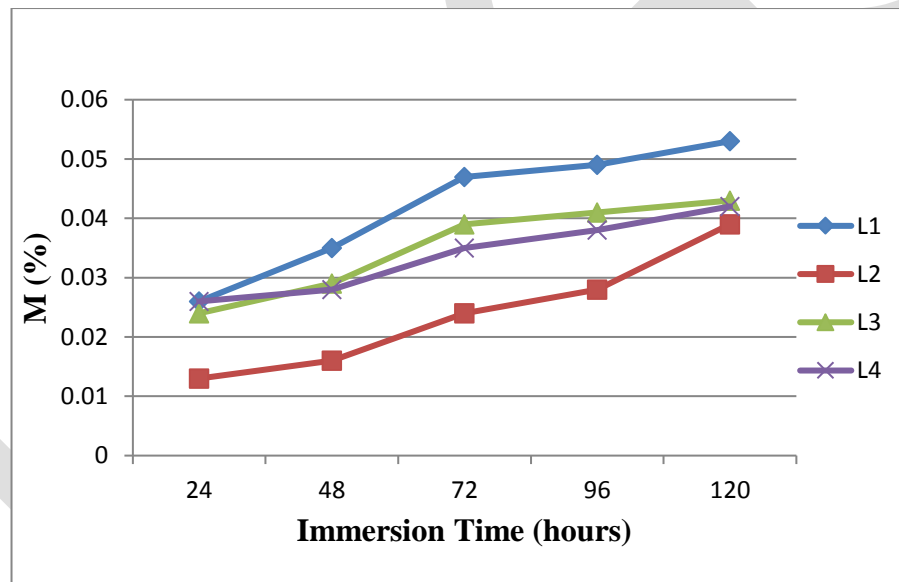


Fig. 11. Water absorption of composites in salt water

CONCLUSION

This current research work presents the studies on the effect of silicon carbide on hybridization of bamboo/carbon reinforced epoxy composites using hand layup method. From the tests, the following conclusions are made:

- The tensile and flexural strength of L4 laminate is high, which is very economical and environmental friendly as compared to the synthetic laminate L2.
- The laminate L1 shows very poor results when compared with laminates L2 and L3 mainly because the laminate L1 only consists of bamboo (natural) fibres.
- The incorporation of bamboo in carbon fibre composites enhances the mechanical properties and it leads to the increase of the utilization of naturally available bamboo fiber.
- Silicon carbide can be added in order to develop the components which are under the load of tensile and flexural with the proper proportion in order to develop economic class of materials.

- From the water absorption test, the laminate L1 is having higher water absorption behaviour as compared to other laminates and also the absorption is more in distilled water for the laminate L1.
- Hardness results show that the laminate consisting of SiC filler material shows the superior results compared to other laminates.

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Assessment of global as well as India's bioenergy potential along with current technologies and research trends in bioenergy

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Abstract - After the 1973 energy crisis the global energy scenario is change rapidly. Due to dissimilar availability of conventional energy sources across the region, continuous rise of its demand, rapidly increasing prices, environmental degradation. These all lead to quick transition of global energy system to renewable energy sources. Which are efficient, environmental friendly and sustainable for the current and future economic, social and societal need [1].

In this review paper an overview of one of the most important renewable energy i.e. Bioenergy is provided. It is the energy from biomass sources like energy crops, residues, byproduct and waste from agriculture, forestry, etc. From the many past years global energy scenarios rely on the biomass for the variety of possible uses. As we get energy from it in all forms solid, liquid, gaseous fuel. As biomass recourses are abundant and relatively inexpensive so improving the understanding of bioenergy potential is crucible. The world bioenergy potential along with India bioenergy potential for different region, land, years for different bioenergy sources are briefly mention here. Research is currently in process to develop suitable technologies for bioenergy production. At last current technologies use for bioenergy production and recent global research topics in bioenergy is discuss in this paper.

Keywords – Renewable energy, bioenergy potential, bioelectricity, biomass, biofuels, energy crops, bioenergy technology

1. INTRODUCTION

The Energy requirement of the world is increasing very rapidly. It is now widely recognize that the conventional energy resources may not be adequate and worthy to keep pace with continuously increasing demand of electrical energy of the world. So long term world energy scenario depends heavily on non-conventional energy sources to decarbonizes and branch out our energy system. In addition to electricity generation from renewable sources like sun, wind, bioenergy play a significant role to mitigate a climate change problems and manage our energy demand [3].

Bioenergy is commonly defined as the renewable energy from the natural biological sources like plants, animals and their byproducts. These sources of bioenergy are called as biomass. In past years and now also immense part of bioenergy is used for coking purpose. This leads to more carbon emission and environmental degradation. But from the past few years several countries were utilize advance technology to convert biomass into fuels and use it for electricity generation.

Worldwide production of bioenergy is increasing rapidly due to rising rates of fossil fuels and growing environmental problems. There are many scenario forecast a higher potential for bioenergy in future. A thorough and detailed evaluation of the available bioenergy potential is therefore needed to deciding the contribution of bioenergy sources into the world energy system. In this article a overview of the world bioenergy potential especially Indian bioenergy scenario as well as current technology and research status of bioenergy is provided.

2. WORLD BIOENERGY SCENARIO

The World energy system shifting toward renewable energy resources. Because of conventional energy sources downside like climate change, pollution, etc. Inclusion of renewable resources in total energy production is increase year by years. During 2000-14 renewable electricity sector grow annual at rate of 4.5%. In this bioenergy had a growth of 8.2% achieving total generation of 493 TWh in 2014. It share 9% of total electricity generation globally from renewable energy in 2014 [4].

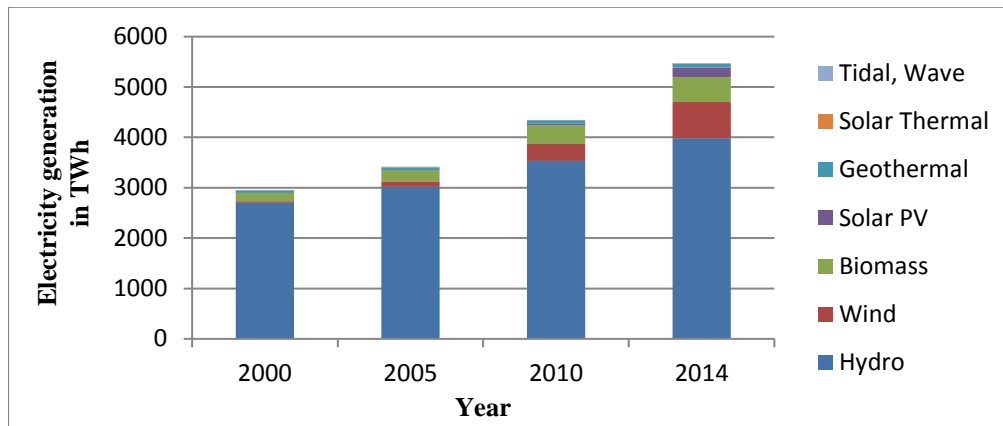


Fig.1 Electricity generation from renewable resources in continents

The total bioelectricity generation is categories into different types. Most of the bioelectricity is from solid biomass sources. These include wood chips, wood pellets, agricultural residues, forest residues, etc.

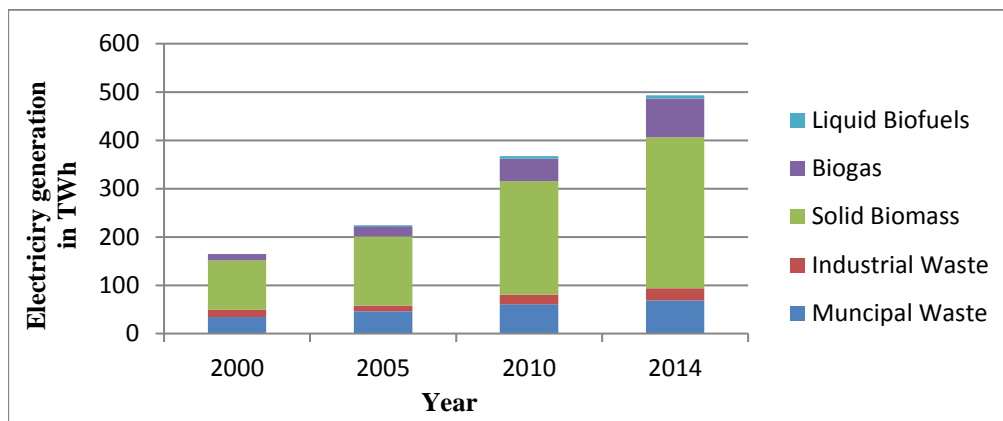


Fig.2 Global electricity generation from biomass

Most of the bioelectricity generation is in the Europe. 40% of the global bioelectricity generation totaling 196 TWh occurs in Europe. Asia has higher energy generation from industrial waste while municipal waste to electricity generation is prominent in Europe. Solid biomass generation is highest in Americas i.e. 118 TWh. USA, China, Brazil, Japan, India are the leading bioenergy producing countries.

Table 1- Electricity generation from biomass in continents in 2014 (TWh)

Sr. No.	Continents	Municipal Waste	Industrial Waste	Solid Biomass	Biogas	Liquid Biofuels	Total
1	Africa	0.00	0.00	1.80	0.03	0.00	1.83
2	Americas	16.9	2.90	118	15.4	0.21	153
3	Asia	11.7	15.2	106	3.51	1.26	138
4	Europe	40.2	6.74	85.6	59.3	4.85	196
5	Oceania	0.00	0.00	2.27	1.88	0.00	4.15
	World	68.7	24.8	313	80.1	6.31	493

Earlier the residues of plants, crops are used for the bioenergy production. Now as the technology developed and awareness about bioenergy is increase. Percentage of plants only used for bioenergy is rising. In many countries the byproduct or residues are burned, dumped into landfill due to lack of bioenergy policy. Now they are starting to use it for bioenergy production. Plantation of new forests and management of existing forests is help to increase the feedstock for bioenergy. Due to all these reasons the potential of biomass is rises year by year.

Table 2- Global potential of biomass in 2012 and 2035 (EJ)

Sr. No.	Main Sector	Sub Sector	2012	2035
1	Agriculture	Dedicated crops – Main product	3.5	30
		By products and residues including manure	2.1	34
		Total agriculture	5.6	64
2	Forestry	-	48.9	78
3	Organic waste	-	1.7	8
	Total	-	56.2	150

2.1 BIOENERGY SUPPLY

Total supply of biomass in 2014 was 59.2 EJ i.e. 10.3% of all energy supply globally. Biomass supply grew at annual rate of 2.3% [9]. The feedstock for bioenergy is come from forestry, agriculture and municipal solid waste.

I) Forestry

Forestry sector generates more than 87% of the biomass feedstock for bioenergy. It is the largest contributor to biomass supply globally due to its large area. Close to 40% of the in America continent is covered by the forest area. Europe follows second at 25% largely due to high concentration in Russia. Asia continent has highest share of planted forest. Russia, Brazil, Canada, USA, China these are the leading countries having high forest area.

Table 3- forest area in continents in 2014 (Mha)

Sr. No.	Continents	Forest Area	Primary Forests	Other naturally Regenerated Forests	Planted Forest
1	Africa	627	136	475	16.1
2	Americas	1595	721	816	57.5
3	Asia	593	117	348	127
4	Europe	1015	278	652	85.2
5	Oceania	173	27	141	4.35
	World	4002	1279	2433	290

II) Agriculture

Agriculture is significant contributor to the biomass supply in terms of energy crops for biofuels production and heat and electricity along with use of residues. Agriculture sector contribute 10% with animal and agricultural byproducts to the total global feedstock production. More than half agricultural area in Europe is under arable land. While the share is less than 12% for oceanic region [10]. Permanent pastures and meadows cover more than 50% of agricultural area for the rest of region excluding Europe. China, USA, Australia, Brazil, Russia, India these are the countries having high agricultural area. Sugarcane, maize, rice, wheat, soya beans are mostly used as biomass.

Table 4- Agriculture area in continents in 2014 (Mha)

Sr. No.	Continents	Agriculture Area	Arable Land	Permanent Crops	Permanent Pastures and Meadows
1	Africa	1132	234	34.0	861
2	Americas	1230	376	27.6	826
3	Asia	1650	482	86.2	1082
4	Europe	468	277	15.3	176
5	Oceania	420	48	1.55	370
	World	4897	1417	165	3316

III) Waste

Municipal solid waste and landfill cover remaining 3% of the biomass feedstock source. Waste obtained from municipalities and industries contributes to the increasing supply of biomass globally. This sector is classified into municipal waste and industrial waste. Municipal waste consist of products obtain from households, industries, hospitals, etc. On the other hand, Industrial waste is

waste consisting of solid and liquid products combusted directly in specialized plants. In 2014 2.21 EJ of waste was converted to energy globally. The waste sector has increased at an annual rate of 4% during 2000-14 [7].

2.2 BIOENERGY AS BIOGAS

Biogas is gaseous fuel produce from biomass using the process of anaerobic digestion of organic matter. Biogas consists of mainly methane and carbon dioxide. Commonly used feedstock for biogas includes manure and sewage, agricultural residues and organic part of household waste. The biogas either uses directly in transportation sector or bounded to generate heat and electricity. Global biogas generation has increased rapidly since 2000. During 2000-14 average growth of production was 11.2%. In 2014 the total biogas production was 1.27 EJ [9].

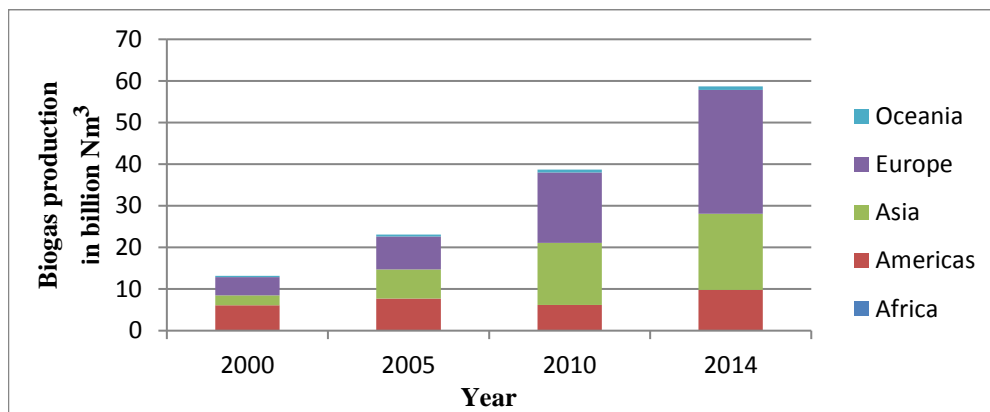


Fig. 3 Global biogas production

Almost half of the biogas production occurs in Europe 32% in Asia and 17% in Americas. Less than 2% of production occurs in Africa and Oceania countries. China, USA, India, Thailand are the leading countries in biogas production.

2.3 BIOENERGY AS BIOFUEL

The biofuels industry has seen tremendous growth in the past 14 years. Liquid biofuel for transport are the leading source of renewable energy in that sector. Biofuels are used predominantly for road transport.

In 2014 total biofuels production reached 126 million liters globally [9]. The annual growth rate of 15% since 2000 is lot higher than the average growth of all biomass supply at 2.3%. Most of biofuels are produced from bioethanol get from fermentation of sugar based crops and other from biodiesel via transesterification of vegetable oils and animal fats. Liquid biofuel production cover 2.9% of the land area used for production of major biofuels crops. Wheat, maize, sugar beet, sugarcane are mostly used for the bioethanol production. Palm oil, vegetable oil is mostly used for biodiesel production.

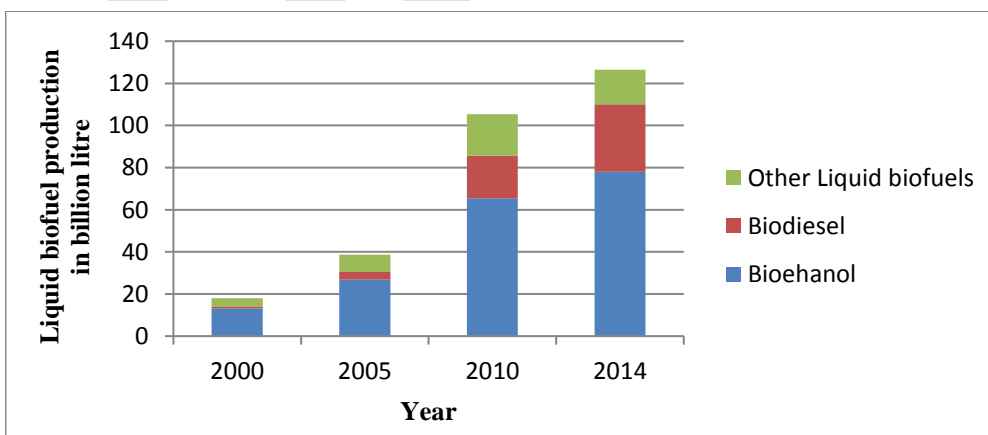


Fig.4 Liquid biofuel production globally

One continent dominates the liquid biofuels production sector. About 95.1 billion liters of biofuels are produced in Americas Predominant in USA and Brazil.

Table 5- Liquid biofuels in continents in 2014 (billion liters)

Sr. No.	Continents	Biofuels	Bioethanol	Biodiesel	Other liquid biofuels
1	Africa	0.06	0.06	0.00	0.00
2	Americas	95.1	68.5	11.0	15.6
3	Asia	11.4	4.53	6.54	0.29
4	Europe	19.4	4.57	14.3	0.53
5	Oceania	0.40	0.28	0.12	0.00
	World	126	78.0	32.0	16.4

3. BIOENERGY POTENTIAL OF INDIA

Over the years renewable energy sector in India has emerged as a significant player in the power generation. India is one of the countries with largest production of energy from renewable sources. In the electricity sector renewable energy account for 20% of the total installed capacity as of 30 June 2018. Among all the renewable energy sources bioenergy is play a vital role. Contribution of bioenergy in total installed grid interactive renewable power capacity as of 31 March 2018 is about 12.7% [2].

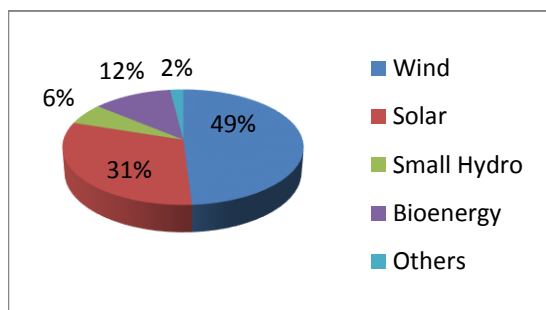


Fig.5 Percentage distribution of renewable Installed capacity in India

Table 6- Renewable installed capacity in India (as of 31 March 2018)

Types	Capacity (in MW)
Grid connected Power	
Wind	34,046.00
Solar	21,651.48
Small Hydro Power Projects	4,485.81
Bioenergy	8,700.80
Others	138.30
Total – Grid connected Power	69,022.39

India is an ideal environment for biomass production given its on account of its tropical location, abundant sunshine and rains. The countries vast agricultural potential provides huge agro residue which can be used to meet energy needs both in heat and power applications. India produces about 400 to 500 million tones of biomass per year [6]. Punjab, Maharashtra, Madhya Pradesh, Uttar Pradesh, Gujarat are the leading states in biomass production. Biomass contributes 32% of all the primary energy use in the country at present. It is estimated that the potential for bioenergy in India include 16,000 MW from biomass and a further 3,500 MW from bagasse cogeneration [2].

Table 7- Bioenergy potential and performance in India

Sr. No.	Source/system	Estimated potential (MW)	Achieved as on 31 Dec 2016 (MW)
A Grid Interactive renewable power			
1	Bio power (agro residue and plantations)	16881	7907.34
2	Bagasse cogeneration	5000	1938.30
B Captive/combined heat and power/distributed renewable power			
1	Biomass/cogeneration (non bagasse)		232.17
2	Biomass gasifier		122.14
3	Family type biogas plants	120 lakh	49.40 lakh

3.1 BIOENERGY AS COOKING FUEL

Traditional solid fuel is still widely used for cooking. According to National survey (2007 – 08) 77.6% of Indian's rural household used firewood chips for cooking. As per the study by International energy agency (IEA) 585 million Indian's were depend on biomass for cooking and this predicted to increase up to 632 million by 2030 [5]. Dependence on bioenergy is expected to continue in India due to increase in rural population and lack of access to commercial fuels in rural areas particularly for cooking.

3.2 BIOENERGY AS BIOGAS

Biogas typically refers to a mixture of different gases produce by breakdown of organic matter in absent of oxygen. It primarily contains methane and CO₂. biogas can be used for clean cooking fuel. It also power gas lamps. In India the estimate for the production of biogas is about 20,757 lakh cubic meters in 2014 – 15. This is equivalent to 6.6 crore domestic LPG cylinder same as 5% of the total LPG consumption in the country [11].

Table 8- State wise estimated potential and cumulative achievements for family type biogas plant

Sr. No.	State/Union Territories	Estimated Potential (nos. of biogas plants)	Cumulative achievement As on 31 March 2017
1	Andhra Pradesh	1065000	549235
2	Arunachal Pradesh	7500	3555
3	Assam	307000	130375
4	Bihar	733000	129844
5	Chhattisgarh	400000	54825
6	Goa	8000	4230
7	Gujarat	554000	433317
8	Haryana	300000	62085
9	Himachal Pradesh	125000	47650
10	Jammu & Kashmir	128000	3163
11	Jharkhand	100000	7579
12	Karnataka	680000	491764
13	Kerala	150000	149568
14	Madhya Pradesh	1491000	365689
15	Maharashtra	897000	899472
16	Manipur	38000	2128
17	Meghalaya	24000	10196
18	Mizoram	5000	5412
19	Nagaland	6700	7953
20	Orissa	605000	270880
21	Punjab	411000	177445
22	Rajasthan	915000	71231
23	Sikkim	7300	9044
24	Tamil Nadu	615000	222870
25	Telangana	-	22571
26	Tripura	28000	3620
27	Uttar Pradesh	1938000	440713
28	Uttarakhand	83000	21558
29	West Bengal	695000	366974
30	A & N Islands	2200	137
31	Chandigarh	1400	97
32	Dadar and Nagar Haveli	2000	169
33	Delhi	12900	681
34	Pondicherry	4300	578
35	KVIC and Others	-	-
	Total	1,23,39300	49,66,628

3.3 BIOENERGY AS BIOMASS CROP YIELD

India's total land area is 328.7 Mha out of which 42.5 Mha is not available for cultivation [6]. The existed land usage in India is mentioned in table 9 below.

Table 9- Potential land areas in India with biomass potential

Sr. No.	Land Details	Areas (kha)	Percentage of India's total land area
1	Forest	69.8	22.9%
2	Net sown area	141.9	46.5%
3	Uncultivated land excluding fallow land	26.9	8.8%

4	Fallow land	24.2	7.9%
5	Not available for cultivation	42.5	13.9%
	Total	328.7	100%

The classification of biomass yield through the three main sources of forestry, agriculture and wasteland is provided below.

Table 10- Potential of biomass yield by source

Sr. No.	Types of resources	Area (kha)	Biomass generation (kt/yr)	Biomass surplus (kt/yr)
1	Agro-residue	16423	95512	43162
2	Forestland	64570	89119	59162
3	Wasteland	54253	66355	44369
	Total	135246	250986	147210

3.4 BIOENERGY AS BIOFUEL

The National biofuel policy of India adopted in December 2009 aims to facilitating development of indigenous biomass feedstock for production of biofuels [2]. The new biofuel policy will incentivize plantation of non-edible oilseeds like jatropha over 11.2 million hectares of land resulting in 13.38 million tons of biofuel. To fulfill its policy target of blending 20% of biofuels in transportation fuel by 2020.

A bioethanol program calls for E5 blends throughout most of the country targeting to raise this requirement to E10 and E20. In 2003 the National government set a 5% mandatory blending for gasoline. In 2005 country became the fourth largest producer of ethanol at 1.6 billion liters and the country has about 125 ethanol producers with a total capacity of 1.25 billion liters of ethanol [11].

4. CURRENT TECHNOLOGIES AND RESEARCH TRENDS IN BIOENERGY

Earlier bioenergy is only used as cooking fuel but from the past 15-20 years have see a strong resurgence along with gradual development of more modern and efficient bioenergy production systems. There many difference types of biomass residue, waste and energy crops available worldwide. To be able to utilize the different types of available biomass in a cost effective and efficient manner range of technologies are developed to convert it into various solid, liquid, gaseous biofuels. Current technologies for bioenergy production and its research status are mention in this segment.

4.1 COMBUSTION

Biomass combustion is the most common biomass conversion technology applied on household and industries since ancient time. It varies from small stoves to multi-megawatt combined heat and power (CHP) system. Over the last decades, however modern biomass combustion technologies have emerged like fully automated pellet boilers, co-firing and efficient combined and power production for a large variety of biomass recourses.

4.2 GASIFICATION

Gasification involves subjecting solid biomass to hot steam and air to produce a gaseous biofuel called producer gas. Biomass gasification is an endothermic thermal conversion technology in which limited sully of oxygen, air, and steam combination survives as oxidation agent. The product gas consists of carbon monoxide, carbon dioxide, hydrogen, varicose contaminant such as char particles, ash, tar, etc.

4.3 PYROLYSIS

Pyrolysis is the basic thermo-chemical process for converting solid biomass to a more useful liquid fuel commonly called a biofuel or pyrolysis fuel. This can be used for power, heat, transport, fuels and chemical production.

4.4 FERMENTATION

This process can be used on certain sugar producing energy crops to produce ethanol, alcohol. Yeast is added to the biomass and the mixture then ferment under specific condition. Then the resulting brew distilled to produce bio-ethanol. This can be used in specialized combustion engines or it can be mixed with petrol to produce a gasohol.

4.5 ANAEROBIC DIGESTION

Anaerobic digestion is the production of a methane rich biogas from wet biomass source like manure, kitchen and garden waste, waste water, etc. The biogas can be used for heat and power generation using as engines or upgraded for use in Natural gas grid. Commercially digestion technologies used are covered lagoon, completed mixed, plug flow, upflow anaerobic sludge blanket reactor (UASB).

4.6 CARBONIZATION AND TORREFACTION

Charcoal production from wood is a most common carbonization technology, but also agro residue like cotton stalks can be carbonized and further upgraded to household fuels. Torrefaction is a partial carbonization process at temperature of 200 to 400°C making the biomass crispy. Torrefied biomass is suitable for co-firing in coal fired power plants.

4.7 TRANSESTERIFICATION

The transesterification of vegetable oils, animal fats or waste cooking oils is the process use for production of biodiesel. In transesterification process a glyceride react with an alcohol in the presence of a catalyst forming fatty acid alkyl ester and alcohol. Now to get high quality of biodiesel, high product yield and various advantages multistage cavitations process is used for biodiesel production.

Research is ongoing to develop new technologies and processes to expand the bioenergy sector. Many research institutes throughout the world are working in bioenergy field. They broadly focusing on the area like

- Sustainable and cost effective supply and use of biomass recourses especially from forest.
- Research and Industry relevant characterization of biomass and biomaterial properties.
- Efficient biomass conversion into materials, bioenergy and other consumer products.
- Acclimation of high activity anaerobic sludge in organic waste water and is microbiological research.
- Township biogas septic tanks.
- Conventional fermentation process for regular biogas production of rural domestic hydraulic digesters.
- Dry fermentation in rural areas.
- Environmental control and waste treatment technology on scaled piggery farm.
- Application of biogas treatment and technical system for poultry and livestock waste.
- The use of land for energy production Vs food production.
- Finding more suitable biofuels crops improving the oil yields of these crops.
- Consequences of ethanol production on domestic food markets.
- Producing cellulosic ethanol.
- Enhancing the overall per acre oil yield of *Jatropha* through advancements in genetics, soil science and horticultural practices.
- Biofuels extraction from the single celled fungi.
- Technology of using the gut micro biomes of wood feeding insects for the conversion of lignocellulotic material into biofuel.
- Recycling and reusability of lignocellulosic byproducts in biorefinery processes.
- Waste biorefineries: Future, green products and waste treatment.
- Biological Methanation or (bio/syn) gas upgrading.
- Advancement in biomass feedstock preprocessing.
- Current advances in micro algal biofuel.

5. CONCLUSION

In this paper we analyze the global as well as India bioenergy potential by comparing different previous research. The available research on bioenergy potential allows an evaluation of existing resources base scenario and gives information about possible future development. Existing research show that bioenergy has capacity to contribute major part of global primary energy supply in future.

In past decades no. of countries exploiting biomass opportunities for the provision of energy has increased rapidly. The

various researches provide the estimation of bioenergy potential but the exact potential estimation is unclear and it extensively varying. We found that the main four source of bioenergy are agricultural, Forest, waste and others. Out of these four sources forest can become a major source of bioenergy. Land availability is the important parameter in the bioenergy potential assessment. For all potential purpose it is vital to clearly define land use policies to ensure restriction of bioenergy cultivation to area that are not in competition with other uses like agriculture, biodiversity, etc. Liquid fuel made from biomass attracting growing interest worldwide. The bioenergy sources are available all around the globe at very low cost as compare to others energy resources. So it can be an effective option for provision of energy services. Therefore more research for making new technologies is needed.

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Enhanced local outlier factor incorporating with Open Close Sequence Filter

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Abstract— In this paper an enhanced local outlier factor incorporating with boundary discriminative noise detection is proposed to identify noisy pixels and restore them properly and do not give false alarm on those which are present at edges. In first stage the proposed algorithm detects noisy pixels by local outlier factor incorporating with Boundary Discriminative Noise Detection (LOFBDND). Since this detection stage using LOF detects edge as noise and miss detect some noisy pixels which will result in high miss detection and false alarm rate so before going into filtering stage, next step will take out edge information. Noise removal of Images using mean filter based on replacing the central pixel value by the general mean of all pixels inside the sliding window. Finally the quality of Image is improved by using Open Close Sequence Filter, this filter is applied as per proposed method in this paper. The results show quantitatively and graphically (in terms of peak signal to noise ratio, mean squared error, accuracy).

Keywords— local outlier factor(LOF), Image noise removal, Boundary Discriminative Noise Detection(BDND), Mean filter.

Introduction

Impulse noise is present in digital images because of bit error in transmission or introduced by malfunctioning of camera's sensor cells, transmission errors, faulty memory locations or timing errors in analog to digital conversion in the imaging process. Impulse noise that usually corrupts images by replacing some of the pixels of the original image with new pixel values. Since, the performance of noise removal methods depends on its effectiveness to detect and remove the faulty pixels. Linear filtering techniques[1] are not widely used because they are unable to preserve the information regarding the distorted pixels while removing the noise. Therefore non-linear filtering techniques are widely used in the restoration process.

The proposed method performs well in removing low to medium density impulse noise with detail preservation up to a noise density of 70% and it gives better Peak signal-to-noise ratio (PSNR) and mean square error (MSE) values.

Literature Survey

Local Outlier Factor

It is an outlier detection strategy to detect the pixels with noise and that detected pixel is different to the original pixel because of noise and that strategy is enhanced by the proposed method of this paper.

The local outlier factor (LOF) method is set of rows generated based on probability distribution[2].

Local outlier factor is a density-based method that finds its neighbors. It is used to calculate the average densities of pixels by calculating the densities of its neighbors pixels.

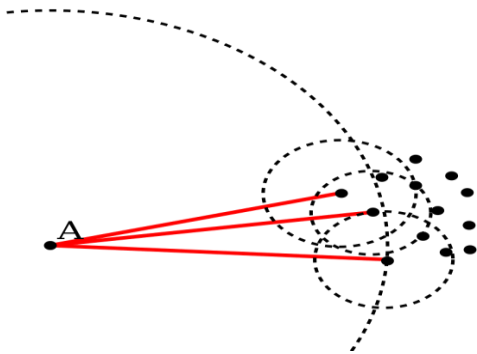
the estimated density[3] of a point h is the number of h 's neighbors.

Suppose $K(h)$ is the set of neighbors of point h , t is the number of points, and $d(p,x)$ is the distance between points p and x . The density is:

$$f^{\wedge}(p) = \frac{1}{t} \sum_{x \in K(p)} d(p,x)$$

and the local outlier factor value is:

$$LOF(p) = \frac{1}{t} \sum_{x \in K(p)} \frac{f^{\wedge}(x)}{f^{\wedge}(p)}.$$



Point A has a high LOF score because its density is low relative to its neighbors' densities. Dotted circles indicate the distance to each point's third-nearest neighbor.

Proposed Method

- 1) The input of the image is to processing based on open close sequence filter.
- 2) `seqfilter(fastqFile)`
- 3) `seqfilter(fastqFile,Name,Value)`
- 4) `[outFiles,nSeqIn,nSeqOut] = seqfilter(____)`

The detection stage is used to calculate the Local Outlier Factor of every pixel p in an image.

$M = \text{medfilt2}(Y, [WF \ WF]);$ noise filtering process.

- 5) To reduce the false alarm at the edges.

Get the edges of image using sobel operator `edgeIm = sobel_mex(gray, 0.7);` Divide edge image into blocks of 3×3 .

For each 3×3 block if the block has more than two edge pixels then declare it genuine and remove edge information

- 5) It is to generate the less noise along edges and the quality of image is also improved.
- 6) By calculating the MSE and PSNR value.

$\text{SquaredErrorImage} = (\text{double}(\text{gray Image}) - \text{double}(\text{noisy Image})) .^ 2;$

$\text{mse} = \text{sum}(\text{sum}(\text{squaredErrorImage})) / (\text{rows} * \text{columns});$

Calculate PSNR (Peak Signal to Noise Ratio) from the MSE according to the formula

$\text{PSNR} = 10 * \log_{10}(256^2 / \text{mse});$

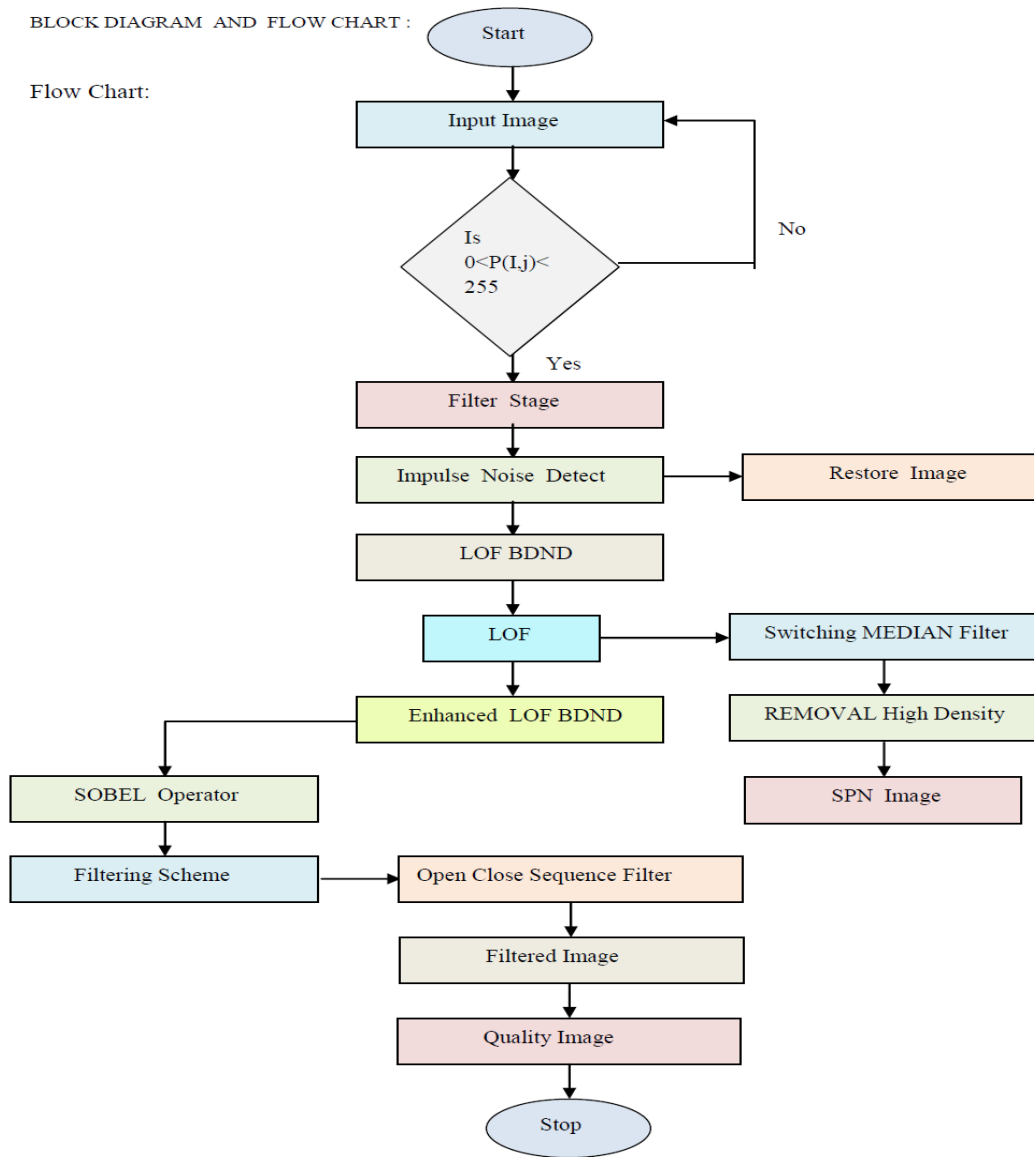
RESULT ANALYSIS OF SIMULATION

The proposed algorithm is simulated in MATLAB R2018a(64 bit). Here some colored and gray scale images are passed to simulation for result analysis. To compare the results of different Images, these Images have density ranging from 40% to 75%. Now these noisy images are restored by using both LOFBDND[4] and the proposed algorithm.

Detection and filtering phase Analysis

BLOCK DIAGRAM AND FLOW CHART :

Flow Chart:



In the given algorithm, Image is being processed to detect the noise and after that filtering step is taken place with open close sequence filter to improve the quality of Image.

Analysis of Visual Performance

TABLE 1:RESULT ANALYSIS FOR TEST IMAGES

Test Image	Parameter	Mean Filter	LOFBDND	Proposed Algorithm
Image 1 (figure 1) (Graph 1 & 2)	SNR	1.16	5.20	7.61
	PSNR	13.11	17.16	19.56
	MSE	46.20	50.82	49.77
Image 2 (figure 2) (Graph 3 & 4)	SNR	9.96	13.70	15.62
	PSNR	14.22	17.96	19.88
	MSE	69	55.91	54.83
Image 3 (figure3) (Graph 5 & 6)	SNR	6.51	10.45	12.57
	PSNR	13.51	17.45	19.57
	MSE	74.83	64.95	64.66

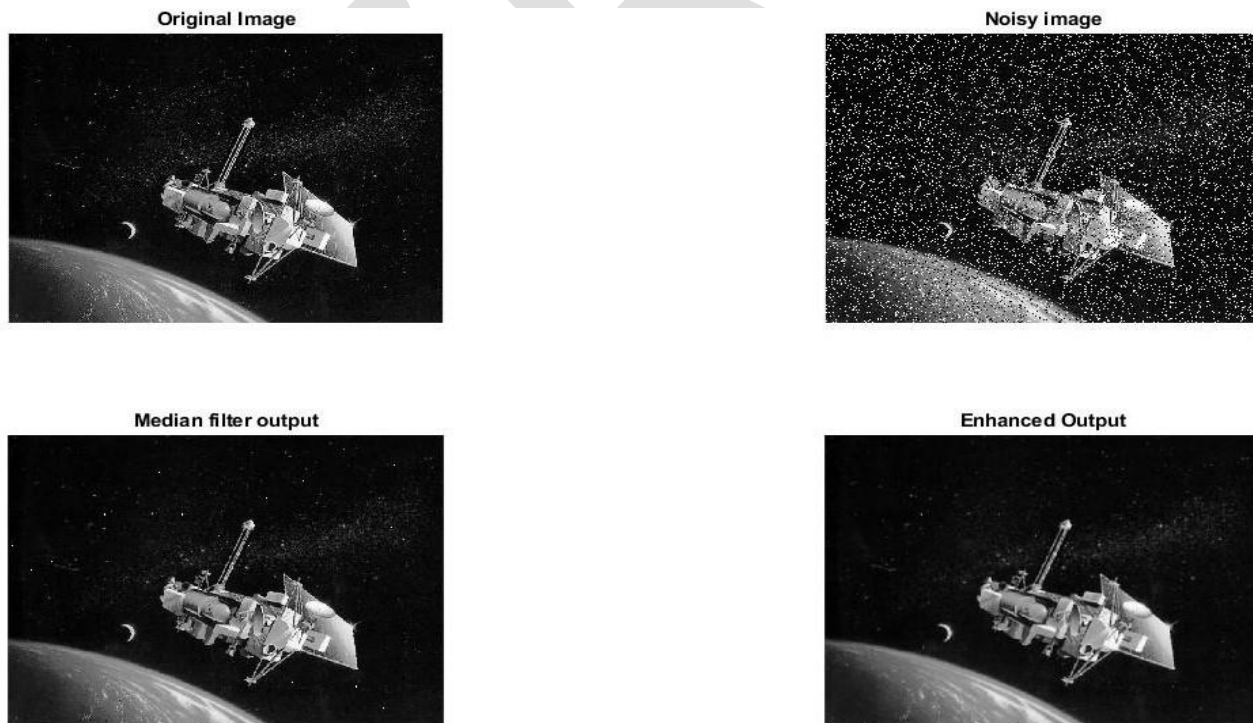
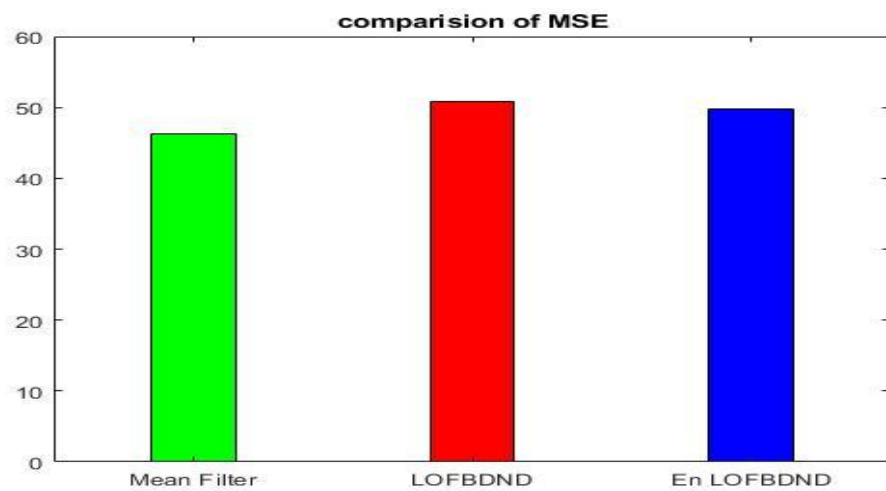
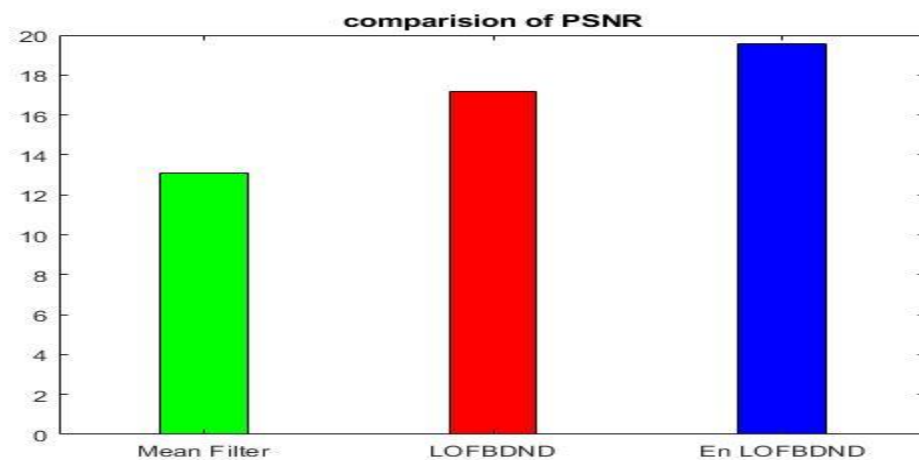


Fig. 1 Test Image 1



Graph 1 Test Image 1



Graph 2 Test Image 1

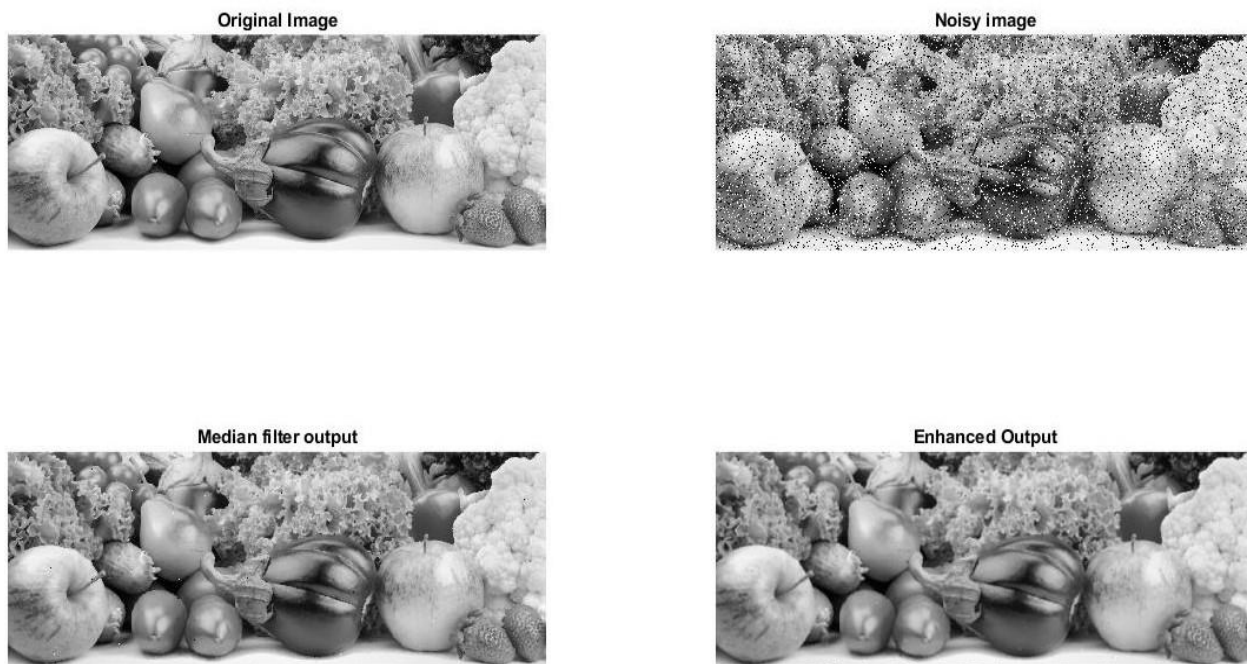
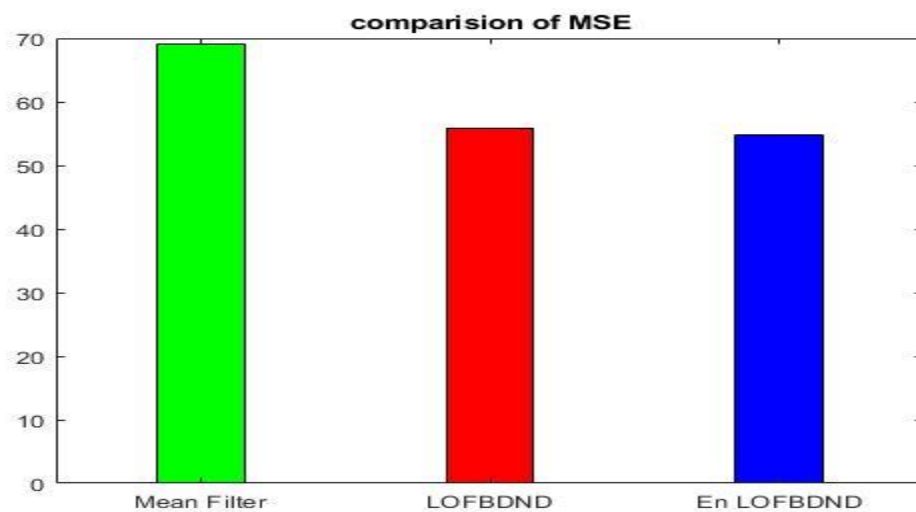
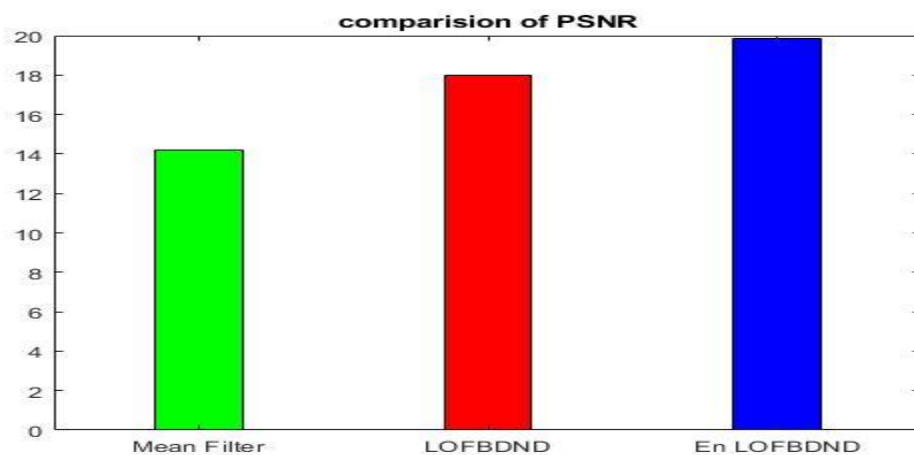


Fig. 2 Test Image 2



Graph 3 Test Image 2



Graph 4 Test Image 2

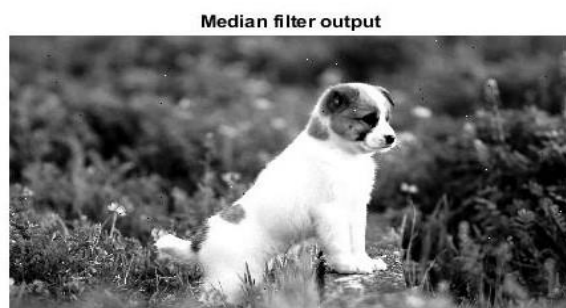
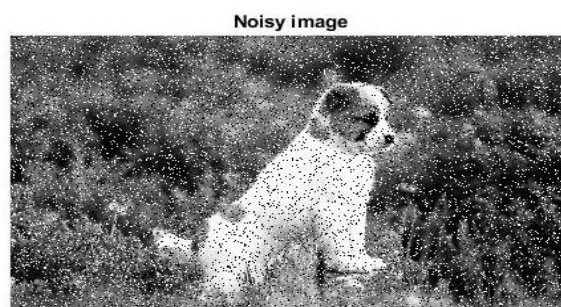
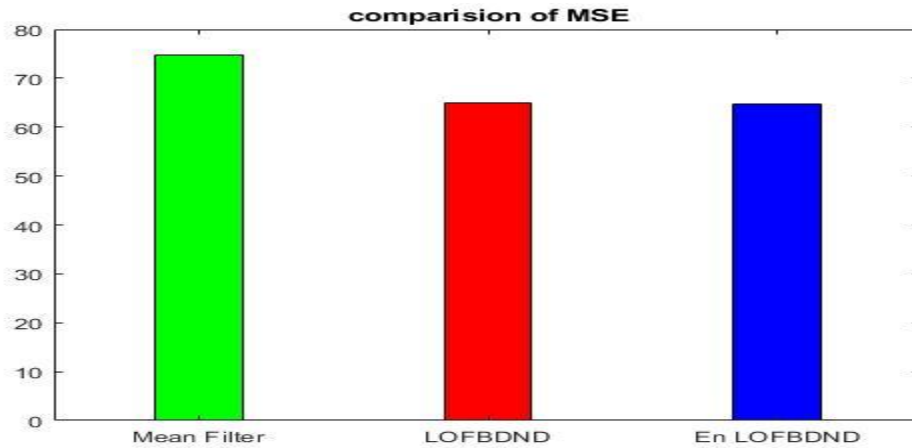
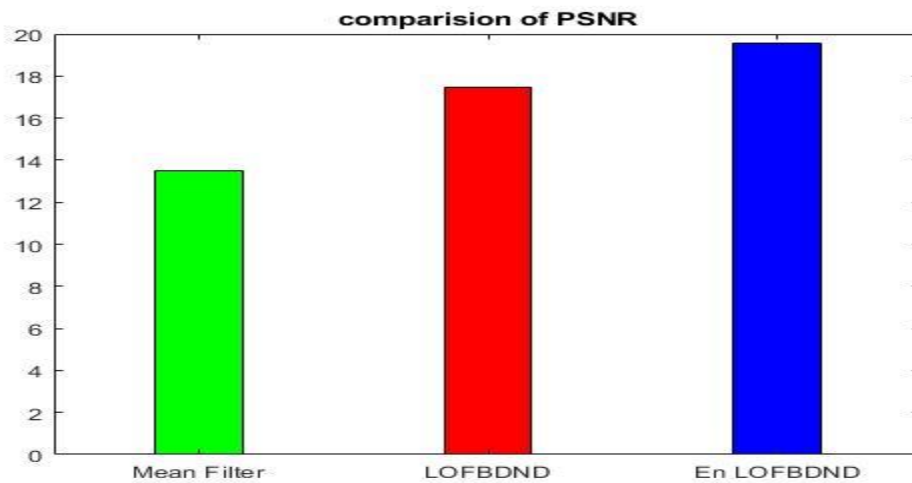


Fig. 3 Test Image 3



Graph 5 Test Image 3



Graph 6 Test Image 3

Proposed Method is applied to different Test Images i.e. Image 1, Image 2, Image 3 and accordingly the result is displayed in Graphs and calculated values SNR, PSNR, MSE are mentioned in the table 1. Here Test Image 1, Test Image 2 & Test Image 3 are compared with graphs by using values of PSNR & MSE[5].

CONCLUSION AND FUTURE WORK

In this paper, the image is restored with proposed method to improve the quality, it uses LOFBDND to find the false pixels present in the Image and restore them with open close sequence filter[6].

A comparison of proposed algorithm is also done with the existing noise removal algorithms in terms of PSNR, MSE.

In future the quality of Image can be improved by introducing Cascading window[7].

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Geological-genetic peculiarities of Goshian gold-sulfide deposit formation (Azerbaijan area of the Lesser Caucasus)

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Abstract: This paper focuses on geological-genetic peculiarities of Goshian deposit formation. Considerable elements of corresponding conditions of gold-ore mineralization localization can be emphasized here, subvolcanic body and joined high-angle faults are the more typical among them.

Sequence and stages of mineral formation process are studied and also distribution of precious metals in ores and sulfide concentrations. Ore bodies refer to vein-disseminated type and are confined to inside part of metasomatic aureole which is represented by quartz-sericite facies of secondary quartzites. It is expected during ore-formation process physic-chemical conditions varied from midwater (quartz-pyritic stage, early-ore) to shallow (quartz-arsenic pyrite-polymetallic with “hidden” gold) up to near-surface (quartz-gold-telluride, quartz-gold goethite-hydrogoethite stage). Formation of Gosha deposit occurred in relatively narrow temperature interval from homogeneous fluids of mainly Na-chloride composition with moderate and low salinity.

It is established the temperature of ore-formation studied by homogenization method of gas-liquid inclusions in transparent minerals (quartz) of different mineral associations varies 140-390° C. Pressure of ore-forming medium calculated by isotherms cross in system H₂O-CO₂ and isochors CO₂ is 0,7-2,0 Kbar.

Keywords: gold-sulfide mineralization, ore bodies, mineralization zones, mineral associations, mineral formation, isotopic data, fluid inclusions.

1.Geological tectonic position of deposits. Metallogeny of Lok-Garabagh zone was studied in numerous works of such authors as R.Abdullayev, Sh.Azizbekov, et al., 1962; T.Hajiyev, 1976; Ramazanov, 1997; V.Baba-zade, 2005, et al. and noble methylation mining-magmatic systems (MMS) are discretely distributed within Lok-Garabagh zone; they are: Gedabek, Garadagh, Chovdar, Goshian, Dagkesaman, Gyzybulag and less considerable deposits, ore occurrence which formed according to activity of magmatic systems appeared in Middle-Late Mesozoic. This zone is of the same pattern of long polyformation development with Mesozoic Paleoisland-arc constructions and this zone is especially rich in deposits of non-ferrous and precious metals, however mineralization scales have yet to be defined. Epigenetic gold-bearing and proper gold-ore deposits are very typical for fragments of Paleoisland-arc (Lok-Garabagh and Kafan). These deposits differ by geological and structural position, quantitative ratio of mineral complexes and gold content [Baba-zade, Ramazanov, 2003] (fig.1).

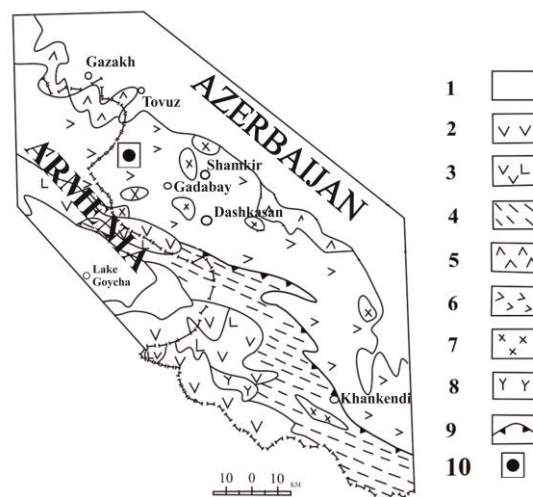


Fig.1. Scheme of work areas location. 1 – molasses, sandy-clayey deposits, in places (in section base) gypsum and ferruginous (Oligocene-Quaternary period); 2 – basaltic beds, dolerites, andesites, trachyandesites (Neogene – Quaternary period); 3 – andesitebasalts, trachy-andesites, terrigenous-carbonaceous flysch (Paleogene) of collision volcanogenic-depression structures on border between adjacent South-Caucasian and Daralagez continental blocks and subjected to late-collision and post-collision magmatic activation; 4 – dunites, peridotites, gabbroids, siliceous limestones, olistostrome (the Upper Jurassic-Cretaceous period);

oceanic formations, obducted on above-mentioned continental blocks and known as Geycha-Akerian suture zone); 5 – rhyolites, dacites, andesite-basalts, tuffaceous sandstones, in places (upper part of section) limestones (Upper Cretaceous period; volcanogenic-sedimentary complex of residual back-arc collision Paleodepressions); 6 – andesitebasalts, andesites, rhyolites, tuffaceous sandstones, clayey shales, in places (upper part of section) reefogenic limestones (Middle-Upper Jurassic-Lower Cretaceous period; fragments of Lessercaucasian Paleoisular-arc known in literature as Paleoisland-arc Somkhito-Garabagh zone and its Kafan block shifted to south-east along submeridional fault); 7-diorites, tonalities, plagiogranites (Middle Jurassic-Early Cretaceous period); 8-monconites, sienites, granosienites (Upper Paleogene); 9-overthrust; 10-Goshian deposit.

Shamkir uplift where Goshian gold-sulfide deposit is located, is represented by large structure of sublatitudinal extension, mainly Middle Jurassic volcanogenic formations participate in its structure they are cut by the Upper Bajocian plagiogranite and granitoid intrusive complexes. Uplift structure is characterized by relatively simple construction and extends its general consistent strike (Abdullayev, Mustafayev, et al, 1988).

Goshian gold-sulfide deposit is a typical representer of volcanogenic deposits with progressive ore-formation and is connected with constant basalt-andesite-dacite-rhyolite formation localizing in upstructure portion of subvolcanic construction.

Goshian field is located in the most north-western area of Shamkir uplift. Goshian deposit is characterized by confinedness to local focal-dome structure of Jurassic period and volcanic and tectonic construction takes the central place in it which is fixed in crossing of large regional faults of north-western, submeridional and sublatitudinal extensions. The more typical elements of ore field which effect on mineralization distribution on deposit area, are subvolcanic body and steeply dipping faults – sublatitudinal and near-meridional faults. A close spatial connection is observed between ore-formation and Low-Upper Bajocian Middle-acid subvolcanic bodies – from andesites, andesitebasalts to rhyolites, rhyodacites and dacites. (Abdullayev, Mustafayev et al., 1988). Correlations of subvolcanic formations and endogenic mineralization of deposit in many cases are the following: their genetic connections can be supposed at relatively large depths. But chiefly (in rhyolites areal) the availability of relationship between hydrothermal and magmatic processes can be supported by geological research: endogenic ore mineralization and rhyolites are of close age; ore mineralization and metasomatites form aureolas around subvolcanic bodies or are localized in endocontacts of their apical parts; mineralization is epigenetical relatively to subvolcanic bodies and according to it we can conclude not large subvolcanic bodies of rhyolites irruptive earlier which are superimposed with ore bodies were outflow ways for solutions from depth. (Baba-zade, Ramazanov, 2003; Mansurov, 2004).

Mineralization of gold-sulfide type is concentrated in different oriented dilation veins and in zones of hydrothermal study of laval and pyroclastic series of andesites of Lower and rhyo-dacite porphyries of the Upper Bajocian as metasomatic bodies. Quartz veins according to morphology are usually different-scale. Along with relatively large simple veins the short ones are found which irregular along the strike and vein dip, with complex ramifications on the rise with transitions into zones of thin veinlet and brecciation. Generally veins form en echelon systems. Moreover, the ore bodies are represented by areas with more intensive hydrothermal alteration zone impregnated by gold-bearing sulfides of productive mineral associations-pyrite, chalcopyrite, etc. of typical vein – disseminated excretion pattern (Suleimanov, 1982; Baba-zade, Musayev, et al., 2003).

2.Metasomatic changes of host rocks. The typical feature of deposit is a widespread of pre-ore propylitization, silicification, kaolinization. Propylitic fields are characterized by zonal structure and it is supported by rise of temperature and solution acidity towards the centre of deposit. Secondary quartzites are along fractured zone and ruptured zone among propylites fields, these quartzites complete processes of pre-ore metamorphism. Due to strong hydrothermal study primary composition of rocks can be hardly recognized according to relicts of primary structures and quartz inclusions. It is assumed secondary quartzite metasomatites formed mainly on acid rocks and rarely tuffs. The main minerals of secondary quartzites alunite, diaspore, dickite, sericite and kaolin form various parageneses. Moreover the mentioned main minerals the other minerals such as pyrophyllite, zunyite, barite are found. Availability of sericite is more significant for zonation determination. Secondary quartzites as area with width of 100-150m stretch along fault zones. According to rocks outcrops they are of bedded, blanketlike form and steeply dip (70-85°) in West and East.

Such structural plan of secondary quartzite metasomatites is supported by drilling data and hypsometric position of facial borders. Despite mineral types of secondary quartzites they form the Upper supra-ore zone in hydrothermal-ore system being ore guides at depth and it needs reassessment to determine the contents of ore bodies under them. Formation of secondary quartzites was accompanied by supply of chlorine, noble and nonferrous metals, in this case content of ore components increases by 1-2 order in propylites and more by 1-2 order – in secondary quartzites.

The main pattern of matter deposition on ore stage – filling of fracture holes and pores. Metasomatism prevails on pre-ore stage, it considerably manifests at beginning of ore stage and accompanies deposit of ore matter as secondary phenomenon in nearly vein space (Baba-zade, Musayev et al., 2003; Mansurov, 2001).

3.Structure of ore bodies and zones of mineralization. Deposit has been revealed by five gallery levels. It is formed by system of quartz-sulfide veins and streaks of small extension (quartz-sulfide morphological type), by series of narrow steeply dipping mineralized and vein zones (morphological type – zones with stockwork veins) (fig.2). Ore bodies of vein type are localized in central part of deposit. Their dipping is steep, almost vertical. They have rather vivid geological borders and inconsiderable wallrock alteration of host rocks and it shows the prevalence of process execution in ore deposition. Typical peculiarity of mineralized and vein zones is highly irregular distribution of gold and availability of well-defined ore columns. Ore bodies №№5; 5 – in west and 3 in southern flanks, №№1 and 2 in northern flank of deposit. Ore zones are represented by silicified and kaolinized (with formation of quartz-kaoline association), by pyritized zone of hydrothermal alteration crooked quartz veined. Areas with intensive pyritization can be marked possessing small lens, veinlets, pockets and pyrite dissemination; here can be found pocketry of chalcopyrite, sphalerite

4.Mineral associations and stages of mineral formation. According to the results of mineralogical study of aggregates of ore and non-ore minerals, structural and textural peculiarities of ores in spite of simple mineral ore composition, majority of main minerals generations – quartz and pyrite one can conclude of long-term ore formation and multiple stages of hydrothermal-ore process (fig. 4, 5, 6).

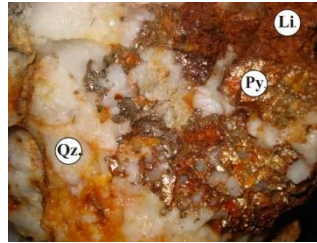


Fig. 4 Hand specimen shows quartz-pyrite-gold mineralization stage. (Qz.- quartz; Py.-pyrite; Li.-limonite)

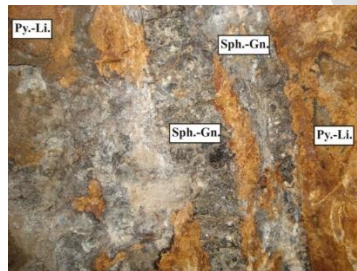


Fig. 5 Hand specimen shows quartz- polymetallic mineralization stage. (Sph.- sphalerite; Gn.-galena; Py.-pyrite; Li.-limonite)

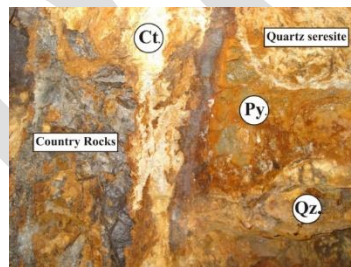


Fig. 6 Photo shows the inter-relationships between the different stages of mineralization. (Qz.- quartz; Py.-pyrite; Ct.- carbonates)

There are pre-ore and ore stages. Pre-ore stages includes all complex of metasomatic changes of host rock such as areal propylitic changes, silicification, sericitization, kaolinization and pyritization of fractures and crushed rhyolitic dacites. According to textural relationship of mineral aggregates indicating manifestations of tectonic movements in process of mineralization and it can be supported by availability of breccia-like textures and textures of inter-mineral intersection, ore stage can be divided into five successively formed stages of mineral formation (Baba-zade, Khasayev, et al., 2007; Mansurov, 2001;). Each stage is confined to some stages of deformation within the whole cycle of ore stage: quartz-pyrite (pyrite) early ore, quartz-arsenopyrite-polymetallic with “invisible” finely dispersed gold, quartz-gold-telluride (Productive), quartz-gold-hetite-hydrohetite (Productive) and final, post-ore, quartz-carbonate (Post-productive). As it is seen these three stages are gold-bearing: the first, quartz-pyrite stage, including minerals of metasomatites and pyrite, started by quartz formation – the main component of ore. Active migration of silica to water solutions during formation of hydrothermal deposits is possible only under alkaline conditions and this minimizes the ideas of joint migration of metals with silica. After quartz extraction which prevails in metasomatites composition mass densely disseminated and veinlet pyrite extractions (quartz-pyrite association). In this case microinclusions of pyrrhotine and chalcopyrite are found in large cuboctahedral habitus of crystals with size of two decimal places mm and in aggregates of isometric round forms of pyrite – I. At the same stage magnetite-hematite association was bedded. Quartz fine-grained is in intergrowth with small scales of sericite and fine-grained pyrite and it could partially form during recrystallization of diagenetic pyrite-markasite aggregates. As it is seen ore-genetic elements present at earliest portions of hydro-therms and further they gradually increase its concentration at late stages. At the second quartz-arsenopyrite-polymetallic stage redeposition and recrystallization occur. Minerals of this stage fill open joints and cement brecciated metasomatites with disseminated sulphur pyrite mineralization. This stage is represented by quartz-arsenopyrite-pyrite-chalcopyrite, quartz-pyrite-chalcopyrite, quartz-sphalerite-galena association; besides the mentioned minerals there are bornite, cinnabar in small and changeable quantities and alloy of “invisible” finely dispersed gold which is an important form of its concentration in Goshian deposit. Hidden gold is connected with chalcopyrite and pyrite, and silver – with fahl ores, sphalerite and chalcopyrite, sometimes with bornite (Baba-zade, Khasayev, et al., 2007) [fig. 7].

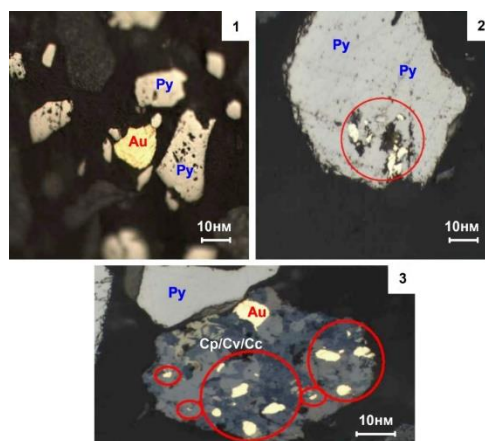


Fig. 7 Microphotographs of gold grains (yellow) in primary sulphide ores:

1) free gold; 2) inclusions in pyrite (Py); 3) inclusions in chalcopyrite (covelline, chalcocite) (Cp/Cv/Cc).

One of the main mineral form for gold presence in ores – is tellurium compounds among which hessite and petzite and in some cases minerals of Au-Ag-Te, Bi-Te-S systems represented by bismuth tellurate, altaite, tetradytmite which are optically diagnosed and supported by X-ray. They characterize the third productive quartz-gold-telluride stage with paragenetic association of minerals quartz-gold-molybdenite, quartz-fahlore-gold, quartz-tetradytmite-bismuth tellurate petzite-hessite-native gold. Tellurides are confined to those areas of ore bodies (sampling data) where high content of gold and silver is determined and develop jointly with chalcopyrite, sphalerite, halenite and tennantite.

Association of minerals of this stage are dimensionally combined with quartz-arsenopyrite-polymetallic stage, in veins of which veinlet quartz extraction develop with dissemination of molybdenite, tetradytmite, hessite, sometimes – petzite. Molybdenite forms finely-squamosed crystals (up to 0,01mm) in non-ore mass. Hessite (up to 0,6 x 0,1mm) is deposited in intergranular openings of pyrite and jointly with tetradytmite forms structure of mutual intergrowth.

Native gold closely associates with hessite and can be found in it as small veinlet formations or series of contiguous small (0,025-0,065mm), almost isometric inclusions. Small inclusions of petzite of irregular shape and also small amount and undefined number of silver telluride enriched by silver in comparison with hessite can be found in hessite. Results of microprobe analysis of hessite are in table 1.

Table 1

Chemical composition of tellurides and gold

Minerals	Au	Ag	Cu	Te	Se	Total
Hessite	0,91	60,50	0,22	37,10	not defined	98,73
	1,36	60,18	0,08	36,81	-	98,43
	1,98	60,48	not defined	36,26	-	98,72
Petzite	25,94	40,62	not defined	32,75	not defined	99,31
	23,66	43,00	0,20	34,06	0,19	100,92
	25,29	43,13	0,01	32,91	not defined	101,53
Gold	99,66	8,89	not defined	not defined	-	99,55
	87,34	10,90	not defined	-	-	98,24
	89,03	11,59	next	-	-	100,62
	86,91	12,51	0,03	-	-	99,79

Tetradymite and bismuth tellurate form bladed crystals (from 0,2 x 0,2 to 1,2 x 0,15mm and 0,082 x 0,042 mm correspondingly), creating structure of mutual intergrowth with hessite. Rarely tetradymite and bismuth tellurate develop in marginal parts of crystals of pyrite – III. Petzite is rarely found in quartz-telluride association and forms small extractions in mutual intergrowth with hessite. Bismuth tellurate as bladed crystals (0,042 x 0,082 mm) can be found in association with pyrite, tetradynamite, hessite. Rarely is found. Generally one can conclude for this productive stage the following: 1) the main part of native gold is closely connected with bismuth tellurates, silver and gold; 2) hessite Ag_2Te is probably mineral-concentrate of gold and silver and this defines its specific role in mineralization; 3) look of ore closely connected with tellurides has size of 0,002-0,2 mm and this points out dispersion form of its presence in ore mass.

Thus, such ore-genetic elements as gold, silver, molybden, tellurium, bismuth were in formation of quartz-gold-telluride stage in hydrothermal solutions.

The next time formation – quartz-gold-goethite-hydrogoethite stage is the second on scale and productivity (association quartz-goethite-hydrogoethite-native gold with pyrite alloy). The main mineral of the stage is goethite composing 80-90% of ore minerals volume. It is found in solid goethite-hydrogoethite aggregates with size of 1-3 to 2-5 mm with weather pits. According to relicts and also to goethite pseudomorphosis the latter displaces and develops on pyrite. In this case gold is found in those polished sections, where amount of substituted pyrite is 60-80% from primary one. Native gold forms thin inclusions in goethite – from 0,005 x 0,003 to 0,1 x 0,06 mm and more (fig. 8).

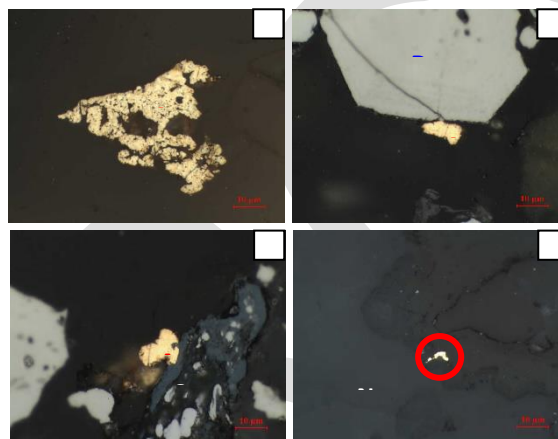


Fig. 8 Photos of gold grains (yellow) in sample of oxide ore (Comp. A)

- a)– large free and partially porous grain; b)– free grain around pyrite (Py);
- c)– is confined to covellite (CV) and to dark (indeterminate) minerals (NOP); d)– free grain (marked by red) is confined to dark (indeterminate) minerals.

Comparison of native gold of two generations connected with the third and fourth stage of hydrothermal process allows to conclude: 1) gold-I – low-grade is confined to massive pyrite; 2) gold-II – larger and high karat gold (by reason of redeposition) is confined to solid goethite-hydrogoethite aggregates (during oxidation of primary ore gold didn't migrate but deposited in place).

Thus, according to correlations between minerals of ore bodies, regular evolution of different generations composition including a native gold itself, one can state a successive change in time of quartz-arsenopyrite-polymetallic by quartz-gold-telluride and then by gold-goethite-hydrogoethite mineralization and it can be supported by spatial separate mineral associations in ore bodies. And in this case process of endogenic mineralization starts with formation of nearby joints metasomatic mineralized zones bearing quartz and ferrous sulphides (Proskuryakov, Khrenov, et al., 1979; Petrovskaya, et al., 1976).

5. Thermodynamic parameters of mineral formation. To solve this question necessarily to define temperature conditions of redvided concentrations formations by using thermobarometric analysis based on study of gas liquid inclusions in ore minerals. Methods of research includes the following. Microinclusions are found in transparent polished plates (mainly of vein quartz of different stages of ore process). Sizes, form, phase composition and quantity of inclusions are studied.

According to data of previous researchers such as A.A.Aliyev (1975), A.A.Magrabi and P.S.Garilyuk (1975), M.I.Mansurov (2001) succession of mineralization within each stage of mineralization occurred due to basicity entrainment of gashydro-therms and cyclicity, change of numerous ionization potentials of minerals.

Vein quartz is characterized by microinclusions of mineral-forming solutions of size 2-3 to 10-15mk. On relative age there are primary, primary-secondary and secondary inclusions (Yermakov, 1972; Yermakov, Dolgov, 1979). The same age generations inclusions were marked according to their morphology and temperatures of homogenization. In studied quartz the primary inclusions are usually represented by “negative microcrystals” of hexagonal syngony located on zones of growth. Vesicle is usually isometric in it and therefore it is opaque due to absolute refraction. Primary inclusions consist of water solution and gas. Primary-secondary and secondary inclusions can be characterized by irregular flattened form because they are, as a rule, confined to resistive fractures. Vesicle distinguishes by a big transparence in flattened inclusions. Mineralogical characteristics of plate material allows to correlate temperature of homogenization for primary and primary-secondary inclusions with formation conditions of this stage of mineral

formation. Secondary inclusions were used to characterize temperature parameters of next stages. So, each quartz plate was studied as source of information about several stages and phases of mineralization represented by different generations of inclusions (Yermakov, Dolgov, 1979).

About 40 quartz plates from Goshian deposit were studied. 35 measurements of temperature of homogenization were carried out.

The main results obtained are following.

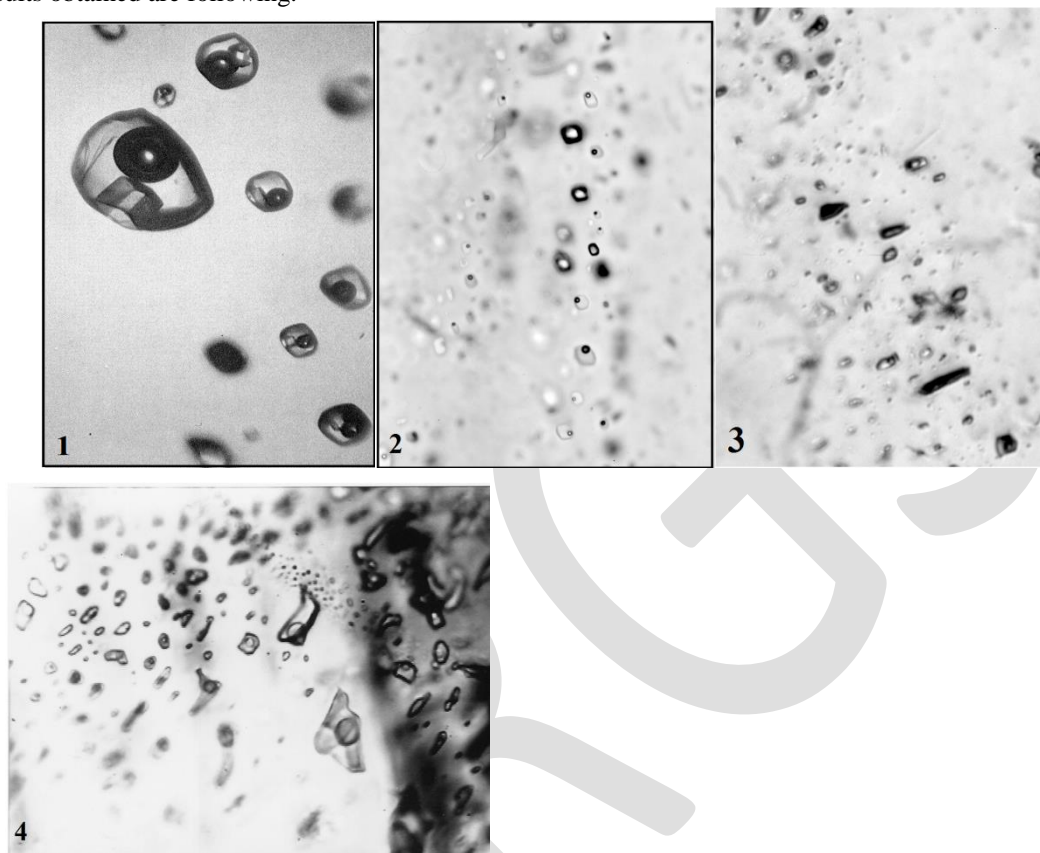


Fig.9 gas - liquid inclusions in goldbearing quartz of Goshan deposit. 1) Primary 2 phase: gas-liquid (two-phase); 2) Substantially gasaceous: primary-secondary; 3) Substantially liquid: secondary three phase; 4) Liquid.

Fluid inclusions underwent thermometrical research in thermal chamber. According to it temperatures of homogenization were defined, these results are shown at fig. 10. Histograms of homogenization temperatures (Bowers, Helgeson, 1983) have polymodal nature in studied subjects and marked generations of inclusions fit abovementioned mineral associations. It is determined within Goshian ore field the same associations can be characterize by close temperature intervals of homogenization, despite of the fact they are subordinate or main productive in this subject. It is supposed the formation temperature of mineral associations are connected with level of erosion truncation of ore field. As it is established inclusions of first type almostly can homogenize into liquid phase by temperature 150-305°C with maxi interval 300-350°. Gas component of these inclusions, chiefly consists of dioxide carbon, homogenizes into liquid rarely into gas phase. It occurs by 12,0-22,8°C. The main mass of CO₂ homogenizes by temperature 4-13,5°C. In this case density of CO₂ estimates by interval 0,80 to 1,10 g/sm³. In gas phase of captured fluids besides CO₂ methane and dissolved chlorides are also present. It is defined methane presence in inclusions mainly occurs by temperature gas-hydrate melting above 10°C. Below this melting temperature they contain dissolved chlorides. Concentration of salts in fluid according to melting temperature of gas-hydrate (CO₂ 7,3 H₂O) is 1015,3 mas % - eq. NaCl, estimated according to melting temperature of ice (Roedder, Bodnar, 1980; Brown, Zamb, 1989).

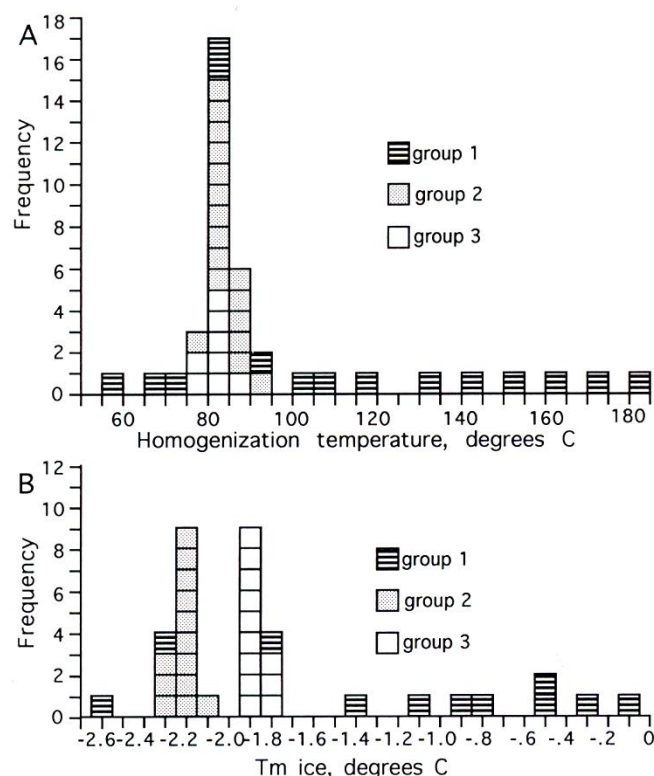


Fig. 10. Histogram of homogenization temperatures of fluid inclusions in quartz of Gosha deposit: 1. inclusions of I-II types; 2. inclusions of III type.

Fluid inclusions of second type represented essentially by gas components corresponding on CO₂ composition homogenize by temperature 21,5 to 23°C. In this temperature interval density of CO₂ is 0,59 to 0,95 g/sm³.

Homogenization of fluid inclusions of third type into liquid phase occurs by temperature 140-200°C. These solutions are characterized by higher concentrations of salts (from 7,5 to 10,2 mas. %-eq. NaCl). Besides natrium solution possesses magnesium as well.

Analysis of data obtained on thermometrical research shows during crystallization of minerals from Goshian deposit three types of fluids were captured, they differ due to composition: 1) water fluid with CO₂, CH₄ and Na and Mg chlorides; 2) gas fluid consisting of CO₂ and CH₄ alloy and 3) water fluid with moderate salinity possessing Na and Mg chlorides. The first two fluids are simultaneous and probably they are derivatives of the same fluid and formed during its foliation by pressure and temperature reduction or just only pressure. As temperatures of homogenization for both types of inclusions occurred the same in many cases one can suppose that separation of volatiles from fluid was caused by sudden drop in pressure but not by temperature reduction. Essential water fluid is typical for final stages of deposit formation. It could appear by fluid boiling as well consisting of H₂O + CO₂ alloy with chlorides. (Yermakov, 1972; Yermakov. Dolgov, 1979).

Isotopic composition of sulphur in sulphide minerals, and quartz oxygen of Goshian ore field was studied. Isotopic composition of sulphur is studied in main sulphide minerals-pyrite, chalcopryrite, sphalerite and galena represented by quartz-pyrite-gold-ore and quartz-polymetallic stages with gold. Correlation of sulphur isotopes in sulphides varies +3 to +6,8 ‰, partially for pyrite +3,2+4,1‰, galena +3,0+3,3‰. As a result of measurings values of sulphides $\delta^{34}\text{S}$, bedded at different stages, change insignificantly (Gavrilyuk, Magribi, 1997; Baba-zadeh, 2003; Mansurov, 2001).

Table 2 Isotopic composition of sulphides sulphur of the Goshian ore field

Mineral	$\delta^{34}\text{S}\text{‰}$	Mineral	$\delta^{34}\text{S}\text{‰}$	Mineral	$\delta^{34}\text{S}\text{‰}$
Pyrite	6,8	Chalcopryrite	4,1	Sphalerite	4,1
Pyrite	3,5	Chalcopryrite	4,4	Sphalerite	3,2
Pyrite	4,2	Chalcopryrite	4,8	Sphalerite	3,1
Pyrite	5,4	Sphalerite	3,3	Sphalerite	3,0

$\delta^{18}\text{O}$ quartz isotopes from different stages of mineralization of Goshian deposit vary +7,5 +16,9‰. In this case quartz of early quartz-sericite stage can be characterize by $\delta^{18}\text{O}$ values by interval +7,5 +8,7 ‰. Quartz of quartz-molybdenite stage is characterized by $\delta^{18}\text{O}$ values by interval +9,9 +11,0‰, and productive quartz-pyrite-oregold +12,6 + 15%. Quartz of late quartz-polymetallic stage enriched in heavy oxygen isotope. For it $\delta^{18}\text{O}$ values are +14,9 +16,9‰.

Table 3

Isotopic composition of quartz oxygen of Goshian deposit

$\delta^{18}\text{O}\text{‰}$			
Stages of mineral formation			
I Quartz-sericite	II Quartz-molybdenite	III Quartz-pyrite-goldore	IV Quartz-polymettallic
+7,5	+9,9	+12,6	+14,9
+7,9	+10,2	+13,0	+16,2
+8,0	+10,4	+14,1	+16,9
+8,5	+11,0	+14,3	--
+8,7	--	+15,0	--

Correlation of obtained results with literature data (Berger, Drews, Goldfarb, Snee, 1994) shows $\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ values of minerals from deposit of Goshian ore field are the same with data obtained according to numerous goldore deposits. A distinguishing feature of Goshian deposit is an essential change of $\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ values while the values of many volcanogenic hydrothermal goldore deposits correspond to narrow intervals consisting on average 2-3%.

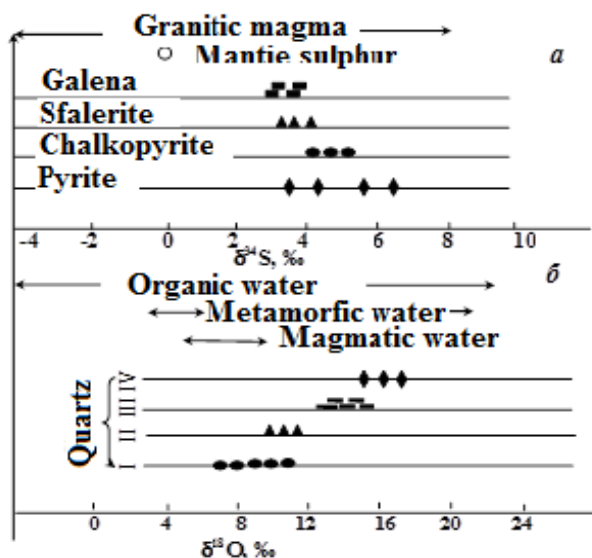


Fig.10. Isotope composition of the minerals from Gosha ore field: a - isotope content of sulphur of sulfide minerals; b - isotope content of oxygen of quartz from different stages of mineral formation on Gosha deposit.

According to results of obtained isotopic data one can judge of source of ore-forming fluid. Water-carbon dioxide fluids, with moderate saltiness like fluid which provided ore deposition, are studied as products of magmatic activity (Ryabchikov, 1975), or reaction of dehydration and decarbonization occurring during metamorphism of terrigenous rocks (Kerrick, 1990). In case with dehydration usually fluid appears with low concentration of salts (usually less 6 mas.% eq. NaCl [Nesbitt, 1971]). Formation of highconcentrated brines is possible by fluid foliation, consisting of H_2O and CO_2 and NaCl, into essentially gas and aqueous saline phases. (Bowers, Helgeson, 1983). According to diagram of $\text{H}_2\text{O}-\text{CO}_2-\text{NaCl}$ system (presented by these authors, fig. 11) with 6 mas.%

content of NaCl fluid foliation occurs into phase enriched in H_2O-CO_2 and liquid enriched in NaCl in temperature interval 600-1000°C under pressure 1-1,5kbar. Under higher pressures fluid remains homogenous (Bowers, Helgeson, 1983).

Foliation of mineral-forming fluid by formation of gold-ore veins of Goshian deposit occurred by other parameters $P=0,7-2,5$ kbar and $T=140-390^\circ C$, as it was mentioned above. Fluid balanced with these rocks must be characterized by the same parameters. So, low temperature fluid enriched in chloride salt could not form as a result of foliation of metamorphogenic fluid appearing by dehydration and decarbonization of rocks. According to above-mentioned chemical composition of mineral forming fluid shows its magmatic origin.

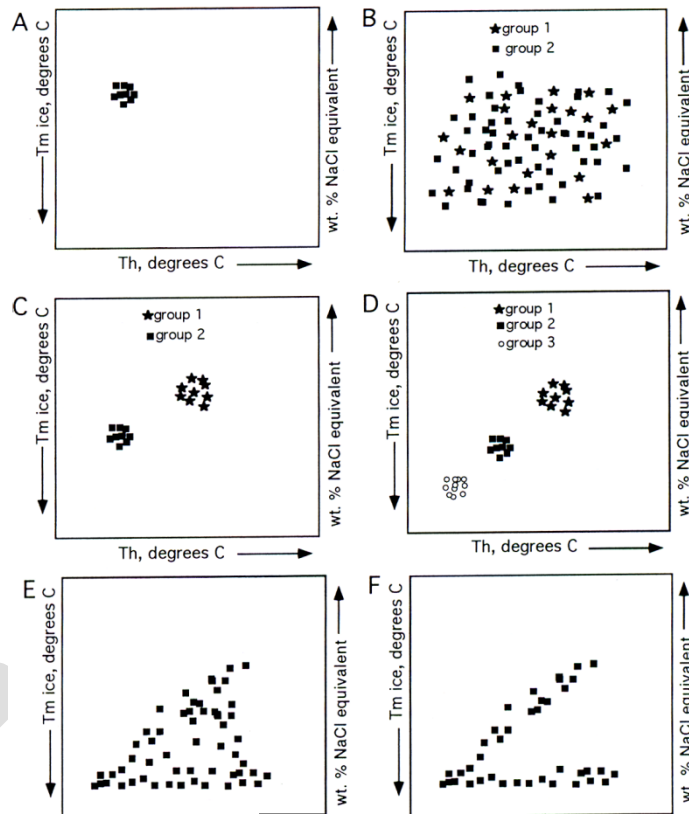


Fig.11 Phase ration in the system. Hatched area shows localization of ore formation on Goshian deposit. Phase boundaries correspond to different compositions .

Data of stable isotopes composition also demonstrates that components of various origin are included in ore deposition. The components supplied to the field of ore deposition and this can be supported by the same isotopic relationship of oxygen and sulphur in veins from different flanks and horizons of Goshian deposit and rock with different composition. To our opinion this points out that isotopic exchange reactions with host rocks didn't influence essentially on values $\delta^{34}S_{H_2S}$ and $\delta^{18}O_{H_2}$.

Data obtained from Goshian deposit shows values $\delta^{18}O$ of water are located in fluid in area of values typical for water, which appeared by transformation of sedimentary rocks with organic matter. These values are also close to isotopes correlation defined for metamorphogenic waters. They lightened by isotope in comparison with primary magmatic water, their values are correspondingly in following interval: -7 up to +20‰, +3 up to 20‰, from 5,5 up to +10‰.

Influence of exchange isotopic reactions of fluid with rock on correlation of oxygen isotopes in mesothermal mineral-forming systems is insignificantly (Kerrick, 1987). That's why initially magmatic fluid ($\delta^{18}O_{H_2O} = +7\%$, interacting with volcanogenic host rocks by 400 and 300°C, can enrich in light oxygen isotope up to 2‰. According to this there is a version of presence of magmatic origin water in ore-forming system (Kerrick, 1987). Estimated isotopic composition of oxygen in fluid is preferably interpreted as a result of shifting of two fluids differing by their values. One of them could have magmatic origin, and other was depleted by heavy isotope of oxygen and could appear as a result of water formation from organic matter decay. In this case variations of $\delta^{18}O_{H_2O}$ value and its reduction up to -1‰ can quite be explained (Ohmoto, Rye, 1979).

Sulphur like oxygen could have a different origin in the process of ore deposition especially when its isotopic composition is located in area of values from +7‰. As a possible sources mantle and magmatic systems and also host sedimentary rocks are considered. Values $\delta^{34}S_{H_2S}$ equal to (+2) – (+7) ‰ are attributed to fluid derivative from granitoid melting where isotopic correlation of sulphur varies from -3 to +7‰ (Ohmoto, Rye, 1979). On this base one can suppose that sulphur participating in formation of Goshian deposit was extracted from magmatic sources. Does not exclude also the participation in the process of ore deposition of mantle sulphur and also sulphur borrowed from host rocks; their isotopic composition is located correspondingly in intervals from -3

to +3‰ and from less +10 to +20‰. So, there is no a straight answer to this issue: did the sulphur supply to ore-forming system jointly with fluid which separated during crystallization of granitoid magma or maybe it was borrowed from host ore bodies rocks (Ohmoto, Rye, 1979).

So, one can suppose fluids had a different nature during deposit formation. They possess products of magmatic and metamorphogenic origin, their displacement occurred rather fast in area of ore deposition or nearby it. The crucial role probably performed by fluid of magmatic origin.

Results of research conducted on stages and length of mineralization formation allow to conclude:

- 1) Deposit formed by system of quartz-sulphide veins and veinlets of short length (quartz-sulphide-vein and morphological type), series of close dip steeply mineralized and vein zones (morphological type of mineralized and vein zones) and stockwork zones (morphological type – zones of stockwork veins).
- 2) According to relations between minerals of ore bodies, systematic evolution of different generations composition including native gold one can talk of successive change in time: quartz-arsenopyrite-polymetallic by quartz-gold-tellurid and then by gold-goethite-hydrogoethite mineralization and this is supported by spatial disconnection of mineral associations in ore bodies. In this case process of endogenic mineralization starts with formation nearby fracture metasomatic mineralized zones containing quartz and iron sulphides.
- 3) Temperature of ore formation, studied by methods of homogenization of gas-liquid inclusions in transparent minerals (quartz) of different mineral associations, varies in interval from 140 to 390°C. Pressure of ore-forming medium estimated by crossing of isotherm in system H₂O-CO₂ and isochors CO₂ is 0,7-2,0 kbar.
- 4) Taking into account that quartz veins possess the fragments of host rocks completely substituted by quartz-sericite aggregate, one can suppose they formed in balance with fluid pH from 5,45 to 6,1 at temperature 250-400°C and under 0,5-3,0 kbar pressure. Under conditions of quartz-sericite-potassium feldspar metasomatism fluids. Will be in balance with medium by pH from 5,2 to 6,1.
- 5) According to research data on isotopic composition of oxygen and sulphur in ore-forming fluids, one can suppose fluids could have a different nature, they possess products of magmatic and metamorphogenic origin, in this case prevailing role belonged to fluids of magmatic origin.

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