International Conference on Innovative Research in Science and Technology

(ICIRST-19)

Madurai, India

30th -31st August, 2019

Institute For Engineering Research and Publication (IFERP)

www.iferp.in

Publisher: IFERP Explore

Editorial:

We cordially invite you to attend the **International Conference on Innovative Research in Science and Technology (ICIRST-19)** which will be held at **Madurai, India** on **August 30th-31st, 2019**. The main objective of **ICIRST** is to provide a platform for researchers, engineers, academicians as well as industrial professionals from all over the world to present their research results and development activities in relevant fields of Innovative Research in Science and Technology. This conference will provide opportunities for the delegates to exchange new ideas and experience face to face, to establish business or research relationship and to find global partners for future collaboration.

These proceedings collect the up-to-date, comprehensive and worldwide state-of-art knowledge on cutting edge development of academia as well as industries. All accepted papers were subjected to strict peer-reviewing by a panel of expert referees. The papers have been selected for these proceedings because of their quality and the relevance to the conference. We hope these proceedings will not only provide the readers a broad overview of the latest research results but also will provide the readers a valuable summary and reference in these fields.

The conference is supported by many universities, research institutes and colleges. Many professors played an important role in the successful holding of the conference, so we would like to take this opportunity to express our sincere gratitude and highest respects to them. They have worked very hard in reviewing papers and making valuable suggestions for the authors to improve their work. We also would like to express our gratitude to the external reviewers, for providing extra help in the review process, and to the authors for contributing their research result to the conference.

Since June 2019, the Organizing Committees have received more than 60 manuscript papers, and the papers cover all the aspects in Electronics, Computer Science, Information Technology, Science Engineering and Technology and Management. Finally, after review, about 20 papers were included to the proceedings of **ICIRST-2019**.

We would like to extend our appreciation to all participants in the conference for their great contribution to the success of **ICIRST-2019** We would like to thank the keynote and individual speakers and all participating authors for their hard work and time. We also sincerely appreciate the work by the technical program committee and all reviewers, whose contributions made this conference possible. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank to organizing committee for their hard work.

Acknowledgement

IFERP is hosting the **International Conference on Innovative Research in Science and Technology** this year in month of August. The main objective of ICIRST is to grant the amazing opportunity to learn about groundbreaking developments in modern industry, talk through difficult workplace scenarios with peers who experience the same pain points, and experience enormous growth and development as a professional. There will be no shortage of continuous networking opportunities and informational sessions. The sessions serve as an excellent opportunity to soak up information from widely respected experts. Connecting with fellow professionals and sharing the success stories of your firm is an excellent way to build relations and become known as a thought leader.

I express my hearty gratitude to all my Colleagues, Staffs, Professors, Reviewers and Members of organizing committee for their hearty and dedicated support to make this conference successful. I am also thankful to all our delegates for their pain staking effort to travel such a long distance to attain this conference.

Mr. Ankit Rath
Chief Scientific Officer (CSO)
Institute for Engineering Research and Publication (IFERP)

International Conference on Innovative Research in Science and Technology

(ICIRST-19)

Madurai, India

30th-31st August, 2019

Keynote Speaker

Organized by

Institute For Engineering Research and Publication (IFERP)

Dr.J.Karthikeyan
Principal & Professor-EEE
Mangayarkarasi College of Engineering
Paravai, Madurai, Tamil Nadu, India

Message

It is indeed a matter of great pleasure to be a part of "International conference on Innovative Research in Science and Technology (ICIRST-19)," and to interact with zealous scholars and tech-savvy engineers' gathering at Madurai on August 30th -31st.

Today's world is the outcome of quests for innovative technical and scientific inventions by the intellectual efforts of modern humanities. Accelerating research in every field has guaranteed enhanced and comfortable human life. However, at the same time, the environmental catastrophe should be accepted as the annoying outcome of the uncontrolled industrial advances. Inspite of some exceptional and revolutionary discoveries in engineering and technology, few challenges like global warming, carbon emanation and the ecological deterioration are still in search of improved solutions.

Technological and scientific research and development seem to be the only resolution for the mankind to deal with such challenges. It has become mandatory that the contemporary researchers and enthusiasts should cooperatively discover solutions to these issues through abiding perseverance and determination. The theme of ICIRST is indeed in line with the demand of next-gen innovative research and technologies, without the same the solution of aforesaid challenges cannot match the expectations of the modern mankind.

The ideas and innovations in technologies need to be verified at universal level. International conferences like ICIRST-19, provide supreme platform for peer investigators to discuss their innovative concepts and offer the opportunity for joint efforts in order to obtain enhanced results.

I hope at ICIRST-19, students and researchers will acquire and exchange quality knowledge through various sessions. My sincerest thanks to organizing committee and best wishes for the prolific and enthusiastic conference.

Dr.J.Karthikeyan

ICIRST-19

International Conference on Innovative Research in Science and Technology

Madurai, India, 30th-31st August, 2019

Organizing Committee

Dr. S. Sevugarajan
PROFESSOR AND HOD
Electronics and Communication Engineering
AAA College of Engineering and Technology
Sivakasi, Tamilnadu

Dr. S. John alexis
PROFESSOR & HOD
Automobile Engineering,
Kumaraguru College of Technology,
Coimbatore, Tamilnadu

Cynthia J
PROFESSOR AND HOD
Computer Science and Engineering
Kumaraguru College of Technology
Coimbatore,Tamil Nadu

Dr. E. Kaliappan
PROFESSOR AND HOD
Electrical and Electronics Engineering
Easwari Engineering College (SRM Group)
Chennai,Tamil Nadu

Dr.T.Revathi
SR. PROFESSOR & HEAD
Information Technology
Mepco Schlenk Engineering College
Sivakasi, Tamilnadu

B. Soundara
PROFESSOR & HEAD
Civil Engineering
Bannari Amman Institute of Technology
Coimbatore,Tamil Nadu

Dr.D.Selvathi
SENIOR PROFESSOR
Electronics and Communication Engineering
Mepco Schlenk Engineering College
Sivakasi, Tamilnadu

Dr. C. Sujatha
PROFESSOR
Electronics and Communication Engineering
SSM Institute of Engineering and Technology
Dindigul, Tamil Nadu

Dr. K.kavitha
PROFESSOR
Electronics and Communication Engineering
Velammal College of Engineering and
Technology,. Madurai, Tamilnadu

Dr. A. Muthiah
PROFESSOR
Mechanical Engineering
P.S.R. Engineering College
Sivakasi, Tamilnadu

Dr.G.L.Sathyamoorthy
PROFESSOR
Civil Engineering
Kumaraguru College of Technology
Coimbatore,Tamil Nadu

Dr. J.premalatha
PROFESSOR
Civil Engineering
Kumaraguru College of Technology
Coimbatore,Tamil Nadu

CONTENTS

SL.NO	TITLES AND AUTHORS	PAGE NO
1.	GPS and GSM Based Automatic Border Alert System for Fisherman ➢ ***R.Duraibabu*** ➢ ***R.Kesavarajan*** ➢ ***T.Hari Prasath*** ➢ ***S.Rajendran***	1-3
2.	Effect of Alkaline treatment on banana fiber reinforced Epoxide Composites ➢ ***G. Kirubakaran*** ➢ ***M. Aadithya*** ➢ ***C. Madankumar*** ➢ ***C. Senthamaraikannan***	4-8
3.	An Experimental Study of Al-6062, Stainless Steel, and Inconel-625 using Machinability Analysis ➢ ***Pradeep Kumar Mishra*** ➢ ***Mandeep Singh*** ➢ ***Sasmita Nayak*** ➢ ***Dillip Mishra***	9-15
4.	Investigation of Tool wear rate (TWR) during the Electric discharge machining (EDM) of Hybrid Al-6061 metal matrix composite ➢ ***Pradeep Kumar Mishra*** ➢ ***Mandeep Singh*** ➢ ***Sthipragyan Maharana*** ➢ ***Pragyansu Maharana*** ➢ ***Dillip Mishra***	16-20
5.	Effects of grain size on surface roughness of thin pure Cooper sheets in metal micro forming ➢ ***Mandeep Singh*** ➢ ***Anamul Hossian*** ➢ ***Pradeep Kumar Mishra*** ➢ ***Dillip Mishra***	21-25
6.	Synergistic Effect of Selenium Nanoparticles (SeNPs) With Various Antibiotics as an Antimicrobial Activity ➢ ***Kavitha Varak*** ➢ ***Puppala Kavya Priya***	26-30
7.	Experimental Work on the Flexural Behaviour of Infilled Composite Concrete Beams ➢ ***S.M.Leela Bharathi*** ➢ ***R.Mano Karthick*** ➢ ***R.Sathish Kumar*** ➢ ***U.Ajay Kumar*** ➢ ***A.Srithar***	31-33
8.	CAT Swarm Optimization Based Solid State Faultcurrent Limiter in Distribution System ➢ ***M.Manisha*** ➢ ***V Rithi Andal Pooja*** ➢ ***Mrs.B.Noorul Hamitha***	34-37

CONTENTS

SL.NO	TITLES AND AUTHORS	PAGE NO
9.	Continuous Abstractive Recall-Oriented Understudy for Gisting Evaluation ➢ ***Nithyashree M*** ➢ ***Dr. Sukumar T*** ➢ ***S. Kalavathi*** ➢ ***K. Kamal Kumar***	38-42
10.	Structural Determination of CI Engine Fuel Additives through Dielectric Relaxation Studies ➢ ***Prathima A*** ➢ ***Thenappan T***	43-47
11.	Electrolyte Shock Treatment ➢ ***M.Susmitha*** ➢ ***M.Viswadharani*** ➢ ***A.Karthikeyan*** ➢ ***R.Ganesan***	48-50
12.	Construction of Multi-Storeyed Buildings in India With Environmental Perspective ➢ ***Rajkumar R*** ➢ ***Kavya L*** ➢ ***Vishvaa R S*** ➢ ***Kamaleswari T***	51-55
13.	Evaluation of Mechanical Properties of Hybrid Intralayer Jute/Flax and Sisal/Flax Polymer Epoxy Composites ➢ ***Dr.C.Senthamaraikannan*** ➢ ***Kirubakaran.G*** ➢ ***Ananda Karthick N*** ➢ ***GiriPrasath*** ➢ ***K.kabilan*** ➢ ***P.N.karthikbalaji***	56-60
14.	A Narrative Amalgam Algorithm for Job Shop Scheduling Problem ➢ ***Muthiah A*** ➢ ***S.Kalidass*** ➢ ***Muthusamy.K*** ➢ ***Sundarrajan.D***	61-63
15.	High-Utility Pattern Mining by Removing Recurrent Patterns ➢ ***M.S.Bhuvaneswari*** ➢ ***S.Kavitha*** ➢ ***N.Balaganesh***	64-68
16.	Experimental Investigation on Strength Characteristics of Concrete Partially Replaced with Seashells and Coconut Shells as Coarse Aggregates ➢ ***Nitin Panaskar*** ➢ ***Ravi Terkar***	69-74
17.	The Flood Mitigation System ➢ ***Mithun R*** ➢ ***Sruthi Nivaashini V*** ➢ ***Sahaya Shalmiya J*** ➢ ***Sangavisri I*** ➢ ***Likith Sai N***	75-79

CONTENTS

SL.NO	TITLES AND AUTHORS	PAGE NO
18.	Improving Efficiency of Grain Processing Industry Using Value Stream Mapping (VSM) – A Case Study ➢ ***K. Ram Prasad*** ➢ ***M.Nishal*** ➢ ***Varun V V***	80-85
19.	Analysis and prediction of Chronic Kidney Disease using Machine Learning Algorithms ➢ ***Srinitya G*** ➢ ***Daniel Madan Raja S***	86-88
20.	Empirical Analysis on Recycled PET Fiber Reinforced Concrete with Fly Ash ➢ ***Velmurugan S*** ➢ ***Ashwathi R***	89

ICIRST-19

International Conference on Innovative Research in Science and Technology

Madurai, India

30th-31st August 2019

PAPERS

ICIRST-19

Organized by

Institute For Engineering Research and Publication (IFERP)

GPS and GSM Based Automatic Border Alert System for Fisherman

[1] R.Duraibabu, [2] R.Kesavarajan, [3] T.Hari Prasath, [4] S.Rajendran

[1][2] UG Student, [3][4]Assistant Professor

[1][2][3] Kamaraj College of Engineering & Technology, Tamil Nadu, India

[4] Kalasalingam Academy of Research & Education, Tamil Nadu, India

[1] rduraibabu14@gmail.com, [2] apkkesavarajan@gmail.com, [3] hariprasatheee@kamarajengg.edu.in,

[4] rsrajendran2008@gmail.com

Abstract:

This paper describes about the border alerting for fishermen using GPS and engine control unit. In day-to-day life, we hear about the many problems confronted by the Indian fishermen, were captured by the neighboring countries because of crossing the border. The target of this system is utilized to encourage the fishermen to explore inside our sea nation border Using GPS (Global Positioning System) and GSM (Global system for mobile communication), GSM sends the message to the coastal guard office. If the boat nearer to the restricted zone the alarm will turn on and the sound keep on increasing and also speed of the engine will get reduced. If the fishermen fails to ignore the warning and they move to reaches the restricted zone automatically engine gets off and send through the message.

Keywords:

GPS, GSM, Microcontroller (At mega- 328)

1. INTRODUCTION

Sri Lanka and India coast nations are remote by their sea borders. In Tamilnadu about 20,000 vessels make spinning in the Bay of Bengal. The main aim is to give a well equitable user friendly environment for Indian Fisherman to handle risky situation with the help of engine control. This paper comes with a steady solution for this problem and protects the Indian fisherman from dangerous situation and being crossing the marine boundary and save their life and improve the safety of fisherman. The system is designed by using GPS and GSM. A GPS route device is a device that specifically discovers natural area by getting data from GPS satellites. This device can track the GPS data every single time at whatever point the fisher man's cross the Indian border. It is a significant depression issue and encourages trouble in the both people and also their economic expenditures.

2. LITERATURE SURVEY

D.Jim Isaac et al [1] the paper titled as "Advanced border alert system using GPS and with intelligent Engine control unit "In our system using GPS and GSM, where GPS is used to find the location of the boat. If the boat nearer to the boundary primarily it warning the fishermen with the alarm and emits the location of the boat to the nearest coast office via GSM communication. When it further nears the marine boundary an interferer is sent to the Engine Control Unit which controls the speed of the engine with the help of the electronic fuel injector. and its low cost marine. By this method, we can alert the fishermen and also monitor them thereby avoiding banned activities such as smuggling, intruders, etc. This is very much useful to save the fisherman's lives. And the thread reduce due to the sea pirates.

S. Kiruthika et al [2] the paper titled as" A Wireless mode of protected defence mechanism to mariners using GSM technology "In our system using only GPS to receive the information from the satellite and stored border locations to detect whether the boat has crossed the border or not. If so the mariner is alerted and the message is transmitted to nearby coast office through RF signals at VHF (30-300MHz) range which covers wide area.

Naveen Kumar.M et al [3] the paper titled as" border alert and smart tracking system with alarm uses DGPS and GSM and this system uses DGPS to track the location of the boat and to activate an alarm which consists of a Piezo-buzzer, when the border is move toward or crossed. Also, in addition, the DGPS information is sent to control office, and also the information is sent to the family at regular time intervals that are in expectation about their family member's safety.

3. METHODOLOGY

The GPS device will repetitively give the signal which determines the latitude and longitude and indicates the position of the fishermen and which gets read and displayed in the LCD. The hardware which interfaces with microcontroller, LCD display, GSM modem and GPS

 ISBN: 978-93-89107-36-4

Receiver. GPS provides consistent positioning, navigation, and timing services to users on a continuous basis in every day and night.

Then GPS store the storage of the maritime position. While comparing the previous maritime restricted position and current position and result will be the latitude and longitudinal degree of the boat's location is determined If the boat nearer to the restricted zone the alarm will turn on and the sound keep on increasing and also speed of the engine will get reduced by using pulse width modulation. In its simplest pulse width modulation output signals are constructed by comparing two signals. The signals are restricted position (carrier signal) and current position (modulation signal) pulse width modulation operating at a low power frequency. While carrier frequency higher than the modulation frequency, the alarm will keep on increasing, if the other case carrier frequency lowers than the modulation frequency, the alarm will keep on decreasing.

Then the fishermen fails to ignore the warning and they move to reaches the restricted zone automatically engine gets off by means of relay and send through the message to the coastal guard. A microcontroller is interfaced serially to a GSM modem and GPS receiver. The block diagram of the entire system is given.

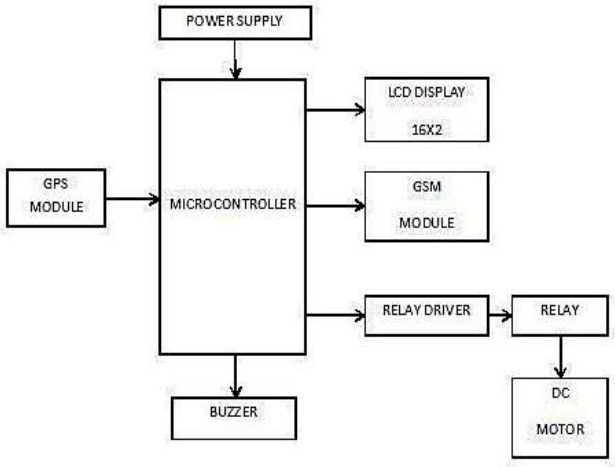
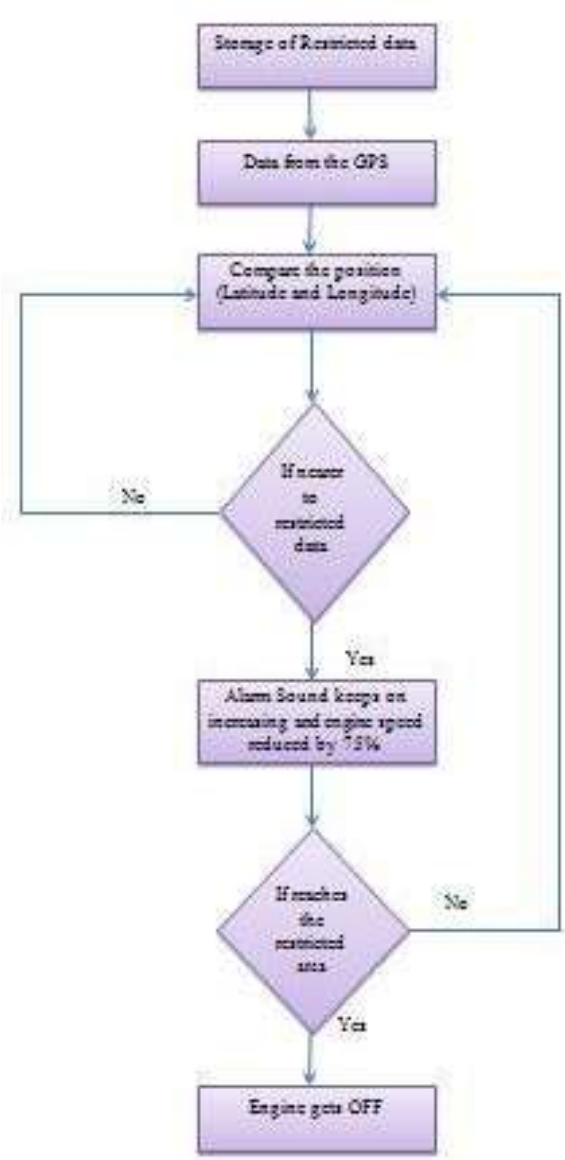


Fig-1: Block diagram of the system

4. FLOWCHART



5. HARDWARE COMPONENTS

A) GSM MODULE

GSM network operate in a number of different carrier frequency and its frequency up to 900MHz or 1800MHz. GSM module is utilized for transmission of message looking for help. The GSM makes use of narrowband Time Division Multiple Access (TDMA) technique for transmitting signals. It cannot be utilized as a part of seas as towers cannot be placed in middle of the ocean so it place in coastal control office. Thus the coastal continuously receive the GPS information from the GPS Address. The main aim of this GSM system is to ensure continuous monitoring of each boat and information given to the coastal office. When

boat crosses border, the stored message adjacent to with compared position and message sent to the desired authority person by using GSM module.

B) GPS

The Global Positioning System (GPS) is a space-based navigation system that provides location and time information in all weather conditions.. The GPS detects the latitude and longitude of the boat's position and sends the data to the microcontroller. This capability allows finding out whether the boat has crossed the restricted area or not. This gives the current position of the boat to the ATMEGA 328 Microcontroller in the Engine Control Unit. It compares the current position and stored restricted position if the boat is at a distance of Three kilometer from the restricted area and then processor to generate an alarm keep on increasing and also reduced the speed of the engine, The latitudes and longitudes received from the microcontroller is compared with the stored restricted area values and reaches the restricted area, the engine will get off.

$a=\sin^2(\Delta\varphi/2)+\cos\varphi 1 \cdot \cos\varphi 2 \cdot \sin^2(\Delta\lambda/2$

$c=2\cdot\text{atan2}(\sqrt{a},\sqrt{(1-a)})$

$d = R \cdot c$

dist = sin(deg2rad(lat1)) * sin(deg2rad(lat2)) + cos(deg2rad(lat1)) * cos(deg2rad(lat2)) * cos(deg2rad(θ));

φ *is latitude, λ is longitude, R is earth's radius (mean radius= 6,371km)*

C) ENGINE CONTROL UNIT

The ECU consists of an AT mega 238, random access memory (RAM), read only memory (ROM), and an input/output interface. This unit is used to stop motor when it is reaches the restricted area. If it is nearer the restricted area, the motor speed reduced by using pulse width modulation. The Electronic Control Unit (ECU) can control almost every operation in an engine together with explosion systems.. In electronic control unit operate at electronic fuel injector with a solenoid valve to control the fuel supply in the engine When the alarm is generated it is necessary to stop the engine from moving forward The fuel injector is fitted with a solenoid valve which is a electromagnetically controlled mechanical valve. When the GPS position matches the stored restricted value, the result of the value give to the fuel injector. So this in turn reduced the fuel supply which stops the engine from moving forward.

D) POWER SUPPLY

The power supply is provided DC motor and microcontroller. The DC power supply with both positive and negative output voltages, a center-tapped transformer is used and Arduino operates at low power.

E) RELAY

A relay is an electrically operated switch. Where many relays are used to an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid state relays .Relays are used where it is necessary to control a circuit by a low-power signal where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers they repeated the signal coming from one circuit and re-transmitted it on another circuit.

F) BUZZER

If the boat nearer to the restricted area the alarm will keep on increasing by means of pulse width modulation. It ranges from (0-255).

CONCLUSION

In the recent times the capture of Indian fishermen across Sri Lanka border has been increased. It is difficult for the fishermen to discover the borders and lost into other country' borders. Our objective is to give wireless support to those fishermen and aside from to go out after them if they are found missing. This project is a low cost efficient method of wireless tracking. It also gives sufficient information to both ship and coastal guardians of anyone crossing the border.

FUTURE SCOPE

The process of directing the fishermen can be enhanced by placing the engine control unit system in the coastal office. They remotely control the engine to restart the boat for the safety of fishermen.

REFERENCE

1. Jim Isaac , the paper titled as "Advanced border alert system using GPS and with intelligent Engine control unit "International Journal of Electrical and Computing Engineering (IJECE) Vol. 1, Issue. 4, June 2015
2. S.Kiruthika, N.Rajasekaran the paper titled as" A Wireless mode of protected defense mechanism to mariners using GSM technology" International Journal of Emerging Technology and Innovative Engineering Volume I, Issue 5, May 2015 (ISSN: 2394 – 6598)
3. G.Sivagnanam , A.J.Midhun, N.Krishna, G.Maria Samuel Reuben A.Anguraj5 "Coast guard alert and rescue system for international maritime line crossing of fisherman" " at International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 Issue 2, Volume 2 (February 2015)
4. NaveenKumar.M Ranjith.R The paper titled as" Border alert and smart tracking system with alarm using DGPS and GSM" International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN: 0976-1353 Volume 8 Issue 1 – APRIL 2014.

Effect of Alkaline treatment on banana fiber reinforced Epoxide Composites

[1] G. Kirubakaran, [2] M. Aadithya, [3] C. Madankumar, [4] C. Senthamaraikannan

[2][3] UG Student, [1][4]Assistant Professor

[1][2][3][4] Department of Mechanical Engineering, Sri Venkateswara College of Engineering, Sriperumbudur, India

[1] kirubakaran@svce.ac.in, [2] aadithyalrmk@gmail.com, [3] mathankumarchelladurai@gmail.com, [4] senthamarai@svce.ac.in

Abstract:

Bio composites are materials that are made up of natural fibres and a polymer as a matrix have been produces as an alternate solution and material to synthetic fibres and environment concern that has risen due to the over production and usage of artificial materials. Fibres are a class of hair-like materials that are continuous 'filaments' or are in discrete elongated pieces, similar to pieces of threads. It is one of the key components of composite material. The use of composite materials is increasing steadily in field engineering and various other fields rapidly. The accessibility of fibres and simplicity of assembling have enticed scientists worldwide to attempt by regional standards accessible inexpensive fibre and to learning their achievability of fortification determinations and to what degree they fulfil the obliged particulars of great strengthened polymer composite aimed at structural requisition. This Investigation describes the mechanical behaviour of banana fibre reinforced composite upon alkalisation with NaOH & KOH solutions with the references to the tensile loading and flexural strength testing on the fibre and comparing with the reference of untreated banana fibre properties. All the tests have been fulfilled in line with ASTM standards. Banana fibre is a ligno-cellulosic fibre which is obtained from the pseudo-stem of Banana plant (Musa sapientum) and is one of the best fibres with good relative mechanical properties such as its high strength, smaller elongation, light weight, and it is bio- degradable and has no negative effect on environment and thus can be categorized as eco-friendly fibre. Some of the advantages of using composites are high tensile strength, Improved torsional stiffness and impact properties, Lower embedded energy, lesser noise production during operation, lower vibration transmission than metals among others.

Keywords:

Banana fibre; alkalisation- NaOH & KOH; tensile strength; flexural strength; biodegradable; ASTM standards

1. INTRODUCTION

Composites are multifunctional material systems that provide characteristics not obtainable from any discrete material. They are cohesive structures made by physically combining two or more compatible materials, different in composition and characteristics and sometimes on form. Over the last thirty years, composite materials like plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Composite have become an integral part of our day-to- day life and can be found everywhere. Composites have been around for a long time with the classic example of bricks made from straw and mud. In general, the composite materials consist of matrix reinforced with fibres. Bio-based polymers such as bio composites can offer more sustainable materials with a lower environmental footprint and reduced carbon footprint. They can also reduce or avoid microplastic emissions in the environment if used properly to its full potential. A new study in the journal *Environmental Science and Technology* says it's possible that humans may be consuming anywhere from 39,000 to 52,000 microplastic particles a year. With added estimates of how much microplastic might be inhaled, that number is more than 74,000. Additionally, bio composites can offer special properties such as higher stiffness and strength. In combination with biodegradable plastics, fully bio-based and biodegradable solutions are possible. These composites are generally thermosetting plastics. Thermosets are polymer materials which are liquid or malleable at low temperatures, but which change irreversibly to become hard at high temperatures.

Table 1 Properties of banana Fibre

Tenacity	29.98 g/denier
Fineness	17.15
Moisture Regain	13.00%
Elongation	6.54
Alco-ben Extractives	1.70%
Total Cellulose	81.80%
Alpha Cellulose	61.50%
Residual Gum	41.90%
Lignin	15.00%

Natural fibres are classified according to their origin. They are vegetable, or cellulose-base, class includes such

important fibres as cotton and jute. The animal, or protein-base, fibres include wool, mohair, and silk. An important fibre in the mineral class is asbestos. Table 1 gives us the properties of banana fibre. Epoxy resins are a family of monomelic or oligomeric material that can be further reacted to form thermoset polymers possessing a high degree of chemical and solvent resistance, outstanding adhesion to broad range of substrates, a low order of shrinkage in cure, impact resistance, flexibility and good electrical properties (J.L.Massingill Jr et al.,2007). The 50% banana fibre and 50% epoxy resin composite Materials can withstand the higher loads when compared to the other combinations and used as an alternate material for conventional fibre reinforced polymer composites (M. Ramesh et al.,2014). The electrical properties as well as mechanical properties of banana fibre reinforced polyester composites were found to be dependent on the fibre content as well as the fibre surface modification (L. A. Pothan et al., 2007). The physical, mechanical, and thermal properties of banana-fibre-reinforced thermoplastic PP composites at various fibre volume percentages were invested and the properties were at a maximum and the thermal stability was also quite high (Sanjay K et al., 2010). Chemical modification improves the storage modulus of banana fibre reinforced polyester composites. Finally, it can be concluded that composites with better modulus and low damping ideal for use as a substitute for building material can be developed from banana Fibre and polyester resins by the judicious control of the interphase chemistry (Laly A. Pothan et al., 2005).

2. FABRICATION

2.1 Fabrication of NaOH treated specimen:

The specimens are fabricated by firstly soaking the banana mat in 2% NaOH solution for increased bonding capacity for about two hours. After that the mat is taken out and is rinsed until traces of NaOH is removed completely using distilled water Fig 1. The rinsed mat is air dried overnight and heated in a Hot Air Oven for about 30 minutes in 50 degrees Celsius Fig 2. After the fibre is completely dry, a dead weight is placed on top of the mats to remove any creases left behind during the drying process Fig 3. Before layering up, the mould is prepared with a release agent to ensure that the part will not adhere to the mould. A mixture of epoxy resin and hardener is applied over all the surface thoroughly. The mixture of epoxy resin and hardener is taken in a ratio 10:1. The fibre volume is 80%matrix + 20% fibre. Now the layers are stacked one after the other. New layers are stacked one above another and there by 3 layers are made as a whole Fig 4. Then a polythene sheet is sprayed with a releasing agent and is placed over a laminate and a galvanized sheet and is placed over the polythene sheet to get even surfaces without any wrinkles. Then the entire setup is placed in a compression moulding machine at 350 psi pressure is applied and is allowed to cure for 24 hours Fig 5. The composite is taken out and inspected for imperfections and defects.

Fig 1 Banana mat soaking

Fig 2 Drying using Hot Air Oven

2.2 Fabrication of KOH treated specimen:

The specimens are fabricated by firstly soaking the banana mat in 2% NaOH solution for increased bonding capacity for about two hours. After that the mat is taken out and is rinsed until traces of KOH is removed completely using distilled water Fig 1. The rinsed mat is air dried overnight and heated in a Hot Air Oven for about 30 minutes in 50 degrees Celsius Fig 2. After the fibre is completely dry, a dead weight is placed on top of the mats to remove any creases left behind during the drying process Fig 3. Before layering up, the mould is prepared with a release agent to insure that the part will not adhere to the mould. A mixture of epoxy resin and hardener is applied over all the surface thoroughly. A mixture of epoxy resin and hardener is taken in a ratio 10:1. The fibre volume is 80%matrix + 20% fibre. Now the layers are stacked one after the other. New layers are stacked one above another and there by 3 layers are made as a whole Fig 4. Then a polythene sheet is sprayed with a releasing agent and is placed over a laminate and a galvanized sheet and is placed over the polythene sheet to get even surfaces without any

 ISBN: 978-93-89107-36-4

wrinkles. Then the entire setup is placed in a compression moulding machine at 350 psi pressure is applied and is allowed to cure for 24 hours Fig 5. The composite is taken out and inspected for imperfections and defects.

Fig 3 Dead weight placed over the dried mat

Fig 4 Layering of mat and epoxy resign

Fig 5 Compressing using Hot Press Moulding

3. EXPERIMENTAL PROCEDURE

The dimension of the rectangular specimen is 250mm in length,25mm in breadth,3mm in width is held by the two grippers of the INSTRON® 3382 machine and the pulling speed applied on the specimen is 5mm/min in order to measure the ultimate stress the specimen can withstand before its breaking point is known as tension test. The flexural and Tensile test for this specimen is proceeded as per the ASTM standard (D790 & D3039). For the tensile test, the specimen size was 150 × 15 mm2 and gauge length was 70 mm. Specimen dimension for flexural test was 100 mm × 15 mm × 70 mm. The specimen is held on Tinius Olsen's® model IT503 machine and the specimen is tested at the speed rate of 1.2mm/min.

Fig 6 Tensile test specimen

Fig 7 Flexural test specimen

4. RESULT AND DISCUSSION

4.1 Tensile Test

From table 2, infer that the tensile properties of the banana fibre treated with KOH is unparalleled, showing exceptional tensile properties 39.66 MPa with NaOH treatment coming close second at 36.60 MPa. The maximum load however is different, where the NaOH treatment is higher at 1720 N. It is conclude that the tensile properties are overall better with the KOH treatment.

Table 2 Tensile test results

S.NO	MATERIAL	TENSILE STRENGTH (MPa)	MAXIMUM LOAD (N)	STRAIN
1	Untreated Banana Laminates	23	1120	5.8
2	NaOH Treated	36.60	1720	3.1
3	KOH Treated	39.66	1460	4.28

 ISBN: 978-93-89107-36-4

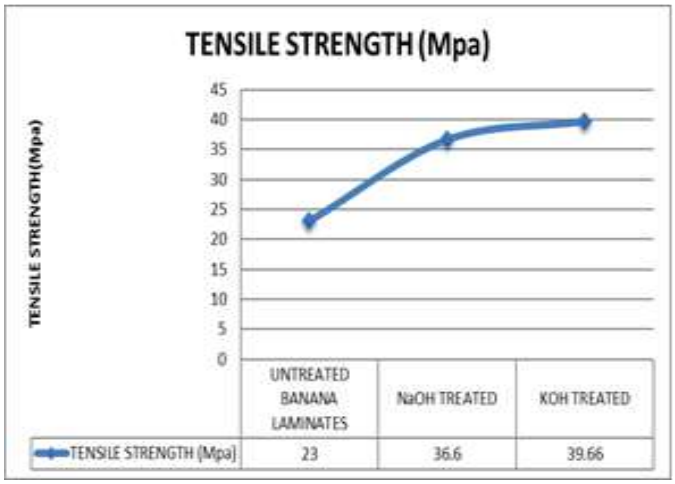


Fig 8 Tensile test graph

4.2 Flexural Test

The table 3 refers to the Flexural properties of the banana fibres treated and untreated. From the table 3, ascertain that the properties of the banana fibre treated with KOH exhibit superior behaviour. The flexural strength that the material withstood is 61.78 MPa and the Maximum load is 43 N. The tests have been performed in line with the ASTM standards and the results reflect the same.

Table 3 Tensile test results

S.NO	MATERIAL	FLEXURAL STRENGTH (Mpa)	MAXIMUM LOAD (N)	STRAIN
1	Untreated Banana Laminates	44.14	71	12.4
2	NaOH Treated	61.28	43	12.2
3	KOH Treated	61.78	43	18.83

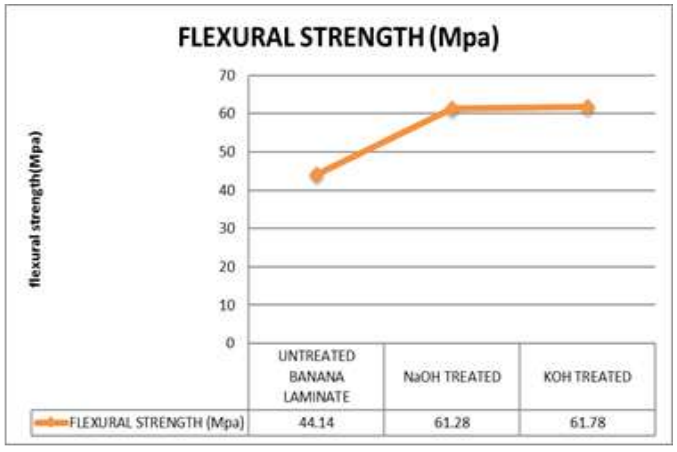


Fig 9 Tensile test graph

CONCLUSION

In this study, mechanical properties were tested on the three composites and from the results obtained, these conclusions were drawn:

- The fabrication of banana fibre reinforced composites with same ratio of epoxy and fibre volume (80%matrix+20% fibre) is possible by hand lay-up process.
- From the current experiments results, it has been observed that alkalisation of the fibre laminates gives better effect on the mechanical properties of the composites like as tensile strength & flexural strength.
- On comparing the tensile strength of untreated banana fibre laminate with NaOH and KOH treated laminates, better and higher tensile strength is show by KOH treated laminates and it is clear by the bar chart.
- Similarly comparing the Flexural strength of untreated banana fibre laminate with NaOH & KOH treated laminates, better properties are exhibited by KOH treated laminates.
- From the experiment the results conclude that alkalisation of the fibre with 2%of KOH solution for 4 hours shows better mechanical properties.

REFERENCE

1. M. Ramesh,T.Sri Ananda Atreya, U. S. Aswin, H. Eashwar, C. Deepa2014, Processing And Mechanical Property Evaluation Of Banana Fiber Reinforced Polymer Composites, 12th Global Congress On Manufacturing And Management, Gcmm 2014
2. L. A. Pothan, C. N. George, M. Jacob And S. Thomas 19/2007, Effect Of Chemical Modification On The Mechanical And Electrical Properties Of Banana Fiber Polyester Composites, Journal Of Composite Materials, Vol. 41,No.19/200723710021-9983/07/192371–16$10.00/0doi: 10.1177/0021998307075456_ Sage Publications 2007.
3. Laly A. Pothan, Sabu Thomas, G. Groeninckx Received 4 September 2005; Accepted 4 September 2005,The Role Of Fibre/Matrix Interactions On The Dynamic Mechanical Properties Of Chemically Modified Banana Fibre/Polyester Composites,
4. Laly A. Pothan, Tress Relaxation Behaviour Of Banana Fibber-Reinforced Polyester Composites N. R. Neelakantan Andbhaskarrao Department Of Chemical Engineering,Iit Madras, India Sabuthomas*School Of Chemical Sciences Mahatma Gandhi University, Kottayam, Kerala, India.
5. J.Santhosh, N.Balanarasimman, R.Chandrasekar, S.Raja Study Of Properties Of Banana Fiber Reinforced Composites

6. Phys. Chem. C2007, 111, 7527-7531 A.Alavudeenm. Thiruchitrambalam, N.Venkateshwaran and A. Athijayamani Department Of Mechanical Engineering, Arulmigu Kalasalingam College Of Engineering, Krishnankoil- 626190, Tamilnadu, India Review Of Natural Fiber Reinforcedwoven Composite
7. M. Jannah, M.Mariatti*Anda. Abubakar School Of Materials And Mineral Resources Engineering, Engineering Campus Universitiy Saints Malaysia, 14300 Nibong Tebal, Penang, Malaysia H. P. S. Abdulkhalil School Of Industrial Technology, University Saints Malaysia11800 Penang, Malaysia Effect Of Chemical Surface Modifications On The Properties Of Woven Banana-Reinforced Unsaturated Polyester Composites.
8. Hetal Shah, B.Srinivasulu And Subhas Shit Central Institute Of Plastic Engineering And Technology, Plot No 630, Phase Iv, Gidc, Vatva, Ahmedabad-382445, India Corresponding Author E-Mail:- Vasuludr@Gmail.Com The Effect Of Surface Treatment On The Properties Of Woven Banana Fabric Based Unsaturated Polyester Resin Composites.
9. J.L.Massingill Jr. R.S.Bauer* Applied Polymer Science: 21st Century Epoxy Resins, Coatings Research Institute, Eastern Michigan University, Ypsilanti, Mi 48197, Available Online 2 September 2007, Https://Www.Sciencedirect.Com/Science/Article/Pii/B9780080434179500234?Via%3dihub.

An Experimental Study of Al-6062, Stainless Steel, and Inconel-625 using Machinability Analysis

[1] Pradeep Kumar Mishra, [2] Mandeep Singh, [3] Sasmita Nayak, [4] Dillip Mishra

[1][3] College of Engineering and Technology, Bhubaneswar, India
[2][4] University of Technology, Sydney, Australia
[1] pradeepkumarm190@gmail.com

Abstract:

Electro-discharge machining (EDM) is a popular non-conventional machining process used to machine extreme hard materials, making complex shapes in dies and moulds, machining sharp edges and corners that cannot be machined by other processes. In addition, making prototype parts, drilling curved holes, milling can also be done by EDM. In this paper, Aluminum alloy (Al 6061), stainless steel (SS-304) and Inconel 625 are studied and compared with other for distinguishing the output results and to find the effect of peak current on them. The machinability of EDM in terms of material removal rate (MRR), electrode wear rate (TWR/EWR) and surface roughness (Ra) are evaluated. A copper tool is used to conduct the experiment. Further, wire-EDM is used to cut transverse section of work-pieces to again test and to show the smoothness of material. The energy dispersive analysis of X-rays (EDAX) is a microanalysis tool for elemental analysis, and which is used in this study for the measurement of base metal surfaces and machined surfaces. Thereafter, surface irregularities like surface cracks, globule of debris, poke marks are compared with different materials. To measure the distinctness of the material, surface crack density (SCD) is calculated for each material with different parameters and comparison is done. Finally, MRR, TWR, Ra and SCD with respect to peak current has been measured.

Keywords:

Electro-discharge machining (EDM), Machinability analysis, energy dispersive analysis of X-rays (EDAX), surface crack density (SCD), material removal rate (MRR), electrode wear rate (TWR/EWR)

1. INTRODUCTION

Electro discharge machining (EDM) is invented by an English scientist Joseph Priestly in 1770. Though, EDM has not been used till the late 1943 due to incomplete developmental stage. Then, Russian scientist has established the complete model of EDM with the application of erosion technique which can be controlled and utilized for machining process [1]. In an initial attempt, EDM has been used for shape the metal in manufacturing industry. Thereafter, EDM methods were moved to a machine tool [2].

In the modern area of manufacturing process, a various non-conventional sources namely sound, mechanical, electrical, photonics, and electrons. Due to rapid development of industrialization, machine materials are becomes harder, which is very difficult to machine. As there are many industries require hard materials such as aerospace, power plant engineering and other civil structures to increase the robustness of the material and system as well [3]. Novel improvements in the area of material science has a great impact and remarkably changes the scenario of metallic materials to have a better mechanical and thermal characteristics, and good electrical conductivity property to easily machined by spark attrition.

Over the past few years, EDM has been referred to as one of the breakthrough technology towards the movement of traditional machining to electric based machining to enhance the accuracy and faster the process. In addition, EDM have been replaced the various operations which was done by conventional method of drilling, milling and grinding. Moreover, it is the ability to machine the several shape with hard component which are very precise. There are many hard materials like ceramics, composites, heat resistant steels, and carbides, which are not practically machined with other types of machine. Thus, EDM plays a key role in the field of manufacturing industry and the application areas are aerospace, nuclear energy sector, medical, sports and automobile [4].

Numerous studies have attempted to explain the EDM technique with considering the several electrical parameters such as voltage, current, duty cycle, pulse and it relates to the MRR, TWR, and surface roughness (SR). In [5], investigates the MRR with different pulse through EDM and the material used in this study is Al-6061. The microstructure and hardness deviation of AL-6061 has been studied in [6], which is necessity for further cleaning of manufacturing phases. In [7], the feasibility study and the application of optimization in rotary EDM has been carried out to inspect the machinability of Al-203/6061 material by means of the Taguchi procedure. The micro-EDM has been

proposed in [8], where the process can be facilitate very rapid manner with a thin gap. A machinability and traditional based heat treated material using EDM procedure has been portrayed [9]. In [10], Al-6061 has been tested through die-sinking EDM mechanism with the variation of current magnitude to estimate the influence on surface morphology. On the other hand, there are various application oriented study has been introduced in [11,12]. Recently, wire-EDM has been introduced to measure the MRR, SR, recast surface, hardness and metallurgical variations [13,14]. A number of authors have considered the soft computing techniques to optimize the parameters of EDM to enhance the performance index of metals [15, 16]. Thus far, a number of studies have highlighted factors that are associated with EDM and the measurement indexes.

This paper is organized is as follows. In an initial attempt, the brief introduction of background study and literature review is narrated. Thereafter, a clear understanding of EDM and its indexes is presented. Further, a proposed methodology is demonstrated. The results and implication finding is portrayed. Finally, last section gives the conclusion of the study.

2. EDM

It is an electro-thermal machining procedure, where electrical power has been utilized to produce the electrical spark. Due to electric spark, the material removal process is carrying out. The application of this process is principally to machine the hard materials. Further, it can also be used to shape the materials in small sets and/or job-shop base. More importantly, the work-piece must be an electrically conductive to machine the material shape by EDM [17].

A. EDM PRINCIPLE

During this principle, the removal of metal property from the work-piece is the main concern. This can be done by high-speed periodic spark between the work-piece and tool. The Fig.1 shows the diagram of work-piece, electrode, and spark within a dielectric fluid by the application of electric voltage. The relationship between tool and work-piece is cathode and anode respectively. When the voltage applies in the system, a high-spark is discharged in the gap within a 10 μs. Thereafter, the acceleration takes place between electron and electron, which becomes conductive. At that instant, collision takes place and creates a channel of plasma. In Fig.2, displays the flushing diagram of machining. The gap between work, and tool is usually 0.025mm and it is adjusted by servo system. Moreover, the work-piece, and tool are immersed in a dielectric fluid. As far as dielectric fluid is concerned, generally such type, silicon oil, kerosene, and liquid paraffin [18].

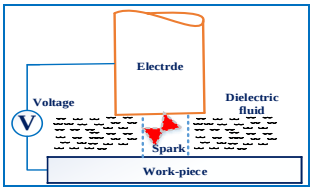


Fig.1 EDM process diagram

Fig.2 Flushing diagram

Furthermore, to explain in-depth in the process of EDM, the input electric current plays a vital role. When the electric resistance is reduce to very low, then the current density increases significantly, which increases the ionization ad it creates an influential magnetic field. At that moment, a high-pressure is established among the work-piece and tool. As a consequence, high heat is reached, and with this some portion of metal is melted and depleted. This process is known as material removal [19].

Generally, two types of EDM, namely Die-sinking, and wired-EDM (W-EDM). In Die-sinking EDM, a die shaped conductive metal has been used as electrode to produce the electric arc. Alternatively, in wire-EDM, a conductive metal wire has been used as electrode. However, Die-sinking EDM is suffers from accuracy point of view. To enhance the accuracy profile of metal W-EDM can be used.

There are various essential parameters of EDM such as spark on and off time, arc gap, duty cycle, voltage, overcut, and discharge current. Using these parameters, the amount of voltage and peak current can be controlled to material removal rate and refine the work-piece. In addition, dielectric fluid provides the oxygen-free working environment to avoid the electrical breakdown. Thereafter, flushing procedure can be applied to clean the metal particles effectively [20]. The experimental setup of flushing procedure with nozzle is depicted in Fig.2.

3. EXPERIMENTAL TEST

In this section, a detail experimental set-up, selection of work-piece and tool selection is discussed. In an initial attempt, the EDM model i.e. EMS-5535 which is die-sinking based with constant gap type and positive polarity material have been utilized to perform the experimental test. The parameter of the dielectric fluids are taken as 0.83, and 102°C for specific gravity and flash point respectively. Further, the electrode is used in this study is negative-polarity based. The EDM set-up machine is shown in Fig.3.

Fig.3 EDM set-up

Fig.4 W-EDM machine

 ISBN: 978-93-89107-36-4

The work-pieces are chosen for this experiment are, SS-304, Al 6061, Inconel 625. The dimensions of SS-304 are 101x 41x 5 mm3, 100x41x5 mm3, 100x42x5 mm3.The dimensions of Al 6061 are 61x52x3 mm3, 60x52x3 mm3, 61x52x3 mm3.The dimensions of Inconel 625 are 51x51x5 mm3, 51x49x5 mm3, 51x51x5 mm3. Copper (99%) is chosen as electrode with dia 16 mm and length of 110.8 mm. Initial weight of copper was 264.8 gram.

The work-piece have been taken as positive polarity throughout the experiment is shown in Fig.5.

a) Al-6061 **b) Inconel-625** **c) SS-304**

Fig.5 Work-piece before machining

There are various control and fixed parameters to process the work-piece such as peak current (IP), pulse (Ton), voltage (V), spark gap, flushing pressure, and duty cycle (D) and which is in the range of 6A-10A, 300µs, 25V, 50µm, 2.1bar, and 85% correspondingly.

The observation table of experimental study is presented in table-1, Table-2, and Table-3 for Al-6061, SS-304, and INCONEL-625 respectively.

After machining the diagonal segment of each specimen, a further test has been conducted through W-EDM, is displayed in Fig.4. The average roughness values are measured by Taylor's Hobson (surtronic 25) tester. It is battery powered, portable and self-contained instrument for measurement of surface texture. The gauge length is selected as 0.25 mm.

a) Al-6061 **b) Inconel-625** **c) SS-304**

Fig.6 Work-piece after machining

After machining with W-EDM, the work-pieces are shown in Fig.6. Fig.7 presents the surface roughness tester to measure the roughness of the work-piece and the values are presented in Table-4.

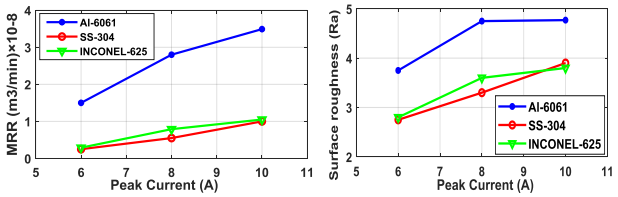
Fig.7 Taylor-Hobson Talysurf "Surtonic-25"

After W-EDM operation, the small work-pieces were observed for irregularities in under scanning electron (SEM). For comparison purpose, all SEM micrographs are taken at 500X magnification.

The surface crack density was measured. The SCD are measured by dividing the total crack length with the image area. It is a relative measurement, all the images to be taken at a particular magnification. Also, EDAX (EDS) of machining surface were compared against the base metal to check the foreign atoms adhering to the machined surface.

4. RESULTS

In this section, the experimental results is demonstrated and MRR, TWR, Ra and SCD are measured. The MRR vs peak current is plotted in Fig.8.a with three different work-pieces. It shows that, MRR increases with rise in peak current, which is a better machinability characteristics of work-piece. In addition, the effect of peak current on TWR is presented in Table-5.



a) **b)**

Fig.8. a) MRR vs peak current, b) Surface roughness vs peak current

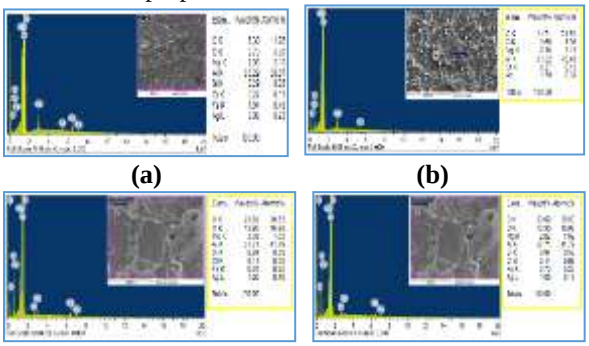
Al 6061	6A	TWR = No Significant Wear
	8A	TWR=1.321 x 10-4 (cc/min)
	10A	TWR = No Significant Wear
Inconel 625	6A	TWR = 2.021 X 10-4 (cc/min)
	8A	TWR = No Significant Wear
	10A	TWR = No Significant Wear
SS-304	6A	TWR = 1.421 X 10-4 (cc/min)
	8A	TWR = 2.234 X 10-4 (cc/min)
	10A	TWR = No Significant Wear

 ISBN: 978-93-89107-36-4

It is clear that tool wear is very less during the experiment. Lower tool wear signifies better machinability. Further, effect of peak current on average surface roughness is presented in Fig. 5.b.

5. EDAX ANALYSIS

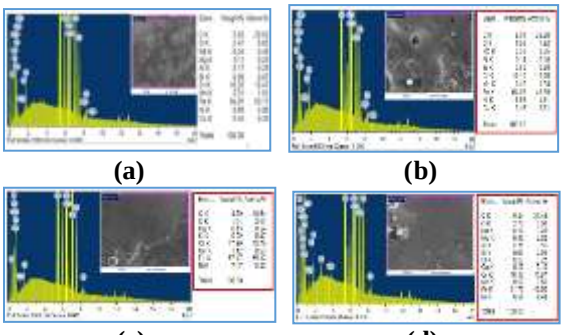
In this analysis, composition of the base metal is compared with machined surface. This technique is a non-mortal and the samples of interest can be studied with limited or no trial preparation.



(a) (b) (c) (d)

Fig.9. a) EDS of Al 6061 base metal, b) EDS of Al 6061 on machined surface at 6A current, c) EDS of Al 6061 on machined surface at 8A current, d) EDS of Al 6061 on machined surface at 10A current.

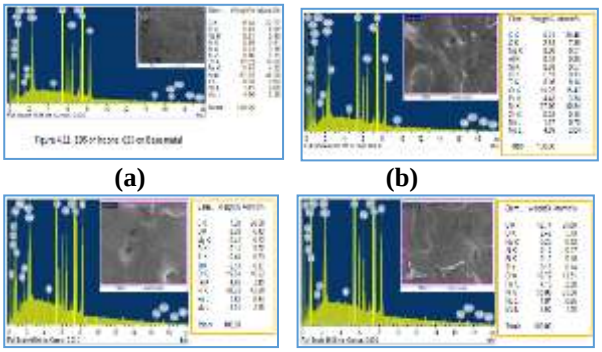
With the analysis of Fig.9 by EDAX, there is increase in carbon enrichment and oxygen enrichment with increase in peak current for Al 6061.



(a) (b) (c) (d)

Fig.10. a) EDS of SS-304 base metal, b) EDS of SS-304 on machined surface at 6A current, c) EDS of SS-304 on machined surface at 8A current, d) EDS of SS-304 machined surface at 10A current.

From the Fig.10 (a-d), it is concluded that, carbon and oxygen enrichment increases in machining surface for SS-304.



(a) (b) (c) (d)

Fig.11. a) EDS of Inconel-625 base metal, b) EDS of Inconel-625 on machined surface at 6A current, c) EDS of Inconel-625 machined surface at 8A current, d) EDS of Inconel-625 machined surface at 10A current.

It is evident that there is no significant increase in carbon and oxygen percentage in machining surface for Inconel 625 in Fig.11 (a-d).

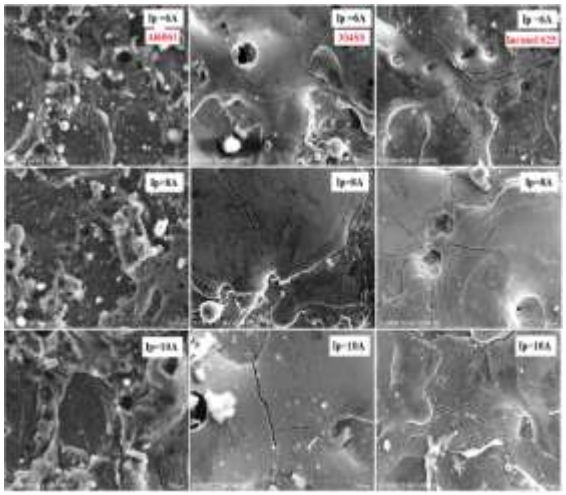


Fig.12: SEM micrographs

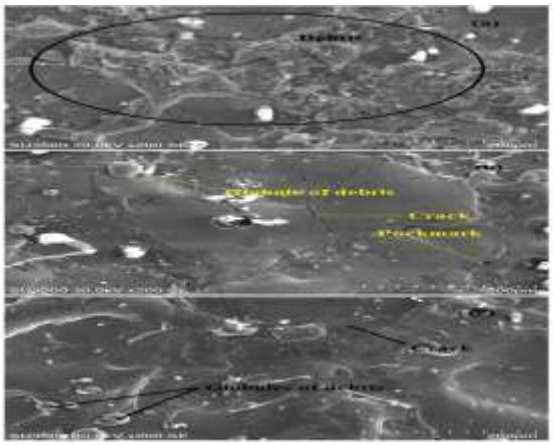


Fig.13: SEM micrographs revealing surface irregularities

It is observed that, there is no surface crack in case of Al 6061.Width of surface crack is more in case of SS-304 and width of surface crack is less in case of Inconel 625 as compared to SS-304 in Fig.12.

B. SCD calculation

It is the ratio of total crack length and the total image area. To calculate the SCD, the SEM micrographs were first converted into ".pdf" format and then opened with PDF Xchange Viewer software. The scale was set accordingly and SCD was then calculated. Fig.13 shows the SCD of SS-304 machined at 6A. All the measurements indicated are in µm. The total crack length for the image is

(10.85+29.45+47.93+42.2+55.07+117.84+36.74+59.64+ 31.79) = 431.51 µm.

This value when divided by the image area (247.19x190.78) sq. µm gives the value of SCD = 9.15 X 10-3. Similarly, SCD of other samples were calculated and a graph was plotted to reveal the variation of SCD with respect to peak current.

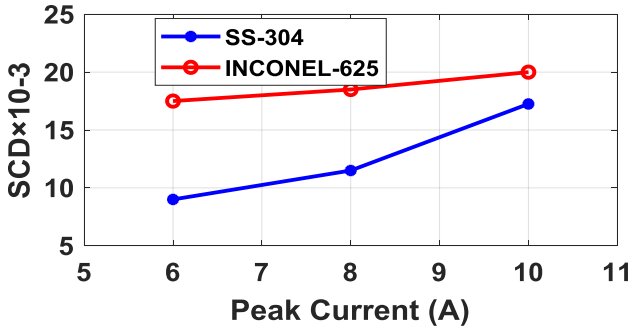


Fig.14. SCD vs peak current

It is concluded that with increase in peak current, surface crack density increases for both SS-304 and Inconel 625 in Fig.14.

Table-6: calculation of SCD

Sample	Total crack length(µm)	Total image area (µm^2)	SCDX10^{-3} (µm/µm^2)
SS-304 (6A)	431.51	47158.9	9.15
SS-304 (8A)	506.82	47286.13	10.7
SS-304 (10A)	790.29	47150.26	16.7
Inconel-625 (6A)	826.35	47317.25	17.4
Inconel-625 (8A)	889.55	46918.41	18.9
Inconel-625(10A)	944.74	46918.41	20.1

CONCLUSION

This study presents the behavior of Al-6061, Inconel-625 and SS-304 by EDM with copper as the tool. The experiments were conducted to check the variations of output parameters like MRR, TWR, Ra, and SCD with respect to the peak current. The peak current was varied at three levels i.e. at 6, 8 and 10 Amperes and all other parameters were preserved constant. The following conclusions were made: a) MRR, TWR, SCD, and Ra during the process increases with rise in peak current, b) crack length and crack width also increases with increase in peak current, c) SEM micrograph reveals the globules of debris, poke mark, surface cracks for all work surfaces, Al 6061 do not show any surface crack because it is ductile in nature.

Table-1 Experiment observations For Al 6061

Machining ⟶		Work-piece		Electrode		Machining time in min	Depth of cut
Sl no.	Setting parameters	Weight before	Weight after	Weight before	Weight after	T_m	D.O.C (mm)
1	I_P =6A, Ton=300µs,D= 85%	26.4	25.9	264.5	264.5	12.27	1
2	I_P =8A, Ton=300µs,D= 85%	26.4	25.8	264.5	264.4	7.57	1
3	I_P =10A, Ton=300µs,D= 85%	26.0	25.5	264.4	264.4	5.25	1

Table-2 Experiment observations For SS-304

Machining ⟶		Work-piece		Electrode		Machining time in min	Depth of cut
Sl no.	Setting parameters	Weight before	Weight after	Weight before	Weight after	Tm	D.O.C (mm)
1	IP =6A, Ton=300µs,D= 85%	187.1	186.0	264.7	264.6	60.10	0.7
2	IP =8A, Ton=300µs,D= 85%	176.6	175.5	264.6	264.5	25.53	0.7
3	IP =10A, Ton=300µs,D= 85%	176.8	175.8	264.5	264.5	12.16	0.7

 ISBN: 978-93-89107-36-4

Table-3 Experiment observations For Inconel 625

Machining ⟶		Work-piece		Electrode		Machining time in min	Depth of cut
Sl no.	Setting parameters	Weight before	Weight after	Weight before	Weight after	Tm	D.O.C (mm)
1	IP =6A, Ton=300µs, D= 85%	105.6	103.8	264.8	264.7	70.02	1
2	IP =8A, Ton=300µs, D= 85%	101.7	99.9	264.7	264.7	27.45	1
3	IP =10A, Ton=300µs, D= 85%	106.1	104.3	264.7	264.7	19.45	1

Table 4 Average surface roughness (Ra) values

SAMPLES Ra values	SS-304 (6A)	SS-304 (8A)	SS-304 (10A)	Al-6061 (6A)	Al-6061 (8A)	Al-6061 (10A)	INCONEL-625 (6A)	INCONEL-625 (8A)	INCONEL-625 (10A)
1	3.98	3.02	3.24	4.16	3.98	4.96	2.28	3.4	2.5
2	2.94	4.2	3.34	4.0	5.86	5.5	3.34	2.84	4.4
3	2.2	4.78	2.84	3.22	4.96	4.02	3.26	3.46	3.36
4	2.02	3.76	3.14	3.8	3.94	4.4	2.8	3.62	3.02

REFERENCE

1. N. M. Abbas, N. Yusoff, and R. Mahmod, "Electrical discharge machining (EDM): practices in Malaysian industries and possible change towards green manufacturing," Procedia Engineering, vol. 41, pp. 1684-1688, 2012.
2. J. A. McGeough, Advanced methods of machining. Springer Science & Business Media, 1988.
3. M. Kunieda, B. Lauwers, K. P. Rajurkar, and B. Schumacher, "Advancing EDM through fundamental insight into the process," CIRP annals, vol. 54, no. 2, pp. 64-87, 2005
4. N. M. Abbas, D. G. Solomon, and M. F. Bahari, "A review on current research trends in electrical discharge machining (EDM)," International Journal of machine tools and Manufacture, vol. 47, no. 7-8, pp. 1214-1228, 2007.
5. A. Pramanik, A. Basak, M. N. Islam, and G. Littlefair, "Electrical discharge machining of 6061 aluminium alloy," Transactions of Nonferrous Metals Society of China, vol. 25, no. 9, pp. 2866-2874, 2015
6. A. Akkurt, "The effect of cutting process on surface microstructure and hardness of pure and Al 6061 aluminium alloy," Engineering Science and Technology, an International Journal, vol. 18, no. 3, pp. 303-308, 2015.
7. B. H. Yan, C. C. Wang, H. M. Chow, and Y. C. Lin, "Feasibility study of rotary electrical discharge machining with ball burnishing for Al2O3/6061Al composite," International Journal of Machine Tools and Manufacture, vol. 40, no. 10, pp. 1403-1421, 2000.
8. S.-T. Chen and C.-H. Chen, "Development of a novel micro w-EDM power source with a multiple Resistor-Capacitor (mRC) relaxation circuit for machining high-melting point,-hardness and-resistance materials," Journal of Materials Processing Technology, vol. 240, pp. 370-381, 2017.
9. K. Rajkumar, S. Santosh, S. J. S. Ibrahim, and A. Gnanavelbabu, "Effect of Electrical discharge machining parameters on microwave heat treated Aluminium-Boron carbide-Graphite composites," Procedia Engineering, vol. 97, pp. 1543-1550, 2014.
10. S. Arooj, M. Shah, S. Sadiq, S. H. I. Jaffery, and S. Khushnood, "Effect of Current in the EDM Machining of Aluminum 6061 T6 and its Effect on the Surface Morphology," Arabian Journal for Science and Engineering, vol. 39, no. 5, pp. 4187-4199, 2014.
11. D. Aspinwall, S. Soo, A. Berrisford, and G. Walder, "Workpiece surface roughness and integrity after WEDM of Ti–6Al–4V and Inconel 718 using minimum damage generator technology," CIRP annals, vol. 57, no. 1, pp. 187-190, 2008.
12. I. Ayesta, B. Izquierdo, O. Flano, J. A. Sánchez, J. Albizuri, and R. Aviles, "Influence of the WEDM process on the fatigue behavior of Inconel® 718," International Journal of Fatigue, vol. 92, pp. 220-233, 2016.
13. P. Sharma, D. Chakradhar, and S. Narendranath, "Evaluation of WEDM performance characteristics of Inconel 706 for turbine disk application," Materials & Design, vol. 88, pp. 558-566, 2015.
14. P. Sharma, D. Chakradhar, and S. Narendranath, "Effect of wire diameter on surface integrity of wire electrical discharge machined Inconel 706 for gas turbine application," Journal of Manufacturing Processes, vol. 24, pp. 170-178, 2016.
15. C. Mascaraque-Ramirez and P. Franco, "Experimental study of surface finish during electro-discharge

machining of stainless steel," Procedia engineering, vol. 132, pp. 679-685, 2015.

16. C. P. Mohanty, S. S. Mahapatra, and M. R. Singh, "An experimental investigation of machinability of Inconel 718 in electrical discharge machining," Procedia materials science, vol. 6, pp. 605-611, 2014.
17. A. Y. C. Nee, Handbook of manufacturing engineering and technology. Springer, 2015.
18. K. Ho and S. Newman, "State of the art electrical discharge machining (EDM)," International Journal of Machine Tools and Manufacture, vol. 43, no. 13, pp. 1287-1300, 2003.
19. D. Reynaerts and H. Van Brussel, "Microstructuring of silicon by electro-discharge machining (EDM)—part I: theory," Sensors and Actuators A: Physical, vol. 60, no. 1-3, pp. 212-218, 1997.
20. C. J. Morgan, R. R. Vallance, and E. R. Marsh, "Micro-machining and micro-grinding with tools fabricated by micro electro-discharge machining," International Journal of Nanomanufacturing, vol. 1, no. 2, pp. 242-258, 2006.

Investigation of Tool wear rate (TWR) during the Electric discharge machining (EDM) of Hybrid Al-6061 metal matrix composite

[1] Pradeep Kumar Mishra, [2] Mandeep Singh, [3] Sthipragyan Maharana, [4] Pragyansu Maharana, [5] Dillip Mishra

[1] College of Engineering and Technology, Bhubaneswar, India
[2][3][4][5] University of Technology, Sydney, Australia
[1] Mandeepsingh@student.uts.edu.au

Abstract:

Hybrid Aluminum metal matrix composites have become leading materials due to their excellent engineering characteristics and applications. In this experimental work, Al6061 based hybrid metal matrix composite is fabricated by stir casting process, where the 'SiC_p' and 'Gr_p' are used as reinforcements. Due to the abrasive nature of reinforcements, the hardness of fabricated samples is increased, which was very much difficult to machine by traditional methods. Therefore, in this study an effective machining process (EDM - Electric Discharge Machining) is used for machining the developed metal matrix composite. This paper investigates the significant effect of EDM machining parameters like pulse-on time (T-on), pulse-off time (T-off), voltage (V) and current (I) on a response variable (TWR- tool wear rate). For machining, the fabricated samples, three different electrodes materials; Steel-304, Brass and Copper with a Ø12mm each were used. The design matrix is developed by Taguchi L_{27} approach in Minitab software. The ANOVA technique is used to check the signification of the model. The SEM (Scanning electron microscope) and EDS (Energy-dispersive X-ray spectrometer) were done to study the surface characteristics and elements analysis, respectively of the machined electrodes.

Keywords:

Al-MMC (Aluminum metal matrix composite), EDM (Electric discharge machining), Stir casting, SEM (Scanning electron microscope), EDS (Energy-dispersive X-ray spectrometer)

1. INTRODUCTION

MMC (metal matrix composite) are one of the most advanced human-made materials, which are made up by mixing of at least two distinct metals [1]. A MMC mainly consist two phases (a) matrix phase (b) reinforcement phase, where matrix phase (consist a metallic alloy) is the basic part of a MMC that is reinforced with ceramic phase in the formation of particles, fibers (short, long, aligned, and continues) and platelets [2]. MMCs are used in various industries and structural application due to their superior sets of mechanical, thermal and environmental properties. A MMC has very light in weight, low coefficient of thermal expansion and thermal resistance, good damping capacity; it is good to wear resistances and good in corrosion resistance [2]. By adding the reinforcement into various forms and configurations (short, long, aligned, continues and discontinues) the strength and stiffness of prepared MMC samples can be modified. When at least two different reinforcements are added into the metallic matrix phase to fabricate a MMC, then that composite material is called a hybrid metal matrix Composite [3]. Here in this research work, we fabricated a hybrid MMC. To fabricate this hybrid MMC material the Al 6061 is used as the matrix phase, where the SiC_p and Gr_p are reinforced into different compositions with the same configurations. To develop this hybrid MMC samples, the stir casting method is used [4]. In this experimental study, we machined the developed sample with EDM (Electric Discharge Machine). EDM is one of the non-conventional machining processes; it is used in modern manufacturing industries due to their effectiveness and economical approach [6].

Three different material rods (copper, brass and steel 304) each with 12mm Ø are used as electrodes. To perform the EDM operations, a design matrix is developed in Minitab software by using the DOE approach. Here is our main emphasis on calculating and examining the TWR (Tool wear rate) of three different electrodes and investigate the process parameters, which mostly affect our response (TWR).

2. MATERIAL AND METHODS

A. Fabrication of Al-based hybrid MMC

It was a big challenge to prepare a metal matrix composite with uniform distribution of reinforcement phase and without any microstructure defects [8]. As per our

requirements, the reinforcement phase is added into the matrix phase within various sizes and shapes (short, long, aligned, continue and discontinues) [2]. However, in this study, the configuration of both SiCp and Grp are same, they both reinforced via 200 mesh size with an average size of 75µm. The SiC_p and Gr_p are reinforced into Aluminum 6061 in the following composition, shown in Table.1.

Table.1. The weight percentage of reinforcement of Al6061

Al MMC-1	Gr_p	SiC_p
87%	3%	10%

To prepare the composite, we used stir-casting process, which is one of the types of liquid state processes [4]. In stir casting process the Al 6061 alloy is kept in graphite crucible inside the electric vertical muffle furnace. The high temperature (850°C) of muffle furnace quickly melted the aluminum alloy. The SiC_p and Gr_p were preheated at 800°C temperature into another electric muffle furnace, to improve the wet-ability of reinforcements [8]. After melting the Al 6061, it is cooled down to come into a semi-solid state where the preheated particles of Sic and Gr are reinforced into the labelled compositions. A graphite stirrer is used for carrying the mechanical stirring during the mixing of reinforcements. After the proper mixing, the molten metal was poured into preheated cast iron mould, and then the it is left at environmental temperature for cooled down, after the solidification we got our required casted composite (as shown in Fig.1). For machining, the developed composite sample three different materials (Copper, Brass and Steel 304) rods are selected as electrodes (each has a Ø of 12mm), as shown in Fig.2.

Fig.1.

Fig.2.

Fig.1. The developed Al MMC (SiC_p10% and Gr_p3%) sample.

Fig.2. Three different electrodes (Before machining), a) Steel-304, b) Brass and c) Copper

B. Testing of developed sample and electrodes

To confirm and check the uniform distribution of reinforcements (SiC_p and Gr_p) and examined the microstructure of developed samples, the scanning electron microscopy (SEM) was done (as shown in Fig.3). Same as it, to study out the microstructure of electrodes before machining the SEM was done at equal magnification level (as shown in Fig.4).

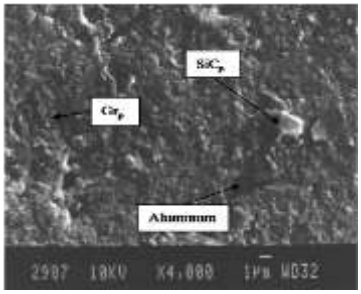


Fig.3. SEM images Al MMC (SiC_p10% and Gr_p3%)

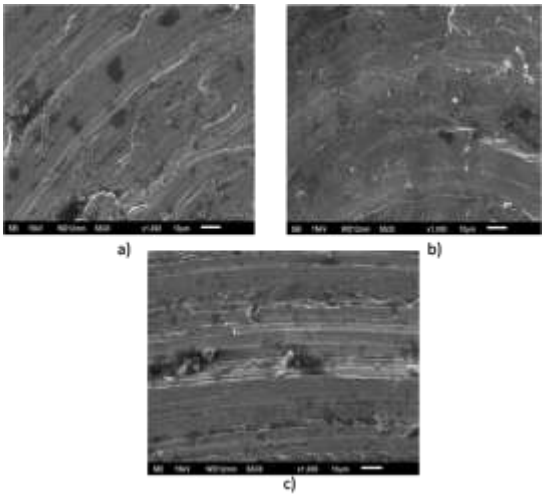


Fig.4. SEM images (before machining) of three electrodes, a)Steel-304, b) Brass and c) Copper

C. Experimental planning

Final experiments design matrix is developed by using the design of experiments in Minitab software. Taguchi L27 (3^5) technique is applied to optimize the significant parameters of EDM, where the response (TWR in g/sec) is directly affected. The series of experiments are planned with four process parameters and three levels (as shown in Table.2). Table.2. Selected parameters and their levels.

Machining parameters	Levels		
	1	2	3
Pulse-on time	30	60	90
Pulse-off time	30	60	90
Voltage	10	12	14
Current	6	7	8
Tool	Steel	Brass	Copper (1)
	(-1)	0	

 ISBN: 978-93-89107-36-4

The design matrix developed by Taguchi L27 (3^5) approach is shown in Table.3. The designed experiments were performed on Oscar Max Die-Sinking EDM machine (Taiwan made) shown in Fig.5.

Table.3. Design matrix

	Pulse on-time	Pulse off-time	Current	Volatge	Tool
1	30	30	6	10	-1
2	30	30	6	10	0
3	30	30	6	10	1
4	30	60	7	12	-1
5	30	60	7	12	0
6	30	60	7	12	1
7	30	90	8	14	-1
8	30	90	8	14	0
9	30	90	8	14	1
10	60	30	7	14	-1
11	60	30	7	14	0
12	60	30	7	14	1
13	60	60	8	10	-1
14	60	60	8	10	0
15	60	60	8	10	1
16	60	90	6	12	-1
17	60	90	6	12	0
18	60	90	6	12	1
19	90	30	8	12	-1
20	90	30	8	12	0
21	90	30	8	12	1
22	90	60	6	14	-1
23	90	60	6	14	0
24	90	60	6	14	1
25	90	90	7	10	-1
26	90	90	7	10	0
27	90	90	7	10	1

The specifications of Oscar max machine are shown in Table.4. During the EDM process, both W/p and electrodes are immersed in the dielectric fluid. A commercial-grade EDM oil (density=0.76) was utilized as dielectric fluid.

Fig.5. Oscar max EDM machine

Fig.6. Electronic weighing machine.

Table.4. EDM machine specifications

Model/Machine name	S645 CMAX/Oscar Max (Taiwan made)
Work Tank	1500 mm(L), 940 mm(W), 520 mm(H)
Work Table	1000 mm(L), 600 mm(W)
Table Travel (X)/(Y)	600mm/450mm
Servo Travel	400 mm
Distance Between Platen and table	300 mm-700 mm
Max. Electrode Weight	250 Kg
Max. Workpiece Weight	2000 Kg
Max. Current	180 A
Max. MRR	1500 mm^3/min
Weight	3600 Kg

D. The calculation for TWR (Tool Wear Rate).

To determine the TWR, we calculated the weight difference of tool electrodes (before and after the machining) and over the machining time. The Equation.1 is used to calculate the TWR.

$$\text{TWR (g/sec)} = \frac{(T_{bm} - T_{am})}{MT} \qquad (1)$$

Where, T_{bm}–Electrode weight before machining (gm),
T_{am} – Electrode Weight after machining (gm),
MT – Machining Time of each trail (sec).

To quantify the weight of tool/electrode a weighing machine (model PGB 200) with a maximum capacity of 200gm and readability of 0.001gm is used, as shown in Fig.6.

3. TAGUCHI L27 (3^5) ORTHOGONAL ARRAY

Analysis of the S/N ratio on TWR

Taguchi, the factorial design is used in this study to generate the design matrix with less complexity [8]. In this study, the orthogonal array L_{27} $^{(3^5)}$ is used. Equation.2 was used to find out the S/N ratio. Table.5 shows the experimental results and their corresponding S/N ratios for the lower tool wear rate

$$(\text{TWR}) = -10\ X\ Log10\ (\frac{Sum(Y^2)}{n}) \qquad (2)$$

 ISBN: 978-93-89107-36-4

Table.5. Average tool wear rate and S/N ratio

	Pulse on-time	Pulse off-time	Current	Volatge	Tool	Avg TWR	S/N
1	30	30	6	10	-1	0.000120	78.4164
2	30	30	6	10	0	0.000950	60.4455
3	30	30	6	10	1	0.000080	81.9382
4	30	60	7	12	-1	0.000100	80.0000
5	30	60	7	12	0	0.004150	47.6390
6	30	60	7	12	1	0.000060	84.4370
7	30	90	8	14	-1	0.000160	75.9176
8	30	90	8	14	0	0.000720	62.8534
9	30	90	8	14	1	0.000060	84.4370
10	60	30	7	14	-1	0.000140	77.0774
11	60	30	7	14	0	0.001710	55.3401
12	60	30	7	14	1	0.000090	80.9151
13	60	60	8	10	-1	0.000100	80.0000
14	60	60	8	10	0	0.001040	59.6593
15	60	60	8	10	1	0.000020	93.9794
16	60	90	6	12	-1	0.000110	79.1721
17	60	90	6	12	0	0.000979	60.1843
18	60	90	6	12	1	0.000060	84.4370
19	90	30	8	12	-1	0.000140	77.0774
20	90	30	8	12	0	0.001590	55.9721
21	90	30	8	12	1	0.000030	90.4576
22	90	60	6	14	-1	0.000120	78.4164
23	90	60	6	14	0	0.001370	57.2656
24	90	60	6	14	1	0.000030	90.4576
25	90	90	7	10	-1	0.000120	78.4164
26	90	90	7	10	0	0.000050	86.0206
27	90	90	7	10	1	0.000050	86.0206

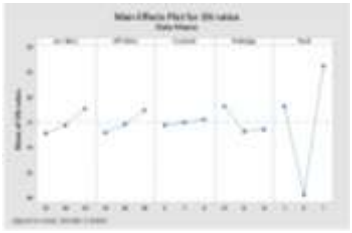


Fig.7. The main effect of TWR

Fig.8. Pictorial view of used electrodes, a) Steel-304, b) Brass and c) Copper

From S/N graph (Fig.7) the combination of optimal parameters for minimum tool wear rate is a pulse on time (30), pulse off time (30), current (6), voltage (12) and tool (brass).

B. Analysis of the S/N ratio on TWR

The ANOVA (Analysis of variance) is employed to check out the second-order mathematical model of the above equation. Table 6 shows the ANOVA with rank by each parameter while machining of Al-HMMC. The percentage contribution by each parameter shows the significant parameters that affect the TWR while machining of MMC.

Table.5. ANOVA for TWR

Level	On time	Off time	Current	Voltage	Tool
1	72.9	73.07	74.53	78.32	78.28
2	74.53	74.65	75.1	73.26	60.6
3	77.79	77.5	75.59	73.63	86.34
Delta	4.89	4.42	1.07	5.06	25.74
Rank	3	4	5	2	1

4. RESULT AND DISCUSSION

A. Mechanism of Tool Wear

In EDM operation, high thermal energy is applied to generate a spark for eroding the workpiece, during the process, the electrode (tool) is also dissolved. The main advantage of EDM is its capability to machine the hard material within the desired size and shapes. Here our main emphasis is to calculate the tool wear rate of three used different material electrodes, shown in Fig.8. Fig.9 (a-c) shows the SEM (scanning electron microscope) images of tool electrodes after the electric discharge machining of Al MMCs.

From SEM images of used electrodes, it was analyzed that the cracks and craters are produced in all three electrodes after the EDM operations. The EDS operation was done to verify the element analysis of used electrodes. The EDS analysis is shown in the following images Fig.10 (a-c).

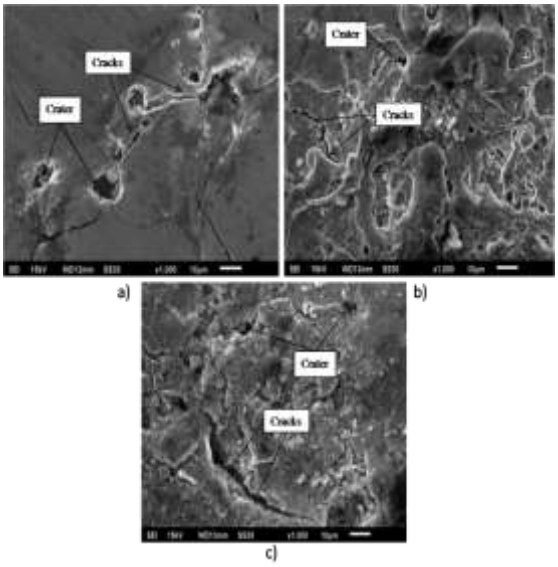


Fig.9. SEM images of electrodes after EDM, a) Steel-304, b) Brass and c) Copper.

 ISBN: 978-93-89107-36-4

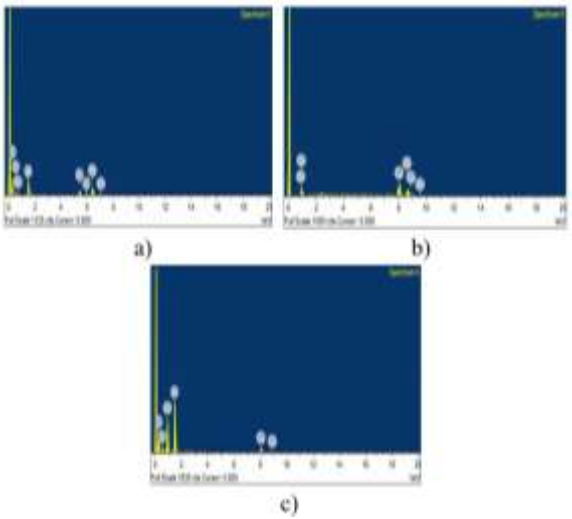


Fig.10. EDS spectral analysis, a) Steel-304, b) Brass and c) Copper

The tool wear rate (TWR) percentage of three different electrodes is represented in the following Table.7.

Table.7. Tool wear rate percentage.

Electrode (code)	TWR percentage (%)
Steel-304 (-1)	55%
Brass (0)	25%
Copper (1)	80%

CONCLUSION

In this experimental work, EDM was conducted on the Al-based hybrid MMC sample (fabricated by Stir casting process), by using three different electrodes (Steel-304, Brass and Copper) of Ø12mm each. The final design matrix was developed by using the Design of experiment (Taguchi L_{27}) technique in Minitab software. Here our focus was to investigate the signification/impact of selected parameters and their levels/ranges where our response variable (TWR) is mostly affected. The desirability approach was employed to calculate optimization. The mean S/N ratio graphs and ANOVA was generated for analyzing the effect of process parameters. From the analysis, the following conclusion was conducted.

(1) In this experimental study, it was examined that the Copper-based electrode has a high tool wear rate (80%) as compared to other electrodes (Steel-304 and Brass).

(2) The 'voltage' and 'pulse-on time' both are the significant parameters which directly caused the high tool wear rate of all the three different material electrodes.

(3) The TWR is minimum at a high level of 'pulse-off time', and on the other side, the 'current' has a constant effect on TWR.

REFERENCE

1. Amresh kumar, Gaurav saini, H.S Bains and Alakesh Manna, 2015, "Mechanical behavior of particle reinforced Aluminum matrix composite-A review". National conferences on mechanical engineering (NCME_2015), p.p-297-301.
2. David E.Alman, "Properties of metal matrix composites". U.S department of energy, Vol-21, p.p-838-858.
3. Johny james.S, Venkateran.K, Kuppan.P and Ramanujam.R, 2014, "Hybrid aluminum metal matrix composite reinforced with SiC and TiB2". Procedia engineering, Vol-97, p.p-1018-1026.
4. Jaswinder singh and Amit chauhan, 2015, "Characterization of hybrid aluminum matrix composite for advanced application-A review". Journal of materials research and technology, no of pages-11.
5. E.kilickap, O.cakis, M.akray and A.inan, 2005, "Study of tool wear and surface roughness in machining of homogeised SiC-p reinforced aluminum metal matrix composite". Materials processing technology, p.p-862-867.
6. C.velmurugan, R.subramanian, S.thriugnanam and B.anandavel, 2011, "Experimental investigation on machining characteristics of Al6061 hybrid metal matrix composite processed by EDM". International journal of engineering, science and technology, Vol-3, p.p-87-101.
7. Kompan chomsamuts and J.somkiat, 2012, "Optimization parameters of tool life material using the taguchi approach and response surface methodology". International journal computer science, Vol-9, ISSN: 1694-0814.
8. R.K gangram bhandare and P.M sonawane, 2013, "Prepration of aluminum metal matrix composite using stir casting method". International journal of engineering and advanced technology, Vol-3, ISSN: 2249-8958.
9. V.balaji, N.sateesh and M.M hussain, 2015, "Manufacturing of Aluminum metal matrix composite (Al 7075-SiC) by stir casting technology". Materials today, p.p-3403-3408.
10. R.V barenji, H.H pourasl and V.M khojastehnezhed, 2016, "Electric discharge machining of AISI D6 tool steel prediction and modeling of the material removal rate and tool wear ratio", PRE:6341.
11. Umesh.K garg, M.P kaur and V.K garg, 2008, "Removal of Nickel from aqueous solution by adsorption on agriculture waste biomass using a response surface methodology approach". Bioresources technology, p.p-1325-1331.

Effects of grain size on surface roughness of thin pure Cooper sheets in metal micro forming

[1] Mandeep Singh, [2]Anamul Hossian, [3] Pradeep Kumar Mishra, [4] Dillip Mishra

[3] College of Engineering and Technology, Bhubaneswar, India
[1][2][4] University of Technology, Sydney, Australia
[1] Mandeepsingh@student.uts.edu.au

Abstract:

Size effect is a superior occurrence in micro forming process. Once the deformation process is scale down to micro scale, the presences of geometry size and single grain size start to play a significance role on the material deformation behaviour. In this work, size effect on surface roughness is inspected in the form of the coupled effect of workpiece geometry and grain size: the ratio of material thickness (T) to average grain size (D) by the micro tensile test of pure copper foil. Tensile tests were carried out on the foil with constant thickness and width, while to achieve different grain sizes, the foil were annealed for different time. The surface roughness of all tensile tested copper samples is tested on the 3D laser-scanning microscope. The identified analysis provides a basis for further vital exploration to understand the influence of size effects in metal micro forming.

Keywords:

Size effects, Copper samples, Tensile test, Micro-forming

1. INTRODUCTION

In the recent years, the micro metallic parts have been attained more attention due to their wide applications and superior characteristics [1]. The metal micro forming is a superlative micro-scale deformation process to fabricate the submillimeter range metallic parts with multi facilitation [7]. Metal micro forming is a prominent field where size effects play a significant role. In metal micro forming, all the process problems and material behaviour problems, which becomes complicated with further steps in miniaturization, are only highlighted with concerning the size effects [1,10]. The relationships between the dimensions, microstructure, and surface geometry in treated workpieces as well as in tools are different in macro and micro-scale forming, which caused the formation of 'size effect' phenomenon [1,9]. Therefore, the study of deformation behavior characteristics of different materials foils is very important to understand the influence of size effects in metal micro forming.

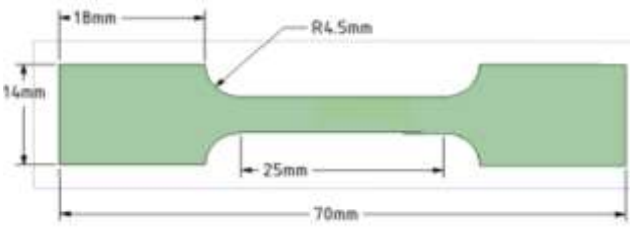
In metal micro forming technology, a great deal of research on size effects on material deformation behaviours of thin films have been studied extensively in the previous researches [5], but the micro-scales investigation for thin films are typically at least. In the metal micro forming, the surface roughness is one of the problem caused by non-uniform deformation of metal foils. In addition, the increase in surface roughness of the metal foils occurs during plastic deformation and it is one of the main factor affecting the ductile fracture behaviour of metal foils [14]. Thus, it becomes significant to clarify the mechanism of surface roughness in metal micro forming process. As the deformation process scales down to micro scale, the characteristics of single grain involved in the deformed region start playing a major character in the material deformation behaviours [10]. In this paper, the effect of different grain sizes on the surface roughness of very thin copper sheets (t=50 μm) has been investigated by conducting micro tensile tests

2. MATERIAL

Nonferrous metals are broadly used in electrical devices in terms of micro parts due to their high electrical conductivity and good ductility. The outstanding wear resistance and bearing properties enhance the applications of nonferrous metals. The most commonly used wrought forms are strips, rods, and tubes. In this study, a pure copper (99.9 %) foil is selected as the investigational material. The schematic and actual copper tensile sample is shown in Fig.1 (a-b).

3. HEAT TREATMENT AND POLISHING

To obtain different average grain sizes in the selected material and to achieve different thickness to grain size effect ratios, annealing process was carried out. The micro tensile samples were annealed in a well-sealed vacuum tube annealing furnace (Fig.2 (a)). Because the samples are very small, besides vacuum condition during heat treatment, the Ar air protection was also adopted to avoid oxidation. After annealing, samples for micro tensile test were etched using a solution of 5ml saturated aqueous sodium thiosulfate, 45mL water, 20g potassium metabisulfite for 10 seconds.



(a)

(b)

Fig.1. (a) Diagram of micro tensile samples (b) Real copper specimen

The most difficult job was to get a high diamond finish on copper samples for determining the average grain size. The normal size Alpha aluminium powder (0.5 and 0.3 microns) used to polish the copper samples. To achieve a good shine in soft cooper material the Alpha aluminium powder was constantly rubbed on samples after grinding.

Table.1. Sample preparation procedure for microstructural analysis

Procedure	Surface	Solution
Grinding (2 min)	9 µm Largo cloth	Water
Polishing (1 min)	3 µm Mol cloth	Alpha or Gamma aluminium powder (0.5 microns)
Polishing (20 sec)	OP-chem	Alpha aluminium powder (0.3 microns)

All the samples were mounted on grinder and polish machine, as shown in Fig.2 (b). The grinding and polishing procedures for metallography are presented in Table.1.

(a)

(b)

Fig.2. (a) Vacuum tube annealing furnace, (b) Grinder and polish machine

4. 3D LASER SCANNING MICROSCOPE

An electric stage, and a large area of the strained foil surface can be observed by using different lens to enlarging the pictures automatically. To measure the average grain size after polishing, the average grain intercept method (AGI) is used. In AGI technique, randomly positioned line segments are drawn on the micrograph and then counting the number of times each line segment intersects a grain boundary and quantify the grain size in a given material [12].

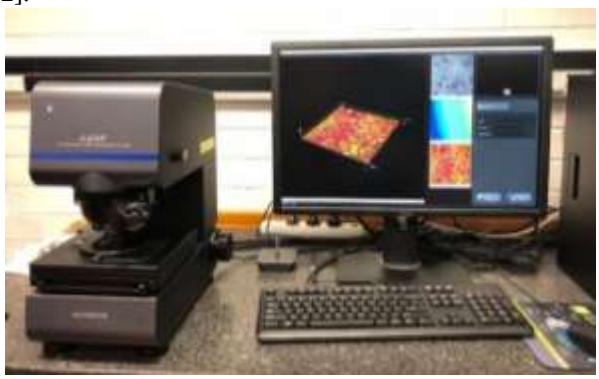


Fig.3. 3-D laser scanning microscope

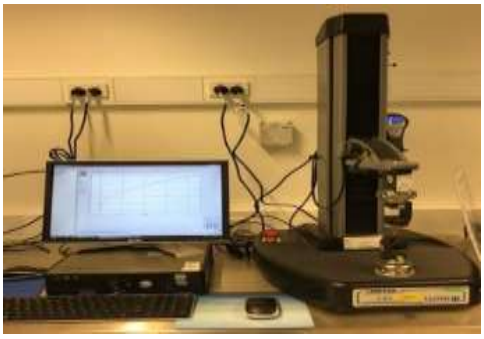
This 3D laser confocal microscope is also used to the precisely measures shape and surface roughness at the submicron level. All the microstructure and grain size of the prepared specimens before the tensile test are in shown in Table.2.

5. EFFECT OF T/D ON TENSILE TEST AND SURFACE ROUGHNESS

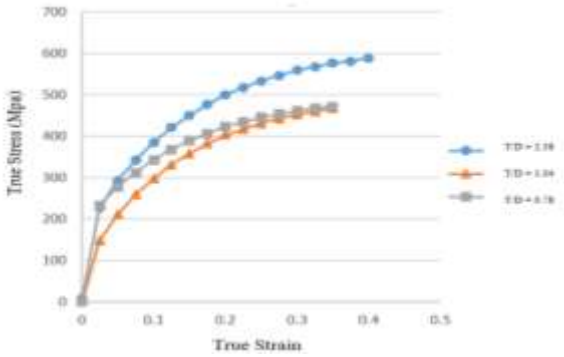
The impact of grain size comparative to the sample thickness becomes very important, specifically when the sample is actually thin, and then the T/D effect is analysed with flow curves. To carry out the uniaxial micro tensile test on materials with different grain size effect ratios, a set of METEX universal tensile testing machine with a maximum

 ISBN: 978-93-89107-36-4

capacity of 1KN (as shown in Figure.4 (a)) is used. The true stress-strain curves of the copper samples with different grain sizes are shown in Fig.4 (b). The true stress-strain graph represents the required stress to origin the further plastic flow in the material. In the previous studies the selected ratios (T/D >1, T/D =1 and T/D <1) are only used to investigate the flow stress in thin foils not for the surface roughness. However, in this work all, these three ratios are studied to understand the occurrence of the surface roughness and the crystal orientation between the grains that effects it most. Therefore, in the three nominated different ratios of T/D the different surface texture images were attained with the help of 3D laser microscope. The height profile and surface texture of the tensile-tested samples are shown in the following Fig.5 and Fig.6, respectively. It is observed that the surface roughness of deformed sample increases significantly with the decrease of T/D, because the surface grains are less constrained and easier to deform on the free surface with small ratio of T/D. Further, Fig.5 (a-c) shows the height profiles of tensile tested samples all the copper samples are tested on the 3D laser-scanning microscope. From Fig.7, it can be clearly observed that the surface roughness increases with the decrease of T/D ratio. Because, in T/D<1 the average grain size is greater than sample thickness, which means the grains involved in the tensile samples are incomplete. Consequently, due to the lack of grain boundaries it becomes very easy to initiate the surface irregularities.

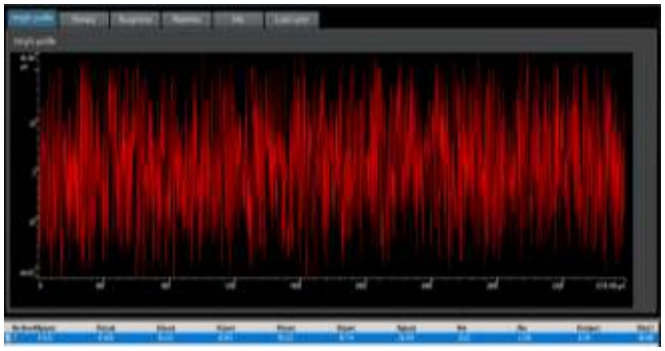


(a)

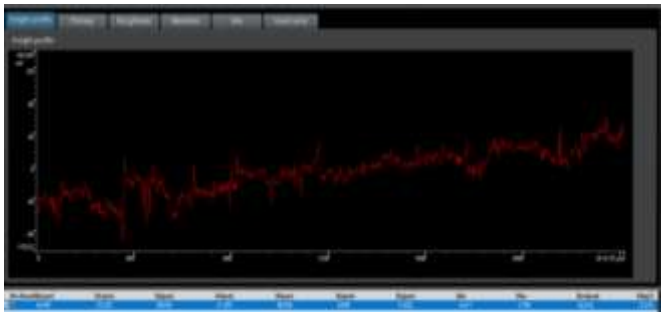


(b)

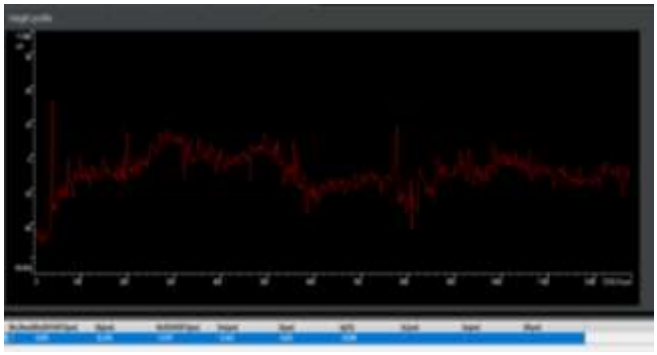
Fig.4. (a) METEX universal testing machine
(b) True stress-strain curves



(a)



(b)



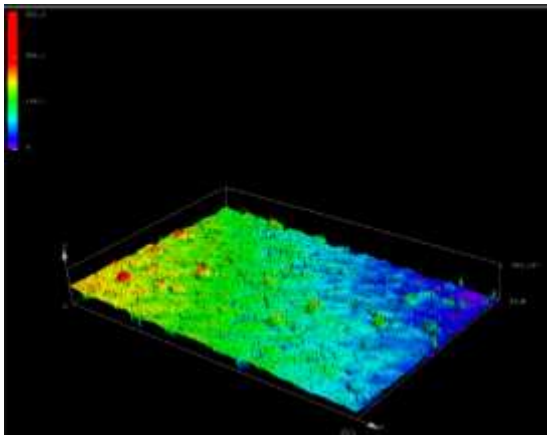
(c)

Fig.5. Hight profiles of (a) T/D = 0.78
(b) T/D = 1.04
(c) T/D = 2.38

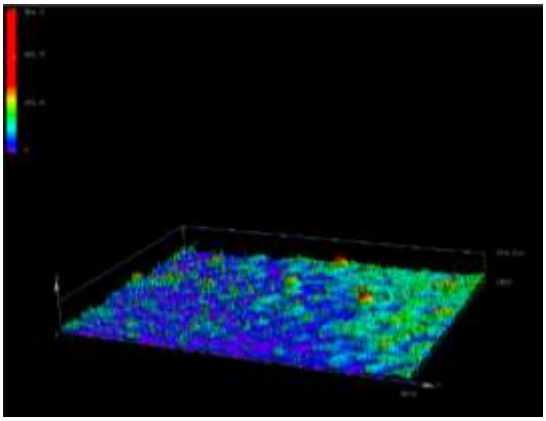
 ISBN: 978-93-89107-36-4

	Sample 1	Sample 2	Sample 3
Material	Copper	Copper	Copper
Temperature	600	600	600
Time	10 min	20 min	30 min
Thickness	50 µm	50 µm	50 µm
Average grain size	21 µm	48 µm	56 µm
T/D	2.38	1.04	0.78
Microstructure			

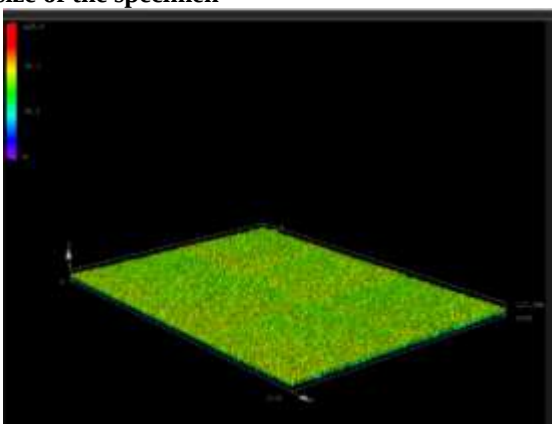
Table.2. Microstructure and grain size of the specimen



(a)



(b)



(c)

Fig.6. 3D Surface texture of (a) T/D = 0.78, (b) T/D = 1.04, (c) T/D = 2.38

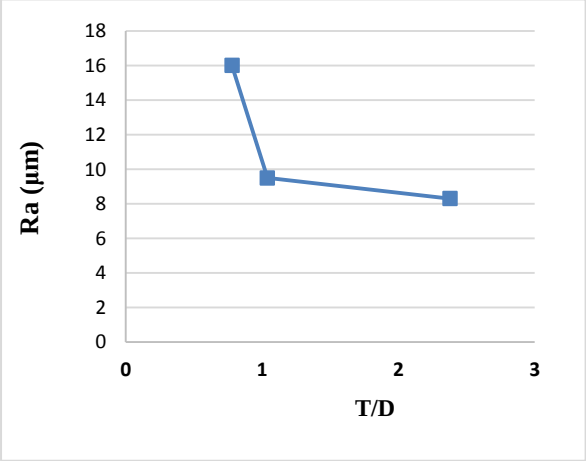


Fig.7. Surface roughness vs T/D

6. CONCLUSION

In this article, the influence of the size effects on selected material surface roughness are investigated. To confirm the effect of T/D ratios, the surface roughness analysis has been conducted with tensile tests for pure copper foils. From this study, it is found that in deformed samples the surface roughness is expressively increased with the decline in T/D ratio. In other words, we can say that the surface roughness increases with the increase of grain size. The reported results from this study also help to define the hardening behaviour of grains in polycrystalline material. This investigation provide vital evidence to the effect of surface roughening on the ductile fracture behaviour..

REFERENCE

1. U. Engel, R. Eckstein, Microforming—from basic research to its realization, Journal of Materials Processing Technology 125-126 (2002) 35-44.
2. E. Egerer, U. Engel, Process Characterization and Material Flow in Microforming at Elevated Temperatures, Journal of Manufacturing Processes 6(1) (2004) 1-6.
3. F.-K. Chen, J.-W. Tsai, A study of size effect in micro-forming with micro-hardness tests, Journal of Materials Processing Technology 177(1) (2006) 146-149.
4. U. Engel, Tribology in microforming, 2006.
5. G. Simons, C. Weippert, J. Dual, J. Villain, Size effects in tensile testing of thin cold rolled and annealed Cu foils, Materials Science and Engineering: A 416(1) (2006) 290-299.
6. J. Jeswiet, M. Geiger, U. Engel, M. Kleiner, M. Schikorra, J. Duflou, R. Neugebauer, P. Bariani, S. Bruschi, Metal forming progress since 2000, CIRP Journal of Manufacturing Science and Technology 1(1) (2008) 2-17.
7. X. Lai, L. Peng, P. Hu, S. Lan, J. Ni, Material behavior modelling in micro/meso-scale forming process with considering size/scale effects, Computational Materials Science 43(4) (2008) 1003-1009.
8. A. Molotnikov, R. Lapovok, C.H.J. Davies, W. Cao, Y. Estrin, Size effect on the tensile strength of fine-grained copper, Scripta Materialia 59(11) (2008) 1182-1185.
9. F.-H. Yeh, C.-L. Li, Y.-H. Lu, Study of thickness and grain size effects on material behavior in micro-forming, Journal of Materials Processing Technology 201(1) (2008) 237-241.
10. B. Guo, F. Gong, C. Wang, D.-b. Shan, Flow stress and tribology size effects in scaled down cylinder compression, 2009.
11. B. Guo, F. Gong, C. Wang, D. Shan, Size effect on friction in scaled down strip drawing, 2010.
12. J.H. Deng, M.W. Fu, W.L. Chan, Size effect on material surface deformation behavior in micro-forming process, 2011.
13. M.W. Fu, W.L. Chan, Geometry and grain size effects on the fracture behavior of sheet metal in micro-scale plastic deformation, Materials & Design 32(10) (2011) 4738-4746.
14. W.L. Chan, M.W. Fu, B. Yang, Experimental studies of the size effect affected microscale plastic deformation in micro upsetting process, 2012.
15. D. Anand, D.R. Kumar, Effect of Thickness and Grain Size on Flow Stress of Very Thin Brass Sheets, Procedia Materials Science 6 (2014) 154-160

Synergistic Effect of Selenium Nanoparticles (SeNPs) With Various Antibiotics as an Antimicrobial Activity

[1] Kavitha Varak, [2] Puppala Kavya Priya

[1][2] Keshav Memorial Institute of Commerce and Sciences, Narayanaguda, Hyderabad, Telangana, India
[1] kavithavarak@gmail.com

Abstract:

Nanoparticles (NPs) are advantageous in treating bacterial infections. Scientists found that Selenium Nanoparticles (SeNPs), owing to their unique structure and properties, may be more effective than antibiotics as they have a larger surface area and therefore can be more in contact with the external environment. The antibacterial effect of selenium may be due to the fact that at a particular concentration nano-selenium interacts with the bacterial cell surface and penetrates into the cell, thus causing damage. Some studies in recent years have suggested the use of combination of antibiotics+SeNPs, the synergistic effect of which often surpasses their individual's inhibitory activity. In our work we performed synergetic effect of SeNPs and 3 commercial antibiotics. We found that the Nanoparticles enhanced the reaction rates of antibiotics in a synergistic mode as well as in its own way on different kinds of pathogens

1. INTRODUCTION

Over the last decade, there has been a remarkable global focus on conventional as well as biogenic metallic Nanoparticles as innovative tools for combating the high rates of antimicrobial resistance [1], [2]. Resurgent interest in NPs has been stimulated by the appearance of drug-resistant bacteria and the increasing rate of hospital infection outbreaks.

NPs in particular have demonstrated broad-spectrum antibacterial properties against both Gram-positive and Gram-negative bacteria. The NPs have a direct contact with the bacterial cell wall, without penetrating the cell, which would be less prone to promoting resistance in bacteria than antibiotics [3]. Due to their excellent antimicrobial resistance properties, NPs have been widely used in many fields. In fact, the application of NPs in fighting bacteria has decreased bacterial infection [4].

Several NPs have been documented for antimicrobial activity [5], as the bacteria are less likely to develop resistance to nanoparticles, the nanoparticles (NPs) are increasingly used to target bacteria as an alternative to antibiotics [6], [7], [8].

More recent option from the perspective of nanotechnologies and bacterial infections are Selenium Nanoparticles (SeNPs). SeNPs were investigated for various medical applications and as a potential material for orthopedic implants [9], [10], as anti cancer agent, Selenium has been investigated for various medical applications such as anticancer applications. Selenium as a dietary supplement has been demonstrated to reduce the risks of various types of cancers including prostate cancer [9], [10] lung cancer [11]and esophageal and gastric-cardiac cancers.

Currently, studies indicating the ability of the selenium compounds to inhibit bacterial growth and formation of bacterial biofilms are also available [12]. Scientists found that SeNPs, owing to their unique structure and properties, may be more effective than antibiotics as they have a larger surface area and therefore can be more in contact with the external environment [13]. The antibacterial effect of selenium may be due to the fact that at a particular concentration nano-selenium interacts with the bacterial cell surface and penetrates into the cell, thus causing damage. Selenium compounds are effectively used as anti-fungal agents in shampoos for the treatment of the dry scalp [13].

Many vast range of microbes are used to study the antimicrobial effect of SeNPs few of such microbes we used are E.coli, Pseudomonas, Staphylococcus aureus, Salmonella, Bacillus subtilis, Candida, zygomycota etc. The pathogenic microorganisms used for the present study were E.coli, Pseudomonas, Staphylococcus, Bacillus & Salmonella.

Some studies in recent years have suggested the use of combination of antibiotics, the synergistic effect of which often surpasses their individual's inhibitory activity [14], [15]. In our work we performed the inhibitory activity of SeNPs on 5 different pathogens, inhibitory activity of antibiotics on 5 different pathogens. Then the zone of inhibition of SeNPs was compared to that of Antibiotics inhibitory Zone. In the final stage we performed the synergetic effect of SeNPs+commercial antibiotics the pathogenic microbes and measured their synergistic activity.

 ISBN: 978-93-89107-36-4

2. MATERIALS AND METHODS

A) Synthesis of Selenium Nanoparticles

Selenium nanoparticles (SeNPs) was synthesised according to Sheng-YiZhang et al; protocol [16] with little modifications.

B) Collection of Pathogenic Sample

The samples were collected from various places and organizations. The pus sample was collected Hospitals, Hyderabad. The water sample was collected from Musi River, Moosrambagh, Hyderbad. The soil sample was collected from Purana Pul bridge, Hyderabad.

C) Inoculation and Isolation Pathogenic Samples

The samples were isolated and inoculated based on the protocols of Gopal Reddy et al., [17].

The identification of Microorganisms were done by staining techniques and by biochemical tests. After the isolation and identification of various organisms, the antibiotic sensitivity test and selenium nanopartical inhibitory tests by diffusion methods were performed. And also the synergistic effect of SeNPs of different concentration with various antibiotics was done.The plates were incubated at 37°C for 24 hrs. The inhibition zone diameters of them were measured and the Synergistic effect was calculated by the following equation.

Synergistic effect = (B-A)/A × 100

Where,

'A' is Zone of inhibition for antibiotics

'B' is Zone of inhibition for the antibioitic + SeNPs

3. RESULTS

The pathogenic organisms which were collected from various sources were identified as Pseudomonas, Bacillus, E.coli, Staphylococcus based on morphological and biochemical tests. Their morphological characters, showed brown greenish colour, slightly yellow colour, pink colour colonies colonies, Golden yellow colour, pale yellow colour colonies on agar medium. In gram staining they were observed as rod shaped pink colour, rod shaped purple colour, Cocci shaped pink colour colonies, Cocci shaped purple colour, rod shaped pink colour confirming Gram-ve, Gram+ve, Gram-ve,, Gram+ve Gram –ve for Pseudomonas, Bacilli, E.coli, Staphylococcus, Salmonella respectively.

The result of various Biochemical test infer that the sugar fermentation was observed by gas bubble formation in durhams tubes in all the pathogens, giving +ve result. While indole test the Bacillus, E.coli formation of dark red colour layer indicates +ve results and light pink colour layer indicates –ve results in Pseudomonas, Staphylococcus, Salmonella. The Methyl Red test indicates bright red colour in all the pathogens, giving +ve results. While Voges-Proskauer test the Bacillus and Staphylococcus showing pink colour layer that indicates +ve results, while Pseudomonas, E.coli, Salmonella indicates –ve results. While Hydrogen sulphide test all pathogens are showing –ve results. While Citrate utilization tests Pseudomonas, Bacillus subtilis, Staphylococcus, Salmonella are showing +ve results, E.coli shows –ve result. While Gelatin Hydrolysis Pseudomonas, Bacillus subtilis, Staphylococcus, Salmonella are showing +ve results, E.coli shows –ve result.

Table:1-Diameter of Inhibition Zone (mm) of difeerent concentartions of SeNps against various pathogens

S. No	Pathogen	SeNPs			Antibiotics		
		50µl (5µg)	100µl (10µg)	150µl (15µg)	Penicillin	Streptomycin	Tetracycline
1.	Pseudomonas	25 mm	31 mm	39 Mm	10 mm	30 mm	_
2.	B. Subtilis	40 mm	46 mm	50 Mm	10 mm	25 mm	_
3.	E. coli	30 mm	40 mm	43 Mm	10 mm	30 mm	30 mm
4.	Staphylococcus	35 mm	35 mm	40 Mm	7 mm	25 mm	30 mm
5.	Salmonella	30 mm	35 mm	50 Mm	10 mm	26 mm	30 mm

Table: 1, Interprets the result of diameter of the inhibition zone in mm of all pathogens. The highest antimicrobial activity of 150µl SeNPs was seen in Bacillus subtilis, salmonella followed by E.coli, Staphylococcus, pseudomonas. The increasing level of SeNPs concentration lead to inncrease in diameter of inhibition zone, i.e., when SeNPs concentation were increased from(5µg to 15µg, the diameter of inhibition zones were also increased **(Fig1,2).**

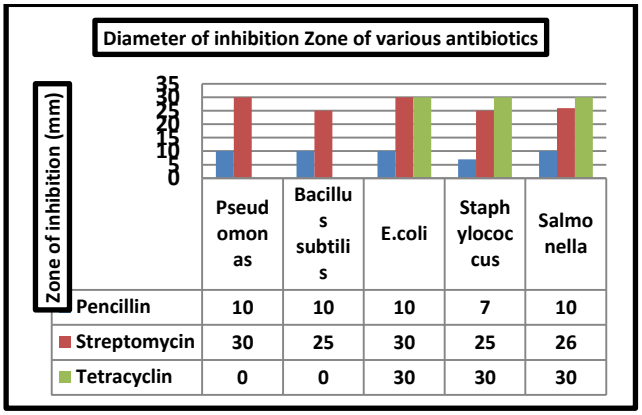


Figure:1 Diameter of Inhibition Zone of various antibiotics

 ISBN: 978-93-89107-36-4

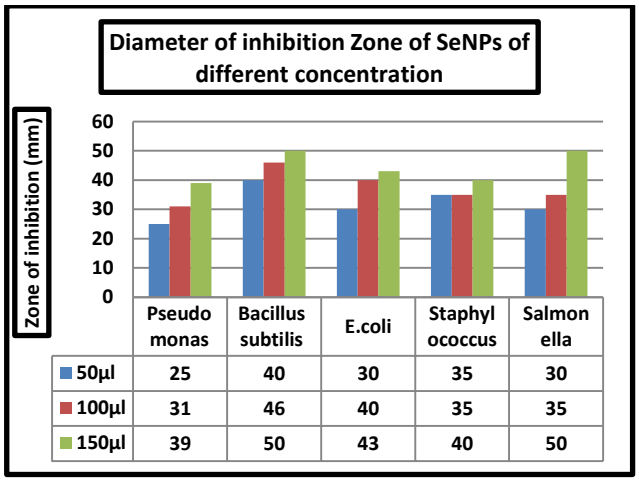
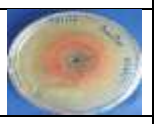
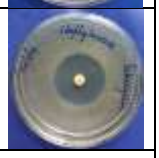
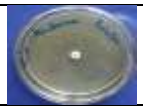
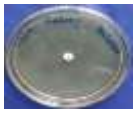


Figure:2 Diameter of Inhibition Zone Of SeNPs of different ncentration

In the present study three antibiotics (Pencillin, Streptomycin, Tetracyclin) were used as control gainst SeNPs to compare their inhibitory activity against pathogenic bacteria. Penicillin showed 10mm zone of inhibition for pseudomonas, e.coli, Bacillus subtilis, Salmonella and 7mm for Staphylococcus. while streptomycin showed highest zone of Inhibition 30mm for Pseudomonas and E.coli, Salmonella showed 26mm, Bacillus, Staphylococcus showed 25mm zone of inhibition. Tetracyclin showed highest zone of Inhibition (30mm) for E.coli, Staphylococcus, Salmonella while Psedomonas, Bascillus Zone of Inhibition was not observed. over all the highest zone of inhibiton of antibiotics was less compared to that of SeNPs **(Fig 3).**

Figure 3: Minimum inhibitory Zone of Intiation of SeNPs and Antibiotics on Pathogens

S. No	Antimicobial Agent	Zone of Inhibition (ug)		
		5	10	15
Bacillus				
1	SeNPs			
2	Antibiotics			
E.coli				
1	SeNPs			
2	Antibiotics			
Streptococcus				
1	SeNPs			
2	Antibiotics			
pseudomonas				
1	SeNPs			
2	Antibiotics			
Salmonella				
1	SeNPs			
2	Antibiotics			

After the individual sensitivity tests of antibiotics and SeNPs on pathogens, the further experment was done on combined sinsitivity of both antibiotics+SeNPs on pathogens **(fig 4).**

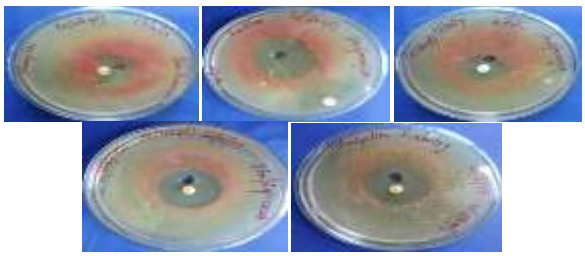


Figure:4 Synergistic effect of SeNPs+Antibiotics showing Zone of Inhibition of all pathogens.

The combination of SeNPs with different antibiotics was investigated against five pathogenic bacteria using the disc diffusion method. The diameter of the inhibition zone in mm around the different antibiotic disks with SeNPs was determined as shown in (Table:2). The highest increased fold area was found for Tetracycline in presence of SeNPs 150µl against Pseudomonas (83%). The highest fold area was observed against Bacillus subtilius (167%), followed by E.coli (140%), Staphylococcus (66%), Salmonella

 ISBN: 978-93-89107-36-4

(66%). It was found that the Nanoparticles enhanced the reaction rates of antibiotics in a synergistic mode as well as in its own way on different kinds of pathogens **(Fig 5, 6).**

Table:2 Diameter of Inhibition Zone (mm) of synergistic effect of SeNPs with various antibiotics

Pathogens	Antibiotics	Diameter of Inhibition Zone			
		SeNPs (mm)	Antibiotics (mm)	Se + Ab (mm)	Fold area increasing %
Pseudomonas	Tetracyclin	43	30	55	83
Bacillus subtilis	Streptomycin	39	30	80	167
E.coli	Streptomycin	50	25	60	140
Staphylococcus	Tetracyclin	50	30	50	66
Salmonella	Tetracyclin	40	30	50	66%

Figure:5 Diameter of Inhibition Zone (mm) of synergistic effect of SeNPs with various antibiotics

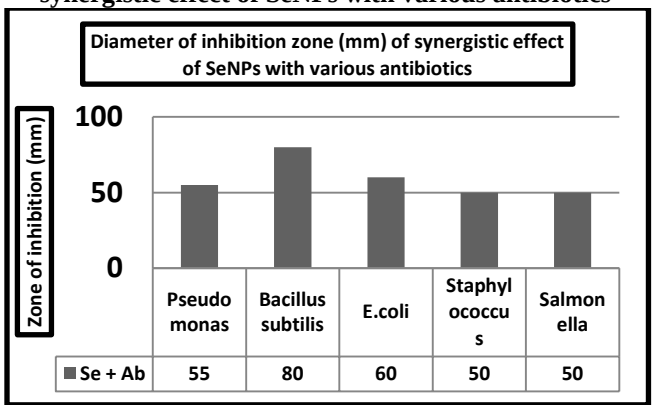
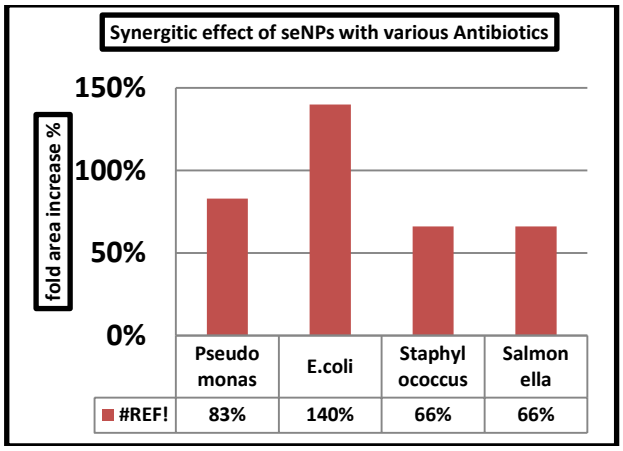


Figure:6 Synergistic effect of SeNPs with various Antibiotics



4. DISCUSSION

Determination of the inhibition zone of SeNPs at different concentration:-According to Bahig El-Deeb et al., [14], the highest antimicrobial activity of 100 µl SeNPs was seen in the order of S. aureus and B. cereus (29mm) followed by MRSA (27 mm), S. agalactiae (25 mm) and E. coli (13 mm). However, apart from E. coli, SeNPs did not show a significant effect on all bacterial growth of Gram negative bacteria. The increases of SeNPs concentration lead to increase of diameter of inhibition zone, when the SeNPs concentrations were increased from 100µl (10µg) to 150µl (15µg), the diameter of inhibition zones were increased. Similar results were observed in our study.

According to our study, the highest antimicrobial activity of 150µl SeNPs was seen in Bacillus subtilis, salmonella followed by E.coli, Staphylococcus, and pseudomonas. The increase of SeNPs concentration lead to increase in diameter of inhibition zone, when the SeNPs concentration were increased from 50µl (5µg) to 100µl (10µg) to 150µl (15µg), the diameter of inhibition zones were increased.

In the study [14], they used six antibiotics to compare their inhibitory activity when combined with SeNPs against pathogenic bacteria. They found that the SeNPs have greater Zone of Inhibition when compared to individual antibiotic the similar results were observed in our study.

Overall it was found that our results were similar to [14], where the synergistic effect of antibiotic+SeNPs showed highest Inhibitory Zone when compared to individual Minimum Zone of Inhibition (MIZ) of antibiotic and SeNPs respectively.

CONCLUSION

In the present study, all tested combination of SeNPs + Antibiotics showed higher synergistic inhibition against the growth of the pathogenic bacteria, compared to individual inhibition. This combinatorial approach may serve as adjunct to the existing therapies and may help to retrain the escalating nosocomial threats.

ACKNOWLEDGMENTS

Ms. Kavitha Varak, the author acknowledges the support from Keshav Memorial Institute of Commerce and Sciences, Naryanaguda, Hyderabad.

REFERENCE

1. Beyth N, Houri-Haddad Y, Domb A, Khan W, Hazan R. Alternative antimicrobial approach: nano-antimicrobial materials. Evid Based Complement Alternat Med. (2015); 2015:246012.

2. Gupta A, Landis RF, Rotello VM. Nanoparticle-based antimicrobials: surface functionality is critical. F1000Res. (2016);5 F1000 Faculty Rev-364.
3. Knetsch MLW, Koole LH. New strategies in the development of antimicrobial coatings: the example of increasing usage of silver and silver nanoparticles. Polymers Basel.(2011);3:340–366.
4. Linlin Wang, Chen Hu, Longquan Shao. The antimicrobial activity of nanoparticles: present situation and prospects for the future. International Journal of Nanomedicine (2017):12 1227-1249.
5. Dizaj SM, Lotfipour F, Barzegar-Jalali M, Zarrintan MH, Adibkia K. Antimicrobial activity of the metals and metal oxide nanoparticles. Mater Sci Eng C Mater Biol Appl. (2014);44:278–284.
6. Zhang L, Pornpattananangku D, Hu CM, Huang CM. Development of nanoparticles for antimicrobial drug delivery. Curr Med Chem. (2010);17(6):585–594.
7. Ranghar S. Nanoparticle-based drug delivery systems: promising approaches against infections. Braz Arch Biol Techn. (2012);57:209–222
8. Pelgrift RY, Friedman AJ. Nanotechnology as a therapeutic tool to combat microbial resistance. Adv Drug Deliv Rev. (2013);65(13–14):1803–1815.
9. Wang, Q. and T.J. Webster, Nanostructured selenium for preventing biofilm formation on polycarbonate medical devices. Journal of Biomedical Materials Research Part A, (2012). 100A(12): p. 3205-3210
10. Rayman MP. Selenium in cancer prevention: a review of the evidence and mechanism of action. Proc Nutr Soc. (2005);64(4):527–542.
11. Clark LC, Dalkin B, Krongrad A, et al. Decreased incidence of prostate cancer with selenium supplementation: results of a double-blind cancer prevention trial. Br J Urol. (1998);81(5):730–734.
12. Clark LC, Combs GF, Jr, Turnbull BW, et al. Effects of selenium supplementation for cancer prevention in patients with carcinoma of the skin. A randomized controlled trial. Nutritional Prevention of Cancer Study Group. JAMA. (1996);276(24):1957–1963.
13. Onica, kundu, srivastava. Selenium nanoparticles may act like antimicrobial agents.THE HINDU. (2019).
14. Bahig Ei-Deeb, Abdullah Al-Talhi,Nasser Mosatafa,Rawan Abou-assy. Biological synthesis and structural characterization of Selenium Nanoparticles and Assessment of Their Antimicrobial Properties. American Scientific Research Journal for Engineering, Technology and Sciences (ASRJETS) (2018)vol 45, No 1,pp 135-170.
15. Stan Laura-Melinda, The Necessity to Exploit the Economic Network's Synergistic Potential, LAP LAMBERT Academic Publishing, Saarbrücken, Germany, (2011), p. 6
16. Sheng-YiZhang, Juan Zhang, Hong-YanWang, Hong-YuanChen. "Synthesis of selenium nanoparticles in the presence of polysaccharides". (2004). 58, Issue 21:2590-2594
17. M.Gopal reddy, M.N.Reddy, D.V.R.Saigopal, K.V. Mallaiah. Laboratory experiments in Microbiology. Book, Himalaya Publishing House. (2005).

Experimental Work on the Flexural Behaviour of Infilled Composite Concrete Beams

[1] S.M.Leela Bharathi, [2] R.Mano Karthick, [3] R.Sathish Kumar, [4] U.Ajay Kumar, [5] A.Srithar

[1] Assistant Professor, [2][3][4][5] UG student

[1][2][3][4][5] Department of Civil Engineering, Karpagam Academy of Higher Education, Coimbatore, Tamil Nadu, India

Abstract:

Recent researchers of civil engineering mainly focus in the field on replacement of concrete by the help of light weight materials in order to achieve the light weight concrete structures with improved strength and durability simultaneously. In the design part of conventional Reinforced Cement Concrete (RCC) beams as per IS 456-2000, the concrete is used to take care of compression alone not tension. The tensile stresses developed on the beam are purely carried out by reinforcement. Hence the fibres which are subjected to only tensile stresses require some infill material to hold the reinforcement along with the beam but not for the purpose of load carrying since the centre of gravity (CG) of the tensile force is acting at the centre of main reinforcement. In this experimental work an attempt is made to partially replace the concrete present in the tension fibres of normal Reinforced Cement Concrete beams with the help of brick masonry and the bending behavior of such light weight materials Infilled Composite concrete Beams (ICB) is studied by comparing the performance of normal RCC beams. From the test results it is noted that the ICB beams having the maximum deflection of 16.67 mm under the moment of 2.3 kNm which is 2.3 % lesser than the normal RCC beam. By comparing the rate analysis it is noted that the total amount of ICB beams are 11% lesser than the normal RCC beams.

Key words:

Tensile stress, light weight concrete structures, Infilled Composite concrete Beam, Reinforced Cement Concrete beams, tension fibres, Centre of Gravity

1. INTRODUCTION

Based on the results from the previous research work conducted by many researchers [4] it is to be noted that the strength of an infilled beam was about 80% of the conventional reinforced concrete beams. And it was observed that 30% saving in the materials in the economical aspect. The main objective of this project work is to study the behaviour of brick light weight material infilled composite concrete (ICB beams) beam experimentally by comparing the flexural behaviour of infill beam with normal Reinforced Concrete beams (RCC beams).

2. MATERIALS AND METHODS

a) CEMENT

300 gm of cement is taken. Initially a trial percentage of water (p) is added with cement to make cement paste. This paste is filled in the mould of Vicat apparatus. The surface is made smooth and level. The plunger in the Vicat apparatus is released on the cement paste sample and the scale reading is noted down. As explained in the Table 1 calculation is done and it is found that the standard consistency of the cement is 33%. By using this standard consistency percentage the Initial and Final setting time of cement has been calculated from the same Vicat apparatus.

Figure 1 Standard consistency of cement

Observation:

Cement Used = OPC 53
Weight of sample taken = 300gm
% of water added = 0.85 % of p
Standard Consistency = 33 %
The final setting time of cement = 540 min

Table 1 Standard Consistency of cement

Sl No	Weight W1 (Kg)	Weight W2 (Kg)	Water absorption in %
1	3.680	4.005	8.83

 ISBN: 978-93-89107-36-4

B) AGGREGATES

As per IS 2720 (part 1–sec2): 1980 a sample of about 1 kg for 10 mm to 4.75 mm or 500g if finer than 4.75 mm is taken. From the Sieve analysis experiment as shown in the Figure 2a it is noted that the specific gravity of fine aggregate is 1.98. The specific gravity of fine aggregate noted is 1.98. Similarly for Coarse Aggregate (CA) it is calculated as 1.34. The Sieve analysis of Fine aggregate (FA) has been done and from the test the particle size distribution curve has been drawn as mentioned in Figure.2b.

Figure 2a Sieve Analysis of FA

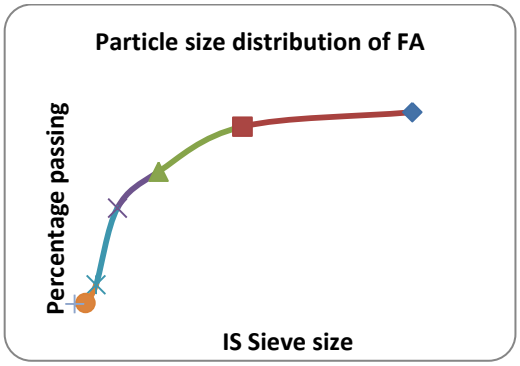


Figure 2b Sieve Analysis of FA

C) BRICK

Five bricks are taken for testing and the bricks are put in an oven at a temperature of 105^0C for drying.) Bricks are weighed in a digital weighing machine and it is record as W_1. The bricks are kept in water for 24 hours as shown in the Figure 3. Then they are taken out of water and wiped with a damp cloth for 3 minutes.

Figure 3 Water Absorption of Bricks

The bricks are weight again and recorded as W_2. From the observation as shown in the Table 2, the percentage of water absorbed by the brick = 8.83

Table 2 Water Absorption of Bricks

Wt of sample in (g)	% of water add	Quantity of water taken (ml)	Depth of penetration of plunger (mm)	
			Top	Bot
300	25	75	22	28
	27	81	17	33
	29	87	21	29
	31	93	37	13
	33	101	43	7

3. DESIGN OF BEAM

From IS 10262-2009, the mix design of M40 grade concrete has been done and the mix ratio calculated as 1:1.8:1.6 using 0.4 water cement ratio. The beam is designed as a singly reinforced beam as per IS 456-2000. The detailing of the beam is shown in Figure 4.

- Effective depth (d)

  = Total depth -clear cover –dia of stirrups –half the dia. of main bar

  = 150-25-8-(10/2)

  = 112 mm
- Depth below NA (from the centre of main bar)

  d-xu = 112-40

  = 72 mm

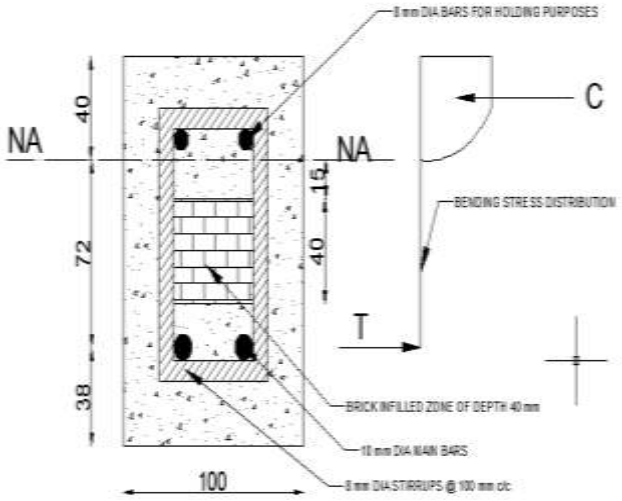


Figure 4 Detailing of ICB beams
(All dimensions are in mm)

As per IS 456 the depth of concrete in the tension zone (below the NA in this case) is only for holding the reinforcement since the concrete tensile strength is neglected. Hence in the 72 mm concrete depth (below NA) some portions are infilled with light weight brick materials

 ISBN: 978-93-89107-36-4

and the change in bending effect has been studied experimentally. Depth of Infilled zone = 40 mm (@ 15 mm from NA)

4. RESULTS AND DISCUSSIONS

After 28 days curing the beams are white washed and prepared for flexural test. The beams are marked at the one third of span for load application and at each 1 cm interval the beams are marked to identify the cracks.

Figure 5 Bending test on Beam

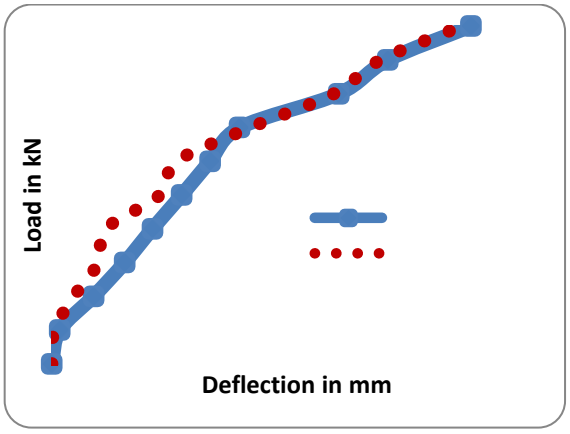


Figure 6 Bending test comparison between RCC and ICB

The spacing of the beams has been arranged and the deflectometers are fixed at the one third of the span and middle portion. The loading plate is arranged in such a way that the two point loads are applied at the spacing of L/3 distance of the span as shown in the Figure 5. A load measuring dial gauge has been placed under the hydraulic jack. The least count of the deflectometer is 0.01mm. The load is applied and for each 1 kN application of load the corresponding deflection has been noted down. By comparing the results of RCC and ICB beams (as shown in Table 3) it is clear that the behaviour of both beams is not significantly varied. The ICB beam behaved almost like RCC beam and in the failure load of 10 kN ICB beam has the maximum deflection of 16.7 mm which is 2.3% lesser than normal RCC beams.

Table 3 Bending test results

Beam	Maximum Load in kN	Maximum Deflection in mm			Max. Moment in kNm
		Right	Middle	Left	
RCC	10	16.2	17.1	16.1	2.3
ICB	10	11.1	16.7	12.2	2.3

5. CONCLUSION

By replacing the concrete by using brick as an infilled material below the neutral axis (40 mm), the flexural behaviour of ICB has been studied by comparing the bending behaviour of normal RCC beam. From the test results it is noted that the ICB beams having the maximum deflection of 16.67 mm under the maximum moment of 2.3 kNm which is 2.3 % lesser than the normal RCC beam and the behaviour of both RCC and ICB beams are almost similar. By comparing the rate analysis it is clear that the total amount of ICB beams are 11% lesser than the normal RCC beams..

REFERENCE

1. S.k. Dudey , Rakesh Patel , K.K. Pathak, Analysis of infilled Beams Using Method Of Initial Functions And Comparision With FEM, International Journal 17, pp.158-164, (2014)
2. P.M. Pradhan, P.L. Pradhan, R.K.Maskey, A Review On Partial Infilled Frames Under Lateral Load, Journal of Science, Engineering and Technology, Vol. 8, No.1, pp-142-152.(2012)
3. Ning, Dehu Yu, Chunwei Zhang, Shan Jiang Pushover Analysis On Infill Effects On The Faiure Pattern Of Reinforced Concrete Frames, Applied Science, Vol no. 7, Pg no 428, (2017)
4. Rakesh Patel, S.K. Dubey, K.K. Pathak, Infilled reinforced concrete beams for sustainable construction, J. Civil Eng. Architect, 7 (11) pp.1369-1374, (2013)
5. Rakesh Patel, S.K. Dubey, K.K. Pathak, Analysis of RC brick filled composite beams using MIF, Procedia Eng. 51, (2013)
6. Rakesh Patel, S.K. Dubey, K.K. Pathak, Effect of elastic properties on the behaviour of beams, Int. J. Struct. Eng. 5 (1) (2014)
7. IS: 456, Plain and Reinforced Concrete Code of Practice, (2000)
8. IS:10262, Mix design of plain cement concrete, (2009)

CAT Swarm Optimization Based Solid State Faultcurrent Limiter in Distribution System

[1] M.Manisha, [2] V Rithi Andal Pooja, [3] Mrs.B.Noorul Hamitha

[1][2] UG student, [3] Assistant Professor,

[1][2][3] Electrical and Electronics Engineering, Kamaraj Colloge of Engineering and Technology, Chittoor, Tamil Nadu, India

Abstract:

This project proposes a modified bridge type flux-coupling non-superconducting fault current limiter (BSFC-NSFCL) for suppressing the fault current. A flux-coupling reactor and a bidirectional bridge switch are combined to perform the functions of steady-state line current sharing and fault current suppression. The proposed system is addressing a new and modern optimization tool such as cat swarm optimization (CSO) algorithm. It is generated by observing the behaviors of cats, and composed of two sub-models, i.e., tracing mode and seeking mode, which model upon the behaviors of cats. The modified CSO based BSFC-NSFCL mainly utilizes the magnetic flux cancellation effect to make the limiter behave as a short circuit on the circuit during normal operation. Hence, there is almost no impact on the power system when the limiter is used. When a fault event occurs, the bridge switch turns off immediately, and then the magnetic flux cancellation effect disappears. Thus, the impedance of primary coil inserts into the circuit to restrict the fault current phenomena. Once the fault is removed, the bridge switch turns on again, and the BSFC-NSFCL recovers to the normal operation.

1. INTRODUCTION

In today circumstances ,rapid development of power network cause the fault current of the system increased greatly. The levels of fault current in many places have often exceeded the withstand capacity of existing power system equipment. As implication to this matter; security, stability ,and reliability of power system will be negatively affected. Thus, limiting the fault current of the power system to a safe level can greatly reduce the risk of failure to the power system equipment due to high fault current flowing through the system. Because of that, there is no surprise to fault current limiting technology has become a hotspot of fault protection research since this technology can limit the fault curren to alow level. In power system design view, limiting the fault current to alow level can reduce the design capacity of some electrical equipment in the power system. This will lead to the reduction to the investment cost for high capacity circuitbreakers and construction of new transmission line. Consequently, from both technical and economical points of view, fault current limiting technology for reducing short circuit current is needed.

2. FAULT CURRENT LIMITER

$$P_{loss} = R_p i_{Lp,\mathrm{rms}}^2 + R_s i_{Ls,\mathrm{rms}}^2 + \frac{2I_{Ls,\mathrm{peak}}}{\pi}(V_{sw} + 2V_{DF}). \qquad (1)$$

Where *iLp*,rms and *iLs*,rms are the rms values of the flux-coupling reactor's primary and secondary steady-state currents, respectively, *iLs*,peak is the maximum value of the flux-couplingreactor's secondary steady-state current, *RP* and *RS* are given.

$$\alpha = \frac{3 \times P_{loss}}{3 \times P_{load}} = \frac{R_p i_{Lp,\mathrm{rms}}^2 + R_s i_{Ls,\mathrm{rms}}^2 + \frac{2i_{Ls,\mathrm{peak}}}{\pi}(V_{sw} + 2V_{DF})}{i_{line,\mathrm{rms}}^2 \times R_{load}}, \qquad (2)$$

The operation principle of the BSFC-NSFCL can be divided into two states, depicted as follows.

1) Normal state:

During this state, the line current separately flows through the primary and secondary windings of the flux-coupling reactor. The circuit diagram of this state is demonstrated as Figs. 3(a) and 3(b), respectively. During this state, the IGBT turns on, and the diode strings D1 and D4 and D2 and D3 conduct, alternatively. Therefore, the bridge switch allows the secondary current to flow through the secondary winding of the flux-coupling reactor bi-directionally. Since the primary and secondary coils of the BSFC-NSFCL are wound in an opposite and concentric arrangement, it is magnetically coupled in this state, and the fluxes resulted from the primary and secondary coils counteract each other. Thus, the voltage across the flux-coupling reactor is nearly zero. The turns of the flux-coupling reactor's primary side is less than its secondary side so that it can ensure that less line current flows through the bridge switch. The turn's ratio Np/Ns is 1/n, where Np and Ns are the number of turns in the flux-coupling reactor's primary and secondary coils, respectively. This design purpose is mainly to achieve the current sharing function so that the power loss of the bridge switch can be reduced. Moreover, if the bridge switch fails, the flux-coupling reactor will still remain in the circuit and acts as a reactor. As long as the impedance of the flux-coupling reactor's primary coil is designed to be capable to limit the fault current to the expected value and to make the load

voltage maintain an acceptable level, there is almost no reliability issue for installing the BSFC-NSFCL in the distribution power network. During this state, the voltage across the BSFC-NSFCL is small enough to be negligible, so there is almost no influence on the circuit when the BSFC-NSFCL is installed.

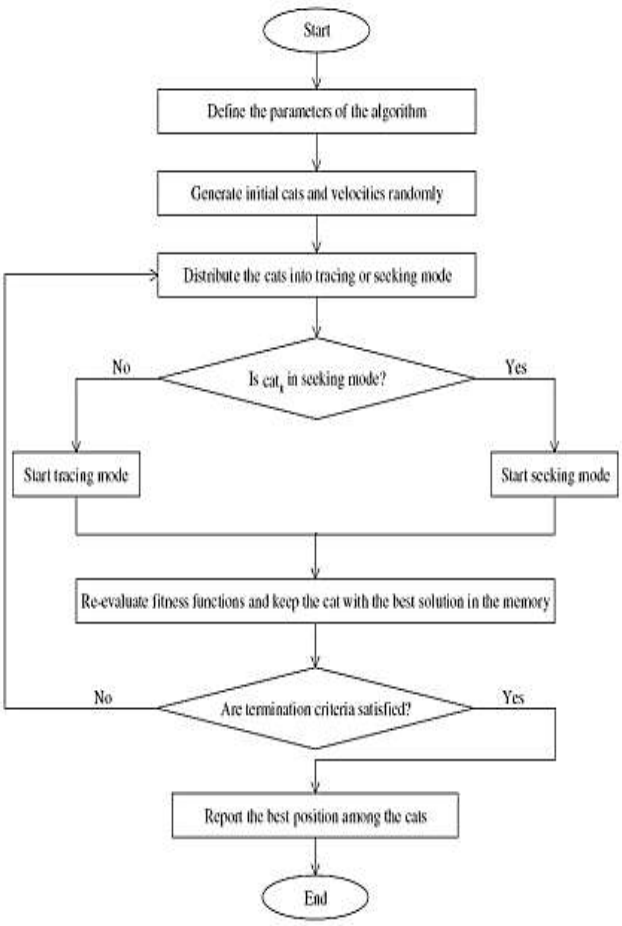
2) Fault state

When a fault event occurs at the downstream of the BSFC-NSFCL, the current detection and control circuit detects the fault current and then turns off the bridge switch. The secondary side of the flux-coupling reactor is open-circuited, and the fault current will totally flow through the primary side of the flux-coupling reactor. Since the primary inductance of the flux-coupling reactor can restrain the fault current to the expected fault current value. After the fault is cleared, the BSFC-NSFCL will fast recover to the normal state and be ready for the next short-circuit fault occurrence.

3. NATURAL PROCESS OF THE CAT SWARM OPTIMIZATION ALGORITHM

Despite spending most of their time in resting, cats have high alertness and curiosity about their surroundings and moving objects in their environment. This behavior helps cats in finding preys and hunting them down. Compared to the time dedicated to their resting, they spend too little time on chasing preys to conserve their energy.

Inspired by this hunting pattern, Chu and Tsai (2007) developed CSO with two modes: “seeking mode” for when cats are resting and “tracing mode” for when they are chasing their prey. In CSO, a population of cats are created and randomly distributed in the M-dimensional solution space, with each cat representing a solution. This population is divided into two subgroups. The cats in the first subgroup are resting and keeping an eye on their surroundings (i.e., seeking mode), while the cats in the second subgroup start moving around and chasing their preys (i.e., tracing mode). The mixture of these two modes helps CSO to move toward the global solution in the M-dimensional solution space. Since the cats spend too little time in the tracing mode, the number of the cats in the tracing subgroup should be small. This number is defined by using the mixture ratio (MR) which has a small value. After sorting the cats into these two modes, new positions and fitness functions will be available, from which the cat with the best solution will be saved in the memory. These steps are repeated until the stopping criteria are satisfied.



4. SEEKING MODE (RESTING)

During this mode the cat is resting while keeping an eye on its environment. In case of sensing a prey or danger, the cat decides its next move. If the cat decides to move, it does that slowly and cautiously. Just like while resting, in the seeking mode the cat observes into the M-dimensional solution space in order to decide its next move. In this situation, the cat is aware of its own situation, its environment, and the choices it can make for its movement. These are represented in the CSO algorithm by using four parameters: seeking memory pool (SMP), seeking range of the selected dimension (SRD), counts of dimension to change (CDC), and self-position consideration (SPC). SMP is the number of the copies made of each cat in the seeking process. SRD is the maximum difference between the new and old values in the dimension selected for mutation. CDC tells how many dimensions will be mutated. All these parameters define the seeking process of the algorithm. SPC is the Boolean variable which indicates the current position of the cat as a candidate position for movement. SPC cannot affect the value of SMP

$$X_{cn} = (1 \pm \text{SRD} \times R) \times X_c$$

in which

X_c - current position;

X_{cn} - new position; and

R - a random number, which varies between 0 and 1.

$$P_i = \frac{|FS_i - FS_b|}{|FS_{\max} - FS_{\min}|}, \quad \text{where } 0 < i < j$$

Where,

P_i probability of current candidate cati;

FS_i fitness value of the cati;

FS_{max} maximum value of fitness function;

FS_{min} minimum value of fitness function; and

$FS_b = FS_{max}$ for minimization problems and

$FS_b = FS_{min}$ for maximization problems.

5. TRACING MODE (MOVEMENT)

The tracing mode simulates the cat chasing a prey. After finding a prey while resting (seeking mode), the cat decides its movement speed and direction based on the prey's position and speed. In CSO, the velocity of cat k in dimension d is given by

$$v_{k,d} = v_{k,d} + r_1 \times c_1(X_{\text{best},d} - X_{k,d})$$

$$X_{k,d,\text{new}} = X_{k,d,\text{old}} + v_{k,d}$$

in which

$X_{k,d,new}$ new position of cat k in dimension d; and

$X_{k,d,old}$ current position of cat k in dimension d.

6. SIMULINK RESULTS

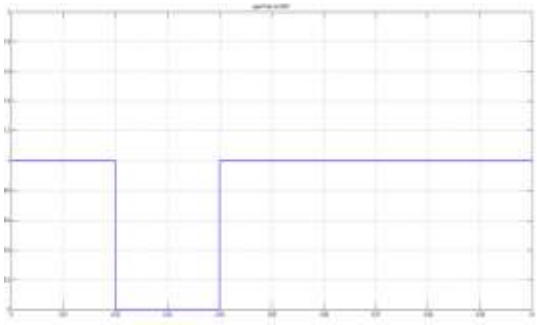


Figure 5.8 generated gate Pulse for IGBT

The Gate pulse generated for the IGBTs in the BSFC-NSFCL is shown in the following figure. The Plot represents that the L-G fault is injected between the time intervals 0.002 to 0.004s. T. The injected 3L-L fault current and voltage are measured with the help V-I measurement block and the corresponding waveforms are shown in the following figure 4.6

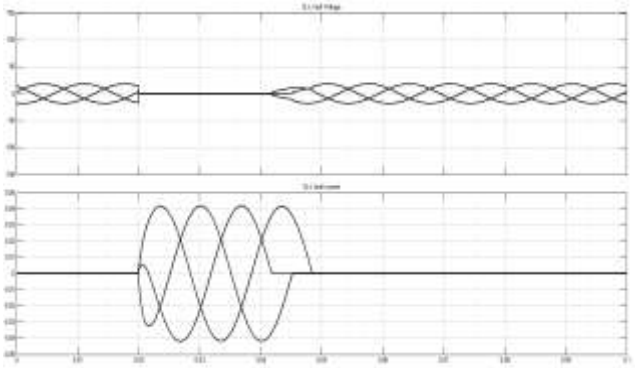


Figure 5.9 3L-L fault voltage and current

The fault current limitation is analyzed on both load side and source side and with and without BSFC-NSFCL block. The current waveforms in the source side with fault on two cases are with and without BSFC-NSFCL is represents in the following figures 4.7 and 4.8 respectively.

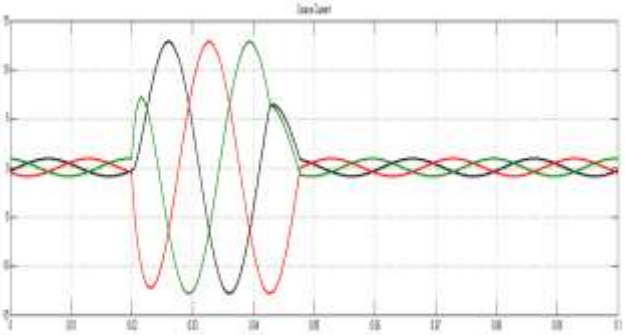


Figure 5.10 Source side current with Fault & without BSFC-NSFCL

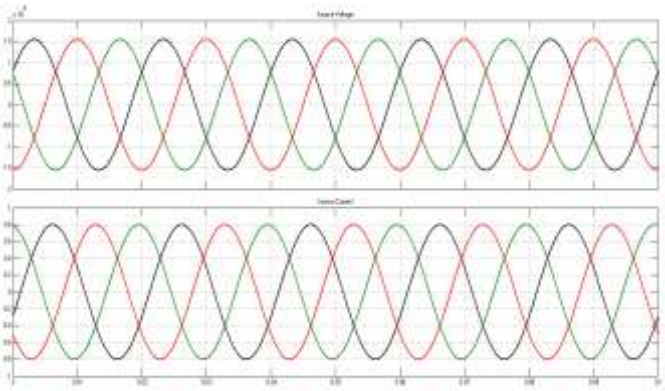


Figure 5.11 Source side voltage & current with Fault &BSFC-NSFCL block

The above waveforms demonstrates the importance of BSFC-NSFCL on the power system very clearly. The source current and voltage are still stable during the fault occurrence time period [0.002 to 0.004s]. By this way the BSFC-NSFCL supports the source side stability at critical scenarios.

The voltage and current waveforms on the load side with fault on two cases ie. with and without BSFC-NSFCL is represents in the following figures 4.9 and 4.10 respectively.

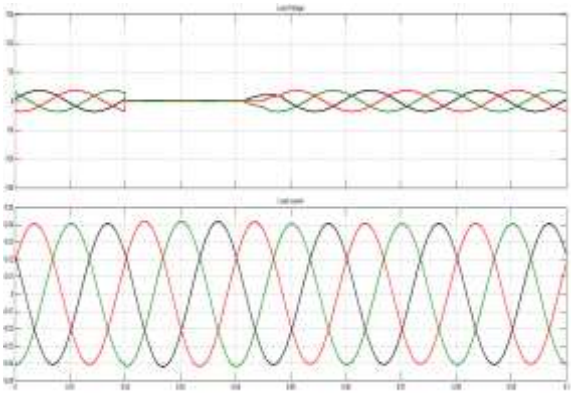


Figure 5.13 Load voltage & current with Fault &BSFC-NSFCL block

The above waveforms demonstrates the importance of BSFC-NSFCL on the power system very clearly. The source current and voltage are still stable during the fault occurrence time period [0.002 to 0.004s]. By this way the BSFC-NSFCL supports the source side stability at critical scenarios.

7. CONCLUSION

In this work, a flux-coupling reactor and a bidirectional bridge switch are combined to perform the functions of steady-state line current sharing and fault current suppression. The proposed system is addressing a new and modern optimization tool such as cat swarm optimization (CSO) algorithm. It is generated by observing the behaviors of cats, and composed of two sub-models, i.e., tracing mode and seeking mode, which model upon the behaviors of cats. The modified CSO based BSFC-NSFCL mainly utilizes the magnetic flux cancellation effect to make the limiter behave as a short circuit on the circuit during normal operation. Hence, there is almost no impact on the power system when the limiter is used.

REFERENCE

1. Abapou .M and Hagh M.T, "Nonsuperconducting fault current limiter with controlling the magnitudes of fault currents," IEEE Trans. Power Electron., vol. 24, no. 3, pp. 613–619, Mar. 2009.
2. Jafar. M, Naderi S.B, Tarafdar Hag.M, Abapour.M, and Hossein S.H "Voltage sag compensation of point of common coupling (PCC) using fault current Limiter," IEEE Trans. Power Del., vol. 26, no. 4, pp. 2638–2646, Oct. 2011.
3. Kalsi.S, Applications of High Temperature Superconductors to Electric Power Equipment, New York: Wiley-IEEE Press, 2011, pp. 173–217.
4. Nazari-Heris.M, Nourmohamadi.H, Abapour .M and Sabahi .M "Multilevel nonsuperconducting fault current limiter: analysis and practical feasibility," IEEE Trans. Power Electorn., vol. 32, no. 8, pp. 6059–6068, Aug. 2017.
5. Quaia.S and Tosato.F, "Reducing voltage sags through fault current limitation," IEEE Trans. Power Del., vol. 16, no. 1, pp. 12–17, Jan. 2001.
6. Radmanesh,.H Fathi, S,H and GharehpetianG.B, "Bridge-type solid-state fault current limiter based on AC/DC reactor," IEEE Trans. Power Del., vol. 31, no. 1, pp. 200–209, Feb. 2016.

Continuous Abstractive Recall-Oriented Understudy for Gisting Evaluation

[1] Nithyashree M, [2] Dr. Sukumar T, [3] S. Kalavathi, [4] K. Kamal Kumar

[1][2][3] Sri Venkateswara College of Engineering, Sriperumbudur, Tamil Nadu, India
[4] Assistant System Engineer, TCS
[1] nithyamanohar18@gmail.com, [2] sukumart@svce.ac.in, [3] kalavathi@svce.ac.in, [4] roshkamal1204@gmail.com

Abstract:

Summarization of scientific papers is a unique way of text summarization which allows us to use abstracts as human created labels for our dataset as they are written by the authors. This enables us to train our models using the collected data. In this work, we overview different approaches to text summarization and compare their results with different evaluation metrics. We demonstrate the downsides of ROUGE, the most commonly used summarization metric and introduce our own metric called CAROUGE, which gives more accurate scores for abstractive summaries. We also present our new dataset of 2000 scientific papers collected from arXiv. All experiments, described in this paper are performed on the data from our dataset, except for the final stage of our project where we involve 5 human judges to do a manual summarization of several papers from the dataset.

Keywords:

Scientific text summarization, ROUGE, seq2seq, NLP, word embeddings

1. INTRODUCTION

Automatic text summarization is the process of creating brief and precise content while preserving the actual meaning [1].

A. Extractive vs Abstract summarization

Extractive text summarization identifies and extracts important words, phrases, or sentences from a document and clusters them as a summary. The summary thus produced is a subset of the words from original summary [5]. Most work in the field of text summarization has been done around extractive summarization. Generally, it produces better results in terms of the amount of information preserved in a short summary.

Abstractive text summarization allows us to write summaries that are similar to summaries written by human. Generally speaking, abstractive models perform worse than extractive ones. They are hard to train and often deviate too much from the original text. And since they try to describe the meaning of a text using different words, they don't preserve much information [19]. Nevertheless, abstractive summarization is closer to what humans do when they write text summaries. Hence it is one of the promising AI topics.

B. Scientific text summarization

The problem of summarizing scientific texts is very different from general-purpose text summarization. Every scientific paper starts with an abstract, which is the summary of a document created by its human-author. This allows us to create a human-labeled dataset of scientific papers just by separating abstracts from the text body.

2. RELATED WORK

Das et al. made a survey of the most successful text summarization techniques as of the year 2007 [2]. Similar survey was made 10 years later by Allahyari et al [1].

ROUGE - the most widely used metric for text summarization was presented by Chin-Yew Lin in July 2004 [7]. The metric developed by us is greatly influenced by the work of is author. Great overview of existing evaluation metrics was also done in [2] and [1].

Fedus, Goodfellow, and Dai [3] wrote an amazing paper about their application of generative adversarial networks to the problem of filling the gaps in text. However, as we show in section IV, this approach cannot be easily applied to our problem.

3. DATA COLLECTION AND PREPARATION

Through the open policy of arXiv we were able to collect our own dataset of scientific papers from stat.ML category.

Structure of the data

Each paper on arXiv has a unique identifier (for example: 1801.01587). It can be used to extract any data that is available and relevant to that paper, including its metadata and full text as a PDF.

Our dataset contains 2000 documents (papers). Each one of them is represented by a row with the following properties:

1. arXiv's unique identifier
2. title
3. abstract datasets

 ISBN: 978-93-89107-36-4

4. body of the paper

For our problem a set of 2000 papers from one category is enough [15]. For example, DUC (Document Understanding Conference) dataset which is among the most commonly used datasets in the field of text summarization has 30 sets with approximately 10 documents each.

Cleaning the text

We collected our data as PDF files and parsed them to extract the raw text. This produced a huge amount of uninterruptable UTF-8 characters from mathematical expressions after removing those extra characters. We wanted to remove everything that is not known English word, but that would filter out words like "GAN", "backprop" etc. as most standard corpora of words such as nltk.corpus, doesn't include specialized scientific terminology. So, we filtered the words using manually created rules based on features like word length and frequency of vowels[18]. This leaves some noise behind, but it will not affect our models.

4. MODELS FOR TEXT SUMMARIZATION

Three main classes of models that are used for text summarization tasks include statistical frequency computation models (TFIDF etc.), graph methods (TextRank, LexRank etc.) and machine learning approach.

A. Statistical methods

These methods are based on the assumption that the importance of a word or sentence in a text depends on the total number of times it appears in the document. This means that this classical approach ignores context and lexical features of the text. Furthermore, they are able to perform only extractive summarization.

B. Graph models

We can build a graph of each document where words or sentences are nodes and the edges are the connections between each pair of nodes. The weights on these edges represent the similarity between words or sentences in the whole text [17]. While proving to have better results than simple frequency-based methods, graph models are still bounded by the absence of lexical understanding and ability to perform extractive summary only.

C. Machine learning approach

In the last years, lots of attention was focused on learning how to apply neural networks to NLP tasks, including text summarization. Using encoder-decoder models it is now possible to produce abstract summaries. In [10] the off-the-shelf attentional encoder-decoder RNN that was originally developed for machine translation was applied to summarization and out-performed state-of-the-art systems on two different English corpora. However, there is not much information about neural networks usage in scientific text summarization [14].

Generative adversarial networks (GAN) are another promising approach for text summarization. Until recent years they were considered in applicable to the discrete problems of natural language processing (NLP). The latest papers introduce novel approaches to overcoming these issues by combining GANs with reinforcement learning. Applying generative adversarial networks to the problems of NLP is considered to be a complicated task because GANs are only defined for continuous data, and all NLP is based on discrete values like words, characters, or bytes. However, in their latest paper Fedus, Goodfellow, and Dai [3] overcome this problem by using reinforcement learning to train the generator while the discriminator is still trained via maximum likelihood and stochastic gradient descent, and use it to fill the gaps in the text. This is an amazing result that can become an inspiration for others to develop GAN-based solutions for the problems of text summarization [16]. Nevertheless, summarization is way more complex than the problem of filling the gaps, and therefore, to our knowledge, there are no successful examples of applying adversarial networks to problems similar to ours. We ourselves have tried this new approach, but failed to produce good results.

5. EVALUATION METRICS

Evaluating a summary is a difficult task because there is no such thing as a single summary that would be ideal for a given document. In most cases even human evaluators cannot decide which of the given summaries is better [2]. Unlike other NLP problems, such as translation or parsing, when it comes to text summarization, we cannot clearly define what makes a summary good or bad. Therefore, we must make assumptions about the space of good summaries.

1. Assume that a good summary would be close to some ideal summary manually created by humans.
2. Assume that the goodness of summary can be measured as the amount of important information it contains (this assumption can be inferred from the definition of text summarization).

In the following sections we describe one commonly used summarization metric that is based on the first assumption and propose our own metric that is based on second one (we will show that the proposed metric can be formulated in a different way to work with the first assumption).

A. ROUGE

The most widely used score for evaluating text summarizations is ROUGE (Recall-Oriented Understudy for Gisting Evaluation) introduced by Chin-Yew Linin 2004[7].

$$ROUGE-N(s)=\frac{\sum r\in R\Phi n(r),\Phi n(s)}{\sum r\in R\Phi n(r),\Phi n(r)}\text{----------(1)}$$

Here Φn(d) is a binary vector representing the n-grams contained in document d, s is the generated summary and r is the human-created summary. In simple terms, ROUGE-N is a fraction q/k, where q is the number of n-grams that are present in both *s* and *r*, and *k* is the total number of *n*-grams in *r*.

ROUGE works well for extractive text summarization. But if we need to evaluate the generated summary which contain different words from the ones that occurred in paper, the score will always be small because, even though the new words can be close to the expected ones, two summaries don't overlap in terms of word equality.

For example, if the human-created summary is *"The great paper"* and our model produces *"A wonderful article"*, ROUGE score will be 0, even though the summary is perfect.

B. CAROUGE

We propose a metric that uses word embeddings to evaluate summaries based on their semantic distance to the space of good summaries. Our assumption is that a good summary of a document contains words that are semantically close to the most important words or n-grams in that document [20].

Let s be the generated summary. If |s| is the number of words in summary s, then m = |s|−n +1 is the number of n-grams in this summary. Let s1, s2,...,s_m be all n-grams of summary s and let c1,c2,. . .,ck be the k most important n-grams in the document. As we will show in section 5.2.1, there are many ways of measuring the importance of n grams in a document. The definition of n-gram importance is closely related to the two base assumptions that were mentioned at the beginning of section 5. The metric we propose is in fact a continuous version of ROUGE-N[13]. Instead of testing the equality of n-grams in the compared summaries we use the continuous measure of semantic distance between those n-grams.

For each *n*-gram in the generated summary we calculate the embedding-based score as its distance to the closest important *n*-gram in the document.

$$CAROUGE-N(s_i)=\frac{1-min_j\|s_i-c_j\|}{k}\text{----------(2)}$$

Now we define the score of the whole summary as the average score of its words

$$CAROUGE-N(s)=\frac{\frac{1}{n}\sum_{i=1}^{n}1-min_j\left\|s_j-c_j\right\|}{k}\text{----------(3)}$$

Measuring word importance

Deciding which words or sentences are important in a piece of text is part of the extractive summarization problem. There- fore, one way to choose *k* important words would be to use part of a simple extractive model. For example, we could use tf-idf (term frequency-inverse document frequency) which would assign the highest scores to the words (*n*-grams) which are very frequent in the given document and very infrequent in other documents.

Another way of choosing important words would be to follow the assumption of ROUGE, according to which a good summary should be as close as possible to the human-created summaries. This means that we will compare generated summaries to the corresponding paper abstract (which are in fact author-created summaries).

Using the same example as in the section 5.1 we can see that CAROUGE score of a decent abstractive summary will be greater than 0.

r = "The great paper"
s = "A wonderful article"
ROUGE(*s*) = 0
CAROUGE(*s*) = 0.8956

6. EXPERIMENTS AND RESULTS

We have tried different methods of text summarization, both extractive (TextRank, RAKE) and abstractive (Seq2Seq, Seq- GAN).

A. RAKE

Rapid Automatic Keyword Extraction algorithm (RAKE) [11] is a keyword extraction algorithm which tries to determine key phrases in a body of text by analyzing the frequency of word appearance and its co-occurrence with other words in the text. Its main advantages include time efficiency, operating on individual documents. It can be easily applied to new domains and multiple types of documents. RAKE is very sensitive to unclean data, as it relies on word frequency.

Table. 1. Example of an abstract generated

Title	The Multivariate Generalized von Mises distribution: Inference and applications
Real abstract	Previously proposed multivariate circular distributions are shown to be special cases of this construction. Second, we introduce a new probabilistic model for circular regression which was inspired from Gaussian Processes, and a method for probabilistic principal component analysis with circular hidden variables
Generated abstract	many data modelling problems since higher order generalized von mises distributions model circular variables using distributional assumptions probabilistic principal component analysis ppca proposed resulting distribution inherits desirable characteristics paper makes three technical contributions multivariate generalized

 ISBN: 978-93-89107-36-4

B. TextRank

In this research we used a basic model TextRank as a baseline for comparison. This is a graph method, influenced by Page Rank algorithm which represents the documents as a connected graph [9]. We trained TextRank separately for each body of the paper and produced an extractive abstract-length summary. Scores were calculated on the basis of ROUGE score [20]. Unlike RAKE which operates n-grams, TextRank generates summaries using whole sentences. For that reason, the generated summaries are more readable.

C. Seq2Seq

We have used deep LSTM seq2seq model with attention for a task of text summarization. Seq2seq have proven to provide state-of-art result in tasks of sequence generation. At this point it is tough to produce an abstract from the text of a paper, so we started with a simpler task of generating a title from the text of an abstract as input model takes paper abstract converted to the vectorized representation using word embeddings. The input sequence is limited by 600 words. All abstracts that is bigger than limit is omitted. All smaller abstracts are padded with SOS word that represents the end of a sequence. Model outputs sequence derived from the probability distribution. Each output word samples from this distribution having input sequence and previously generated samples. Output sequence is limited by 30 words. First SOS word represents the end of a generated summary.

After some training our model was able to generate meaningful titles for most abstracts. Take a look at this example:

Abstract this is great popcorn and i too have the whirly pop. the unk packs work wonderfully. i have not found it too salty or the packages leak. i have found the recent price of $35 too expensive and have purchased direct from great american for half the price.

Table 2. Example of an abstract generated by TextRank

Title	Churn Prediction in Mobile Social Games: Towards a Complete Assessment Using Survival Ensembles
Real abstract	for each player, we predict the probability of churning as function of time, which permits to distinguish various levels of loyalty profiles ... Our results show that churn prediction by survival ensembles significantly improves the accuracy and robustness of traditional analyses, like Cox regression
Generated abstract	Conditional inference survival ensembles are constructed based on unbiased trees avoiding this problem the resulting prediction of this model contains for each player a survival function indicating the probability of churn as a function of time since the registration in the game.

Predicted summary great popcorn!!
Actual summary great unk american popcorn

7. EVALUATING RESULTS

In the table below you can see the results of our experiments represented by mean scores of several models that were used to generate abstracts for same 2000 papers from our dataset given their text bodies.

Table 3. Evaluating summarization algorithms

Model	ROUGE-1	ROUGE-2	CAROUGE-1
RAKE	0.08	0.02	0.82
TextRank	0.18	0.04	0.89

We have also involved some human mediators and asked them to come up with titles for 5 papers from our dataset, given their abstracts.

Table. 4. Evaluating human judges

Model	ROUGE-1	ROUGE-2	CAROUGE-1
Human	0.77	0.43	0.98

CONCLUSIONS

We have discussed different approaches to scientific text summarization and evaluated them with both ROUGE and CAROUGE (Continuous Abstractive ROUGE) - a new metric proposed by us that uses word embeddings to produce more accurate scores of abstractive summaries.

As we have seen in section 7, both ROUGE and CAROUGE metrics give very high scores to human-created summaries, and much lower scores for the summaries produced by algorithms. However, considering the fact that ROUGE assumes human-judgement to be perfect, the score of 0.77 is way too low. As we explained in section 5.1, this happens because human judgement is abstractive by its nature, and ROUGE score words best on extractive summaries. This problem is fixed by our metric, which gives the score of 0.98 on the same data.

ACKNOWLEDGEMENTS

We would like to express our gratitude to Ms.K.Girthana and Mr.S.Swamynathan for helping us with their valuable pieces of advice. Also, we are very grateful to Ms.M.Sujatha, Ms.Shreenidhi M, Mr.Babu Manohar, Mr.Sanjay Kumar and Mr.Roshan K for providing their manually created summaries for some papers from our dataset.

REFERENCE

1. Mehdi Allahyari, Seyedamin Pouriyeh, Mehdi Assefi, Saeid Safaei, Elizabeth D. Trippe, Juan B. Gutierrez, and Krys Kochut. Text summarization techniques: A brief survey, International Journal of Advanced

Computer Science and Applications(IJACSA), Volume 8 Issue 10, 2017.

2. Dipanjan Das and André F. T. Martins. A survey on automatic text summarization,2007.
3. William Fedus, Ian Goodfellow, and Andrew M. Dai. Maskgan: Better text generation via filling in the gaps, 2018.
4. Zhe Gan, Kai Fan, Zhi Chen, Ricardo Henao, Dinghan Shen, and Lawrence Carin. Adversarial feature matching for text generation, 2017.
5. Yogan Jaya Kumar, Ong Sing Goh, Halizah Basiron, Ngo Hea Choon, and Puspalata C Suppiah. A review on automatic text summarization approaches, 2016.
6. Yitong Li, Trevor Cohn, and Timothy Baldwin. Bibi system description: Building with cnns and breaking with deep reinforcement learning, 2017.
7. Chin-Yew Lin. Rouge: a package for automatic evaluation of summaries. July 2004.
8. Linqing Liu, Yao Lu, Min Yang, Qiang Qu, Jia Zhu, and Hongyan Li. Generative adversarial network for abstractive text summarization, 2017.
9. Rada Mihalcea and Paul Tarau. Textrank: Bringing order into text. In Proceedings of the 2004 Conference on Empirical Methods in Natural Language Processing, 2004.
10. Ramesh Nallapati, Bing Xiang, and Bowen Zhou. Sequence-to- sequence rnns for text summarization. CoRR,
11. Stuart Rose, Dave Engel, Nick Cramer, and Wendy Cowley. Automatic Keyword Extraction from Individual Documents. 03 2010.
12. S. Furui et al., "Speech-to-text and speech-to-speech summarization of spontaneous speech," IEEE Transactions on Speech and Audio Processing, 2004.
13. I. Mani and M. T. Maybury, Advances in automatic text summarization. Cambridge: MIT Press, 1999.
14. A. Nenkova and K. McKeown, "Automatic summarization," Foundations and Trends in Information Retrieval, 5 (2-3), pp. 103-233.
15. J. Zhang et al., "A Comparative study on speech summarization of broadcast news and lecture Speech," in Proc. Interspeech 2007.
16. D. Shen et al., "Document summarization using conditional random fields," in Proc. IJCAI 2007.
17. S.-H. Lin et al., "A comparative study of probabilistic ranking models for Chinese spoken document summarization," ACM Transactions on Asian Language Information Processing, 8(1), pp. 3:1-3:23, 2009.
18. S. Xie and Y. Liu, "Improving supervised learning for meeting summarization using sampling and regression," Computer Speech & Language, 24(3), pp. 495,2010.
19. S. Kumar and W. Byrne, "Minimum Bayes-risk decoding for statistical machine translation".
20. "Discriminative n-gram language modeling," Computer Speech and Language". vol 21, Issue 2, April 2007, Pages 373-392.

Structural Determination of CI Engine Fuel Additives through Dielectric Relaxation Studies

[1] Prathima A, [2] Thenappan T

[1] Guest Faculty, Sethupathy Govt Arts College,Ramanathapuram, Tamilnadu, India
[2] Professor, Alagappa University, Karaikudi, Tamilnadu, India
[1] aprathima1305@gmail.com, [2] fearlessphy2019@gmail.com

Abstract:

The objective of this paper is to investigate the molecular interaction between corrosion inhibitors and oxygenates molecules through dielectric relaxation studies. It makes one to understand the fuel additives its structure. Fuel additives is a chemical substance, added to fuel ,in concentration typically of less than 1% to impart or enchance needed properties or to overwhelm objectionable properties. They include octane enhancers, antiknock compounds and oxygenates, as well as corrosion inhibitors, detergents, and dyes. It alters the rate at which fuel burns, reduce harmful emissions, prevent premature detonation, stop corrosion, and prevent the formation of deposits in the fuel system and combustion chambers. In view of this, amine and alcohol mixtures most important one. because of amine can be used as a antioxidants,corrosion inhibitors and also be used to control the deposits in engine. Antioxidants are the molecule that inhibits the oxidation of other molecule and used as fuel additives when creating fuel blends. Alcohol can be used as oxygenates. They are used to reduce the carbon monoxide emissions creating when burning fuel.Therefore it is seemed important to examine the molecular interaction studies on those additives. Dielectric relaxation studies are of great help in the assignment of the molecular structure or configurations, particularly those of organic compounds and also helps to detect the formation and composition of complexes in them. The molecular complex formation can be investigated by studying the dielectric relaxation parameter values such as static permittivity (ε_0), Permittivity at optical frequency (ε_∞), dielectric constant at microwave frequency (ε'),dielectric loss (ε'') at microwave frequency, density (ρ) and the coefficient of viscosity (η) for the system,1-butanol in (benzene + tert.butylamine) and 1-propanol in (benzene + tert.butylamine) taken for the investigation at three different temperatures 303K, 313K and 323K are reported. Using these parameters values of most probable relaxation time (τ_0), relaxation time corresponding to group rotation (τ_1) which is otherwise known as intramolecular relaxation time, relaxation time due to overall rotation of the molecule (τ_2) and distribution of relaxation time (α) are obtained using Higasi model and the values are also reported. The hetero interaction through hydrogen bonding between the molecules of corrosion inhibitors and oxygenates have been identified by the dielectric relaxation process.

Keywords:

Multifunctional fuel additive, hetero interaction, oxygenates, corrosion inhibitor

1. INTRODUCTION

Additives are chemical agents added to oils, fuels, and coolants to impart specific beneficial properties to the finished products. It creates new fluid properties, enhance properties already present and reduce the rate at which undesirable changes take place in a fluid during service. Some additives have multi-functional properties. Multifunctional diesel additive packages are frequently more complex and may combine deposit control additive with cetane number improver, Oxygenates, antifoam additive, corrosion inhibitor, antioxidants, metal deactivators and demulsifier [1].Oxygenates – are fuels infused with oxygen. They are used to reduce the carbon monoxide emissions creating when burning fuel. Oxygenates can be based on either alcohol or ethers [2]. Literature survey shows that Butanol is a feasible alternative to ethanol due to its higher energy density, being less prone to water contamination, less corrosive, better blending stability and higher cetane number with respect to ethanol [3]. Tert-butylamine are generally considered to better than secondary or primary amines as fuel antioxidants [4] as well as deposit control additives and corrosion inhibitor [2].The present work was aimed to get better understanding of the nature of molecular interaction pr based on the study of the temperature dependent dielectric relaxation in multifunctional additive mixtures of 1) 1-butanol in (benzene +tert-butylamine) and 2) 1-Propanol in (benzene +tert-butylamine) at microwave frequencies.

2. MATERIALS AND METHODS

Compounds used in the present study were of AR grade and were all procured from SRL, India. The static permittivity ε_o at 1 KHz was measured using a digital VLCR-7 meter supplied by M/S Vasavi electronics, India, after calibrating it for standard liquids like carbon tetrachloride, benzene, toluene and chlorobenzene. The permittivity at optical frequency ε_∞ was obtained by squaring the refractive Index for sodium D-line, which was measured with the help of an Abbe's refractometer. The

 ISBN: 978-93-89107-36-4

uncertainties in static permittivity, refractive index and density were ±0.0005, ±0.0002 and ±0.0001 g/cc respectively. All measurements were made at 303±1K, 313±1K, and 323±1K using a water circulating thermostat arrangement. For density measurement, a 10ml specific gravity bottle was employed. Its volume at the given temperature was determined using pure water. Density measurements of each sample were made at the required the losses due to evaporation of the sample were minimized. The viscosities of the mixtures were measured by using Ostwald's viscometer. ε' and ε" were measured by using a standard liquid cell supplied by M/s. SISCO Ltd., Allahabad, in conjunction with a X- band microwave set up, at 9.75GHz and temperature 303K,313K and 323K respectively. It is shown in fig 1.The constant temperature was maintained by water – circulating thermostat supplied by Ragga Industries, Chennai, India. The fluctuation in temperature was ± 0.1K.

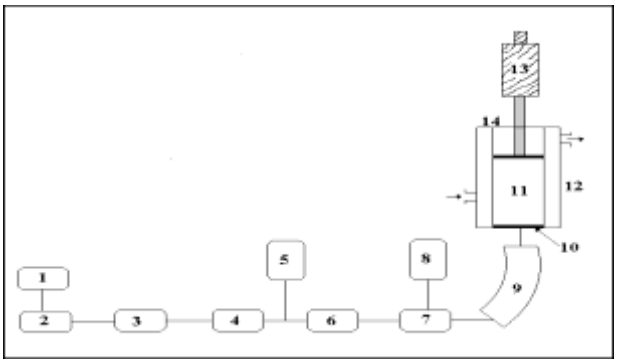


Fig 1.Microwave X – Band Test Bench

1.Power supply 2.Reflex Klystron K – 27 3.Tuner 4.Ferrite isolator 5.Frequency meter 6.Attenuator 7.Slotted line carriage 8.Crystal detector 9. H-Plane bend 10.Teflon window 11.Liquid cell 12.Constant temperature jacket13.Micrometer head 14.Plunger

3. THEORY

The dielectric relaxation time (τ) was calculated using Higasi's method [5-9]. Assuming ε_0, ε' , ε" and ε_∞ vary linearly with weight fraction w_2 of the solute. We have:

$$\varepsilon_0 = \varepsilon_1 + w_2 a_0 ; \varepsilon' = \varepsilon_1 + w_2 a' ;$$

$$\varepsilon'' = a'' w_2 : \varepsilon_\infty = \varepsilon_{1\infty} + a_\infty w_2 ; \quad \varepsilon_\infty = \varepsilon_{1\infty} + a_\infty w_2$$

The following expression were used for obtaining ε' and ε"

$$\varepsilon' = \left(\frac{\lambda_0}{\lambda_c}\right)^2 + \left(\frac{\lambda_0}{\lambda_d}\right)^2 \qquad \varepsilon'' = 2/\pi \left(\frac{\lambda_g \lambda_0^2}{\lambda_d^3}\right)\left(\frac{d\rho}{dn}\right)$$

Where, λ_d is the wavelength in the dielectric medium, λ_g , the wave guide wavelength, λ_0 , the free space wave length, λ_d, the cut off wavelength and $1/\rho$ is the standing wave ratio obtained by using a short circuited movable plunger. The uncertainties in the measurement of ε' and ε" are 1% and 5% respectively. The relaxation time for various solutions was also obtained in term of two Debye relaxation mechanisms with the help of the following equation for dilute solution of weight fractionw_2

$$\tau_1 = \frac{a''}{\omega(a' - a_\infty)}$$

$$\tau_2 = \frac{a_0 - a'}{\omega a''} \qquad \tau_0 = \frac{1}{\omega}\left(\frac{A^2 + B^2}{C^2}\right)^{\frac{1}{2(1-\alpha)}}$$

where

$$A = a''(a_0 - a_\infty)$$

$$B = (a_0 - a')(a' - a_\infty) - a''^2$$

$$C = (a' - a_\infty)^2 + a''^2$$

Where, τ_1 is a sort of intramolecular relaxation time , τ_2 is dielectric relaxation time for overall rotation of the whole molecule , τ_0 is the most probable relaxation time, ω is the angular frequency, τ_1 and τ_2 depending on both the weight factor of such mechanism at a given concentration and temperature.

4. RESULTS AND DISCUSSION

The values of static permittivity (ε_0),Permittivity at optical frequency (ε_∞), dielectric constant at microwave frequency (ε'),dielectric loss (ε") at microwave frequency, density (ρ) and the coefficient of viscosity (η) of multifunctional additive mixtures 1) 1-butanol in (Benzene tert-butylamine) and 2) 1-propanol + in (Benzene tert-butylamine) are reported in table - 1 at different temperatures 303K,313K and 323K.The table-1 shows that at equimolar concentration, the ε_{0m} value is higher than in pure liquids in benzene. This implies larger relaxation times for mixtures at equimolar concentrations [10].They have reported that larger relaxation time of the solution is due to the longer size of the molecules and suggested that it is due to the intermolecular association exists between solute and solvent molecules. Values of 'α' obtained by Higasi method are reported in table -2.Value of 'α'in the above studied systems at all the three different temperatures is finite. This shows the existence of more than one relaxation processes, due to the mechanism of group rotation (τ_1) and overall molecular rotation (τ_2). Value of 'α is found to decrease with rise of temperature. This may be due to the fact that at high temperature, molecular rotations of solute molecules become faster and uniform in the solution [11]. Kalaivani et al. [12] have pointed out that for rigid molecules the distribution parameter would be larger. They have also pointed out that in amine-nitrile mixtures in benzene, the association between unlike molecules is maximum for 1:1 molar ratio [12]. From table 3, it can be seen that the most probable relaxation time (τ_0) value for the mixtures is greater than the corresponding value of the pure liquids.

 ISBN: 978-93-89107-36-4

This trend exists in both the systems taken for investigation at all the studied temperatures. This implies the enchancement of the cluster size. Mixing of two liquids results in the formation of bigger molecular size which enhances the relaxation time (τ_0).The hetero interaction between alcohol and amine molecules is such as to form linear multimer. This shows the existence of strong hetero interaction through H-bonding between dissimilar molecules. In all systems value of τ_0 decreases with rise of temperatures. It indicates that, decrease of τ_0 with increase of temperature may be explained as due to the reduced size of the clusters or due to viscous effect or by both. The relaxation time due to group rotation (τ_1) gives information in both the systems indicates that the existence intramolecular interactions. Value of τ_1 decreases with rise of temperature. This may be due to the hindrance offered due to the thermal agitations. In the mixtures containing 1-propanol, τ_1 value is greater than in mixtures containing 1-butanol. Variation of τ_1 with X_2 for different systems at three temperatures are given in figures from 2-3. Value of τ_2 reflects the overall size of the molecules. τ_2 value shows a non-linear variation with the concentration of alcohol. In all the mixtures the maximum value of τ_2 occurs at equimolar concentration of alcohol. This shows that at these concentrations, the aggregates have a large size.

Table.1 Values of ε_m, ε_∞, ε', ε'', ρ and η at different temperatures

Temp. (K)	Concentration of 1-Butanol in (Benzene+Tert.Butylamine)	ε_0	ε_∞	ε'	ε''	ρ g/cc	η x 10^{-2} Pa-s
	0	2.6960	2.1860	2.5063	0.1843	0.8411	1.5270
303	0.33	2.7500	2.1798	2.4890	0.1849	0.8484	1.5740
	0.50	2.8310	2.1674	2.4554	0.1842	0.8528	1.5890
	0.67	2.7770	2.1641	2.4803	0.1870	0.8603	1.5830
	1	2.7230	2.1518	2.4836	0.1792	0.8680	1.5730
	0	2.6690	2.1768	2.5070	0.1821	0.8032	1.2090
	0.33	2.6960	2.1742	2.4897	0.1838	0.8130	1.2540
313	0.50	2.7770	2.1556	2.4565	0.1832	0.8169	1.2770
	0.67	2.7500	2.1442	2.4812	0.1864	0.8210	1.2720
	1	2.6960	2.1412	2.4847	0.1781	0.8277	1.2470
	0	2.6420	2.1677	2.5078	0.1801	0.7872	1.0420
	0.33	2.6690	2.1615	2.4910	0.1824	0.7934	1.0760
323	0.50	2.7500	2.1494	2.4574	0.1823	0.7954	1.0930
	0.67	2.7230	2.1383	2.4823	0.1853	0.7962	1.0850
	1	2.6690	2.1366	2.4875	0.1774	0.8015	1.0630

Temp. (K)	Concentration of n-Propanol in (Benzene+ Tert. Butylamine)	$\varepsilon 0$	$\varepsilon\infty$	ε'	ε''	ρ g/cc	η x 10^{-2} Pa-s
	0	2.6960	2.1860	2.5063	0.1843	0.8411	1.5270
	0.33	2.7770	2.1851	2.4763	0.1862	0.85	1.5470
303	0.50	2.9120	2.1798	2.4375	0.1871	0.8659	1.5880
	0.67	2.8310	2.1706	2.4621	0.1876	0.8639	1.5770
	1	2.7770	2.1624	2.4783	0.1854	0.8716	1.5850
	0	2.6690	2.1768	2.5070	0.1821	0.8032	1.2090
	0.33	2.7230	2.1753	2.4774	0.1853	0.8181	1.2420
313	0.50	2.8580	2.1665	2.4384	0.1862	0.8217	1.2530
	0.67	2.7770	2.1603	2.4630	0.1865	0.824	1.2620
	1	2.7500	2.1474	2.4820	0.1845	0.8295	1.2520
	0	2.6420	2.1677	2.5078	0.1801	0.7872	1.0420
	0.33	2.6960	2.1647	2.4789	0.1845	0.7967	1.0590
323	0.50	2.8310	2.1556	2.4391	0.1849	0.7996	1.0700
	0.67	2.7500	2.1474	2.4641	0.1852	0.8017	1.0800
	1	2.7230	2.1383	2.4840	0.1830	0.8024	1.0660

 ISBN: 978-93-89107-36-4

Table.2 Values of α,τ_0 ,τ_1, and τ_2 at different temperatures

System		α			τ_0 (ps)			τ_1 (ps)			τ_2 (ps)		
		303K	313K	323K	303K	313K	323K	303K	313K	323K	303K	313K	323K
1-Butanol	0	0.16	0.12	0.09	11.82	10.50	9.45	10.21	9.62	9.08	16.97	14.67	12.28
in	0.33	0.24	0.18	0.16	15.14	12.35	10.75	10.63	10.18	9.51	23.27	18.50	16.08
(Benzene+	0.50	0.32	0.30	0.29	24.15	18.78	16.36	11.44	10.67	10.19	33.61	28.83	26.46
Tert.	0.67	0.28	0.28	0.26	16.66	13.93	12.24	10.49	9.63	9.24	26.15	23.77	21.41
Butylamine)	1	0.25	0.24	0.19	12.91	11.21	9.91	9.55	9.02	8.06	22.01	19.56	16.86
1-Propanol	0	0.16	0.13	0.09	11.82	10.50	9.45	10.21	9.62	9.08	16.97	14.67	12.28
in	0.33	0.26	0.22	0.20	18.34	14.55	12.61	11.42	10.75	10.11	26.62	21.85	19.39
(Benzene+	0.50	0.33	0.33	0.33	36.43	28.96	25.15	13.12	12.09	11.13	41.81	37.15	34.94
Tert-	0.67	0.31	0.29	0.28	23.13	18.20	15.53	11.50	10.79	10.06	32.41	27.75	25.44
Butylamine)	1	0.28	0.27	0.26	16.79	13.97	12.04	10.42	9.61	9.08	26.56	23.94	21.53

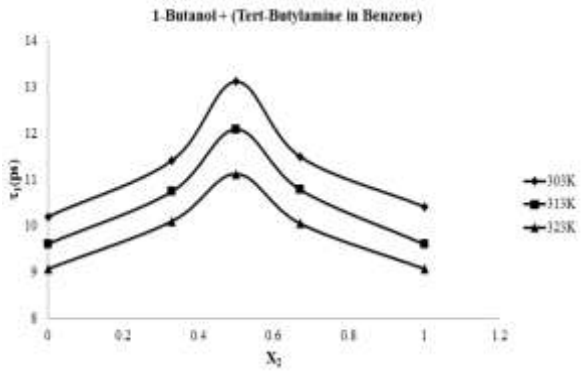


Fig.2 Variation of τ_1 with X_2

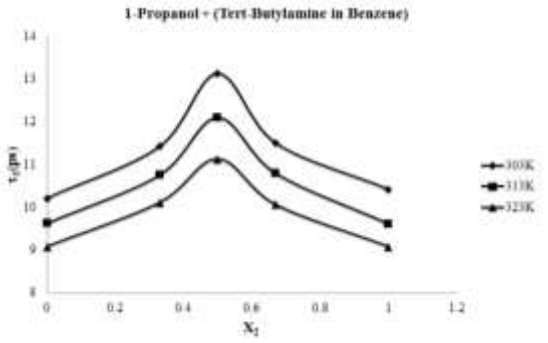


Fig.3. Variation of τ_1 with X_2

As concentration of alcohol increases, number of alcohol molecules also increases. This may be the reason for the enhancement of hetero association. Beyond equimolar concentration self-association among like molecules may lead to the reduction in size which may be the reason for the decrease of τ_2 values. τ_1 and τ_2 values for all the mixtures at all the studied temperatures have a non-linear variation with concentration of alcohol. This non-linear variation confirms the solute-solute interaction [13]. It was concluded that high viscosities provide larger droplet diameters and high penetration of the fuel jet. It leads hinders vaporization, favoring the formation of large diameter droplets and causing incomplete combustion due to the high penetration of the fuel jet, hindering cold starts and increasing the emission of unburned hydrocarbons (HCs) and particulate matter (PM). But at high temperature the size of the molecules reduced. It shows that shortened ignition delay and improved the combustion process [14]. It can be concluded that the addition of oxygenates and corrosion inhibitor had reduced the Hydrocarbon(HC), Particulate Matter (PM), Carbon Monoxide (CO) emissions to a significant with bringing much change in the performance [15].

CONCLUSION

1. The hetero interaction between the molecules of alcohol and amine have been identified by the dielectric relaxation process.
2. Combustion quality depends upon the structure of the fuel and its additive molecules.
3. Most of the oxygenated additive mixtures showed improved combustion phases, decrease in cylinder temperature due to high latent heat of evaporation.
4. Multifunctional fuel additives in fuel blends decreases the ignition delay, improved premixed combustion duration and combustion stability.

REFERENCE

1. Technical Committee Of Petroleum Additive Manufacturers in Europe. (2013).Fuel Additives: Use and Benefits, september2013/ATC Document 113,from https://www.atc-europe.org/public/Doc113%202013-10-01.pdf.
2. P.Sreenivasulu,B.Durga Prasad,G. Naga Malleswar Rao, and S.Sudhakar Babu, "Importance and role of additives for estimating performance and emissions in CI engines using alcohol as fuels- A study," Int. J. Innov. Res. in Sci, vol.2, pp.3827-3836, August 2013.

3. Ekarong Sukjit,"Synergistic effects of alcohol-based renewable fuels: Fuel properties and Emissions," Ph.D.Thesis., School of Mechanical Engineering, The University of Birmingham,2013.
4. Banavali, Rajiv, and Bharati Chheda,"Chemical basis of diesel fuel stabilization by tertiary alkyl primary amines," Amer. Chem. Soc, vol.215, pp.1-7 (abstract), 1998.
5. N.Srinivasan,S.Kumar and S.Krishnan,"Solvent effect on linear correlation factor and dielectric relaxation time of butyl alcohol,"Ind.J.Pure and Appl.Phys,vol.41,pp.876 – 878, November 2003.
6. T.Kalaivani and S. Krishnan,"Dielectric relaxation studies of ternary liquid mixtures of aniline and substituted anilines with acrylonitrile in the microwave region," Ind.J.Pure and Appl.Phys, vol.47, pp.383 – 385, May 2009.
7. Ritu Jain,Nidhi Bhargava,K.S.Sharma and D.Bhatnagar,"Microwave dielectric measurements of binary mixtures of nicotinamide and 1-propanol in benzene solutions at a constant temperature," Ind.J.Pure and Appl.Phys,vol.49,pp.401 – 405, June 2011.
8. T.Ganesh, M.Maria Sylvester,S. Bhuvaneswari, P.Jeevanantham and S.Kumar,"Microwave Dielectric behaviour of ketones in solution state at a constant temperature"IOSR J. Appl. Phy,vol.6,pp.59-63,March –April 2014.
9. M.S.Manjunath and J.Sannappa,"Molecular association of amides with 1-propanol in non-polar solvent : Dielectric study,"Int.J. Pure and Appl Phy,vol.4, pp.71-76,2008.
10. S.N.Helambe, Ajay Chaudhari, and S.C.Mehrotra,"Temperature dependent dielectric study of n-nitrides' in methanol using time domain reflectometery,"J.Mol.Liq,vol.84, pp.235-244, 2000.
11. K.Ibrahim and R.Chandramohan," Dielectric Relaxation Studies of Ternary Mixtures of N- Butyl Iodide with Isovaleric Acid in Benzene in the Microwave Region.," Int. J. Innov. Res. in Sci, Eng and Tech,vol.4,pp.12778-12781,December 2015.
12. T.Kalaivani,S.Kumar and S.Krishnan,"Dielectric relaxation studies of ternary liquid mixtures of aniline and substituted anilines with acetonitrile in the microwave region," Ind. J. Pure and Appl Phy,vol.43,pp.542-544, July 2005.
13. Vir Singh Rangra, and D.R.Sharma,"Dielectric relaxation studies of binary mixtures of acetone and N,N-dimethylacetamide in the benzene solutions using microwave absorption data. Ind. J. Pure and Appl. Phy, vol.41, pp.630-633, August 2003.
14. Renato Cataluña and Rosangela da Silva, "Effect of Cetane Number on Specific Fuel Consumption and Particulate Matter and Unburned Hydrocarbon Emissions from Diesel Engines," Journal of Combustion,vol 2012, Article ID 738940.
15. Harish Sivasubramanian," Effect of Ignition Delay (ID) on performance,emission and combustion characteristicsof 2-Methyl Furan-Unleaded gasoline blendsin a MPFI SI engine,"vol.57,499-507,2018.

Electrolyte Shock Treatment

[1] M.Susmitha, [2] M.Viswadharani, [3] A.Karthikeyan, [4] R.Ganesan

[1][2] UG Student, [3][4]Assistant Professor
[1][2][3][4] Kamaraj College of Engineering & Technology
[1]susmikarthi99@gmail.com, [2] viswadharani99@gmail.com, [3] karthikeyaneee@kamarajengg.edu.in,
[4] rganesaneee@kamarajengg.edu.in

Abstract:

This project deals to remove the bacteria in our skin by using electron movement with the help of electrolyte solution. There are different methods available for removing bacteria in our skin, especially for diabetes patient. The different methods are electrode neutrotheraphy and electrolyte imbalance method. Compare to another method is efficient to remove the bacteria. The advantages of this method are sublimation coating and protect our skin also.

Keywords:

Electrode, Electrolyte solution, Current controller

1. INTRODUCTION

Skin and soft tissue infections (SSTIs) involve microbial invasion of the skin and underlying soft tissues. They have variable presentations, etiologies and severities. The challenge of SSTIs is to efficiently differentiate those cases that require immediate attention and intervention, whether medical or surgical, from those that are less severe. Approximately 7% to 10% of hospitalized patients are affected by SSTIs, and they are very common in

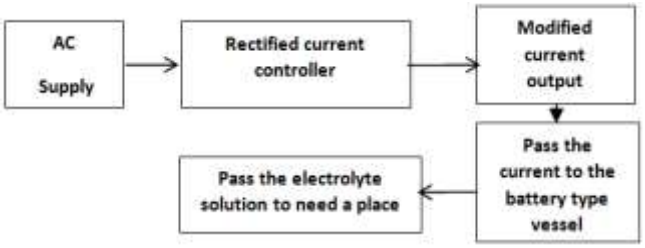
The emergency care setting: The skin has an extremely diverse ecology of organisms that may produce infection. The clinical manifestations of SSTIs are the culmination of a two-step process involving invasion and the interaction of bacteria with host defenses. The cardinal signs of SSTIs

Involve the features of the inflammatory response, with other manifestations such as fever, rapid progression

Of lesions and blue: The diagnosis of SSTIs is difficult because they may commonly masquerade as other clinical syndromes. To improve the management of SSTIs, the development of a severity stratification approach to determine site of care and appropriate empirical treatment is advantageous. The selection of antimicrobial therapy is predicated on knowledge of the potential pathogens, the instrument of entry, disease severity and clinical complications. For uncomplicated mild to moderate infections, the oral route suffices, whereas for complicated, severe infections, intravenous administration of antibiotics is warranted. Recognition of the potential for resistant pathogens causing SSTIs can assist in guiding appropriate selection of antibiotic therapy.

2. BLOCK DIAGRAM

The 230volt AC supply step down by using the transformer to 24volt. In this 24volt 3A current passes through the rectifier circuit. In this rectifier rectify the AC voltage to DC voltage and the current can be controlled by the system. In this current can be controlled by 2mA to 3A. In this regulated current passes through the battery type vessel. In this vessel have to electrode and electrolyte solution. The current passes through the electrode. The electrolyte solution can be ionized done with this process. From this ironized solution can be easily removed by the harmful bacteria



POWER SUPPLY:

Provides the voltage needed to control the current controller to electrodes in electrolyte filled solution

Transformer:

In the system we used in step down type transformer in that transformer will reduce the voltage in 230volt 5amps to 24volt 3amps ac supply.

Advantages

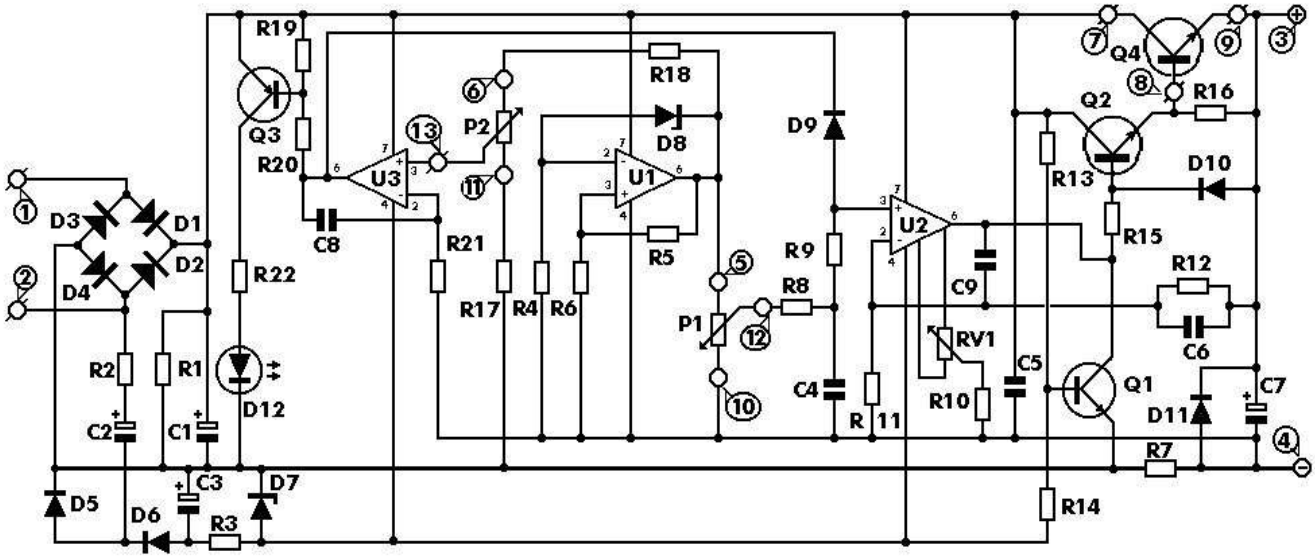
1. It will destroy the harm full bacteria
2. It will clean the cloths and skin
3. It will cure the diapaties patients skin damage problem

 ISBN: 978-93-89107-36-4

3. DESIGN DETAILS

CURRENT LIMITER:

Current limiting is the practice in electrical or electronic circuits of imposing an upper limit on the current that may be delivered to a load with the purpose of protecting the circuit generating or transmitting the current from harmful effects due to a short-circuit or similar problem in the load. The current have been limited and controlled by 3Amps. The current have been regulated by 2mA-10mA.



ELECTROLYTE:

An electrolyte is a substance that produces an electrically conducting solution when dissolved in a polar solvent, such as water. The dissolved electrolyte separates into cations and anions, which disperse uniformly through the solvent. Electrically, such a solution is neutral. If an electric potential is applied to such a solution, the cations of the solution are drawn to the electrode that has an abundance of electrons, while the anions are drawn to the electrode that has a deficit of electrons. The movement of anions and cations in opposite directions within the solution amounts to a current. This includes most soluble salts, acids, and bases. Some gases, such as hydrogen chloride, under conditions of high temperature or low pressure can also function as electrolytes. Electrolyte solutions can also result from the dissolution of some biological (e.g., DNA, polypeptides) and synthetic polymers (e.g., polystyrene sulfonate), termed "polyelectrolytes", which contain charged functional groups. A substance that dissociates into ions in solution acquires the capacity to conduct electricity. Sodium, potassium, chloride, calcium, magnesium, and phosphate are examples of electrolytes, informally known as "lytes."

In medicine electrolyte replacement is needed when a patient has prolonged vomiting or diarrhoea, and as a response to strenuous athletic activity. Commercial electrolyte solutions are available, particularly for sick children (oral rehydration solutions) and athletes (sports drinks). Electrolyte monitoring is important in the treatment of anorexia and bulimia.

Transformer:

A transformer is a static electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. A varying current in one coil of the transformer produces a varying magnetic field, which in turn induces a varying electromotive force (emf) or "voltage" in a second coil. Power can be transferred between the two coils through the magnetic field, without a metallic connection between the two circuits. Faraday's law of induction discovered in 1831 described this effect. Transformers are used to increase or decrease the alternating voltages in electric power applications.

Since the invention of the first constant-potential transformer in 1885, transformers have become essential for the transmission, distribution, and utilization of alternating current electrical energy.[3] A wide range of transformer designs is encountered in electronic and electric power applications. Transformers range in size from RF transformers less than a cubic centimeter in volume to units interconnecting the power grid weighing hundreds of tons.

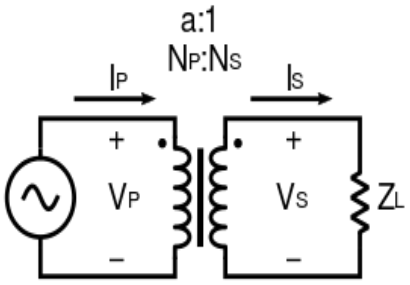


Fig. 5 transformer

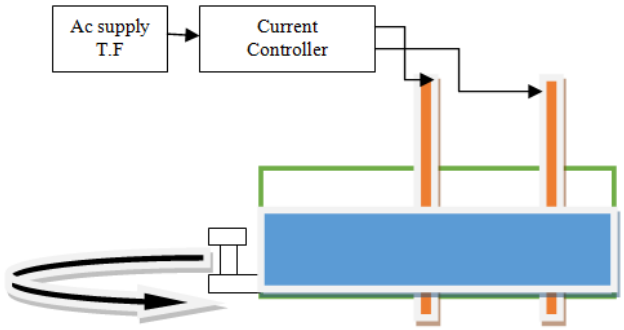
 ISBN: 978-93-89107-36-4

ELECTRODE:

An electrode is an electrical conductor used to make contact with a nonmetallic part of a circuit (e.g. a semiconductor, an electrolyte, a vacuum or air).Configuration of the electrode

An electrode in an electrochemical cell is referred to as either an anode or a cathode. The anode is now defined as the electrode at which electrons leave the cell and oxidation occurs (indicated by a minus symbol, "−"), and the cathode as the electrode at which electrons enter the cell and reduction occurs (indicated by a plus symbol, "+"). Each electrode may become either the anode or the cathode depending on the direction of current through the cell. A bipolar electrode is an electrode that functions as the anode of one cell and the cathode of another cell.

CIRCUIT DIAGRAM:



The 230volt ac supply step down by using the transformer to 24 Volt. In this 24volt 3A current passes through the rectifier circuit. In this rectifier rectify the ac voltage to dc voltage and the current can be controlled by the system by using current controller. In this current can be controlled to 2mA to 3A. In this regulated current passes through the battery type vessel. In this vessel have to two electrode and electrolyte solution. The current passes through the electrode to electrolyte solution. The electrolyte solution can be ionization done by this process. In this ironized solution can be easily removed by the harmful bacteria in damaged skin or cloth.

Working:

Inside the system will take the 230V, 5A supply is reduced to 24V,3A AC by using step down transformer supply will pass through the current controller. In the current controller will control the current and voltage by using various. In the current controller will control the 2mA to 10mA. In the controlled current will flow through the electrolyte solution dipped electrode. In the electrode will ionize the solution. After ionization the electrolyte solution was sprayed to damaged skin. In the solution cleared the bacteria in damaged skin.

RESULT AND DISCUSSION

In the system's output of electrolyte solution were sprayed by diabetes patient skin area In the diabetes patient skin damaged problem to avoid the removing of the body organ.

Construction of Multi-Storeyed Buildings in India With Environmental Perspective

[1] Rajkumar R, [2] Kavya L, [3] Vishvaa R S, [4] Kamaleswari T

[1] Associate Professor (Senior Grade), [2][3][4] Undergraduate Student
[1][2][3][4] Department of Civil Engineering, SSN College of Engineering, Chennai, India
[1] rajkumarr@ssn.edu.in

Abstract:

Economic development and anthropogenic activities directed towards satisfying humans ever increasing desires have led to over exploitation of the natural resource base and generation of contaminants and hazardous waste. The construction of Multi-storeyed building either for residential or for commercial purposes without proper care of environmental protection and energy consumption is a negative approach to the objective planning of sustainable development. These Multi-storeyed buildings and their energy consumption has created so much pressure on the environment.

Keywords:

Multi-Storey, Building, Impacts, Effects

1. INTRODUCTION

Man has demonstrated ability to build tremendous structures. The construction of a remarkable feat, but the Multi-storeyed or High rise Structures has struck a popular chord by default rather than by design. It is presumed to compensate for high Land cost and thus maintain economic balance .In reality it induces ever mounting land prices that the urban dweller is familiar with the consequences of intolerable congestion.

Cultural Effect: The residents of a multi-storey building cannot preserve their ethnic culture. The culture of these apartments and shopping complex tend to mix among each other. Also if persons of different nationals and different states are resident of these apartments, then mixing of language, religion, tradition, behaviour, dressing style and other factors which are day to day activity takes place. If the Multi-storey building has come up in ethnic minority areas, then the culture of surrounding areas also tend to change and culture of ethnic minority is affected by these development

Health and Safety: As discussed above, factors which affect the health of people are air pollution, water pollution, noise pollution, indoor air quality deterioration and solid waste management. Whereas for safety consideration, the Multi-storey building must have fire safety and crime safety measures so that resident of these buildings feels a sense of security.

Psychological effects of Multi-storeyed buildings: Most of the times , people staying in multi-storeyed apartments become poor tempered due to the effect of compact and congested environment. People also become alcoholic and they have a fear for crowd. They become reserved and self-centred. Due to this, lot of suicide cases have been reported.

Aesthetic and Human Interest: If a good architecture is incorporated in the Multi-storeyed building, then aesthetic and scenic view of the area is increased and even tourists come and see the architecture of these buildings. Also if surrounding of these building is developed along with beautiful lawns and gardens, then beauty of these buildings is increased and it gives a scenic sense.

Socio Economic Impact: It has been rightly said that man is a social animal. Therefore social environment plays an important role in the life of a man. Construction of Multi-storeyed buildings has affected the social environment. It has resulted in the development of slums. The lifestyle of people living in flats is getting changed and they do not even care about the health and hygiene of those people who are staying in small houses by the side of their skyline buildings.

2. FACTORS AFFECTING CONSTRUCTION OF MULTI-STOREYED BUILDINGS

Economic factor: As we know that construction of Multi-storeyed building increases the cost of surrounding land to an extent which is unaffordable for an average man. This leads to generation of slums. These slums are horizontal and create massive ecological imbalance. Most of slum colonies are devoid of metalled road, public water supply, sewerage and other civic amenities. Due to these problems, ponding of water takes place in slums which leads to the outbreak of various diseases among people. For example Mumbai has the highest number of slums which covers almost 6% of the Mumbai city.

Social factor: People staying in multi-storeyed buildings always remain inside their flats. They hardly know what is going around them and this often leads to criminal activities. Also it is unsafe for children and older people as they face the trouble of failure of lifts due to frequent power cuts.

Human factor: This is rather difficult to quantify and assess since the stresses caused by high density living and fast paced life cannot be measured.

Indoor Air Quality: It is also an important factor to be paid attention in a multi-storeyed building. Many times the air that we breathe indoors is more polluted than the air outside. CO and NO are produced by the various volatile organics emitted from house hold cleaning products. Many pollutants such as cigarette smoke or radon gas if emitted outdoors have plenty of dilution air so that people tend not to be exposed to hazardous levels of contamination. Chloro-fluro carbon from air conditioning can create breathlessness, eye sight problems and restlessness.

Other indoor pollutants in multi-storeyed buildings are as follows

- Asbestos and other fibrous aerosols (Acoustic insulation, decoration, vinyl floor and cement produce).
- Formaldehyde (Particle board, panelling, plywood, carpets, ceiling tile and other construction material).
- Inhalable particulate matter (smoking, fire places)
- Diffusion from soil, ground water, brick, building material, concrete and tiles.

Table 1: Potential environmental impacts resulting from the construction stage

Construction Phase	Construction practice	Potential environmental impacts
Preconstruction	Site inventory vehicular traffic	Short term and nominal dust, sediment and tree injury
	Test pits	Tree root injury, sediment
	Temporary controls storm water	Short term and nominal vegetation, water quality
	Erosion and sediment dust	Vegetation, water quality negligible if properly
Site work	Clearing and demolition	Short term
	Clearing	Decrease in the areas of protective trees, shrub and ground covers, stripping of top soil, increased soil erosion, sedimentation and storm water run-off
	Demolition	Increased dust, noise, solid wastes
Temporary facilities		
	Shops and storage sheds	Increased surface areas impervious to water, infiltration, increased water run-off, petroleum products
	Accessed roads and parking lots	Generation of dust on unpaved areas
	Utility trenches and backfills	Increased visual impacts, soil erosion and sedimentation for short periods
	Sanitary facilities	Increased visual impacts, solid wastes
	Concrete batch plants	Increased visual impacts, disposal of waste water, increased dust and noise
Earth work		**Long term**
	Excavation	Stripping, soil stockpiling and site grading
	Grading	Increased erosion and sedimentation
	Trenching	Soil compaction
Site drainage		
	Foundation drainage	Decrease in the volume of underground water for short and long term periods, increased stream flow volumes and velocities downstream damages
Permanent facilities		
	Transmission lines and heavy traffic areas	Long term
	Parking lots	Storm water run –off, petroleum products
	Water pumps for lifting of water	Noise, visual impacts

 ISBN: 978-93-89107-36-4

	Dish antenna	Visual impacts
	Solid waste handling equipment	Visual impacts, odours, bacteria, viruses, noise
Project closeout		
	Removal of temporary offices and shops	Short term
	Demolition	Noises, solid waste, dust
	Relocation	Storm water run-off, traffic blockages, soil compaction
Site restoration		
	Finish grading	Sediment, dust soil compaction
	Top soiling	Erosion sediment
	Cleaning	Water quality, oils, phosphates and other nutrients

Noise Pollution: Noise pollution is nothing but generation of unwanted sound. These sounds are very common in apartment culture. In case of advanced level of living standards, people are using radio television, tape recorders, mike etc, very frequently. The operation of these instruments has little concern about the annoyance caused to neighbours not even the sick and ailing. Infrasound produced in manmade environment either by working machines, air conditioning operation may cause blood vessels to contract, our skin to become pale and damage our nervous system. Air conditioners are a constant source of at least 40 to 50 % decibels which also creates noise pollution and irritates the people in these buildings.

Water Pollution: As we approach the end of the century problems, both water quantity and water quality are returning to forefront. The traditional confidence in the quality of drinking water has been seriously taken as we find potential carcinogens in ground water. The people of multi-storeyed buildings have to face the problems of water supply. Due to the construction of tall buildings, the population density has increased abruptly. Large amount of water should be supplied to those densely populated areas which imparts extra burden on water treatment and distribution system. In order to supply huge amount of water to such areas, high discharge distribution pipe and high power meters and pumps are needed. Since the height of multi-storey buildings ranges to even 400 m, very big head is required to be maintained in the distribution pipes so that water can reach at the top most floor. Sudden drawdown in the ground water table is the result of such activities which leads to damage of environment in many ways. Due to Lowering of Ground water table, many plants do not get sufficient water in their root zone. Cities are facing acute water scarcity as more multi-storey buildings come up. Due to high density living, lots of waste water is generated which comes from kitchen, bath and laundry floor, drain waste and sanitary sewage. The disposal of such large quantities of sewage causes pollution of rivers.

Air Pollution: Pure air is vital for life on the earth. It is vital for man, animal, and vegetation alike. A normal healthy person can live about five weeks without food and five days without water but only five minutes without air and this proves the importance of air in our life. Dust and sulphur dioxide are two major pollutants resulting from vehicular activities. Dust affects the people living in lower stories whereas sulphur dioxide and nitrogen dioxide affect people living in upper stories. Sulphur dioxide enters in our body along with the air we breathe. It attacks the lungs and other parts of the respiratory system. Carbon monoxide emission is also caused by vehicular activities. Hourly atmospheric concentration of carbon monoxide often reflect city driving pattern. As more number of people stay in a multi-storey building much vehicular activity will be there and this causes pollution. Carbon monoxide and lead a product of petrol driven vehicle interferes with blood ability to carry oxygen to the cells of the body. With the blood stream carrying less oxygen, the brain function is affected and the heart rate increases in an attempt to offset the oxygen deficit. Oxides of nitrogen are also one of the major air pollutants. Almost all nitrogen oxide emissions are in the form of Nitrogen oxide which has no known adverse health effect at concentration s found in the atmosphere. Nitrous oxide can oxidize to Nitrogen dioxide which in turn may react with hydrocarbons in the presence of sun light to from photochemical smog condition. The lack of horizontal dispersion and presence of direct sunlight provide suitable environment for formation of smog. The multi-storey buildings reduce the horizontal dispersion which leads to the formation of smog in the presence of sunshine. Even solid waste and sewerage of a densely populated area is also a source of air pollution.

Solid waste Generation: Waste generation encompasses those activated in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal . Most of the time, it has been seen that multi-storeyed buildings are erected after demolishing old structures. The demolition of old structures itself results in a large quantity of solid wastes. Digging of foundation also gives large amount of solid wastes. Further such wastes in the form of iron rods, wooden cuttings, brick bats ad so many other wastes. These wastes are often classified as rubbish. The quantities

produced are difficult to estimate and variable in composition but it may include dirt, stones, concrete, bricks, and plaster, plumbing, heating and electrical parts. It has been observed that the characteristics of the population influence the quantity and quality of solid wastes generated. For example the quantities of yard wastes generated on a per capita basis are considerably greater in many of the wealthier neighbourhoods than in either parts of town, usually the residents of multi-storeyed building belong to post population, and they generate much more solid wastes than others.

At the collection sites of solid waste generated by the people residing in the multi-storey building become ideal breeding places for disease causing organisms under warm and moist conditions. The generation of these harmful wastes and their transmission is not only health related concern but also have aesthetic impact.

Ecological Disturbance: Right from the very first brick of foundation is laid to the completion of the Multi-storey building ecology is disturbed in many ways. Deforestation and land levelling is the first step of construction. Cement , steel, stone and wood are the major building materials used in every Multi-storey building, different kind of energy is increasingly exhausted in industries like cement steep hills, forests and destroying the natural ecosystem for making cement , coal, a scarce fossil fuel resource for generating energy in steel industry. Further the energy intensive and pollutant mechanisms used in transporting these resources to the production places are few examples illustrating the cost of development. Complete ecosystems contain a sufficiently diverse set of living and non living components to be entirely self-sustaining. Millions of trees are chopped down every year for erection of multi-storeyed buildings which spoil the whole ecosystem of that place. Some times for developing a plot indiscriminate filling up of banks and ponds are done. Pond in itself is an ecosystem. Filling of ponds leads to drainage problem. As the construction work starts an inflation of labour class leads to further destruction of shrubs and grasses.

The skyline of Indian towns is changing with a chain of Multi-storeyed buildings multiplying at a mind boggling speed, Sun setting can hardly be seen as squares of light start appearing in enormous structures all looking the same. From Delhi to Cochin Indian cities have started to practise the Multi-storeyed culture. Even Kerala, where once only cottages existed through the coconut grooves is now going for Multi-storeyed apartments. Calcutta, the city of Palaces had gradually turned into concrete jungles with the erection of Multi-storey Buildings. In many cases, watery land and ponds are filled indiscriminately in gross violation of municipal rules.

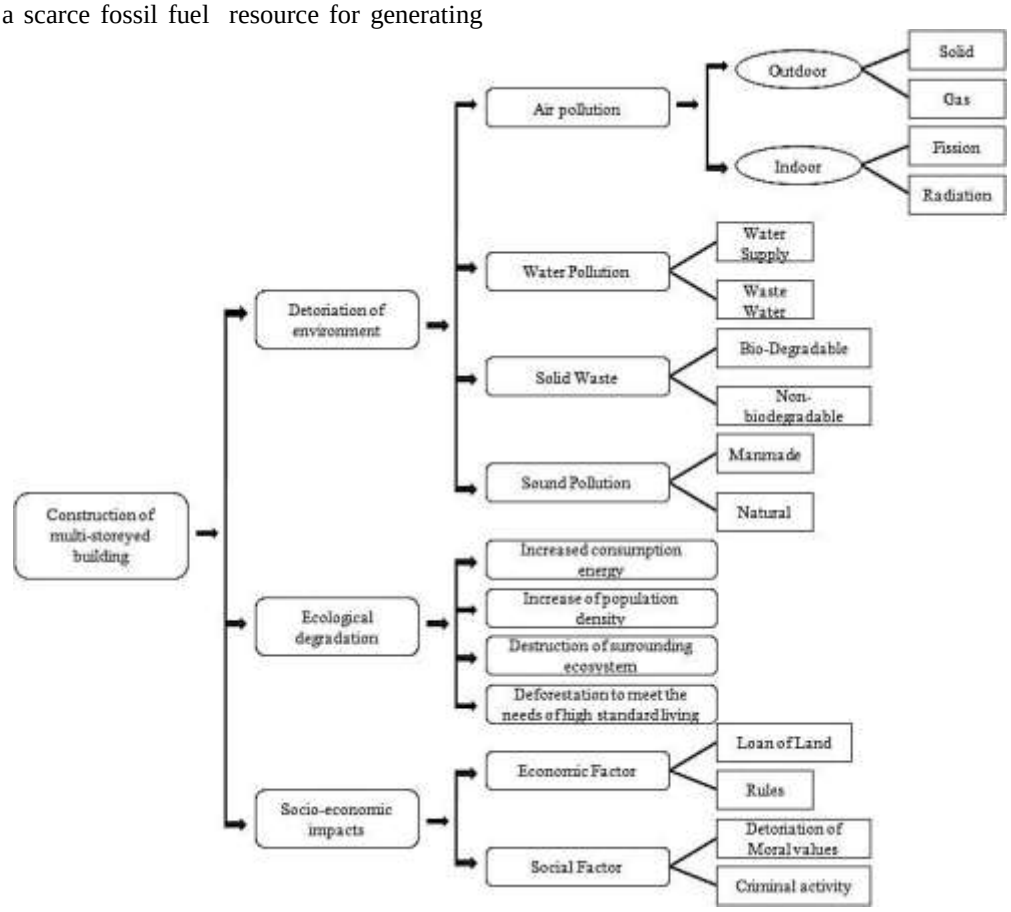


Fig 1: Network approach of impacts

 ISBN: 978-93-89107-36-4

The Chennai Metropolitan area new buildings come up at the rate of 500 per year, according to C.H. Gopinath Rao, renowned architect and former chairman of Institution of Engineers, Tamil Nadu. In Kerala cities are facing the problem of water scarcity as more Multi-storey buildings come up. Private agencies which sponsor flats construct huge water tank to which water is diverted from the municipal water supply system. The resultant water scarcity experienced by single storeyed houses already existing in such areas has led to public protests. The Construction of Multi-storeyed buildings is practised because the cost of the land is extravagant and continuing this process without restraint only adds fuel to the flames of urban congestion , blight and disintegration. This is briefly explained in the flow chart above.

3. CONCLUSION

The strategy of carrying out a Multi-storey review is intended as an aid to decision makers that is developers, planners, engineers and architects. Though such persons have tended to be sceptical of such an effort as costly and time consuming, in the long run it may actually save time and resources through an accounting of planning gaps not initially perceived thus the impact of multi-storeyed buildings are not always positive due to lot of hidden disadvantages it has from environmental point .These buildings are neither sustainable and not have so much advantage that people should opt it for their residential, commercial purposes. This paper makes small attempt to highlight the impact of multi-storeyed building. A full accounting of impacts is needed to check the sustainability of these projects.

REFERENCE

1. Bruel. P.V. and clessen, H.P., 'Infrasonic measurements ", Techinical Review. No .3, 1973 , pp 23-24.
2. Canter. L,N., "Environmental Impact Assessment", Mc Graw Hill Book Company, New York, 1977, PP38-40.
3. Heinke, G.W. "Population and Economic Growth", Environmental Science and Engineering , Pretice Hall Inc, Englewood, 1989, PP- 32-40.
4. Joglekar, M.N.,"Sustainable development Planning", Journal of Indian Architect and Builders, Dec 1992, PP67-71.
5. Rucheiman.L, "Impact Review of High Rise Buildings", Journal of Urban Planning and Development , July, 1977, pp 83-87
6. Soma Basu, "Delhi Bursting at the seams", Survey of the environment, 1995, The Hindu.

Evaluation of Mechanical Properties of Hybrid Intralayer Jute/Flax and Sisal/Flax Polymer Epoxy Composites

[1] Dr.C.Senthamaraikannan, [2] Kirubakaran.G, [3] Ananda Karthick N, [4] GiriPrasath, [5] K.kabilan, [6] P.N.karthikbalaji

[1][2][3][4][5][6] Department of Mechanical engineering, Sri Venkateswara College of Engineering, Pennalur, Chennai, India

Abstract:

This paper aims to find mechanical properties of intra-ply jute/flax and sisal/flax epoxy composites. Laminas were fabricated following the hand lay-up technique in intraply woven methods. Results are presented regarding the tensile, flexural behaviour of fabricated laminates. The testing specimens were prepared from the composite laminate for the determination of Tensile strength, Flexural strength according to the ASTM standard guidelines ASTM D638, ASTM D790, and ASTM D-256 respectively. The experimental results reveal that the mechanical properties of intraply jute/flax and sisal/flax epoxy composite. A greater stress uptake in the intraply jute/flax and flax/sisal composites was obtained by the interlocking structure between the fiber yarns.

Keywords:

Intralayer, Jute, Flax, Sisal, Epoxy, Hybrid Woven, Epoxy

1. INTRODUCTION

Natural fibers have significant cost advantages when compared with synthetic fibers such as glass, carbon, nylon, etc. Among the different types of natural fibres, bast fibres (flax, hemp, jute and ramie) derived from plants are most commonly used in different applications such as automotive, marine and construction, because of their attractive properties in terms of weight (low density) and performance (high specific strength and modulus). It also has higher strength and modulus upon comparing with plastic and is a good replacement for conventional fibers in many applications. Natural fibers have excellent beneficial properties when used as reinforcement for composites. They are low-density materials, yielding relatively light weight composite with high specific Properties. Composites consists of two or more different reinforcing materials bound in the same matrix called as hybrid composites. For achieve better mechanical properties, hybrid composites are investigated. Past few decades many investigations made on hybrid polymer composites. Also by fillers and nano materials are used N. Venkateshwaran(1) et al this work, alkali (NaOH) of various concentrations (0.5%, 1%, 2%, 5%, 10%, 15% and 20%) was used to treat the fiber surface and the effect of these concentrations on the mechanical and visco-elastic behaviour of the composites were carried out. From the experimental investigation, it is found that 1% NaOH treated fiber reinforced composites behaves superiorly than other treated and untreated fiber composite. Hybrid synthetic and natural fiber composites also found in many investigations. G. Yuvaraj (2) et al proved that composite with equal fibre ratio of glass and sisal (50:50) has improved the mechanical properties than composite with minimum percentage of sisal fiber. M. Thiruchitrambalam (3) et al compared mechanical properties of banana/kenaf hybrid composites with respect to SLS and alkali treatment. In this work they conclude the SLS treatment had provided better mechanical properties that the alkali treated. Verma et al. (4) and Mohan et al. (5) have investigated the mechanical properties of jute/glass hybrid composites in both polyester resin and epoxy resin. Mechanical properties of natural fibers are based on fiber alkali treatments, fiber matrix ratio, fiber loadings. Jochen Gassan (6) et al found fibre treatment and increased fibre content decrease the rate of damage development in the composites. M.Ramesh (7) et al found that the incorporation of sisal fiber with GFRP provide superior properties than the jute fiber reinforced GFRP composites in tensile properties and jute fiber reinforced GFRP composites performed better in flexural properties. Winfield (8) analyzed the use of jute-reinforced plastics to low cost housing. In his study jute fabric is directly used as reinforcement. Arifuzzaman Khan et al. [9] developed environmental friendly jute fabric composites and investigated the influence of woven structure on the mechanical properties of the composite. In these composites, it was observed that mechanical strength and modulus in the warp direction are higher when compared to the weft direction. Apart from this, plain-woven jute fabric composites in the warp and weft directions exhibited superior mechanical properties to those of non-woven jute

 ISBN: 978-93-89107-36-4

fabric composites. Currently in India, 90 million tons of fly ash is being generated annually, dumped in 65,000 acres of ash ponds. This huge quantity produces challenging problems, like health hazards and environmental issues. Fly ash comprises of fine particles of silica, alumina, calcium and magnesium oxides. Seung Goo Leo (10) et al improved and modified the flax fibers by ethylene plasma treatment and acetylation. Plasma treatment with ethylene results about the higher thermal resistance and larger interfacial strength in flax/PHB biocomposies that the chemical modification by acetic anhydride without the damage to flax fibers. Hybrid composite materials are widely used in the field of engineering applications due to their strength-to-weight ratio, low cost, and ease of manufacturing. Hybrid composites are preferred to achieve a blend of properties such as ductility, stiffness, and strength which cannot be achieved by single fiber reinforced composites. Hybridization allow designers to tailor the composite properties to the exact needs of the structure for various consideration. The purpose of hybridization is also to obtain a new material obtaining the advantages of its constituents, and overcoming some of their disadvantages.

Table.1 Mechanical Properties of Jute, Sisal and Flax Fiber

Quantity	JUTE	SIAL	FLAX
Materials	 Fig.1	 Fig.2	 Fig.3
Young's modulus (GPa)	26.5	22	22
Tensile Strength (MPa)	393	458	458
Elongation (%)	1.5-1.8	1.5-1.8	1.5-1.8
Density (Kg/m^3)	1470	1450	1450

R Yahaya et al (11) evaluated that the hybridization affects in intermediate mechanical properties of composites compared to the highest Kevlar/epoxy properties and the lowest properties of kenaf/epoxy composite. Alessandro Pegoretti et al (12) studied the impact data clearly show that hybrid intraply composites reached higher ductility index value when compared to those of interply hybrids. Another method for improving the mechanical properties is to add fillers or nano particles while fabricating natural fiber polymer composites. Mohan et al (13) determined, increasing the Wt. % of MWCNT and also varying the stacking sequence of the fiber layers can enhance the mechanical properties of the natural fiber hybrid composites. V. Jute(Fig.1) stem has very high volume of cellulose that can be procured within 4-6 months, and hence it also can save the forest and meet cellulose and wood requirement of the world. Sisal Fiber (Fig.2) is one of the most widely used natural fiber and is very easily cultivated. It is obtain from sisal plant. The plant, known formally as Agave sisal Ana.

Figure.4 Weaving of Jute/Flax Fiber

Flax fiber is extracted from the bast beneath the surface of the stem of the flax plant. Flax fiber (Fig.3) is soft, lustrous, and flexible; bundles of fiber have the appearance of blonde hair, hence the description "flaxen" hair. From the results the following three major conclusions were drawn. The tensile strength of the composite has decreased by 10.4 %, This is because of the air entrapment caused by the nano particles. A.B. Maslinda (15) et al found tensile and flexural strength of the intralayer kenaf/jute and kenaf/hemp laminates were superior to those of the individual kenaf, hemp, jute woven composites due to the different load distributed to the warp and weft fiber directions. Finally in this paper, the intra woven jute/flax and intra woven sisal/flax natural fiber mechanical properties are investigated based on the research gap purpose.

2. EXPERIMENTAL WORK

2.1 Alkaline Treatment:

The Natural fibers are derived from lignocelluloses, they are hydrophilic in nature and hence they become weak at the interface between matrix and fiber. The main disadvantage encountered is including sisal fiber and jute into a polymer matrix is the lack of good interfacial adhesion between the two components, which results in poor properties in the final product. Due to poor adhesion mechanical properties of the natural fiber composite are low and hence it becomes important to improve the adhesion either by physical or chemical methods. Fiber matrix

 ISBN: 978-93-89107-36-4

interfacial adhesion can be improved with many chemical modification of the fiber. One of the familiar and effective chemical modification applied to sisal fibre is an alkaline treatment based on sodium hydroxide.

Fig.5. Fiber mat soaked in NaOH Solution

2.2 Matrix:

The resin used in this work epoxy which is obtained from Bharath Resins, Thirumullaivoyal. Epoxy-Br 111 and Hardner-Hy951. The curing reaction for epoxy resin will start immediately upon addition of suitable catalyst and accelerator. The epoxy resin used in this work is normally preaccelerated. Once die catalyst is added, the curing reaction starts immediately at the room temperature.

2.3 Manufacturing of Laminates:

First weight of four layers of respective (sisal,flax & Jute) fiber cut to dimension 300 x 300 mm. According to the volume fraction (VF), the required volume of matrix is calculated. The ratio of epoxy resin (BR 111) and the hardener (HY 951) are assigned as 10:1 respectively. Then this resin and hardener are mixed in a beaker continuously for 5 minutes to make homogenous mixture. The pot life of the mixture is 20 and 30 minutes. Dam of size 300 x 300 mm is placed over a polythene sheet. Releasing agent (Silicone spray) is applied all over the sheet and on the edges of the dam. Matrix is applied over the sheet using paint brush. Then the first jute fiber layer is placed neatly without any slack over. Then the jute fiber is rolled by a hand roller to ensure the uniform flow of the resin throughout the layer.

Fig.6 Applying Epoxy on the fiber

Fig.7 Jute/Flax Laminate

Fig.8 Sisal/Flax Laminate

3. RESULTS & DISCUSSION

3.1 TENSILE TEST:

The woven and interwoven hybrid composites were subjected to a tensile test, under untreated and treated conditions, to determine their tensile strength.

Furthermore, the two fibers with difference properties created a complex load-sharing property, between the longitudinal and transverse directions, when they were weaved together. This resulted in a greater stress uptake by the interwoven hybrid composites, which were observed to break at higher failure strains, in comparison with the individually woven composites. The proper stress transfer from them matrix to the fibers contributed to a lower crack propagation rate, which resulted in the higher ductility of the interwoven hybrid composites. The tensile strength of interwoven jute/sisal(JS) and interwoven flax/sisal(FS).

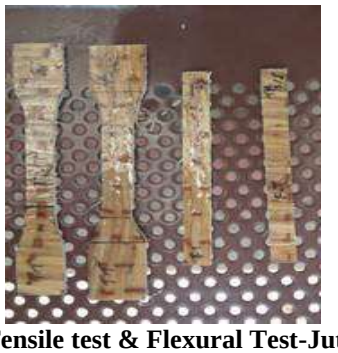


Fig.9 Tensile test & Flexural Test-Jute/Sial

 ISBN: 978-93-89107-36-4

Fig.10 Tensile test & Flexural Test-Flax/Sisal

Table.2 Tensile Strength Properties of Jute/Sisal and Flax/Sisal Inter woven type Hybrid Natural fiber:

Property	Condition	J/S	F/S
Tensile strength (Mpa)	Untreated	48* 10#	55* 14#
	Treated	71* 15#	76* 18#

*Sisal-warp direction, #Jute & Flax Weft Direction.

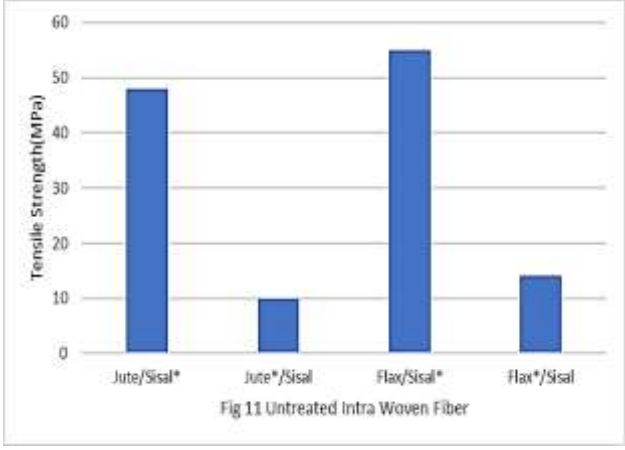


Fig 11 Untreated Intra Woven Fiber

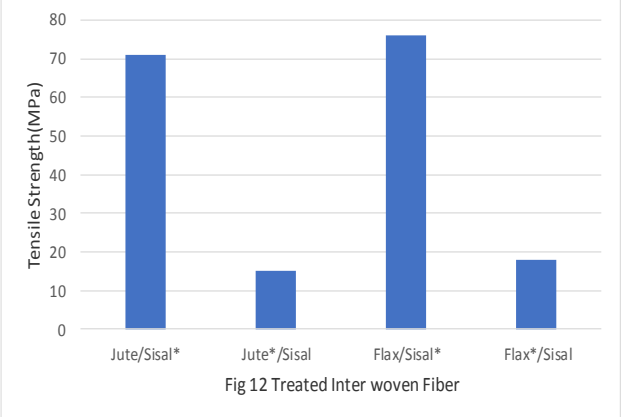


Fig 12 Treated Inter woven Fiber

3.2 FLEXURAL TEST:

The flexural strength describe the ability of composites to withstand a bending load and deformation before reaching their breaking point.

Table summarizes the results obtained from the flexural test. As a result of hybridization, excellent flexural properties were achieved. A flexural performance was recorded for the interwoven hybrid composites, at the untreated and treated conditions.

The increments of the flexural strength show that the interwoven hybrid composites were stronger and more rigid, in comparison with the individually woven composites.

Table.3 Flexural Strength Properties of Jute/Sisal and Flax/Sisal Inter woven type Hybrid Natural fiber:

Property	Condition	J/S	F/S
Flexural strength (Mpa)	Untreated	134* 23#	96* 118#
	Treated	139* 36#	126* 54#

*Sisal – warp direction, #Jute & Flax Weft Direction.

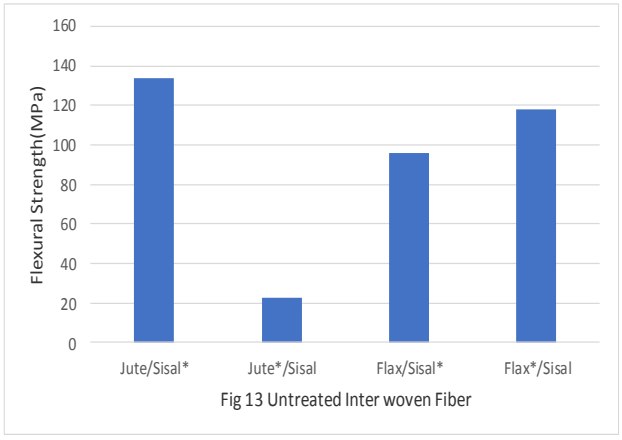


Fig 13 Untreated Inter woven Fiber

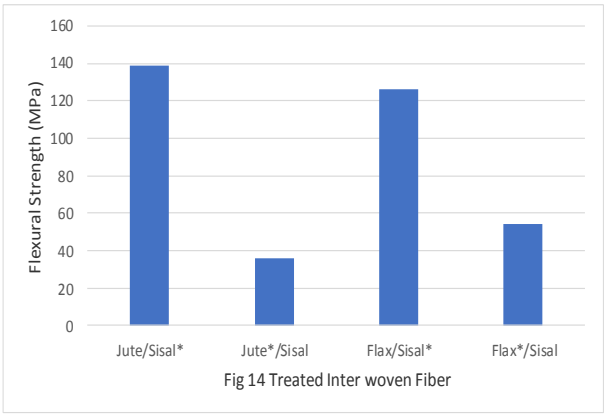


Fig 14 Treated Inter woven Fiber

 ISBN: 978-93-89107-36-4

CONCLUSIONS

The tensile, Flexural and impact mechanical properties of intraply hybrid composites, based on Epoxy, have been investigated. The interwoven jute/sisal, flax/sisal and jute/flax composites, and its effect on their mechanical properties, were investigated following. The conclusions from the experiment as follow:

1. The tensile strength of the interwoven jute/flax and flax/sisal hybrid composites were superior to those of the remaining interwoven composites due to the different load sharing properties.

2. A greater stress uptake in the interwoven jute/flax and flax/sisal hybrid composites was obtained by the interlocking structure between the fiber yarns; therefore, a larger load was required to break the structure. From this combinations, Maximum flexural strength was achieved in the jute/sisal treated interwoven hybrid composites.

REFERENCES

1. N. Venkateshwaran, A. Elaya Perumal , D. Arunsundaranayagam, 2013, Fiber surface treatment and its effect on mechanical and visco-elastic behaviour of banana/epoxy composite. Materials and Design 47, PP: 151–159.
2. G. Yuvaraj, B. Vijaya Ramnath, A. Abinash, B. Srivasan and R. Vikas Nair, 2016, Investigation of Mechanical Behaviour of Sisal Epoxy Hybrid Composites. Indian Journal of Science and Technology, Vol 9(34).
3. M. Thiruchitrambalam, A.Alavudeen, A.Athijayamani, N.Venkateshwaran and A.Elaya Perumal, 2009, Improving Mechanical Properties Of Banana/Kenaf Polyester Hybrid Composites Using Sodium Laulryl Sulfate Treatment. Materials Physics and Mechanics 8, PP: 165-173
4. Verma IK, Anantha Krishnan SR, Krishna Murthy S. Composites of glass/modified jute fabric and unsaturated polyester resin. Composites 1989;20:383–388.
5. Mohan R, Kishore, Shridhar, Rao RMVGK. Compressive strength of jute–glass hybrid fibre composites. Journal of Material Science Letters 1983;2:99–102.
6. Jochen Gassan Andrzej K.Bledzki, 1999, Possibilities for improving the mechanical properties of jute/epoxy composites by alkali treatment of fibres.
7. M.Ramesh K.Palanikumar K. Hemachandra Reddy, 2013, Comparative Evaluation on Properties of Hybrid Glass Fiber- Sisal/Jute Reinforced Epoxy Composites.
8. Winfield AG. Proceedings of second symposium on new fibres and composites, sponsored jointly by Dept. of Science and Technology, India, and UNIDO, January 10–11, 1977:31.
9. Arifuzzaman Khana GM, Teranoc M, Gafurb MA, Shamsul Alama M.2007, Studies on the mechanical properties of woven jute fabric reinforced poly(l-lactic acid) composites. J King Saud Univ Eng Sci 2013.
10. Seung Goo Leo, Sung-Seen Choi, Won ho Park, Donghwan cho, 2003, Characterization of surface modified flax fibers and their biocomposites with PHB. WILEY-VCH Verlag GmbH & KGaA, Weinheim. Macromol. Symp, 197, PP:89—99.
11. R Yahaya, SM Sapuan, M Jawaid, Z Leman and ES Zainudin Mechanical performance of woven kenaf-Kevlar hybrid composites. Journal of Reinforced Plastics and Composites 0(0), PP: 1–13.
12. Alessandro Pegoretti, Elena Fabbri, Claudio Migliaresi and Francesco Pilati, 2004 "Intraply and interply hybrid composites based on E-glass and poly(vinyl alcohol) woven fabrics: tensile and impact properties" Polym Int 53:1290–1297.
13. K. Mohan & T. Rajmohan, 2017, Fabrication and Characterization of MWCNT Filled Hybrid Natural Fiber Composites" Journal of Taylor Francis.
14. V. Manikandan, S. Richard, M. Chithambara Thanu, J. Selwin Rajadura 2015, Effect Of Fly Ash As Filler On Mechanical & Frictional Properties Of Jute Fiber Reinforced Composite. International Research Journal of Engineering and Technology (IRJET) Volume: 02 Issue: 07, PP:154-158.
15. A.B. Maslinda, M.S. Abdul Majid, M.J.M. Ridzuan, M. Afendi, A.G. Gibson, 2017, Effect of water absorption on the mechanical properties of hybrid interwoven cellulosic-cellulosic fibre reinforced epoxy composites. Composite Structures, Issue:167, PP: 227–237.

A Narrative Amalgam Algorithm for Job Shop Scheduling Problem

[1] Muthiah A, [2] S.Kalidass, [3] Muthusamy.K, [4] Sundarrajan.D

[1][2]Professor, [3][4] Assistant Professor

[1][2][3][4] Mechanical Engineering, P.S.R. Engineering College. Sivakasi, Tamilnadu, India

[1] amuthiah68@gmail.com

Abstract:

Job Shop Scheduling Problem (JSSP) is vital one of valid purpose of numerous sorts of production. Every job comprises of a sequence of processes to be practiced in a predetermined order, on particular machines, and amid a continuous period. An effective amalgam algorithm based on (LO) and (FFO) is planned for tackling the smallest value of makespan in JSSP. The point is to discover a distribution for every process and to characterize the succession of processes to reduce the makespan. In this proposed few yardstick problems are utilized to discover the makespan in JSSP. From investigational results demonstrated that the hybrid optimization accomplishes optimal value and minimum completion time compared to individual algorithms FF and LO.

Keywords:

JSSP, Makespan, hybrid, Firefly Optimization, Lion Optimization

1. INTRODUCTION

Scheduling is the distribution of common assets after instance to challenging actions [1]. It has a lot of writing in the processes explore field [2]. Beginning the perspective of scheduling, the assets and everyday jobs are regularly alluded to as machines and jobs and the ordinarily utilized execution assess is the finishing the times of jobs [3]. JSSP be a standout amongst the vital fields in manufacturing optimization where an arrangement of n jobs must prepare on a set of m indicated machines [4]. Every job comprises of a particular arrangement of processes, which must be handled by a particular order [5]. The problem, known to be emphatically NP-hard, is to succession processes on the machines so the greatest completion time general jobs (Cmax) are reduced [6]. For its unequivocally NP-hard nature, numerous proficient optimization strategies are created to get almost ideal arrangements [7]. In addition, many research consequences of the JSSP demonstrate that it is hard to get a sufficient arrangement just by single inquiry plot [8]. Motivated by these points of view, a narrative amalgam algorithm for JSSP in light of lion with firefly optimization algorithm.

2. OBJECTIVES

- To reduce the makespan time and maximal machine workload in JSSP process.
- To develop the schedule of the proposed approach amalgam optimization algorithm is utilized.

3. PROPOSED METHODOLOGY

JSSP is an incredibly significant realistic problem in the two fields of manufacture engineering and combinatorial optimization. It comprises of scheduling to reduce the makespan To solve such a JSSP, a amalgam algorithm, to be specific FF-LOA, in light of FireFly and Ant Lion Optimization. The proposed hybrid algorithm (FF-LOA) is a decent system for such benchmark scheduling problems. At long last, the impact of constraints on the proposed algorithm is analyzed and talked about with respect to how to choose the parameters. The test result affirmed its training and adequacy. The results demonstrate that the planned amalgam algorithm is well-organized and successful gizmo for JSSP.

4. OBJECTIVE FUNCTION

A good schedule is one that limits the total amount of time machines are inactive. The Minimum of fitness is thought to be the best fitness and the fitness equivalent to the solution is said to be the optimal solution for the makespan time minimization process. To assess the fitness function of each subjectively delivered the optimization fitness a function is as:

$$F_i = \min(N(t)) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$N(t) = \min(T_{i-1,\,j}, T_{i,\,j-1}) + T_{i,\,j} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, $N(t)$ is the makespan time, T is the processing time, i is the job order and j is the machine order.

 ISBN: 978-93-89107-36-4

5. PROPOSED HYBRID MODEL (FF-LOA)

A amalgam optimization algorithm is planned for the problem of verdict the lowest makespan in the JSS condition. The JSSP can redress and the performance will develop to an amazing by completing the planned amalgam FF-LOA.

Computational results of Job shop scheduling demonstrated that the amalgam algorithm provides an optimal solution when contrasted and the individual outcomes. The accompanying fig1 demonstrates the amalgam approach for the FF-LOA procedures.

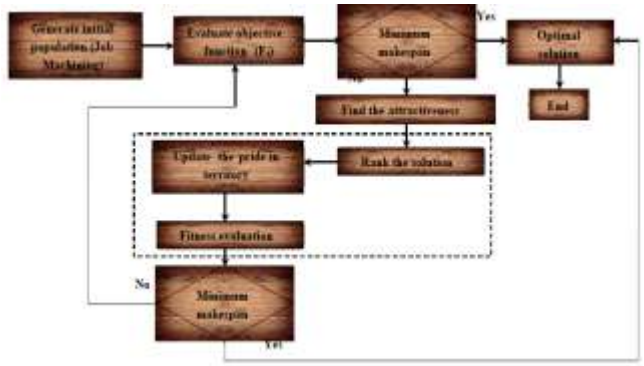


Fig 1: Flowchart for our hybrid approach

Table 1: Makespan time designed for different Problems

Benchmark Problem	dimension	Makespan time	Optimization Technique		
			FF	LOA	Hybrid Technique (FF-LOA)
ft10	(10x10)	930	927	928	***923***
la01	(10x5)	666	666	666	***658***
la02	(10x5)	655	652	653	***649***
la03	(10x5)	597	596	594	***590***
la04	(10x5)	590	584	590	***583***
la15	(10x5)	1207	1207	1205	***1202***
la30	(20x10)	1355	1354	1355	***1352***

6. RESULT AND ANALYSIS

The proposed JSSP with optimization method for minimizing the completion time is finished by using MATLAB. The following FT10 (10*10), LA01 (10*5), LA02 (10*5), LA03 (10*5), LA04 (10*5), LA15 (20*5), and LA30 (20*10) different standard dilemmas make use of getting the lowest time.

Table 1 depicts the makespan time for seven benchmark problems and finds the minimum makespan value by comparing three types of optimization techniques. For the comparison of optimization techniques to the experimental result, the hybrid optimization reaches the minimum completion time. The optimal value gets in LA04 (10*5) benchmark problem.

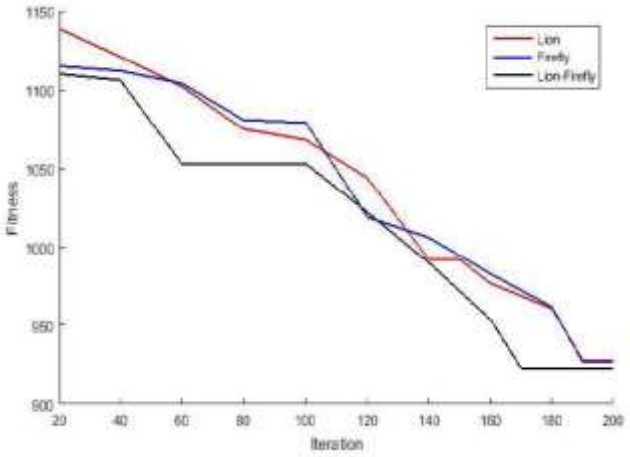


Fig 2: convergence graph for FT10

Fig 2 depicts the convergence graph for benchmark problem FT10 based on increasing iterations. If the iteration value increases the fitness will be changed randomly for all the three approaches. The minimum fitness value attains after reaching the 170th iteration and the optimal value gets in hybrid optimization only when compared to FF-LOA.

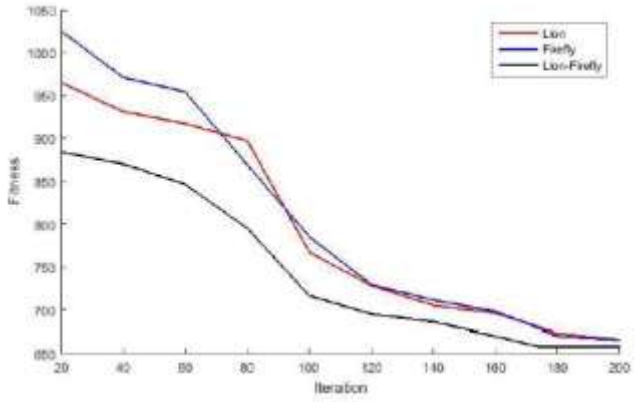


Fig 3: convergence graph for LA01

Fig 3 shows the convergence graph for benchmark problem LA01. The fitness value is reduced while increasing iterations. The minimum fitness value reaches in hybrid algorithm compared to LOA and firefly algorithm. In LA01 the minimum makespan time as 658.

In LA02, the least makespan time as 652 in Antlion, 653 in Firefly and 649 in the hybrid algorithm. Based on this result, hybrid approach reaches the optimal value compared than individual algorithms. Fig 4 shows the convergence graph for LA02. This graph illustrates the fitness value for every optimization techniques

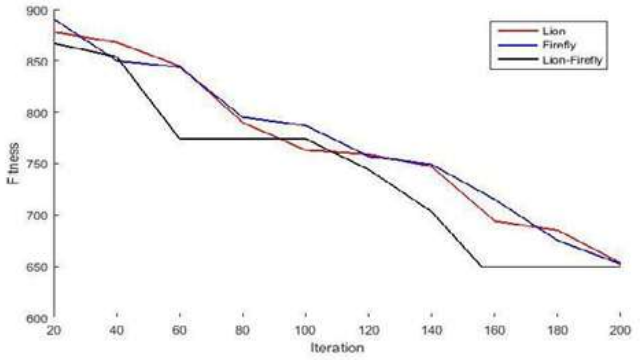


Fig 4: convergence graph for LA02

7. CONCLUSION

In this paper explored diverse benchmark problems specifically machines assess in JSSP by utilizing different optimization strategies. The execution of the proposed hybrid model (FF-LOA) was analyzed by comparing with separate algorithm LOA and FF. The outcome reasoned that the hybrid LOA-FF move toward for work arrangement method is fit for judgment for excellent jobs to the benefits and achieving the least finishing time. The minimum makespan accomplishes the benchmark problem as LA04 (10*5) i.e. 583 in hybrid FF-LOA. The amalgam can award better outcomes for limiting the traverse by taking care of JSSP. Henceforth, this examination can be reached out to incorporate different components introduce in a dynamic domain, which will be profoundly useful to the assembling business as the model will be illustrative of real-world situations.

REFERENCES

1. Jamili, A., Shafia, M.A. and Tavakkoli-Moghaddam, R., "A hybrid algorithm based on particle swarm optimization and simulated annealing for a periodic job shop scheduling problem", The International Journal of Advanced Manufacturing Technology, Vol.54, No.1, pp.309-322, 2011.
2. Giglio, D., Paolucci, M. and Roshani, A., "Integrated lot sizing and energy-efficient job shop scheduling problem in manufacturing/remanufacturing systems" Journal of Cleaner Production, Vol.148, pp.624-641, 2017.
3. Du, H., Liu, D. and Zhang, M.H., "A Hybrid Algorithm Based on Particle Swarm Optimization and Artificial Immune for an Assembly Job Shop Scheduling Problem", Journal of Mathematical Problems in Engineering, 2016.
4. Tang, J., Zhang, G., Lin, B. and Zhang, B., "A hybrid algorithm for flexible job-shop scheduling problem", Procedia Engineering, Vol.15, pp.3678-3683, 2011.
5. Özgüven,C.,Özbakır,L.andYavuz, Y., "Mathematical models for job-shop scheduling problems with routing and process plan flexibility", Journal of Applied Mathematical Modelling, Vol.34, No.6, pp.1539-1548, 2011.
6. Pal, S.K., Rai, C.S. and Singh, A.P., "Comparative study of firefly algorithm and particle swarm optimization for noisy non-linear optimization problems", International Journal of intelligent systems and applications, Vol.4, No.10, p.50, 2012.
7. Babers, R., Hassanien, A.E. and Ghali, N.I.," A nature-inspired metaheuristic Lion Optimization Algorithm for community detection", In Computer Engineering Conference (ICENCO), 2015 11th International, pp. 217-222, 2015.
8. Yang, X.S. and He, X., "Firefly algorithm: recent advances and applications", International Journal of Swarm Intelligence, Vol.1, No.1, pp.36-50, 2013.
9. Wang, B., Wang, X., Lan, F. and Pan, Q., "A hybrid local-search algorithm for robust job-shop scheduling under scenarios", Journal of Applied Soft Computing, Vol.62, pp.259-271, 2018.
10. Giglio,D.,Paolucci, M. and Roshani, A., "Integrated lot sizing and energy-efficient job shop scheduling problem in manufacturing/ remanufacturing systems", Journal of Cleaner Production, Vol.148, pp.624-641, 2017.
11. Yelghi, A. and Köse, C., "A modified firefly algorithm for global minimum optimization", Journal of Applied Soft Computing, Vol.62, pp.29-44, 2018.

High-Utility Pattern Mining by Removing Recurrent Patterns

[1] M.S.Bhuvaneswari, [2] S.Kavitha, [3] N.Balaganesh

[1][2][3] Mepco Schlenk Engineering College (Autonomous), Sivakasi, Tamil Nadu, India
[1] bhuvaneswari@mepcoeng.ac.in, [2] kavilaya9616@gmail.com, [3] balaganesh.nallathambi@gmail.com

Abstract:

High Utility Itemset Mining (HUIM) algorithm is implied uniquely to identify maximum utility for an itemset at a particular time, yet it can't be utilized to discover itemsets that produce high utility. Such high utility itemsets are discovered for the products which may merchandise well for specific season but may not sell well for other time intervals. In this paper we have utilized the LHUIMiner to locate the particular time interim at which the pattern has high utility . The PHUI Miner algorithm is used for finding time interval where some products are sold with unusual profit. To remove the recurrent itemsets found within the same time window we have proposed a new algorithm Closed High Utility Itemset mining algorithm. The Closed High Utility Itemset Mining(CHUI) reduces the itemsets within specific time interval and reduces the processing time and memory usage.

Keywords:

Frequent Itemset Mining, High Utility Itemset, Peak High Utility Itemset, Closed High Utility Itemset

1. INTRODUCTION

Frequent Itemset Mining(FIM) identifies all group of items that occur repeatedly within user defined threshold. FIM believes that all items in the database are essential and can occur just one time in each sequence. To overcome this HUIM a method to find high profit patterns, is utilized to locate the arrangement of things that produce high benefit or it is of high significance to the user. HUIM is commonly considered as a more convoluted issue than FIM as the utility measure utilized in HUIM isn't hostile to montonic contrasted with the support utilized in FIM. The standard FIM cannot be straight forwardly utilized in HUIM to upgrade the pursuit gap. HUIM Two Phase calculation[1] ascertains an maximum limit on the utility measure to advance the hunt gap. The issue of HUIM isn't intended to discover model that clarifies how the utility of itemsets temporaly changes.

To distinguish the itemsets which are beneficial in obscure timespans, another kind of model Local High profit patterns Mining was proposed. It gives an approach to discover itemsets that gives an utility which is more noteworthy than the client indicated limit, inside at least one time interim having a most reduced time length. LHUI-Miner is an algorithm that expands the HUI-Miner algorthim to mine local high utility itemsets. For instance to discover timeframes where client spends part of cash for the items.

Peak High Profit patterns PHUI [2] deals with identifying the timeline where an itemsets has utility higher the usual profit. For example to find time interval where some items are sold together and produce profit more than the usual such as selling schoolbags and notebooks during reopening of school.

HUIM algorithm tolerate from long response times and even problem to execution due to large storage. The issues are solved by Closed High Utility Itemsets(CHUIs) Mining. The possibility of CHUI brief the idea of shut model from FIM.A CHUI is laconic by providing lossless representation result to the user.

2. RELATED WORK

Frequent Itemset Mining(FIM) is a famous system for discovering itemset which are over and over obtained by customer[4]. Apriori algorithm examines the hunt gap of itemsets utilizing an expansiveness breadth-first search. The set of items is received by scanning the database and only repeated item are displayed to the user. Apriori does not take into consideration the whole search gap of frequent itemsets. The obstacle for using Apriori is that it several times reviews the database.

The Elcat algorithm [5] is a FIM algorthim, to overcome the problem in Apriori.The Elcat algorithm review the database once to make a column for each item denoting the transaction where it occurs. If an itemset has more than one item the columnar structure can be obtained without scanning the database by connecting the column of two of its subgroups. Elcat explore pursuit space of itemsets by depth first search.

High Utility Itemset Mining(HUIM) finds out group of items creating large profit in a transactional information [6]. To identify the relation between the items that yields high profit and occur in multiple transaction, a Sequential rule algorithm HUSRM was proposed [7]. High utility consecutive example mining[8] proposed a tight upper

bound on the utility of the itemsets to enhance the hunt space challenge. CRoM was used for pruning the itemsets before generation of appropriate patterns.

In [9] various least utility limit was utilized as opposed to utilizing single utility as everything is unique and they can't be treated likewise. To satisfy HUIM with numerous minimimum utility limit (HUIM-MMU), another sorted downward closure (SDC) property and least minimum utility threshold (LMU) was proposed.

The periodic high-utility itemsets mining [10] gain knowledge of itemsets that are now and again purchased by buyer and yield a high profit. The objective of short-period high-utility itemsets (SPHUI) is to distinguish designs that are engaging both as far as time interim and utility.

The time decaying model [11], calculation decrease the utility of transactions under to allot greater weights to latest data as against to those of oldest. The algorithm periodically refresh the utility of the data in its data structure and cuts the nodes whose utility values is smaller than the thresholds. Maintains a sensible storage by removing unwanted storage space.

A discriminative algorithm called CDSPM (Conditional Discriminative Sequential Pattern Mining) was proposed by to resolve the subgroup-induced recurrent issue. [13] proposed a technique for finding high utility itemsets from the transaction database which includes items with negative profit. [14] made use of the sequence tree for mining high utility sequences.

Utilized the stream rather than the static databases and utilized a high normal utility pattern digging system for recognizing the examples of intrigue.

Top-k co-occurrence items were discovered from the sequential database [16] by directly examining the database in linear order to find the number of times an item has occurred. Using vertical approach mining(VAM) and vertical with index approach mining(VIAM) the searching gap in the database was reduced.

Episode mining and episode rule mining are used to identify a episodes with larger event count and confidence in a single sequence pattern [17]. [18] proposed a method to mine sequential rules from more than one sequential dataset.

3. SYSTEM DESIGN

The entire process involved in the system is shown in Fig.1. The modules involved are i) Peak High Utility Itemset Mining (PHUIM) ii) Closed High Profit Sequence Mining. The peak high utility itemset produced by PHUIM is given as input to the CHUIM which in turn removes the recurrent itemsets within the same time window and produces closed high utility itemsets.

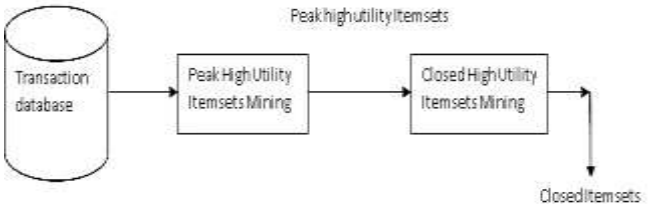


Fig 1. System Design

A. Peak High Utility Itemset Mining(PHUIM)

The PHUIMiner algorithm proposed in [2] is used for finding the peak high utility itemset. PHUI manages finding the time gap where a pattern has profit higher than the standard benefit. The idea of focal moving normal hybrid is utilized to discover the beginning and ending timespan where the benefit of itemsets is a lot higher than the standard thing.

Consider a transaction database as shown in Table 1. For instance, (b, 1) specifies that the name of the item is b and 2 represents the number of the items sold. Timestamps specifies the month during which the items were sold. Table 2 is the utility table where Utility represents the profit of selling the item(profit/unit).

Table 1 Transaction database

TID	Itemsets	Timestamps
1.	(b,1), (c,2), (d,1), (e,1)	M1
2.	(a,4), (b,1), (c,3), (d,1), (e,1)	M3
3.	(a, 4), (c,2), (d,1)	M3
4.	(c,2), (d,1), (e,1)	M5
5.	(a,5), (b,2), (d,1), (e,1)	M6
6.	(a,3), (b,4), (c,1), (d,2)	M7
7.	(c,1), (d,5)	M9

Table 2 Utility Table

Item	a	b	c	d	e
Utility	5	2	3	5	4

Let $D=\{d_1,d_2,....d_n\}$be a set of items(itemset). Each transaction(T) has a unique identifier(tid). The utility of an itemset D in transaction T (u(D,T)) is the sum of the utilities of all the items contained in D that appears in T. The utility of itemsets u(D) is sum of the utilities of D in all the transactions in database. Remaining utilityof an itemset D(rem(D)) is defined as the sum of u(D) and the utilities of the remaing items that occur in the transactions were D occurs.

Example 1: The utility of itemset {c,e} can be calculated as follows:

{c,e} occurs in transaction t1,t2 and t4 , hence u({c,e},)= (2* 3)+(1*4)+(3*3)+(2*4)+(2*3)+(1*4) = 38

Example 2: The remaining utility of {c,e} can be computed as

 ISBN: 978-93-89107-36-4

follows:

u({c,e})= 35

{c,e} occurs in transactions t1,t2,t4

The utilities of items(b,d) other than c and e in t1=1*2+1*5=7 The utilities of items(a,b,d) other than c and e in t2=4*5+1*2+1*5=27

The utilities of items(d) other than c and e in t4=1*5=5

rem({c,e}) = 38 +(7+27+5)

= 77

Extended Utility List(EUL) Structure:

It is used for storing the information about the itemset . The database is scanned and EUL is constructed for each item in the dataset. The items are combined and EUL is constructed for the newly formed itemset and the process is repeated. The EUL can be utilized for identifying the PHUI without scanning the database. The EUL of item a for the util period(M3,M7)is given in Table 3.

Table 3 EUL(a)

Tid	u(a,Tid)	rem(a)
T2	20	20
T3	20	11
T5	25	13
T6	15	21

The algorithm for finding peak high utility itemset is given below:

Algorithm findPHUI
Input :
D: an itemset , $\bar{D}$: extensions of D,
$\bar{D}x$: expanding D with an item x,
$\bar{D}y$: expanding D with an item y ,
MinUtil: a user-specified threshold,
windlength : a window length threshold ,
Extendsof$\bar{D}x$: *extension of* $\bar{D}x$,
Eul:extends of utility list ,
β: threshold
Output: The set of max high utility itemsets and their maximum periods.

1. For each itemset $\bar{D}x \in \bar{D}$ do
2. If $\bar{D}x$.Eul.inutilPeriods ≠ Ø
then output $\bar{D}x$ with $\bar{D}x$ .Eul.inutilPeriods;
3. If $\bar{D}x$.Eul.utilPeriods ≠ Ø then
4. Extendsof$\bar{D}x$ ← Ø ;
5. For itemset $\bar{D}y \in \bar{D}$ such that $\bar{D}y > \bar{D}x$ do
6. $\bar{D}xy$.Eul ← generate($\bar{D}$, $\bar{D}x$, $\bar{D}y$)
7. generatePeaks ($\bar{D}xy$, MinUtil, windlength, β);
8. Extendsof$\bar{D}x$ ← $\bar{D}x$ U $\bar{D}xy$;
9. End
10. findPHUI($\bar{D}x$, Extendsof$\bar{D}x$,MinUtil, windlength);
11. End
12. End

B. Closed High Utility Itemset Mining(CHUIM)

The peak high utility itemsets produced by PHUIM is given as input to the CHUIM. It deals with identifying closed high utility itemsets from the PHUI for each peak window. If n peak itemsets are there within the timewindow [i, j] and m itemsets are there within the timewindow [k,l] then CHUIM is applied first to itemsets in time window[i,j] then to itemsets in window[k,l]. If peak itemset has a superset within the same time window and the difference in utility(profit) between them is above a threshold then the superset is added to the list of closed high utility itemset. If the difference is below a threshold then subset is added to the list of closed high utility itemset. The CHUIM is applied to all the peak windows and the closed high utility itemsets in each peak window is obtained. The process is repeated once again for the peak window until there is no change in the itemsets identified in the peak windows.

Algorithm find CHUI
Input: PHUI- Peak High Utility Itemsets
Output: Closed High Utility Itemsets(CHUI) with peak window

```
1.MinUtil=30;
2.CHUI={}
3. D←constructSubset(D); //groups itemsets within same
                          peak window
4.for p in D
5. D' = itemsets in p
6. while |D'| >1 do
7.  for d1 in D':
8.   for d2 in D':
9.    if d1!=d2 and
       d1.start index== d2. start index and
       d1.end index== d2.end index do
10.        if d1 ⊆ d2 || d2 ⊆ d1 do
11.          diff= |util(d1)- util(d2)|
12.          if diff < Minutil;
13.           if |d1|< |d2|
14.              D'= D'- {d1}
15.              CHUI+={d1}
16.           else if |d2| < |d1|
17.              D'= D'-{d2}
18.              CHUI+={d2}
19.          else
20.           if |d1|< |d2|
21.              D'= D'- {d2}
22.              CHUI+={d2}
23.           else if |d2| < |d1|
24.              D'= D'-{d1}
25.              CHUI+={d1}
26.          end
27.
28.   end
29.  end
30.  end
31. end
32.return CHUI
```

CHUIM is used for finding itemsets which yields more utility at peak window. This reduces the number of redundant temsets and it turn reduces storage and processing time.

 ISBN: 978-93-89107-36-4

4. RESULTS AND DISCUSSION

The proposed Closed High utility Itemset Mining Algorithm is tested on Kosarak and Retail dataset collected from:

https://philippe-fournier-viger.com/spmf/index.php?link=d atasets.php

The kosarak dataset consists of 33330 transactions and the Retail dataset consists of 80915 transactions.

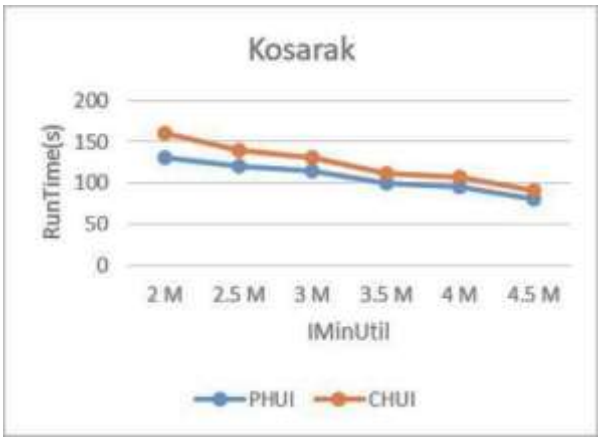


Fig 2a. IMinUtil vs RunTime for Kosarak dataset

Fig 2b. IMinUtil vs RunTime for Retail dataset

Fig 2a, 2b shows the runtime for different lMinUtil values in Kosarak ans Retail dataset.The runtime to find CHUI is more compared to that of the PHUI as it has to compute PHUI then CHUI.

Fig 3a and 3b represents the number of itemsets generated for different lMinUtil values in Kosarak and Retail datasets.As the lMinUtil value increases the number of itemsets decreased.

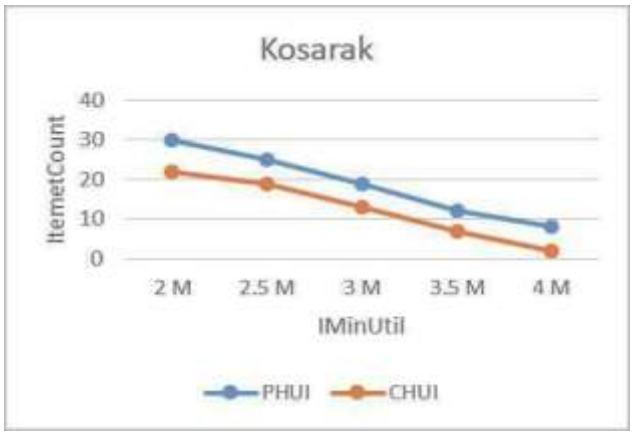


Fig 3a. IMinUtil vs ItemCount for Kosarak dataset

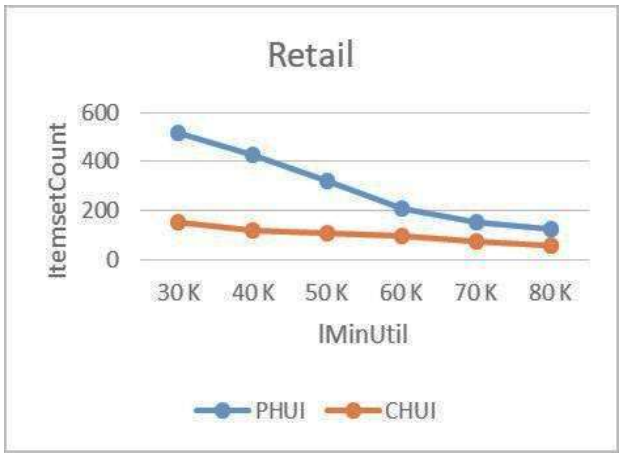


Fig 3a. IMinUtil vs ItemCount for Retail dataset

The storage space (MB) utilized by the itemsets generated by PHUIM and CHUIM is given in Table 4. The memory consumed by the closed high utility itemset is less compared to peak high utility itemsets.

Table 4 Memory Usage

DataSet	Memory Usage(MB)	
	PHUI	CHUI
Retail	320	115
Kosarak	80	30

CONCLUSION

To discover the pinnacle high utility itemset with pinnacle window PHUIMiner algorithm is utilized. As there may be repetitions in the itemset generated CHUIM algorithm is used to find the closed high utility itemset within same peak window. Closed High Utility Itemsets Mining(CHUIM) utilize the Eul structure which decides the entire arrangement of CHUIs in the entire database without creating any applicants. CHUIs is laconic and produces lossless reprenstation to the user.

REFERENCES

1. Liu, Y., Liao, W., Choudhary, A.: A two-phase algorithm for fast discovery of high utility itemsets. In: Proc. 9th Pacific-Asia Conf. on Knowl. Discovery and Data Mining, pp. 689–695 Springer, Hanoi (2005)
2. Fournier-Viger, P., Zhang, Y., Lin, J. C.W., Fujita, H., Koh, Y.S. (2019). Mining Local and Peak High Utility Itemsets. Information Sciences, Elsevier, 481: 344-367
3. Liu, M., Qu, J.: Mining high utility itemsets without candidate generation. In: Proc. 22nd ACM Int. Conf. Info. and Know. Management, ACM, pp. 55–64 (2012)
4. Agrawal, R., Srikant, R.: Fast algorithms for mining association rules in large databases. In: Proc. 20th Int. Conf. Very Large Databases, pp. 487–499, Morgan Kaufmann, Santiago de Chile (1994)
5. Zaki, M. J.: Scalable algorithms for association mining. IEEE Trans. Knowl. Data Eng. 12(3), 372–390 (2000)
6. Zida, S., Fournier-Viger, P., Lin, J. C.-W., Wu, C.-W., Tseng, V.S.: EFIM: A Highly E_cient Algorithm for High-Utility Itemset Mining. In: Proc. 14th Mexican Int. Conf. on Artificial Intelligence, pp. 530–546, Springer (2015)
7. Zida, Souleymane & Fournier Viger, Philippe & Wu, Cheng-Wei & Lin, Chun-Wei & S. Tseng, Vincent. (2015). Efficient Mining of High-Utility Sequential Rules. 157-171. 10.1007/978-3-319-21024-7_11
8. Alkan, O. K., Karagoz, P.: Crom and huspext: Improving eficiency of high utility sequential pattern extraction. IEEE Trans. on Knowledge and Data Engineering, 27(10), 2645–2657, (2015)
9. Jerry Chun-Wei Lin, Wensheng Gan, Philippe Fournier-Viger, and Tzung-Pei Hong. 2015. Mining High-Utility Itemsets with Multiple Minimum Utility Thresholds. In Proceedings of the Eighth International C* Conference on Computer Science & Software Engineering (C3S2E '15). ACM, New York, NY, USA, 9-17. DOI: https://doi.org/10.1145/2790798.2790807
10. Lin, J. C. W., Zhang, J., Fournier-Viger, P., Hong, T.P., Zhang, J.: A two-phase approach to mine short-period high-utility itemsets in transactional databases. Advanced Engineering Informatics, 33, 29–43 (2017)
11. Kim, Donggyu & Yun, Unil. (2016). Mining high utility itemsets based on the time decaying model. Intelligent Data Analysis. 20. 1157-1180. 10.3233/IDA-160861
12. He, Zengyou & Zhang, Simeng & Gu, Feiyang & Wu, Jun. (2018). Mining Conditional Discriminative Sequential Patterns. Information Sciences. 478. 10.1016/j.ins.2018.11.043
13. Philippe Fournier-Viger and Souleymane Zida. 2015. FOSHU: faster on-shelf high utility itemset mining -- with or without negative unit profit. In Proceedings of the 30th Annual ACM Symposium on Applied Computing (SAC '15). ACM, New York, NY, USA, 857-864. DOI: https://doi.org/10.1145/2695664.2695823
14. Yin, Junfu & Zheng, Zhigang & Cao, Longbing. (2012). USpan: An efficient algorithm for mining high utility sequential patterns. KDD 2012. 10.1145/2339530.2339636
15. Yun, Unil & Kim, Donggyu & Yoon, Eunchul & Fujita, Hamido. (2017). Damped Window based High Average Utility Pattern Mining over data streams. Knowledge-Based Systems. 144. 10.1016/j.knosys.2017.12.029
16. Tung Kieu, Bay Vo, Tuong Le, Zhi-Hong Deng, and Bac Le. 2017. Mining top-k co-occurrence items with sequential pattern. Expert Syst. Appl. 85, C (November 2017), 123-133. DOI: https://doi.org/10.1016/j.eswa.2017.05.021
17. Heikki Mannila, Hannu Toivonen, and A. Inkeri Verkamo. 1997. Discovery of Frequent Episodes in Event Sequences. Data Min. Knowl. Discov. 1, 3 (January 1997), 259-289. DOI: https://doi.org/10.1023/A:1009748302351
18. Harms, S.K., Deogun, J.S., & Tadesse, T. (2002). Discovering Sequential Association Rules with Constraints and Time Lags in Multiple Sequences. ISMIS

Experimental Investigation on Strength Characteristics of Concrete Partially Replaced with Seashells and Coconut Shells as Coarse Aggregates

[1] Rajkumar R, [2] Priyadharshini K.P, [3] Kamaleswari T, [4] Kavya L, [5] Vishvaa R.S

[1] Associate Professor (Senior Grade), [2] Student Alumni, [3][4][5] Undergraduate Student
[1][2][3][4][5] Department of Civil Engineering, SSN College of Engineering, Chennai, India
[1] rajkumarr@ssn.edu.in

Abstract:

This study involves partially replacing seashells and coconut shells as coarse aggregates in varying proportions individually and testing their properties like Compressive Strength and Tensile Strength. Various properties of the sea shells and coconut shells were determined. The study involved preparation of 5 samples for each sea shell and coconut shell of varying proportion. The 28 day compressive strength and tensile strength were tested using the Compressive Strength test and Split Tensile test, and an optimum percentage of replacement was determined. The 7 day compressive strength and split tensile strength were studied for the optimum percentage replacement to determine the early strength developed. As a result of these tests, it was determined that 20% replacement was the optimum replacement ratio for sea shells and 10% replacement was the optimum replacement ratio for coconut shells. Graphs were plotted to compare the strength variations of both the shells and a detailed comparative analysis was carried including cost analysis and analysis of variation in strengths.

Keywords:

Seashells, Coconut shells, Compressive Strength, Tensile Strength

1. INTRODUCTION

Concrete has proved to be a versatile material in the construction of structures due to the possibility of moulding it into virtually any shape and geometry. Utilizing this formable nature of the material, concrete architecture has made rapid progress in the recent year. The basic constituents of concrete are cement, water and aggregate (and selected additives). Aggregates are usually described as inert "filler" material of either fine (sand) or coarse (stone) variety. Aggregate tends to represent a relatively high volume percentage of concrete. To minimize the cost of the materials, alternatives have been used for the conventional materials. Recent investigation of Indian sea shells has indicated greater scope for their utilization as a construction material. Greater utilization of seashells will lead to not only saving such construction material but also assists in solving the problem of disposal of this waste product. In addition to sea shells, the concrete with ground coconut shell was found to be more durable in terms of its resistance in water, acidic, alkaline and salty environment. Coconut shell being a hard and not easily degradable material if it is crushed to size of sand can be a potential material to substitute sand. As modern engineering practices become more demanding, there is a corresponding need for special types of materials with novel properties. For reducing the cost of concrete, greater use of pozzolanic materials like fly ash and blast furnace slag was suggested for the cement. While sea shells, glass and ceramic material were used as a replacement for fine aggregates and palm kernel shells, coconut shells and sea shells were used as a replacement for coarse aggregate.

As a part of integrated solid waste management plan that includes recycle, reuse and recovery, the disposed solid waste representing unused resources, may be used as low cost materials. Presently in India, about 960 MT of solid wastes are being generated annually as by-products. It is reported that about 600 MT of wastes have been generated in India from agricultural sources alone. The use of these materials as the substitute material in concrete would reduce the disposal problem now faced by thermal power plants and industrial plants, agricultural areas and at the same time achieving the required strength of concrete. Already many investigations have been going on the partial replacement of coconut shells in place of coarse aggregate. In the present investigation sea shells and coconut shells has been used individually as partial replacement of coarse aggregate. Almost all over the world various measures aimed at reducing the use of primary aggregates and increasing reuse and recycling have been introduced. As a result, in developing countries like India, the informal sector and secondary industries recycle 15–20% of solid wastes in various building materials and components.

 ISBN: 978-93-89107-36-4

1.1 Coconut Shell

Coconut is the primary contributor to the nation's pollution problem as a solid waste in the form of shells, which involves an annual production of approximately 3.18 million tonnes. It also presents serious disposal problems for a local environment, is an abundantly available agricultural waste from local coconut industries. The chemical composition of the coconut shell is similar to wood. It contains 33.61% cellulose, 36.51% lignin, 29.27% and ash at 0.61%. In developing countries, where abundant coconut shell waste is discharged, these wastes can be used as potential material or replacement material in the construction industry.

Properties of Coconut Shell

Coconut shell has high strength and modulus properties. High lignin content make the composites more weather resistant. It has low cellulose content due to which it absorbs less moisture as compare to other agricultural waste. Coconut shells have good durability characteristics, high toughness and abrasion resistant properties. Attempts have been taken to utilize the coconut shells as coarse aggregate and develop the new structural Light Weight Concrete (LWC).

1.2 Seashell

A seashell also known simply as a shell is a hard, protective outer layer created by an animal that lives in the sea. The shells are empty because the animal has died and the soft parts have been eaten by another animal or have decomposed. A seashell is usually the exoskeleton of an invertebrate , and is typically composed of calcium carbonate or chitin. Most shells that are found on beaches are the shells of marine mollusks.

1.2.1 Properties of Seashells

It has high content of Calcium Carbonate so it contributes to the strength properties in concrete. It makes the concrete hard and a naturally available and non-bio degradable material.

2. METHODOLOGY

The following steps were carried out in the experiment.

2.1 Initial Testing

To arrive at mix design as per IS 10262 – 2009, the following tests were carried out. Tests conducted on fine aggregates are Water Absorption Test (by IS 2386 Part III – 1963), Sieve Analysis (by IS 2386 Part I – 1963) and Specific Gravity Test (IS 2386 Part III – 1963). Tests conducted on coarse aggregate are Water Absorption Test and Specific Gravity test as per IS 2386.

By using the results obtained in the above mentioned test, design mix for 0% is obtained as 1:1.57:2.58.As per design mix, the concrete is prepared. The water cement ratio was kept as 0.45.Cubes and cylinders were casted and cured and then the strength tests were conducted.

2.2 Compression Test

Compression test is carried out to find the compressive strength of the concrete. The compression test is carried out using a standard compression testing machine (CTM). Many standard codes recommend concrete sample cubes of size 150mm x 150mm x 150mm.The compressive strength of the cube is calculated and given by the following equation:

$$F_C = \frac{P}{A}$$

Where,

P is the Failure load of the Cube (N)

A is the loaded surface area of the cube (mm^2)

The average value of the compressive strength of the three cubes is taken.

2.3 Split Tensile Test

Tensile strength is the one of the important property of concrete as it very much affects the effect of size of cracking. The splitting tensile strength of the specimen can be calculated as follows:

$$T = \frac{P}{DL}$$

Where,

T is the splitting tensile strength (MPa)

P is the maximum applied load indicated by the testing machine (N)

D is the Diameter of the specimen (mm)

L is the Length of the specimen (mm)

3. RESULTS AND DISCUSSION

The use of naturally occurring shells as partial replacement in course aggregates has been gaining popularity over the years. Considering factors like low cost, easy availability and an effective means of waste disposal, the only point of contention was the strength factor of the shells studied. This study shows that the strength increases with increase in the proportion of sea shells up to certain limit. Beyond that limit the strength decreases as the bond formation becomes tougher owing to the slippery surface of the sea shells. Its compatibility as a coarse aggregate in concrete increases and it reaches an optimum concentration and then decreases with increase in the proportion further.

The optimum proportion of sea shells was observed to be 20%. On the other hand, the strength in Coconut shells concrete decreased. However it turned out to be an essential adoption when employed for low strength concrete scenarios. Coconut Shell concrete is cost effective, light

weight and eco-friendly and suffices where high strength in concrete is not required.

The optimum proportion of coconut shells was observed to be 10%.

4. COMPRESSION TEST RESULTS

Five cube specimens of size 150mm * 150 mm of grade M25 were tested.

4.1 28 days compressive strength for sea shell concrete

The cube compressive strength results of M25 grade mix at 28days made with various proportions of seashells were noted. Table 4.1 depicts the compressive strength of seashell concrete with respect to 28days. Test results were plotted in the form of graphs and shown in Fig 4.1.

Table 4.1 28days Average Compressive test results for sea shell concrete

Percentage of Seashells (%)	Average Compressive Stress(N/mm²)
0	26.07
10	27.11
20	29.06
30	23.47
40	21.31

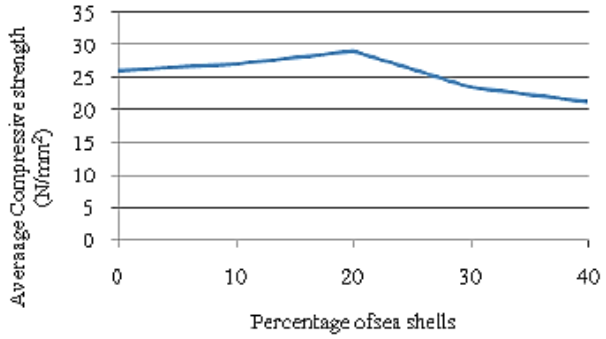


Fig. 4.1 Average Compressive Stress Analysis for Seashells

It is seen that compressive strength for M25 grade concrete was gradually increases from 26.07 to 29.06 for replacement of seashells up to 20%. After that compressive strength decreases with increase in percentage of seashells. So that the optimum proportion of seashell was found to be 20%.

4.2 7 days Compressive Strength of Seashell Concrete

Considering the 28 days compressive strength for seashell concrete, we find that 20% sea shell replacement is the optimum replacement ratio. Hence the 7 day strength is also checked for 20% replacement, to determine the early in the seashell concrete in comparison with the early strength developed in conventional concrete.

Table 4.2 7 days average compressive test results for sea shell concrete

Percentage of Sea Shells (%)	Average Compressive Stress(N/mm²)
0	17.48
20	16.88

4.3 28 days Compressive Strength for Coconut Shell Concrete.

The cube compressive strength results of M25 grade mix at 28days made with various proportions of coconut shells were noted. Table 4.3 depicts the compressive strength of coconut shell concrete with respect to 28days. Test results were plotted in the form of graphs and shown in Fig 4.2.

Table 4.3 28days Average Compressive test results for coconut shell concrete

Percentage of Coconut shells (%)	Average Compressive Stress(N/mm²)
0	26.07
10	24.29
20	20.15
30	18.81
40	15.85

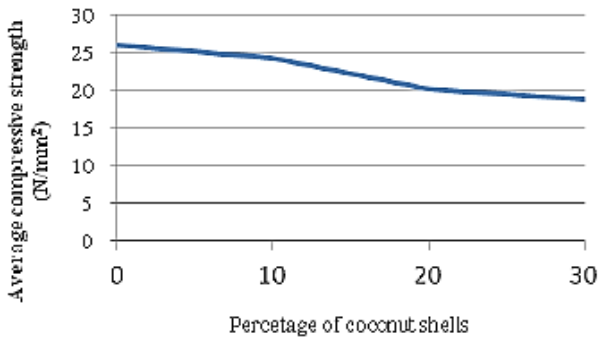


Fig 4.2 Average Compressive Stress Analysis for Coconut shell

It is seen that compressive strength for coconut shell concrete were gradually decreases with increase in percentage of coconut shell, so that optimum mix percentage is reduced to 10% in case of coconut shells.

4.4 7 days compressive strength for coconut shell

Considering the 28 days compressive strength for coconut shell concrete, we find that 10% coconut shell replacement is the optimum replacement ratio. Hence the 7 day strength is also checked for 10% replacement, to determine the early strength developed in the coconut shell

 ISBN: 978-93-89107-36-4

concrete in comparison with the early strength developed in conventional concrete.

Table 4.4 7 day Average Compressive Test Results for Coconut Shell Concrete

Percentage of Coconut shells (%)	Average Compressive Stress(N/mm^2)
0	17.48
10	14.96

5. SPLIT TENSILE TEST RESULTS

Five cylinder specimens of diameter = 150mm and height = 100 mm of grade M25 were tested for the tensile strength in the Universal Testing Machine. The specimens had sea shell and coconut shell respectively in ratio of 0%, 10%, 20%, 30% and 40%.

5.1 28 Days Tensile Strength for Seashell Concrete

The splitting tensile strength results of M25 grade mix at the age of 28days made with various proportions of seashells were observed. Table 5.1 depicts the tensile strength of seashell concrete at 28days. Test results were plotted in the form of graphs and shown in Fig 5.1.

Table 5.1 28 Days Average Tensile Test Results for Seashell Concrete

Percentage of Seashells (%)	Average Tensile Stress (N/mm^2)
0	3.20
10	2.31
20	2.58
30	2.16
40	1.83

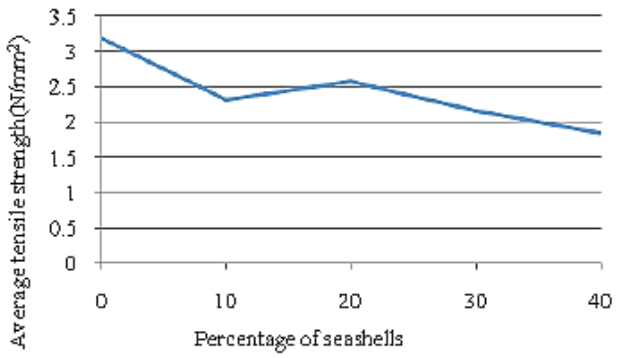


Fig 5.1 Average Tensile Stress Analysis for Seashell

It is observed from the graph that the splitting tensile strength for M25 concrete was decreased initially and increased at 20% replacement and again decreased with increase in percentage of seashell, so that the Optimum replacement of seashell was found to be 20% from the graph.

5.2 7 Days Tensile Strength for Seashell Concrete

Considering the 28 days tensile strength for seashell concrete, we find that 20% sea shell replacement is the optimum replacement ratio. Hence the 7 days strength is also checked for 20% replacement, to determine the early in the seashell concrete in comparison with the early strength developed in conventional concrete.

Table5.2 7 Day Average Tensile Test Results for Sea Shell Concrete

Percentage of Seashells (%)	Average Tensile Stress (N/mm^2)
0	2.07
20	1.69

5.3 28 Days Tensile Strength for Coconut Shell Concrete

The splitting tensile strength results of M25 grade mix at 28days made with various proportions of coconut shells were noted. Table 5.3 depicts the tensile strength of coconut shell concrete with respect to 28days. Test results were plotted in the form of graphs and shown in Fig 5.2.

Table 5.3 28 Average Tensile test results for Coconut shell concrete

Percentage of Coconut Shells (%)	Average Tensile Stress (N/mm^2)
0	3.20
10	2.45
20	2.213
30	1.84
40	1.65

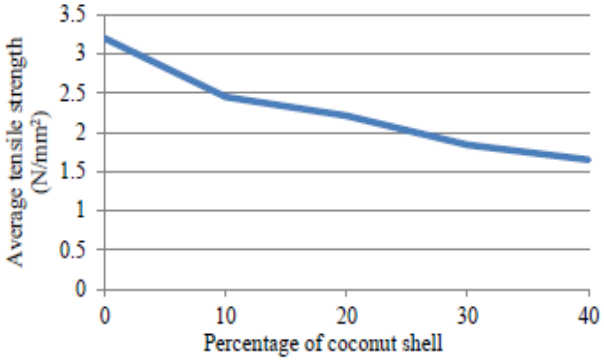


Fig 5.2 Average Tensile Stress Analysis for Coconut Shell

It is seen that tensile strength for coconut shell concrete gradually decreases with increase in percentage of coconut shell, so that optimum mix percentage is reduced to 10% in case of coconut shells.

 ISBN: 978-93-89107-36-4

5.4 7 Days Tensile Strength for Coconut shell Concrete

Considering the 28 days tensile strength for coconut shell concrete, we find that 10% coconut shell replacement is the optimum replacement ratio. Hence the 7 days strength is also checked for 10% replacement, to determine the early strength in the seashell concrete in comparison with the early strength developed in conventional concrete.

Table 5.4 7 days average tensile test results for coconut

Percentage of Coconut Shells (%)	Average Tensile Stress (N/mm^2)
0	2.07
10	1.64

6. COMPARATIVE ANALYSIS

A detailed comparative analysis was carried out including cost analysis and analysis of variation in strengths for both Seashell and Coconut shell concrete.

Table 6.1 Comparison of Properties of Concrete with coconut shell and sea shell

Concrete with Sea shell	Concrete with Coconut shell
Average cost of sea shells = Rs. 100/30kgs	Average cost of coconut shells = Rs.150/ 20kgs
Optimum mix percentage = 20%	Optimum mix percentage = 10%
Highest 28 day compressive strength= 29.06 N/mm^2	Highest 28 day compressive strength =24.29 N/mm^2
Highest 28 day tensile strength = 2.58 N/mm^2	Highest 28 day tensile strength = 2.45N/mm^2
Highest 7 day tensile strength = 1.69N/mm^2	Highest 7 day tensile strength = 1.64N/mm^2
Total cost for per metre cube Production (Optimum mix) = Rs.5200	Total cost for per metre cube Production (Optimum mix) = Rs.4800
Difficult to procure sea shell	Easy to procure coconut shell
Can be used as partial replacement for high strength concrete structures in optimal mix	Can be used as partial replacement for unimportant low strength concrete structures and light weight structures in optimal mix
Usage of sea shells does not have any major effect on the overall weight of the structure	Usage of coconut shells relatively reduces the overall weight of the structure

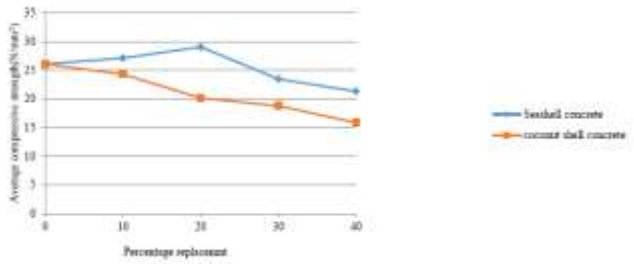


Fig 6.1 Comparison of 28days Compressive strength

7. CONCLUSION

1. Based on the test results obtained, it was determined that 20 % was the optimum proportion for sea shells with an average compressive stress of 29.06 N/mm^2 and average tensile stress of 2.58 N/mm^2
2. Based on the test results obtained, it was determined that 10 % was the optimum proportion for coconut shells with an average 28 day compressive stress of 24.29 N/mm^2 and average tensile stress of 2.45 N/mm^2
3. The possible reason for the lower strength in concrete with partial replacement with coconut shell is the lower density of coconut shells as compared to the density of sea shells Hence, as the strength obtained for sea shell is greater than that of conventional concrete it can be used as a partial replacement for heavy weight structures thus reducing the dependency on blue stone metal, and also providing an efficient method of marine waste disposal.
4. Coconut shell, though do not provide adequate strength help reduce the cost and weight of the concrete and thus prove to be an efficient replacement for light weight and unimportant low strength structure.
5. Usage of M – Sand also helps reduce the cost of the structure without considerably affecting the strength of the structure as compared with concrete prepared using river sand.

 ISBN: 978-93-89107-36-4

REFERENCES

1. Anwar, Abdullah, Sabih Ahmad, and Syed Aqeel Ahmed. (2016). "Performance of Waste Coconut Shell as Partial Replacement of Natural Coarse Aggregate in concrete." International Journal of Scientific & Engineering Research 7.8
2. Elliott Richardson, Alan, and Thomas Fuller (2013) "Sea shells used as partial aggregate replacement in concrete." Structural Survey 31.5: 347- 354.
3. Gunasekaran, K., P. S. Kumar, and M. Lakshmipathy. (2011): "Mechanical and bond properties of coconut shell concrete." Construction and building materials 25.1:92-
4. Kalyanapu Venkateswara Rao, (2015) A.H.L.Swaroop, Dr.P.Kodanda Rama Rao and Ch.NagaBharath, ―Study on strength properties of coconut shell concrete‖, International journal civil engineering and technology, vol.6, issue 3, pp 42-61.
5. Kanojia, Apeksha, and Sarvesh K. Jain. (2017) "Performance of coconut shell as coarse aggregate in concrete." Construction and Building Materials 140 : 150-156.
6. Yerramala, Amarnath, and C. Ramachandrudu. (2012) "Properties of concrete with coconut shells as aggregate replacement." International journal of engineering inventions 6: 21-31.
7. Nagalakshmi, R. (2013) "Experimental study on strength characteristics on M25 concrete with partial replacement of cement with fly ash and coarse aggregate with coconut shell." International journal of scientific & engineering research 4.1: 4373-4381
8. Olivia, Monita, Annisa Arifandita Mifshella, and Lita Darmayanti. (2015): "Mechanical properties of seashell concrete." Procedia Engineering 125 760-764.
9. Osarenmwinda, J. O., and A. O. Awaro. (2009) "The potential use of periwinkle shell as coarse aggregate for concrete." Advanced Materials Research. Vol. 62. Trans Tech Publications.

The Flood Mitigation System

[1] Mithun R , [2] Sruthi Nivaashini V, [3] Sahaya Shalmiya J, [4] Sangavisri I , [5] Likith Sai N

[1][2][3][4][5] UG student, Civil Engineering, PSG Institute of Technology And Applied Research, Coimbatore, India
[1] mithunfrozenfire@gmail.com, [2] v.sruthi31@gmail.com, [3] shalmiya1@gmail.com, [4] sangavisri30@gmail.com, [5] likhithsai222@gmail.com,

Abstract:

El-Nino refers to the cycle of warm and cold temperature of ocean currents,which is accompanied by high air pressure in the Western Pacific and low air pressure in the Eastern Pacific.Floods due to the El-Nino effects are widespread and seems to be inevitable in the 21st century. Such negative impacts increase day by day. Every year there are loss of habitats and destruction of human establishments mainly due to the unadvised actions of man. The aim of this project is to provide a Flood Mitigation System (FMS) which can be implemented to any class of the society. It can be used to protect individual establishments like schools,hospitals and malls or colony of houses. The main principle is to effectively distribute the flood water via channels that are closed during normal conditions. The area that has been studied to better understand the effects of floods is the Chembarambakkam Lake.During the South Indian Floods 2015,this lake was one of the greatest victims. The area affected by the overflowing of the lakes include the places that come under the town and the village panchayat. This method of mitigation protects the man-made property during floods and also reduces the risk of flooding. When the water is effectively distributed, the possibility of stagnant water is also eliminated which reduces the chance of flooding.

Keywords:

Flood Mitigation System (FMS), Barrier walls, Channel, Chembarambakkam, Geotextile, Hydraulic Piston

1. INTRODUCTION

Floods are the most common type of natural disasters globally and have claimed around 53,000 lives only in the past decade.They are usually associated with an abundant flow of water submerging dry land. More than 500 lives have perished from 8 November 2015 to 14 December 2015 due to the submergence of bridges that have been caused by floods.The major negative impact caused by floods is the effect it has on human lives. Apart from drowning other health effects include hypothermia,physical injuries and other chronic diseases like psychiatric comorbities. People living in areas that are overcrowded and congested are more prone to disease outbreaks like enteric fever, Hepatitis A and E. In addition to diseases, health facilities like hospitals become inaccessible to people which increase the number of deaths. Apart from loss of life and property, the other visible impacts are non-availability of clean drinking water, disruption in transportation and communication. The psychological consequences following a flood are usually high due to loss of property and lives. The property loss due to the Chennai floods have been estimated to have cost around INR 15,000 crores.

Chennai being a natural disaster zone received a rainfall of over 33 cm over a 24-hour period from December 1-2(2015).When the causes for the flood was analysed, the main reason that led to these floods was improper urbanisation and implementation of the existing mitigation methods. The drastic decrease in number of water bodies due to exploitation of wetlands is a hurdle for drainage of flood water. Heavy rain in the month of December caused due to the depression in Bay of Bengal is the major cause for Chennai floods, Chennai city along with other districts like Kancheepuram, Cuddalore and Tiruvallur recorded an average rainfall of 33-37 cm in the early days of December 2015.The rains and the overflow of Adyar river and the delay in opening dams caused havoc. The aftermath of the floods had a huge impact on the industrial and agricultural sectors.The extent of devastation caused by floods depends on the type of terrain and vulnerability of the people living in that particular region. This paper deals with the flood mitigation system for Chennai floods and highlights the measures that can be implemented to reduce further incidents.

2. STUDY AREA

The Chembarambakkam lake is located at 13.01158°N and 80.06063°E and extends to about 3800 acres.The study area mainly focuses on the Chembarambakkam lake and surrounding areas. The lake and the 6 village panchayats (Chembarambakkam, Kuthambakam, Narasingapuram, Kattrambakkam, Irungattukottai, Thirumudivakkam) and three town panchayats (Thirumalisai, Mangadu and Poonamalee) comprise of 22,415.33 acres. The scale adopted for this study is 1:236 (1cm of the base equals 236 acres of the actual ground area). The lake is primarily rain-fed. The Adyar river originates from the lake. The full capacity of the tank is 3645 mcft while the outflow is 24 cusecs. The full tank level is 85.40 ft and the lake has lost more than 40% of its water holding capacity due to acute

 ISBN: 978-93-89107-36-4

sedimentation. The delay in opening the sluice gates is the major cause for the havoc caused during the 2015 floods. The inflow and outflow data of the dam in Chembarambakkam on December1,2015 as shown in Table 1.0

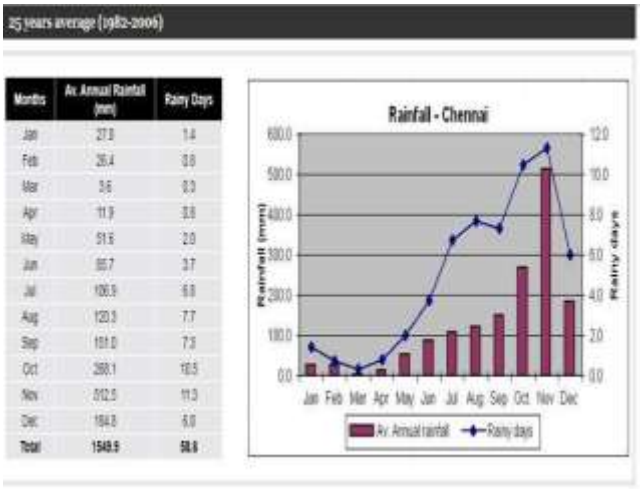
Table 1.0

Time	Height (ft)	Inflow (cusecs)	Outflow (cusecs)
6am	22.1	1300	1300
9am	22.3	7500	3000
Noon	22.7	14000	12000
3pm	23.03	23629	20960
6pm	23.2	29000	29000
9pm	23.4	31000	29000

The inflow was restricted to 29,000 cusecs even though the inflow was 31,000 cusecs in order to protect the reservoir. The rainfall around the lake was 47.5 cm which added to the water content. The outlet is situated at the south part of the lake. The contours of the area were studied from the Disaster Management Support (DMS) Division, National Remote Sensing Centre (NRSC/ISRO), Hyderabad, and it was observed that Thirumalisai, Kuthambakkam, Narasingapuram, Kattrambakkam, Irungattukottai are high lying areas (11,414.72 acres) that are situated around the lake. The model clearly shows the level difference between the different areas surrounding the lake. The areas that are low lying (11,000.61 acres) are: Mangadu, Poonamallee, Chembarambakkam, Thirumudivakkam.

The Chennai – Bangalore (NH-48) highway passes through the high lying areas of the lake. There are other radial roads like the Kundrathur- Sriperambuthur road. The 25 years (1982- 2006) average rainfall data of Chennai, Table 1.1, will help us analyse the importance of the Flood Mitigation System to protect these areas. The high lying areas around the lake are unaffected during the floods. Therefore, the FMS has been installed only in the low-lying areas in the model. The village panchayat in the model (yellow region) shows huts and small towns with outer radial roads. Whereas, the high raised building is to the East of the lake in the town panchayat zone. There are drain holes within the compound walls that will collect the rain water that enters the compound and discharge them into the channel via a one-way pipe opening.

Table 1.1



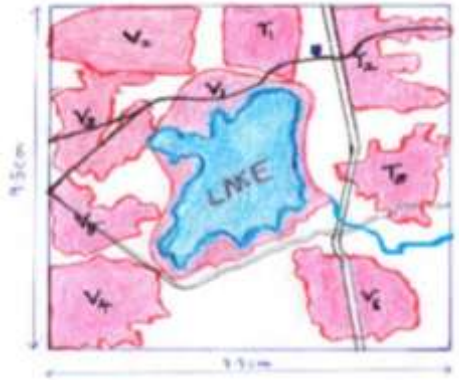


Fig 1.0: Schematic representation of the study area

- Village and town territories

- NH-48 (Chennai-Bangalore highway) -

Kundrathur – Sriperambuthur road

-Chennai outer ring road

- Adyar river

Table 1.2

TERRITORIES

T1- Thirumalisai(1482.63 acres)
T2-Poonamallee(1633.37 acres)
T3-Mangadu(1976.84 acres)
V1-Chembarambakkam(2421 acres)
V2-Narasingapuram(3706.58 acres)
V3-Kuthambakkam(1729.74 acres)
V4-Kattrambakkam(2128.36 acres)
V5 -Irungattukottai(2367.41 acres)
V6-Thirumudivakkam(1169.4 acres)

 ISBN: 978-93-89107-36-4

3. WORKING PRINCIPLE

a. Overview

Floods are caused due to stagnation of water. This maybe due to overflowing of a waterbody or if water cannot find a way to another location during continuous rainfall. The drainage system of our current environment is ineffective to flood water as the flow channel contains several suspended impurities. The walls of the drainage system can also be eroded that may clod the system and may cause flooding in the system itself. When water finds its way during heavy rains to different places and if it is effectively distributed then the risk of flooding is lowered. The objective of this model is to provide a closed channel with geotextile membranes that operate only during floods. The top surface of this channel is covered by a barrier wall which lifts itself during floods to let the flood water flow into the channel. The lifted barrier therefore acts as an external layer for a compound wall if present and as a temporary compound wall where there isn't one. The flood water is transported from one place to another through the closed channel. The channel may or may not connect to a tributary or a rivulet that will carry the water away from the flood plains. During normal conditions the barrier walls can be used as a pavement or a sidewalk.

b. Components

Geotextile Barrier walls: These are usually laid above the open channel and are used as a pavement during normal conditions. They are hinged at the levee level (nearer to the compound wall). They are supported by hydraulic pistons that are installed on the bed of the channel. The standard height of the barrier wall is 2 metres. The material used to construct the barrier walls can be made up of recycled plastic with a water proof coating. Places where a road has to be laid above the channel, the barrier walls can be reinforced to withstand the variable loads. However, these reinforcements should be avoided as much as possible as the load bearing material is yet to be finalised. The walls can be lifted up to a height of 90 degrees. Tilted versions of the walls (such as 70 degrees) can also be used during floods caused by rainfall, as the rainwater slides on the barrier and flows into the channel. The position of the barrier walls during normal and working conditions are shown in Fig 1.1.There are drain holes present inside of the compound that helps to get rid of the rain water that falls into the compound. The water is drained into the channel via a one-way pipe that has a suction mechanism. This way the water on either side of the walls is distributed.

Channels: The channels can be laid up to a depth of 3 meters, depending on the history of flooding in that particular region. It needs a gentle slope to minimize run off from the bed surface. The sides of the wall can be enveloped using a geotextile membrane as shown in Fig 1.2. The channels may or may not discharge into a tributary. The connections have to be made in such a way that the flood water is equally distributed so that the channel itself has an efficient discharge rate.

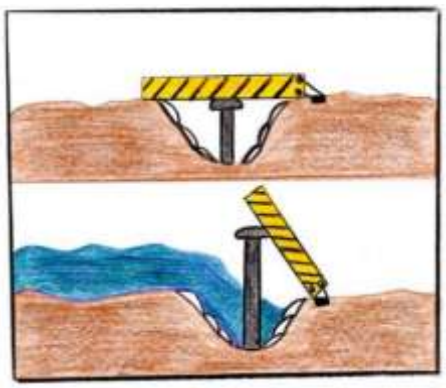


Fig 1.1

Fig 1.2

Sharp edges at turns should be avoided. The channels surround the building. The slope should be laid in such a way that two small channels say east and west should empty into a main channel at the North/South part of the building. It can also be determined by studying the contour of the installation area. It can be designed in such a way that there will be only two main outlets from each surrounding channel. Further connections to a single main channel should be avoided to prevent overflowing of flood water in the channel. Example: - The east wing of the channel can deposit its flood water to the north wing channel and the west wing channel can deposit to the south wing channel. Top view of this example is shown in Fig 1.3

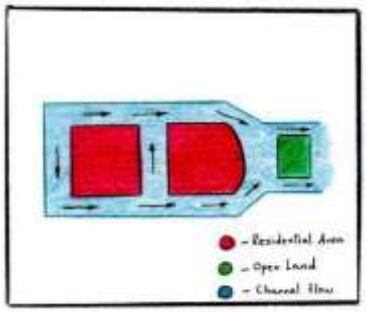


Fig 1.3

 ISBN: 978-93-89107-36-4

Installations: The angle of the barrier wall is preferred to be 90 degrees due to certain advantages such as, the corners of the walls meet in an interlocking manner and this serves as a leak proof barrier wall. Caution must be observed when the barrier walls are installed at an angle less than 90 degrees as the walls should be able to withstand the force of the downpour of the rain. The installations can be made in the shape of any closed figure (without curves) around any building/buildings. Irregular shapes are often the case due to the presence of colonies. Fig 1.4, Fig 1.5 and Fig 1.6 will give a clear understanding of the various methods the barriers and channels can be installed. Any closed shape can be considered for the possibility of the installation. Curved fabrications of the barrier wall should be avoided as it is very difficult to be laid down as a flat sidewalk during normal conditions.

Fig 1.4:- Top view of a single residential

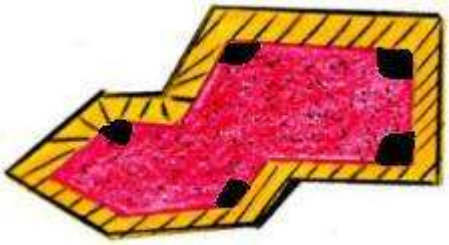


Fig 1.5:- Top view of a colony of building (Regular) with FMS installed houses (Irregular) with FMS installed

The working model gives us a complete understanding of the real time application of the FMS. Fig 1.7, Fig 1.8 and Fig 1.9 show the exact working of all the components of the FMS.

Fig 1.7:-The yellow shaded barrier walls are closed in the normal condition. In this case the barrier walls can be used as a pavement and can also be reinforced in places where a road has to be laid on top of it.

Fig 1.8 :- The yellow shaded barrier walls are partially opened during red alert. The angle can vary from 70 to 80 degrees

Fig 1.9:- The yellow shaded barrier walls are at 90 degrees and the Flood Mitigation System is fully functional.

 ISBN: 978-93-89107-36-4

4. INNOVATIONS

The proposed material for the barrier walls is recycled plastics. They can be compressed to form a wall like structure that can be coated with a water proof layer. Plastics are non-biodegradable and can be lethal when it is not disposed properly. Using this to construct the barrier walls will help us reduce the threat that plastic poses. This can also be taken as an initiative under the Swachh Bharat Campaign. Thin sheets of rubber can also be used to make the corners of the barrier walls leak-proof.

The drain holes inside the compound walls that empty into the channel can be fit with a motor that will help in the suction process. The number of drain holes can vary from place to place. The standard drain holes are installed at the corners of the compound walls and a gentle slope should be provided for the easy flow of rainwater into the channel. The open space below the barrier wall can be covered with a mesh like structure that is big enough to allow rock debris to pass through but prevents dogs from falling into the channel when the barrier is at 90 degrees. It should be noted that the mesh work should not interfere with the mechanism of the piston.

5. DISCUSSIONS

The difference between a normal rain sewer and the FMS channel is that it has a multi functionality which can be operated only during the red alert. The chances of overflooding in the FMS channel is less since it can be in a closed condition during normal rainfalls. They come into place only when there is a danger of flooding. This optional mechanism is unavailable in a standard rain sewer. This will cause flooding in the rain sewer itself.

The model that depicts the vicinity of the Chembarambakkam lake mainly focuses on the installations and working of the Flood Mitigation System. The houses that are present in the high lying areas are not placed to scale as they represent the populated areas. There are merely used for demographic purposes. The mechanisms are shown in such a way that it can be installed for a single residential building or a small colony of houses. The area within the barrier walls have been scaled down even further when compared to the surrounding regions to enable a clear view and understanding of the mechanism this system has to offer. The buildings within this area has not been scale down to equal proportions in order to enable a clear view of the mechanism. Hence, the high raised buildings and the colonies are further downscaled to ensure that the main objective of the project is unharmed, i.e. to present a working representation of the FMS.

6. CONCLUSION

The 2015 floods in Chennai was due to continuous rainfall for over 48 hours. Preventive measures were taken but there proved to be quite ineffective. The Flood Mitigation System may not completely control floods but it can make a difference in the risk level as it aims to equally distribute the water. There are several other ways that can be used to prevent flooding. However, FMS not only drains the flood water away but also gives us an opportunity to reduce the usage of plastics by constructing the barrier walls with recycles plastics. The barrier walls can be operated by a number of ways. The primitive Bascule bridge principles, pulley systems, hydraulic pistons are a few methods in which the barrier walls can be lifted.

It is found that the FMS can easily be installed in any given location. If the proposed FMS is installed in the Chembarambakkam it will help save several establishments during further floods and will also help in improving the drainage system of this region. It should be noted that along with the installation of the FMS we should also adopt green habits such as planting trees which is nature's system of flood mitigation.

REFERENCES

1. Flood Risk Management – A Strategic Approach: Paul Sayers, Li Yuanyuan, Gerry Galloway, Edmund Penning – Rowsell, Shen Fuxin, Wen Kang, Chen Yiwei and Tom Le Quesne
2. Hydraulics and Effectiveness of Levees for Flood Control: Ben Chie YEN, Professor of Civil Engineering, Univeristy of Illinois at Urbana-Champaign
3. Hydraulic Structures Design for Flood Control in the Nyabugogo Wetland, Rwanda: Omar Munyaneza, Yves K. Nzeyimana and Umaru G. Wali
4. A Review of Risk Perceptions and Other Factors that Influence Flood Mitigation Behaviour:P.Bubeck, W. J. W Botzen and J. C. J. H. Aerts
5. Design and construction of a bascule bridge:Sluszka, Peter / Kendall, Martin
6. Flood fatalities in Africa, from diagonosis to mitigation: Giuliano Di Baldassarre, Alberto Montanari, Harry Lins, Demetris Koutsoyiannis, LuigiaBrandimarte and Gunter Bloschl
7. Flood Mitigation Strategies Adopted in Sri Lanka, A Review: Sivakumar SS
8. Strategies for Mitigation of Flood Risk in the Niger Delta, Nigeria:Temi E. Ologunorisa
9. Flooding and Mental Health, A Systematic Mapping Review: Ana Fernandez, John Black, Mairwen Jones, Leigh Wilson, Luis Salvador-Carulla, Thomas Astell – Burt, Deborah Black: The University of Sydney
10. Challenges for achieving sustainable flood risk management: Shah, Mohammad Aminur Rahman, Rahman, Anisur, Chowdhury, Sanaul: Griffith University.

Improving Efficiency of Grain Processing Industry Using Value Stream Mapping (VSM) – A Case Study

[1] K. Ram Prasad, [2] M.Nishal, [3] Varun V V

[1][2] Assistant Professor, Sri Venkateswara College of Engineering, Pennalur, Tamil Nadu, India
[3] Sri Venkateswara College of Engineering, Pennalur, Tamil Nadu, India
[3] varun.vv19@gmail.com

Abstract:

Lean manufacturing technology has been widely recognized for continuously improving productivity and also the quality of the product. This paper deals with lean implementation in the grain processing industry. Value Stream Mapping (VSM) is one of the key lean tools which can be used to identify opportunities for improvement in a production flow process. All the process information related to the processing of grain is collected and a current state VSM is developed showing the current operating status of the rice mill. Then the '5 whys' method is employed and the root causes are determined using Fish bone diagram (Ishikawa diagram). A total of five root causes are determined which form the major problems in the rice mill. These five causes are then solved and a future value stream map is then developed showing the increase in overall efficiency of the process. This study will serve as a guide for the implementation of future lean activities and the betterment of the rice mill when done on a large scale.

Keywords:

Value Stream Mapping, Fishbone diagram, Cycle time

1. INTRODUCTION

Firm's efficiency and competitiveness are two important challenges in today's global market that have motivated many manufacturing firms to plan novel manufacturing management strategies [1].

Due to the challenges and competitiveness prevailing in industries to meet for Quality and customer satisfaction, the companies are in need of process improvement in all aspects of their operations.

Process improvement methodology such as Lean manufacturing, Six Sigma, Value Stream Mapping, Total Quality Management, and so on as has become popular competitive tool, but its successes depends on the nature of organizations [2] and employees' flexibility toward change. Several authors have identified the benefits of applying these process improvement methodologies. For example, [3] applied lean manufacturing to the design process in construction papers. The study indicated that lean efforts increased value adding activities in total work by 31%, reduced unit production errors by 44% of and waiting times 58% in production cycle. [4,5] point out the benefits of applying six sigma for healthcare quality and in health care industry. The study found that Six Sigma has the potential to significantly improve healthcare quality and process, including a decrease patients waiting time in the emergency room, optimize the scheduling time for equipment testing, design a new and remodel existing facilities, and enhance staff to better understand the patient experience, process performances and staffing inter-relationships.

Value Stream Mapping (VSM) is considered one of the most essential (Belekoukias et al., 2014), with Womack (2006) considering it "the most important tool lean thinkers will need to make sustainable progress in the war against muda". VSM is a simple and visual process-based tool which enables the documentation, visualization and comprehension of material and in-formation flows in processes, in order to identify wastes and assist in their elimination (Nash and Poling, 2011). Over the last years, the application of VSM has not only increased within manufacturing plants and supply chains (Forno et al., 2014) but also in process industries and the service sector (Jeyaraj et al., 2013).Taking VSM as a basis, Lai et al. (2008) proposed a framework for combining life-cycle environmental input analysis, total cost analysis, and an energy consumption analysis. Kurdve et al. (2011) used an adaptation of VSM, which they also called E-VSM, at Volvo Penta Vara and Volvo Construction Equipment Braås. Folinas et al. (2014) offered a systematic approach for measuring the environmental performance of a sup-ply chain in the agrifood sector based on VSM. Brown et al. (2014) examined in detail three case studies to demonstrate the breadth of applicability of the Sustainability-VSM tool and the aptness and limitations of the tool in assessing and visualizing sustainability performance in different

manufacturing system configurations. Faulkner and Badurdeen (2014) presented a comprehensive methodology to develop Sustainable Value Stream Mapping by identifying suitable metrics and methods to visually present them.

Although, there are many different studies reports the successful process improvement methodologies used to enhance organizations and companies processes throughout the past decade, lean manufacturing is considered to be one of the most well-known methodologies approach for improving organizational performance because the methodology is simple to apply and also easy to monitor. Lean manufacturing is focused on continuous eliminating non-value added activities and maximizing value added activities through reducing costs and increase the quality of an organization processes. Normally, non-value added activities add costs to the process without enhancing the value. Non-value added activities can called as waste in lean manufacturing. Non-value added activities or waste refer to any activity that does not add value to the process and to activities that a customer would be unwilling to pay for [14]. Waste can be categorized into seven areas: waste due to overproduction, unnecessary waiting, unnecessary transportation, over processing, excess inventory, unnecessary movement, and defects. By eliminating waste in process makes operations significantly improve in low cost more efficiency. Several lean manufacturing tools and techniques were applied such as visual control, 5S, value stream mapping, and Kaizen. One popular tool for lean manufacturing methodology is called Kaizen. Kaizen came from Japanese word that consists of "Kai" and "Zen". "Kai" means change whereas "Zen" means good or for the better. General, Kaizen means continuous improvement by involving every employee from the top to the assembly line who is part of the process. The main purpose of this paper is to explore the impact of applying lean manufacturing in a case study of the company's sheet metal stamping process. The beginning of the research is to study the current situation in the company's sheet metal stamping process through individual interviews of employees and observing problems in the study area. The next section determines the most frequently occurring waste and determines causes using Pareto and the cause and effect diagram. The next section observes how the implementation of lean manufacturing could bring value to the case study company's process. Lastly, the conclusion that consider of lean manufacturing implementation in the company performance is presented.

There are five steps to implement lean thinking in a company: 1) define value from the perspective of the customer, 2) determine the value streams, 3) Achieve Flow, 4) Schedule production using Pull, and 5) seek perfection through continuous improvement. Value stream includes all the specific activities (both value-added and non-value-added) needed to bring a particular product by implementing three important management skills of any business that are problem solving, information management and physical transformation [6]. Lean manufacturing applied tools and approaches such as Just-In-Time (JIT), Total Productive Maintenance (TPM), Cellular Manufacturing and 5S [8]. Moreover, lean accounting, as a coordinated approach, along with lean thinking provides administrators with reliable, accurate and timely information for decision-making. Hence implementation and control, of the lean system as new approach becomes for strategic management approach

The goal of this paper is to apply one of the most significant lean manufacturing techniques called Value Stream Mapping (VSM) to improve the production line of a color industry as a case of study

2. LITERATURE REVIEW

Jafri MohdRohania, SeyedMojibZahraee (2015) have Value stream mapping (VSM) was first found in Monden's 1993 "Toyota Production System" book about circulation kanbans with symbols that resemble VSM. Since then VSM has been used in many sectors. Lean value stream mapping (VSM) is a commonly used method that has been applied successfully in many domains. Despite its success VSM does have shortcomings when it is used to analyse complex processes where the value produced varies for different stakeholders and is largely intangible. Traditional VSM also lacks a practical way of modelling elements that are present in multiple steps of the value stream and a systematic approach to generating different type of improvement ideas.

Teemu Toivonen et al, (2016) Lean fundamental principles was implemented to construct VSM for identification and elimination of wastes by using team formation, product selection, conceptual design, and time-frame formulation through takt time calculation. Based on the future VSM, final results showed that by implementing some lean thinking techniques, Production Lead-time (PLT) decreased from 8.5 days to 6 days, and the value added time decreased from 68 minutes to 37 minutes.

Jafri Mohd Rohani & Seyed Mojib Zahraee, (2015) Manufacturing data were collected from a cover glass manufacturer in China during December 2015. The purpose of this study is to evaluate the performance of the current facility design using E-VSM method, and present several strategies to reduce the energy consumption and production costs. Furthermore, a case study of cover glass manufacturing facility is presented to show that the implementation of environmentally lean strategies resulted in the reduction of both the production costs and emissions.

Yuchu Huang & Masayoshi Tomizuka, (2017) Lean principles were adapted for the process sector for application at a large integrated steel mill. Value stream mapping was the main tool used to identify the opportunities for various lean techniques. We also describe a simulation model that was developed to contrast the "before" and "after" scenarios in detail, in order to illustrate

to managers potential benefits such as reduced production lead-time and lower work-in-process inventory.

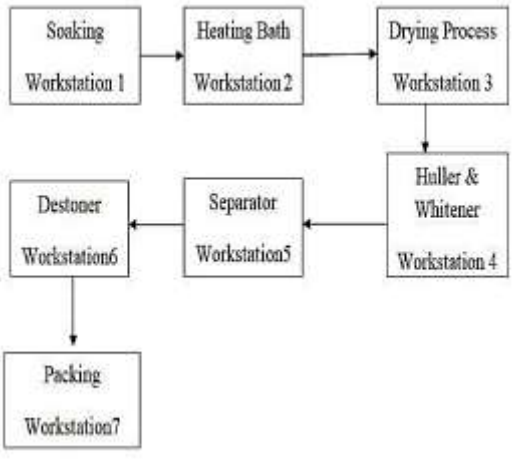
Fawaz A.Abdulmalek et al, (2007)VSM process symbols are used to discuss lean implementation process in the production industry. The existing status of the selected manufacturing industry is prepared with the help of VSM symbols and improvement areas are identified. Some modifications in current state map are suggested and with these modifications a future state map is prepared.

Bhim Singh et al,(2010)VSM is different than conventional recording techniques, as it captures the information at individual stations about station cycle time, up time or utilization of resources, set-up time or change over time, work in process inventory, man power requirement and the information flow from raw material to finish goods. It covers both value adding as well as non-value-adding activities.

Bhim Singh, Suresh K. Garg et al, (2010) Overall Equipment Effectiveness (OEE) is a hierarchy of metrics which focus on how effectively manufacturing equipment is utilised. The results are stated in a generic form which allows comparison against benchmark defined for the industry. Comparisons can also be made in between shifts, products, machines, departments, lines and plants etc.

3. STUDY OF CURRENT PROCESS

Understanding the process- This is the initial stage in the improvement process. The basic concepts and process at each processing line should be carefully noted by visual observation for proper understanding of the process. The following observations should be made for productivity improvement- Working methods, Tools used, Process flow, Number of workstations & their purpose, Sequence of operation, Number of operations at each workstation. The basic rice milling process is shown below.



Time study- The quality of the product lies in the accurate time measurement of each activity. It is important to learn how to measure and record time. Time reflects the method of action. Hence, we need to study the working condition of each process. When measuring work time to prepare standardized work, work units to be measured vary depending on operations. In standardized work, it is necessary to measure both manual and auto or machine time.

Value stream mapping (VSM) is an effective tool for the practice of lean manufacturing. VSM approached the entire process flow in a three-step methods in which first producing a diagram showing the actual material and information flows or Current State on how the actual process operates. This is created while walking down the production line. Secondly, a Future State map is produced to identify the root causes of waste and through process improvements that could give great financial impact to the process, a lean process flow. These improvements are then carried out, the implementation Plan as part and partial details and action needed to gain the paper objectives in process kaizen (continuous improvement) and poka-yoke [19].

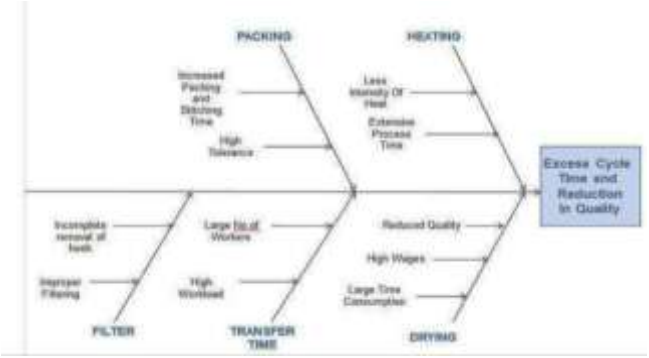
VSM Implementation and Kaizen: A detailed study on the current state map for Wheel cylinder assembly unit is made . A set of kaizen activities initiated and implemented in effort to optimize the productivity of the assembly line. The assembly process is monitored and during the monitoring phase, continuous evaluation on any discrepancies or imperfections on product are being addressed immediately. Necessary counter measures are made to ensure the effectiveness of the new Future state VSM and line productivity stability is achieved.

4. OPERATION TIME FOR EACH PROCESS

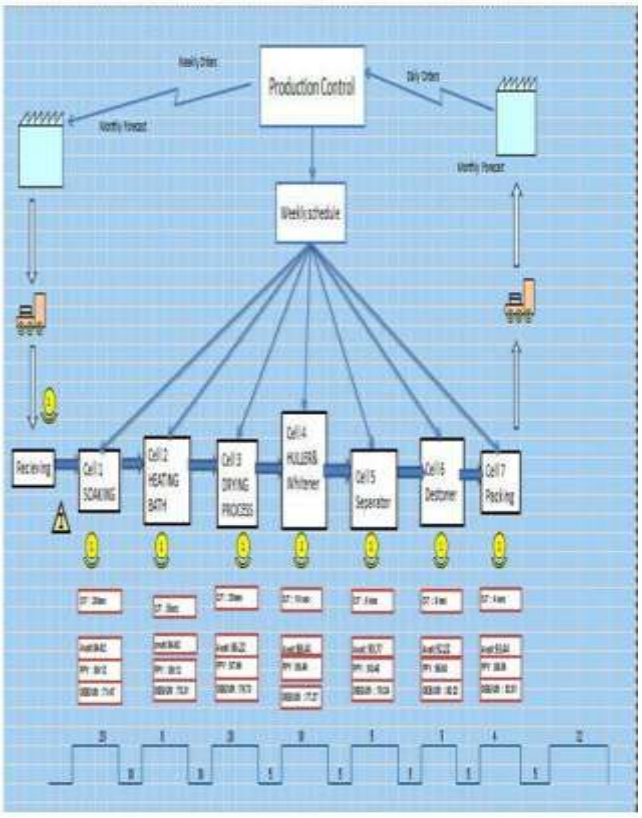
S. No	Process	Work station	Operator	Cycle time
1	Soaking	WS 1	O 1	20
2	Heating Bath	WS 2	O 1	8
3	Drying Process	WS 3	O 2	20
4	Huller &Whitener	WS 4	O 3	10
5	Separator	WS 5	O 4	5
6	Destoner	WS 6	O 5	5
7	Packing	WS 7	O 6	4

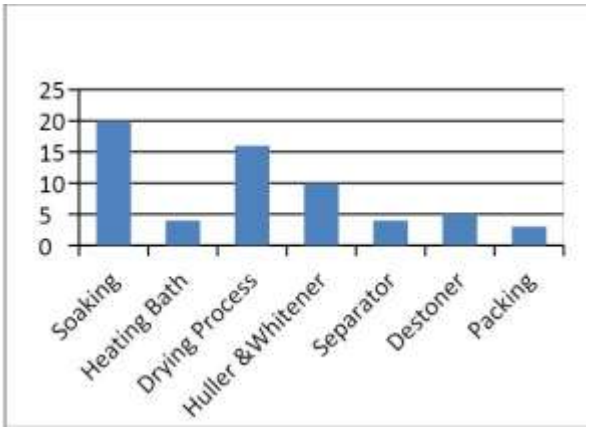
5. FISH BONE DIAGRAM

Ishikawa diagram shown below states the causes and effects of each of the major problems experienced in the industry. Addressing these problems can reduce the cycle time and increase the efficiency to a considerable amount therefore increasing the production of the rice and reducing the damaged goods.



6. CURRENT STATE VSM





7. AREAS OF IMPROVEMENT

From the Current state VSM, the following observations has been made for further improvements in the assembly unit

a. Soaking & Heating Bath:

The current state VSM and operation table for the process carried out gives an idea about the possible areas of improvement in the process flow.

In the workstation 1 & 2, the SOAKING &HEATING BATH are performed separately which leads to more cycle time and also motion waste occurs due to the movement of the worker from workstation 1 to workstation 2.Also the intensity of the heat that acts on the paddy after the soaking process is very less and hence is not effective.

b. Drying Process:

In workstation 3, the DRYING PROCESS, the time consumed for this process is very high as the work can be done only during sunlight, The number of workers involved in this process is also a large amount as they need to help in speeding up the drying process and this results in high wages being paid.

c. Packing:

In workstation 7 PACKING, the main cause is increased packing and stitching time as it takes a lot of time for a person to do the job and the excess of labour will lead to unnecessary costs.

8. PROCESS IMPROVEMENT METHODOLOGY

One of the main pillars of lean methodology is Kaizen. Kai means change and Zen means good. Kaizen is more than just a methodology for continuous improvement. The primary objective of Kaizen is to improve productivity, reduce waste, eliminate unnecessary hardwork and humanize the workplace. With Kaizen, workers at all levels of the organization are engaged in constantly watching for and identifying opportunities for change and improvement. The causes identified using fishbone diagram are rectified by using Kaizen in the following workstations

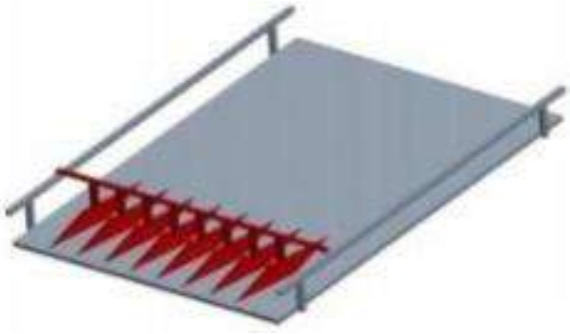
Workstation 1 &2: Soaking & Heating Bath

Less intensity of heat after the soaking process is improved using a simple air blower. The blower is connected to a motor and it is used to speed up the heating process which reduces the cycle time to a large extent. Wastes due to transportation from one workstation to other is also reduced by implementing 5S principles and it has shown a greater improvement in OEE from an avaerage of 70.53 to 74.23 for two workstations

 ISBN: 978-93-89107-36-4

Workstation 3: Drying Process

The main cause of higher time consumption and this is solved by fixing MS plate as shown below onto a slab and kept under direct sunlight to absorb heat. The rice is thrown onto the bed and a lever connected to a motor is used to operate the part which moves to and fro acting as the replacement for workers moving over the slab and thus heating all the rice in a quicker and less expensive manner. This has reduced the cycle time from 20 seconds to 16 seconds.

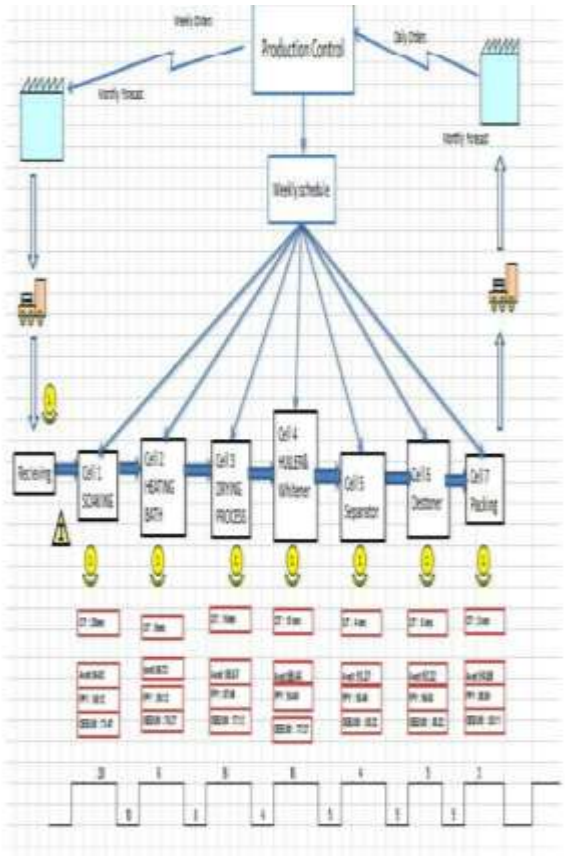


Workstation 7: Packing

The root cause here is the increased time consumption as the worker needs to hold and pour the rice into the bag and then tying it up with the help of a string or rope. This difficulty is reduced by means of a packing machine setup where the rice falls down from a hopper and a bag is placed in the opening. Once the bag is filled a lever is pushed to clamp the bag into place and it is held in that position which makes it easier to stitch the bag. The bag is then dropped by releasing the lever. This has resulted in reduced cycle time from 4 seconds to 3 seconds and increased availability of the machine.

9. FUTURE STATE VSM

A future state map identifies improvement to be made to the value stream that will shorten the overall lead time. To create an effective future state map, the following must be considered: Takt time versus current cycle times. Takt time is the rate of customer demand measured in time. That is the number of working minutes available per day divided by the number of units of product the customer requires per day on average. In general takt times should be calculated on a monthly basis although there are certain exceptions to different applications Cycle times is defined as how often a part is completed by a given process within the value stream. A bar chart is useful for comparing takt time with cycle times for all processes within a value stream.



This future state value stream map consists of the changes made to the current processes which has been refelected reflecting on the output obtained and increased efficiency. The OEE thus calculated has been used to draw the future value stream map

Revised Operation Time Table

S.no	Process	Workstation	Operator	Cycle time
1	Soaking	WS 1	O 1	20
2	Heating Bath	WS 3	O 2	4
3	Drying Process	WS 4	O 3	16
4	Huller &Whitener	WS 5	O 4	10
5	Separator	WS 6	O 5	4
6	Destoner	WS 7	O 6	5
7	Packing	WS 8	O 7	3

DISCUSSION

The results thus obtained, clearly shows that the OEE has increased for 4 workstations and the Takt time for the entire unit has also been improved.The revised Operation table for grain processing shown above indicates that using

 ISBN: 978-93-89107-36-4

VSM, the cycle time for the following workstations has been improved

Workstation	CT before VSM	CT after VSM
WS 2	6	4
WS 3	20	16
WS 7	4	3

CONCLUSION

The goal of this paper was to develop both a current and a future value stream map in the grain processing industry to determine and eliminate the wastes that did not add value to the final product. It was also aimed at reducing the cycle time and improve OEE so as to increase the overall efficiency of the industry. Based on the future value stream map, the final result showed that with the help of principles like Kaizen, JIT and OEE we can reduce the downtime and the cycle time of the process to a considerable amount. More investigation can be done by conducting more in depth research of VSM integrated with computer simulation to verify the proposed VSM method..

REFERENCES

1. Abdulmalek FA, Rajgopal J (2007) Analyzing the benefits of lean manufacturing and value stream mapping via simulation: a process sector case study. Int J Prod Econ 107(1):223–236.
2. Rother, M., Shook, J, Learning to See: Value Stream Mapping to Add Value and Eliminate Muda, The Lean Enterprise Institute, Inc., Brookline, MA.1999.
3. Bhim Singh, S.K. Garg, S.K. Sharma, Chandandeep Grewal, (2010) "Lean implementation and its benefits to production industry", International Journal of Lean Six Sigma, Vol. 1 Issue: 2, pp.157-168.
4. Graves, R., Konopka, J.M., Milne, R.J., 1995. Literature review of material flow control mechanisms. Production Planning and Control 6 (5), 395–403
5. S.G. Li, Y.L. Rong, The reliable design of one-piece flow production system using fuzzy ant colony optimization, Computers & Operations Research 36 (2009) 1656 – 1663.
6. Jafri Mohd Rohani and Syed Mojib Zahraee ,(2015), “Production line analysis via value stream mapping : a lean manufacturing process of color industry”. Universiti Teknologi Malaysia.
7. Liker, J. K. and Hoseus, M., Toyota Culture: the heart and soul of the Toyota Way. New York: McGraw-Hill, 2008.
8. Rother, M., Shook, J., (2009), Learning to See–Value-Stream Mapping to Create Value and Eliminate Muda. Lean Enterprise Institute, Cambridge (USA).
9. Srinivasaraghavan, J. and Allada, V., (2006) "Application of mahalanobis distance as a lean assessement metric," International Journal of Advanced Manufacturing Technology, vol. 29.
10. Womack, J. P., Jones, D. T., and Roos, D., The machine that changed the World: The triumph of lean production. New York: Rawson Macmillan, 1990.
11. Zahraee, S. M., Golroudbary, S. R., Hashemi, A., Afshar, J., & Haghighi, M. (2014). Simulation of Manufacturing Production Line Based on Arena. In Advanced Materials Research,933.
12. Zahraee, S. M., Shariatmadari, S., Ahmadi, H. B., Hakimi, S., & Shahpanah, A. (2014). Application of Design of Experiment and Computer Simulation to Improve the Color Industry Productivity: Case Study. Jurnal Teknologi.
13.] Zahraee, S. M., Shariatmadari, S., Ahmadi, H. B., Hakimi, S., & Shahpanah, A. (2014). Application of Design of Experiment and Computer Simulation to Improve the Color Industry Productivity: Case Study. Jurnal Teknologi.
14. Zahraee, S. M., Hashemi, A., Abdi, A. A., Shahpanah, A., & Rohani, J. M.(2014). Lean Manufacturing Implementation Through Value Stream Mapping: A Case Study. Jurnal Teknologi
15. Rother, M., Shook, J., (2009), Learning to See–Value-Stream Mapping to Create Value and Eliminate Muda. Lean Enterprise Institute, Cambridge (USA). 1–4.
16. Abdullah, F., Rajgopal, J. (2003), Lean Manufacturing in the Process Industry. Proceedings of the IIE Research Conference, CD-ROM, Portland, OR, IIE, Norcross, GA.
17. Wong, Y. C., Wong, K. Y., and Ali, A., (2009), "A study on lean manufacturing implementation in the Malaysian electrical and electronics industry,"European Journal of Scientific Research, vol. 38, pp. 521-535

Analysis and prediction of Chronic Kidney Disease using Machine Learning Algorithms

[1] Srinitya G, [2] Daniel Madan Raja S

[1][2] Bannari Amman Institute of Technology, Alathukombai, Sathyamangalam, Tamil Nadu, India
[1] nitya@bitsathy.ac.in, [2] daniel@bitsathy.ac.in

Abstract:

Health is Wealth: Today the world has taken a step forward where each individual is concerned about what he is consuming on a daily basis and analyses the after effects of the food. Every individual is more concerned about his/her everyday food habits and tries to adapt himself to what nature provides him. We are moving towards a technology oriented living where computers in general and data science and analysis in particular plays a major role in every field. A recent survey from World Health Organization (WHO) tells us that the growth of ageing population may increase by 50% in the forth coming decade. Here, in this paper we mainly concentrate on kidney related issues, and try to predict the presence of chronic kidney disease based on certain parameters available from UCI dataset using decision tree based approach.

Keywords:

health, chronic kidney disease, machine learning, decision tree

1. INTRODUCTION

WHO survey states that between 2020 and 2050 the number of aged people is supposed to double from 11% to 22% across the globe [1]. Chronic kidney disease is a conditions that causes damage to our kidneys and decrease their ability to function normally and does not keep us healthy thereby affecting our day-to-day routine. When kidney disease worsens, wastes may accumulate to high levels in our blood and makes us feel sick and lazy. Complications such as high blood pressure, anemia, weak bones, and nerve damage may occur leading us to totally get bedridden. Early detection of malfunctioning of kidneys and treatment can help chronic kidney disease from getting worse. When the same condition progresses, the situation may lead to failure of kidneys where they may have to be replaced or the patient may be put to dialysis for his lifetime. Though kidney disease is common among all ages, survey reports reveal that the percentage of people affected by kidney failures generally fall under the above 55 category. This usually makes the person immobilized and deprives him from doing his daily activities.

To detect chronic kidney disease the authors implemented (LDA) Linear Discriminant Analysis and (CSP) common spatial pattern filter[3]. [4] Different classification techniques were applied on patient's record available and the authors proved that adial basis function gives better results worked on Naïve Bayesian and k-nearest neighbour algorithms and used it to predict the disease. They proved according to their test results that k-nearest neighbour shows more accurate results than naïve Bayesian. [9] the authors are using Datasets to store medical records. They used support vector machine and Bayesian network to predict kidney disease and select the efficient one among them. [11] SVM and KNN classifiers are compared by the authors and based on their accuracy and execution time for CKD prediction they proved KNN classifier is better.

2. PROPOSED MODEL

Figure 1 shows the proposed model for the analysis to be carried out. The data-set with patient data is considered for pre-processing, which includes removing duplicated, filling up of empty locations. This paper focuses on decision tree and C4.5 algorithm the data set was not completely filled because the algorithm works well for discrete values. The next step after pre-processing is to train the dataset and construct a decision tree for each individual data. After training the dataset, this is now used to test the remaining set of values and the result shown indicates whether a patient is affected by Chronic Kidney Disease (CKD) or not (NCKD).

Fig: 1

 ISBN: 978-93-89107-36-4

3. DATA DESCRIPTION

Parameter	Description
age	age (n)
bp	blood pressure (n)
sg	specific gravity
al	albumin
su	sugar
rbc	red blood cells
pc	pus cell
pcc	pus cell clumps
ba	bacteria
bgr	blood glucose random (n)
bu	blood urea (n)
sc	serum creatinine (n)
sod	sodium (n)
pot	potassium (n)
hemo	hemoglobin (n)
pcv	packed cell volume (n)
wc	white blood cell count (n)
rc	red blood cell count (n)
htn	hypertension
dm	diabetes mellitus
cad	coronary artery disease
appet	appetite
pe	pedal edema
ane	anemia
class	class

Table 1

The dataset for this experiment was taken from the UCI source and it contains patient data with 24 attributes, most of them are clinical and the rest are physiological. Some of the attributes are numerical and some are nominal. The numerical values are indicated in the table by (n) (Table: 1)

4. IMPLEMENTATION

The implementation begins with the collection of raw data and pre-processing it. The data is then sampled and split into training data and testing data. Training data-set is cleaned up and is trained by using the learning algorithm. The results obtained are optimized. The data is then validated for the correctness of its classification. Lastly, the evaluation of the test data set is performed and classified using the decision tree created for the training data set.

Data from the test data set will be entered and for every input decision tree will be generated by calculating entropy and information gain values as per the rules of c4.5 algorithm explained in the section below. From the root to the leaf node the place at which the incoming node is to be placed will be calculated and it depends upon the homogeneity of the node. Prediction process usually occurs at the leaf node in a decision tree. The results obtained on the classification of CKD and NCKD is listed in Table: 2 and Fig: 2.

5. C4.5 ALGORITHM

C4.5 algorithm builds a decision tree for every input from the training dataset using the concept of information entropy. The training dataset consists of already classified samples.

In each node of the tree the algorithm classifies that particular attribute of the data that effectively splits the samples into subsets that deepen onto one class or the other. The splitting criterion is the normalized information gain (difference in entropy). The attribute that has the highest normalized information gain is chosen to make the decision. This process progresses recursively on the partitioned subsets as well.

This algorithm to start up should have a few base cases.

- All chosen samples in the list belongs to the same class. In this case a leaf node is created stating that the node belongs to the base class.
- The node does not provide any information gain. In this case a node is created higher up in the decision tree meaning to choose that class.
- Instance of previously-unseen class is encountered. In this case also a node is created higher up in the decision tree meaning to choose that class.

Algorithm:

The general algorithm for building decision trees is:

- Start the process
- Check each attribute for the above base cases
- Find the normalized information gain of the attribute
- Create a decision node that splits on the normalized information gain
- Repeat on the sub-lists by splitting up on the normalization gain and add those nodes that satisfies the criteria as a child node

6. RESULTS

classification	% classification TP	% classification TN
CKD	99.25	0.75
NCKD	98.75	1.25

Table: 2

The results obtained clearly indicate that the algorithm proposed in this paper classifies the given data to a convincing extent. With more parameters to be processed and introducing a higher level of precision may show considerable improvement in the results of classification.

 ISBN: 978-93-89107-36-4

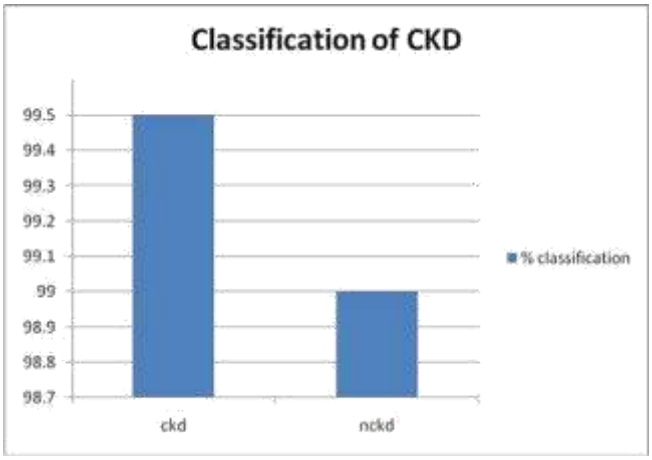


Fig: 2

7. CONCLUSION

Computer vision especially machine learning works absolutely good in predicting health statistics of humans obtained by clinical diagnosis. Prevention is better than cure, yes but prediction of disease earlier is better to treat people in an effective manner and can save the patient by helping him to get back to his normal routine after a prediction. Many advances in machine algorithms aids us to do this prediction accurately. In this paper, c4.5 learning algorithm is used to predict patients with chronic kidney failure (ckd) disease and patients who do not (nckd) suffer from the disease. The results obtained from applying machine learning algorithms for these types of predictions seems to be convincing and better implementation of computer vision into medical diagnosis help us to do more research of this kind in future

REFERENCES

1. https://www.who.int/ageing/10-priorities/en/ accessed on 21 Feb 2019.
2. https://www.who.int/ageing/en/ accessed on 21 Feb 2019.
3. Ling Yu, Duke Billie J. et al. Exosomal Gapdh from proximal tubule cells regulate ENaC activity Nov 2016
4. Verhaar MC, knepper MA et al. Exosomes and the kidney: prospects for diagnosis and therapy of renal diseases. Kidney Int. 80:1138-1145 Aug 2011.
5. Mirja k, Samoylenko A et al. Exosomes as renal inductive signals in health and disease, and their application as diagnostic markers and therapeutic agents. Front. Cell Dev. Biol. 2015 Oct.
6. GuillermoGarcia-Garcia, kunitoshi Iseki et al. Chronic kidney disease: global dimension and perspectives. May 2013.
7. Tharmarajah Thiruvaran et al., IEEE Identifying important attributes for early detection of chronic kidney disease.
8. Shuo Yang, Ran Wei et al. Semantic inference on clinical documents: Combining Machine learning algorithms with an inference engine for effective clinical diagnosis and treatment (2017)
9. Meenambal S. et al. Velocity bounded Boolean particle swarm optimization for improved feature selection in liver and kidney disease diagnosis. Expert Syst. Appl. 28-47 (2016).
10. J Stankovic, Salekin A Detection of chronic kidney disease and selecting important predictive attributes in healthcare informatics (ICHI), IEEE, pp.262-270, oct 2016.
11. [Arora M, Sharma EA. Chronic kidney disease detection by analyzing medical datasets in Weka. Int. Journal. Comput Appl; vol-6: 20-26, Aug 2016.
12. D.K. Vawdrey, T.L. Sundelin,K.E.Seamonsand C.D. Knustson "Trust negotiation for authentication and authorization in health care information system," 25th Annual International Conference of IEEE, vol. 2, issue, pp. 1406-1409, 17-21 September 2003.
13. https://archive.ics.uci.edu/ml/machine-learning-databases/00336/

Empirical Analysis on Recycled PET Fiber Reinforced Concrete with Fly Ash

[1] Velmurugan S, [2] Ashwathi R

[1][2] Bannari Amman Institute of Technology, Alathukombai, Sathyamangalam, Tamil Nadu, India

Abstract:

The most widely preferred material in the construction enterprise around the world is concrete since the ancient period because of its availability, durability and cost. In daily life, the maximum of the beverage containers used are left non-disposable after the usage, which in turn causes environmental degradation. This paper manifests the strengthening technique of concrete by adding recycled PET fibre to the concrete along with fly ash. Fibre Reinforced concrete helps in arresting cracks and also in promoting the characteristics of concrete. The ultimate strength and relative ductility of the structure built with PET fibre reinforced RC beams exhibit greater performance than that of the structure built without fibre. The effects are determined in concrete when recycled Polyethylene terephthalate (PET) aggregate is utilized in concrete. Fibres of length 5, 10cm and 0.5%, 1% and 1.5% volume fractions are used compared to the quantity of concrete and 10% quantity of cement is substituted with class F-fly ash. M25 grade concrete is adapted and the mix design is designed using IS 10262-2009. An analysis is made in obtaining the properties of the concrete when PET fibre is added. The compressive strength test and split tensile strength test are carried out on PET fibre reinforced concrete and the outcomes are examined with conventional concrete.

Keywords:

Polyethylene Terephthalate (PET) aggregate, Ultimate strength, Relative ductility, fly ash, compressive strength, tensile strength, Mix-Design