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The main objective of this conference is to provide a platform for practitioners, academics, policy makers, researchers and students to share original research, reviews and industrial papers in various fields. The conference will aim to improve the culture of research and collaboration among scholars and researchers both regionally and internationally.

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Learning the Comparison of Image Mining Technique and Data Mining Technique

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***Abstract*—Data mining is the computing process of discovering patterns in large data sets involving methods at the intersection of machine learning, statics, and database systems. Image data represents a keystone of many research areas including medicine, forensic criminology, robotics and industrial automation, meteorology and geography as well as education. Image Mining as a research field is an interdisciplinary area combining methodologies and knowledge of many branches including data mining, computer vision, image processing, image retrieval, statistics, recognition, machine learning, artificial intelligence etc. This paper aims at learning the comparison of image mining technique and data mining technique.**

***Keywords*—data mining; image mining; clustering; classification; image retrieval**

I. INTRODUCTION

In the real world, huge amount of data are available in education, medical, industry and many other areas. Such data may provide knowledge and information for decision making. Data mining is a type of sorting technique which is actually used to extract hidden patterns from large databases.

Image mining deals with the extraction of image patterns from a large collection of images. Clearly, image mining is different from low-level computer vision and image processing techniques because the focus of image mining is in extraction of patterns from *large* collection of images, whereas the focus of computer vision and image processing techniques is in understanding and/or extracting specific features from a *single* image. While there seems to be some overlaps between image mining and content-based retrieval (both are dealing with large collection of images), image mining goes beyond the problem of retrieving relevant images. In image mining, the goal is the discovery of image patterns that are significant in a given collection of images.[1]

Analyzing image data forms a keystone of many research areas including medicine (evaluating MRI, interpreting XRays/CT scans), forensic criminology (fingerprint identification, face recognition), robotics and industrial automation (robotic vision), meteorology and geography (satellite imagery) as well as education (computer-aided visualization) and many other fields. Image data plays vital role in every aspect of the systems like business, hospitals, engineering and so on. Image mining normally deals with the study and development of new technologies that allow easy analysis and interpretation of the images. Image mining is not only the simple fact of recovering relevant images but is the innovation of image patterns that are noteworthy in a given collection of images.

The rest of the paper is organized as follows. Section 2 will discuss research issues that are unique to image mining and goal of data mining. Section 3 discusses analysis and classification of image in image mining technique. Section 4 gives data mining technique. Section 5 discusses data management and section 6 gives the comparison of image mining and data mining. Finally, section 7 concludes with some future research directions for image mining and data mining.

II. RSEARCH ISSUE

Data mining, which is defined as the process of extracting previously unknown knowledge, and detecting intersecting patterns from a massive set of data, has been a very active research. Image mining is more than just an extension of data mining to image domain. It is an interdisciplinary endeavor that draws upon expertise in computer vision, image processing, image retrieval, data mining, machine learning, database, and artificial intelligence. Despite the development of many applications and algorithms in the individual research fields cited above, research in image mining is still in its infancy [1].

Image mining is a very important technique which is used to mine knowledge easily from image. Image mining handles with the hidden knowledge extraction, image data association and additional patterns which are not clearly accumulated in the images. The most important function of the mining is to generate all important patterns without previous information of the patterns. Rule mining has been adapting to huge image databases. Numerous researches have been carried on this image mining [13].

The World Wide Web is regarded as the largest global mage repository. An extremely large number of image data such as satellite images, medical images, and digital photographs are generated every day. These images, if analyzed, can reveal useful information to the human users. Unfortunately, there is a lack of effective tools for searching and finding useful patterns from these images. Image mining systems that can automatically extract semantically meaningful information (knowledge) from image data are increasingly in demand. The fundamental challenge in image mining is to determine how low-level, pixel representation contained in a raw image or image sequence can be efficiently

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and effectively processed to identify high-level spatial objects and relationships. In other words, image mining deals with the extraction of implicit knowledge, image data relationship, or other patterns not explicitly stored in the image databases. It is an interdisciplinary endeavor that essentially draws upon expertise in computer vision, image processing, image retrieval, data mining, machine learning, database, and artificial intelligence [14].

Image mining is the process of searching and discovering valuable information and knowledge in large volumes of data. Figure 1 shows the Typical Image Mining Process. Some of the methods used to gather knowledge are, Image Retrieval, Data Mining, Image Processing and Artificial Intelligence. These methods allow Image Mining to have two different approaches. One is to extract from databases or collections of images and the other is to mine a combination of associated alphanumeric data and collections of images. In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. When the input data is too large to be processed and it is suspected to be notoriously redundant, then the input data will be transformed into a reduced representation set of features. Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. Several features are used in the Image Retrieval system. The popular amongst them are Color features, Texture features and Shape features.[2]

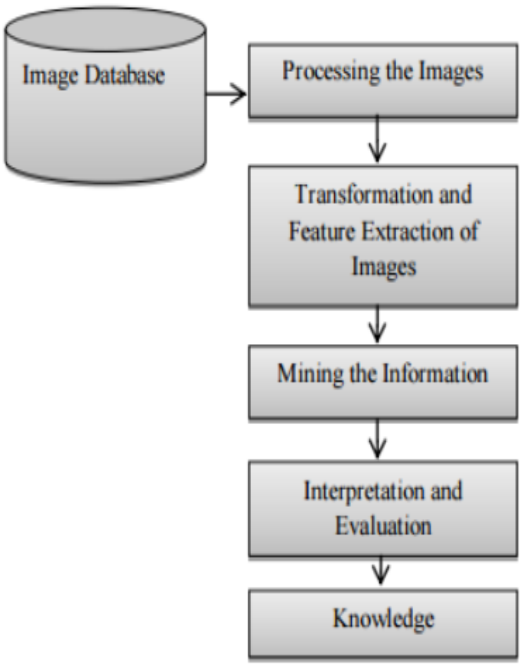


Figure 1. Image Mining Process

The goals of data mining are fast retrieval of data or information, knowledge Discovery from the databases, to identify hidden patterns and those patterns which are previously not explored, to reduce the level of complexity, time saving, etc. Various field adapted data mining technologies because of fast access of data and valuable information from a large amount of data. Data mining application area includes marketing, telecommunication, fraud detection, finance, and education sector, medical and so on. They are:

- Data Mining in Education Sector
- Data Mining in Banking and Finance
- Data Mining in Market Basket Analysis
- Data Mining in Earthquake Prediction
- Data Mining in Bioinformatics
- Data Mining in Telecommunication
- Data Mining in Agriculture
- Data Mining in Cloud Computing

III. Image Analysis and Classification in Image Mining Technique

Image analysis is an inevitable step of image Mining. The analysis is often said to be a pre-processing stage of the image mining. The objective of analyzing an image is to find and extract all relevant features required to represent an image [11].

A. Image Preprocessing

Image preprocessing is an initial step of processing images.
It is utilized for improving the quality of an image before object detection algorithms are applied. Normalizing images is usually performed in order to reduce noise and/or enhance resolution of an image. Different pre-processing procedures might by employed including average, median and wiener filtering for lowering the impact of noise and interpolation based Discrete Wavelet Transform (DWT) and Multiresolution
Image Fusion to enhance the resolution.

B. Object Recognition

Object recognition is a step resulting in segmentation of an image. It focuses on identifying objects in an image and dividing an image into several regions accordingly. It is a task which until recently was considered the main objective of image processing. Visual objects are to be detected from an image according to a model. The model represents certain patterns obtained as an outcome of applying a training algorithm on the training sample. For this purposes, supervised machine learning needs to be deployed.

C. Feature Extraction

Extracting features stands for a process of compressing the information derived from identified objects into a set of attributes. Both local and global descriptors may be used for representing the image. Global descriptors are easier to compute and do not tend to segmentation errors. In comparison, local descriptors provide much precise representation and might discover even subtle patterns. Features are usually represented numerically and provide complex mathematical representation of an image. They describe objects in terms of shape, texture and/or color, etc.

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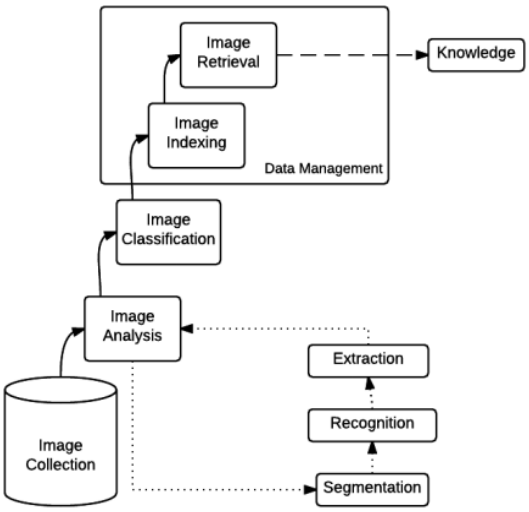


Figure 2. Traditional Image Mining Procedure

Image classification is to categories objects detected in an image. Currently, classification objects are an extensively researched domain. Different approaches have been proposed and tested. However, the field remains in its infancy and categorizing into non-pre-defined classes is still an issue to be solved. The researched methods of categorizing objects as described by[11]are:

D. Supervised Classification

Supervised classification is the original approach of categorizing images. The objective is to divide the detected objects into pre-defined categories. Methods of machine learning (decision tree, rule-based classification, support vector machines, neural networks) are applied on training the system based on the labeled (pre-classified) samples and flowingly, on labeling new images using the obtained (trained) classifiers.

E. Image Clustering

In contrast to standard classification methods, clustering represents unsupervised categorization of objects. The objects are grouped into clusters based on the similarity, not on the basis of predefined labels. Cluster analysis aims at searching for common characteristics without knowing the exact data types. It is oriented on decomposing images into groups of objects similar to each other and different from the other objects as much as possible. The similarity is evaluated based on the calculated features (texture, shape, color,...). Hierarchical clustering, partition based clustering, mixture resolving, nearest neighbor clustering, fuzzy clustering, evolutionary clustering are some of approaches used for unsupervised categorization. After accomplishing the clustering process (dividing the objects into clusters), an expert form the particular field is needed to identify the individual categories (clusters).

IV. Data Mining Technique

Data mining means collecting relevant information from unstructured data. So it is able to help achieve specific objectives. The purpose of a data mining effort is normally either to create a descriptive model or a predictive model .A descriptive model presents, in concise form, the main characteristics of the data set. The purpose of a predictive model is to allow the data miner to predict an unknown (often future) value of a specific variable; the target variable. The goal of predictive and descriptive model can be achieved using a variety of data mining techniques as shown in figure 3[2].

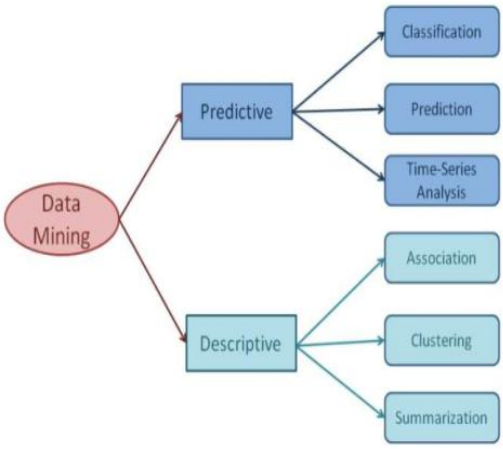


Figure 3: Data Mining Models

A. Classification

Classification based on categorical (i.e. discrete, unordered). This technique based on the supervised learning (i.e. desired output for a given input is known). It can be classifying the data based on the training set and values (class label). These goals are achieve using a decision tree, neural network and classification rule (IFThen). for example, we can apply the classification rule on the past record of the student who left for university and evaluate them. Using these techniques, we can easily identify the performance of the student.

B. Regression

Regression is used to map a data item to a real valued prediction variable [7]. In other words, regression can be adapted for prediction. In the regression techniques target value are known. For example, you can predict the child behavior based on family history.

C. Time Series Analysis

Time series analysis is the process of using statistical techniques to model and explain a time-dependent series of data points. Time series forecasting is a method of using a model to generate predictions (forecasts) for future events based on known past events [8]. For example stock market.

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D. Prediction

It is one of a data mining techniques that discover the relationship between independent variables and the relationship between dependent and independent variables [9]. Prediction model based on continuous or ordered value.

E. Clustering

Clustering is a collection of similar data object. Dissimilar object is another cluster. It is way finding similarities between data according to their characteristic. This technique based on the unsupervised learning (i.e. desired output for a given input is not known). For example, image processing, pattern recognition, city planning.

F. Summarization

Summarization is abstraction of data. It is set of relevant task and gives an overview of data. For example, long distance race can be summarized total minutes, seconds and height. Association Rule: Association is the most popular data mining techniques and fined most frequent item set. Association strives to discover patterns in data which are based upon relationships between items in the same transaction. Because of its nature, association is sometimes referred to as "relation technique". This method of data mining is utilized within the market based analysis in order to identify a set, or sets of products that consumers often purchase at the same time [10].

G. Sequence Discovery

Uncovers relationships among data [7]. It is set of object each associated with its own timeline of events. For example, scientific experiment, natural disaster and analysis of DNA sequence.

V. DATA MANAGEMENT

Images cover a huge amount of information. Depending on the way of storing and indexing images, various knowledge might be searched and retrieved from an image database [11].

A. Storing Images

Zhang et al. identified several differences between image databases and relational databases pointing put the misusing and misunderstanding the term of Image Mining. IM cannot be understood barely as applying data mining techniques on images, as compared to relational databases, there are important differences in handling images:

• Relativity of values - Images can be numerically represented, however, in contrast to relational databases, the values are only significant in a certain context.

• Dependency on the spatial information - When working with image databases, the position of individual pixels is an inevitable factor for correct interpretation of image content.

• Multiple interpretations - In comparison with relational databases, image databases are more difficult to handle, as the same patterns derived from images might have multiple interpretations depending on the context and position.

There are different ways of storing images. Several compression formats (JPEG, MPEG 7, DICOM) store the meta
data in one file with an image. According to [12]), this approach might result in difficulties with analyzing images. Databases of such images are not the most suitable candidates for data mining, as they are not optimized for time and memory consumption when performing image retrieval.

VI. IMAGE MINING VS. DATA MINING

The most common misconception of image mining is that image mining is nothing more than just applying existing data mining algorithms on images. This is certainly not true because there are important differences between relational databases versus image databases. The following are some of these differences:

(1) Absolute versus relative values. In relational databases, the data values are semantically meaningful. For example, age is 35 is well understood. However, in image databases, the data values themselves may not be significant unless the context supports them. For example, a grey scale value of 46 could appear darker than a grey scale value of 87 if the surrounding context pixels values are all very bright.

(2) Spatial information (Independent versus dependent position). Another important difference between relational databases and image databases is that the implicit spatial information is critical for interpretation of image contents but there is no such requirement in relational databases. As a result, image miners try to overcome this problem by extracting position independent features from images first before attempting to mine useful patterns from the images.

(3) Unique versus multiple interpretations. A third important difference deals with image characteristics of having multiple interpretations for the same visual patterns. The traditional data mining algorithm of associating a pattern to a class (interpretation) will not work well here. A new class of discovery algorithms is needed to cater to the special needs in mining useful patterns from images [3,4,5,6].

VII. CONCLUSTIONS

Data mining is a powerful concept for data analysis and process of discovery interesting pattern from the huge amount of data, data stored in various databases such as data warehouse, World Wide Web, external sources. Interesting pattern that is easy to understand, unknown, valid, potential useful. This paper is described what the goals of image mining, data mining are and also learning the comparison of mining technique.

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Emotionomics - The Science of Spirituality

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The emotions are part of our being. The concepts like emotions/devtions /culture/values etc. have occupied the back stage since last few centuries plus. May be because of the focus on the applied sciences; these concepts are still pushed further backward because of the proactive focus on the applied sciences. Though the management sciences are relying on the applicability of this gifted trait of human beings to their deserved advantage in the area of HR, Marketing and branding etc, the understanding of the emotions on wider spectrum needs a deeper search, the search which assists and provides a launch pad to enter into the area of devotions finally leading us to the gates of the spirituality. This paper discusses as to how to explore and use this beautiful subject, the science of emotionnomics to remain actively calm and calmly active to lavage the trait of emotions in the area of faster human evolution.

The emotions are not seen but felt and the feelings have not provided us the scientific All the preachers have tried to preach the human race as how to look within; looking within means and implies entering into the domain of the spirituality. The problem with us is that we brand every thing. We brand spirituality, we brand religions- Hindu religion (Hinduism), Muslim religion (Islam), Buddhism (Indian Buddhism, Tibetan Buddhism, JapaneseBuddhism, Sri Lankan Buddhism, Thailand Buddhism) etc. etc. and Instead using these tools of religion and spirituality to provide right guidance and directions, we start patenting them and get ourselves involved in the deep ocean of intellectual spiritualism and intellectual analysis .We analyse spirituality with intellect rather than making an attempt to understand it through **surrender.** We make spirituality as point of discussion drawing ourselves into vast depths of analytical oceans and false satisfaction.

The intellectual analysis provides us still another beautiful platform of considering our selves as intellectuals raising our selves at the top of the **self (ego).**It is experienced that good orators and the persons good at logic may convince any body about the efficacy a particular religious approach as better than the other religion. This may lend us to believe and we start leaning towards that approach. We get diverted and loose the focus. Instead of finding good in a specific religion and using the good practices of that religion for self development, we get involved and become the brand ambassadors of that religion. The tag of Tibetan Buddhist / Indian Buddhist / Catholic priest etc starts showing up on us. People start approaching us, start admiring us, start labeling us, inviting us to deliver lectures / discussions and we start feeling evolving ourselves fast. The cheers of crowds of seminar halls sounds very pleasing to our ears and instead progressing devotionally we start sailing on the seven seas of emotions generated by praises and appreciation of our knowledge base and skills of our oratory. We have to be careful of such emotional states. The emotions in sucha state of mind succeed in creating a launch pad for you to take off into yet another direction of becoming intellectual spiritualists than finding self in self (**the spirituality**)

This implies that emotions though are fine tools to help us to enter into the area spiritual domain, none the less a little misstep into intellectual ignorance may cost us extended efforts to reach the state a self realization/actualization by few more incarnations.

Therefore, the race to elevate the state of consciousness using the emotional platform has to be executed with utmost precision. it appears that the tested methodologies adapted by the academic institutions including ancient Indian system of Gurukulas educational system can be used with minor modifications in our efforts to elevate our selves on the plane of consciousness. The elements like presence, professionalism, precision and perfection may prove to be effective in our practices undertaken to re define and elevate the level of our conscious states.

One of the most difficult states of mindis to control its wandering nature. Since the mind factor is vital in regulating our consciousness states, it enjoins on the practicing devotee to steer the mind using the element of presence. The element of presence helps to keep mind in the state of **presence.** This statement of keeping mind in state of presence may look difficult to conceive but is simple to understand the nature of the mind. Over incarnations, mind has created its own world and moves freely in past and future. To keep it to stay in the present quadrant, it is difficult and requires deep, regular and long practice. The analysis of the state of mind shall reveal that mind stays in present quadrant for a negligibly small period. The share of mind staying in the past and future quadrants depends upon the prenatal and post natal tendencies of a particular individual. Some academicians favor to stay in future quadrant with slogan like 'Think big – Think beyond' and the others prefer to stay in past quadrant believing in theory that you learn from past mistakes hoping to improve in future.

These above states of mind to stay in past or in future are emotionally linked states. Staying in present only is referred to as controlled state of mind. Staying in past or in future is like staying in a dream state dissipating the power of mind. The perfect state of mind is when you learn to remain

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'actively calm and calmly active'; while remaining in present state you are able to think about past or for future alike. If you are able to use emotion trait of yours effectively, you can posses all the five minds for future success i.e respectful mind, ethical mind, **alone** creative mind, rational mind and synthesizing mind. All of these minds are associated with respective emotional states. The emotional states of such minds prove highly effective when the emotions get into the shape of devotions and the devotion is the characteristic of God state, the Divine State-**the spirituality**

The alone can never progress **till he** is emotionally involved in the activity he undertakes. Therefore the science of emotions, emotionomics may be referred to as science of logic and science of rationality.

As and when you undertake a job, you do ask four questions to yourself

1. Is work being undertaken **attainable** !
2. Is work **measurable**!
3. Is work **time bond** and!
4. Is work being undertaken with **specific orientation**!

Each of the above asked questions are with an emotional state of mind (absorbed state of mind). Having asked yourself the above questions, you start executing the assigned / chosen activity with another state of emotional mind i.e. executing mind and the under taken activity thus gets executed with presence, precision and perfection. Though performance of an activity while adhering to above parameters precisely may not be immediately be attainable, none the less the science of emotionomics makes you aware about the depth, utility and efficacy of each of the executing variables.

The phrase' work is worship' is generally understood as performing the work with fullest devotion supports the logic advanced by science of emotions that emotions give leave age in performance of work **-.the worship and hence the sprituality**

To understand the emotionomics further you have to enter into co-relationship of emotion and consciousness. As we understand that emotion is an intense feeling - a state of mind arising out of interaction with an environment or thought and processed using psyche – physiological platforms with full awareness. The mind which is consciously unaware is therefore unable to generate emotion or we may say that a person without emotion may be classified as / referred to as person without driver to steer his conscious mind to higher levels i.e. super consciousness or cosmic consciousness levels. This implies that emotionomics can be designated as the science helping you to reach the cosmic conscious states.

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A Digital Approach of National Identity- Aadhar Card; Future Aspects in Crime Investigation & Nation Security with Corrective Measures

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Abstract-: **With the inflating rate of crime in our society, the advancement has become a necessity for various perspectives such as security as well as investigation. Around the world, the distinguish scientists are coming up with new and multidisciplinary research/inventions which could be used for nation security and in crime investigation/ national identity. Now a day, personal identification of an individual has been digitalized at national/ International level everywhere that permits and make it easy to get access to prove the identity of anyone. A numerous ubiquitous, perpetual and unique identical features e.g. fingerprints, palm prints, retina, DNA-fingerprints etc. are utilized by security agencies to secure in form of personal testimony in developed countries. Indian government took a very important initativeby making it a compulsion to digitalize the personal data of each and every individual and secure it in form of unique identity in form of 12 numerical values. This identity card is issued by the Unique Identification Authority of India after its records are verified with the details of every Indian citizen including biometric and demographic data. This individualized information could be beneficial for investigating agencies during the crime scene investigation and securityby revealing the identity of suspect. From the perspective of investigation, this biometric is lacking features which would have made it more unique and conclusive such as palm prints, dna from blood or biological fluid. With these advancement, it would be a great achievement for law enforcement agencies to nab the suspect and put them behind the bar in every type of crime.**

Keywords: **Identity, Suspect, forensic practice, investigation, crime scene etc.**

I. INTRODUCTION

In the present scenario, the national security has become an enormous issue for every nation. The ever-increasing rate of crime in our society demands the advancement and digital approach towards the establishment the identity of suspects/culprits. To secure the nation and provide the security to its citizen, every country is centralizing its citizen's unique identity digital data in form of various forms i.e. Metrix system, retina scanning, voice identification. The Indian Government took imitative towards to provide the universal digital identity to every citizen. In 2009, Aadhar card was launched with a detachment to provide the digital data to the identity of its citizen but due to a few of difficulties such as technical snags, incorrect data display raised a question against its importance[1]. In 2014, this program was started again with many resolved issues and ease in its acceptance. Aadhar card was an attempt to identify and digitalized the identity of people from the purpose to track the social security of an individual. This program was inspired by the social security number issued by a few of countries i.e. USA, china etc. but conceptually, Aadhar is supposed to benefit of social inclusion on all development parameters and pitched as more than an identity card[2].

In extension to this, it helpsto reduce the corruption since every individual carry only unique identity number and that has become a necessity to connect every document such as bank account, domestic supply (gas connection), passport, digital locker, mobile sim card, voter card etc. with the aadhar card that not only increase the security of an individual but also, prevent from fraudulent and make it easy to do the things within a short latency time. Since 2017, Indian Government has made it mandatory to connect the aadhar card with every social aspect of usage[3]. In a few of the issues, public distribution system is one which require social security measure which is related to the unique identity of a person and helps to claim the identity of a person who migrate from one place to another and prevent the corruption in subsidized supplies such as food, kerosene etc. Financial inclusion is another issue in which the banks don't have any incentive to create and manage the accounts for people with insignificant income especially in case of a migrant. Some aspects such as direct cash transfer, food security, employment are some large scale public schemes that could be better managed by using this unique id and everyone could be benefited from it[4]. In this study, we focused over the practice of Aadhar card and its use in crime investigation and security of nation and society.

II. CONVENTION OF AADHAR CARD

Aadhar card is a universal biometric card that stores an individual's personal details in a government database which is fast becoming the government base for public welfare. It is used for a number of purpose and being centralized it can distribute and keep track of the various schemes provide by the government. Acquisition of passport is a daunting endeavor which require plenty of time in the process of

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application, verification checks by law enforcement agencies. Now, it will be possible within 10 days from Aadhar card and police verification can be scheduled at later. Oher assets such as opening a bank account, digital life certificate has become easier in which only UID is required along with a passport size photo[5]. Receipt of monthly pension and disbursing the provident fund to retired government employees that timely pension can be received. Any Government scheme such as Jan DhanYojna that is to offer considerable help to people in remote and rural areas to avail the services[6]. It is very ease to access to carry it anywhere anytime in form of digital e copy which is available in download version whenever and wherever is require. Now, according to the latest update of aadhar card it has been made mandatory for most and day to day activities i.e. mobile number should relate to aadhar card, driving license, PAN card, IT return[7].

III. ASPECTS OF AADHAR CARD IN INVESTIGATION AND SECURITY

With the increasing rate of crime in our society, New techniques of investigations are emerging rapidly towards the less latency time and conclusive identification of an individual. A numerous forms of evidences are encountered from the scene of occurrence which play a vital role to establish the identity of suspect. In all the evidences, Fingerprints are considered unique, perpetual and universal of every individual like DNA-fingerprints. These prints are encountered in several conditions such as latent prints, semi-visible, plastic and patent prints in form of the few ridges present at surfaces/ objects or at the entry of exit which provides the information about an individual i.e. gender, age etc. If these fingerprints ridge details could intensify at scene of occurrence and could directly connected from the UID (Aadhar Card), the information about the suspect such as address, name, age and gender can gather immediately. It will prove a great helping hand for the investigators/ law enforcement agencies to nab the suspect within a few latency times after the commencement. This centralized system of aadhar card will be able to provide the information about the terrorist involve in an anti-national activity.

In cases of sexual harassment, rape etc. the fingerprints are found over the different body parts of the victim including other biological evidences; can be left by using fluorescence powder and lifting techniques. If the victim is dead in those cases, the hard x-ray can be used for intensification of fingerprints and information about the suspect/ culprit can be gathered from it. Whereas, the examination of biological samples and their analysis will take much time rather than the procedure which will require only a few of minutes. In cases of murder/ attempt to murder, burglary, the struggle marks in form of the fingerprints present at front part of body can be recovered and matched with the data of aadhar card.

In other prospects of forensic science, questioned documents examination field is very important to prove the authenticity of the documents and to identify the author/suspect of it. These documents are encountered in numerous forms such as disputed, forged or copied by other persons and hence a question raised against its authenticity. It may include valuable documents i.e. power of attorney, will, authority letter, important secret official files, leak defense documents, bank documents, suicide notes, drawings etc. where the identification can be done by using the analysis process of questioned documents but it will be time taking. But it could be an ease access to get the information about the actual person by using the UID. It is considered the when a person writes or draw something, nobody can help them to hold the pen or to facilitate the movement of hand or to write, in those cases, the touch of their fingerprints at writing surface left their identity in form of latent fingerprints. If these latent fingerprints could be intensified from the paper and matched with the available data of aadhar card, it will immediately reveal the identity of the culprit/ victim. The culprit could be nabbed before their commencement in any other crime.

During the examination of any firearm or weapon of offence, the fingerprints which will be present at the magazine of firearm, barrel, trigger, handle of weapon, safety pin lock etc. could be intensified easily. When these intensified fingerprints will be scanned at UID, the identity of culprit will be revealed within a few of second. Since so long in a few of the cases, it is claimed that the evidences have changed in the forensic laboratory which was handed over for analysis. During the handling of evidences, audio video evidences, cybercrime, mobile etc., a procedure of information about investigating officer, name of handling officer, designation etc. are noticed yet the questioned raised against the authenticity of evidences that can be proved easily from with the help of UID if it was exchanged/ disputed. In this process, the fingerprints present on the envelope can be easily intensify and the people those who were involved in that act could be caught.

Now a day in cases of mobile crime such as murder, rape or kidnapping, vehicle is frequently used to move from one place to another. In these cases, the identity of the vehicles are hide either by changing their number plate or colour, by providing a few of modification and are found heirless condition from the road side/ forest and the identity of vehicle remain in question. The identity of the culprits/ owner can be done by collecting their fingerprints from the steering of vehicle/ handle of the gate of vehicle, inner lock, window etc. After a requirement of intensification, these fingerprints could be scanned from the UID data and identity with full details will be revealed at the screen within a few of seconds.

IV. CORRECTIVE MEASURES

As being a biometric system, Aadhar card consists the digital dossier of fingerprints and retina. Fingerprints which are encountered in numerous conditions at scene of occurrence, but there is no significant role of retina except the unique identity of an individual. Fingerprints are also encountered in smudged forms and carry minutiae details while palmar surface (palm prints) has a wide area and the chances of its

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occurrence are greater. Palm prints can be implemented at various surfaces/objects e.g. entry & exit, over the weapon of offences, bottle of beverages, vegetables & fruits etc. therefore, the palm prints of an individual could be recorded along with the fingerprints. In case of unidentified dead bodies, the palm prints record can be helpful to identify the detail of victim. If a dead body is found from the water, fingerprints are destroyed or damaged by insects (depends on the time of dead body in water), palm prints which covers the large area of palmar surface; identity could be established.

Instead of retina, if sweat and saliva information (DNA) could be recordin the profile of an individual, it will provide the instant information of culprit involve in heinous crime. In almost all cases such as murder, sexual offences, attempt to murder, human trafficking, mobile crime scene; saliva and sweat is encountered over the body (hand, neck, check, lower abdomen, thigh) of the victim. In mobile crime scene, the chances to identify the suspect, because the deposition of sweat and palm prints of suspect/ culprit are encountered over the steering of vehicle, handle of vehicle seat cover, horn etc. In case of hit and run, where the vehicle is recovered from the crime scene in the absence of driver, by the saliva and sweat, it will be easy to identify the information about driver at the time of incident.

There are some many instances, in which the information of an individual could be recovered from the crime scene at a time by using these important clues of evidences. Now a day, in this era of advancement; investigation agencies have to be advance to nab the culprit and put them behind the bar.

V. CONCLUSION

As per the latest information, the supreme court of India has ordered that the government cannot be stopped from using the aadhar card for its non-welfare schemes like opening of bank accounts, verification of existing and new mobile phone numbers and other user credentials etc. However, it did maintain that the government cannot make Aadhaar mandatory for welfare schemes and it has allowed the government to use it in some schemes, not permitted to be used as a mandatory requirement that must be. Once the UID completion work will be over, it must be centralized and authorized for the access to the investigation agencies so that at the time of instances, it could be utilized by them to nab the suspect/ culprits/ anti-national activists. This facility will not help to nab the culprits but will also help to prevent their involvement in the other illegal commencement. The crime rates will decrease instantly and will also protect the right to be provided to the Indian citizens which are lacking by this time because of the entry of refugees and other people who easily get access in India. Aadhar card with some modification in its system might be proven one of the best technology for individuality in the world.

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Application of Fuzzy MAHP for Computing Risk Severity Index for Elevated Corridor Metro Rail Project

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***Abstract*—Complex giant infrastructure projects are endangered to greater risks due to its unique features in various phases like feasibility, design, development, implementation and execution. So, a systematic process of risk analysis is required to classify, identify, and analyse these risks, and to formulate risk response strategies. This paper is an attempt to compute risk severity index of the elevated corridor metro rail project using Fuzzy MAHP (Modified Analytical Hierarchy Process). AHP is a structured technique that can help in identifying the risk severity for the major activities of a project. Fuzzy logic is incorporated within AHP to map the interrelationship between input parameters of AHP like priority vectors of likelihood of occurrence and impact created due to that risk for a particular activity. Case study of Bangalore elevated corridor metro rail project construction at various phases are presented to validate the concept of this technique.**

***Keywords*— Risk severity index, MAHP, elevated corridor, metro rail, fuzzy MAHP, risk analysis.**

I. INTRODUCTION

According to Choi et.al (2004), Risk identification is a process to acknowledge risk events and to identify characteristics of risk events for the selected project based on the risk-related information. It is of considerable importance because the processes of risk analysis and response strategies may only be performed on the identified potential risks.

To improve the chance of success and reduce potential risks, in the initial phase, project risks and uncertain factors should be carefully identified, assessed and monitored (Kuo and Lu, 2013).Project risks have a direct impact on the project schedule, cost and performance (Sarkar and Dutta, 2011).

Sarkar et.al (2016), had developed risk indices for Quality, Safety and Environment by using MAHP for Delhi metro elevated rail corridor project.

AHP was familiarized by Saaty (1980) as a management tool for decision making in multi attribute environments. The fundamental approach of AHP is to break down a "big" problem into several "small" problems; while the solution of these small problems is relatively simple, it is conducted with a view to the overall solution of the big problem. The main uniqueness of AHP is its inherent capability of weighting a great number of different-nature factors-qualitative and quantitative-in order to make a decision, thereby producing a formal and numeric basis for solution(Saaty1987).

Shapira and Simcha (2009) had explained AHP in a simplified manner. Firstly identified the problem and then Hierarchy construction, in this step, a list of attributes are generated. The attributes are organized in a hierarchy -type structure that reflects their mutual relationships. The highest level of the structure consists of the primary goal of the problem. A second -level attribute set includes all of the secondary goals that together contribute to achieving the primary goal. The second level attributes are directly affected by all of the attributes in the set located one level lower. Attributes with no other attributes under them in the hierarchy structure are termed as leaf attributes.

The third step is Pair-wise Comparison, after mapping interrelationship between attributes by the hierarchy, relative weights of the attributes are determined by comparing them in pairs, separately for each set in the hierarchy. The results for each set are in the hierarchy. The results for each set are recorded in a separate comparison matrix. When comparing attribute pairs, the following must be determined:

Importance of two attributes is compared by giving them numbers on a scale. Shapira and Simcha (2009) used 1-9 scale as developed by Satty (1980) to convert qualitative equations into quantitative ones. Integers in comparison matrices that are greater than 1 represent a higher degree of importance attributed to the attribute in the row relative to the attribute in the column. The number 1 means that the two attributes compared have equal importance.

The fourth step is Synthesized Matrix, this matrix is obtained from the pair wise comparison matrix. Each element of the synthesized matrix is obtained by dividing the value of the element of the pair wise comparison matrix by their respective column total.

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After Synthesized Matrix, Priority Vectors (PV's) are calculated. The outcomes of synthesized matrix are priority vectors. These are obtained by summing up the elements in each row of the synthesized matrix and then dividing by the number of the elements in that row. The highest value of the vector is given the maximum priority.

Relative Weight Computation: Several approximation methods can be used to compute the eigenvector, of the comparison matrix, of which the Average of Normalized Columns (ANC) method is the most accurate. ANC computation of vector wi, the relative weight of the attribute in row i which is an element of the eigenvector w, for a reciprocal n x n matrix, is as follows:

$$Wi = \frac{1}{n}\sum_{j=1}^{n}(aij/\sum_{k=1}^{n} akj) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where;

n= Number of rows or columns in a square matrix
wi= The relative weight of the attribute in row i
aij= Element located in row i and column j of the comparison matrix
akj=Element located in row k of any normalized column i , j , k =1,2,....n

Weighted Sum Matrix: The weighted factor elements of the weighted sum matrix are obtained by multiplying each element of the pair wise comparison matrix by their respective priority vector. The weighted sum is the summation of the elements row wise. The Eigen Values (λ) are obtained from the following relationship:

Eigen Value (λ) = Weighted Sum / Priority Vector ..... (2)

Consistency index (CI) = (λmax- n) / (n-1)..... (3)

Where;
n= number of attributes

The consistency ratio CR is a measure for controlling the consistency of pair wise comparisons. Consistency Ratio (CR) is to measure how consistent the judgements have been relative to large samples of purely random judgements. Value of consistency ratio should be less than 0.2 for more consistent judgements.

CR = CI / RC ..... (4)

Where;

RC is the Random Consistency Index

The AHP is used for scaling the weights of the elements (risks) in each level of hierarchy with respect to elements (risks) of the next higher level. The fuzzy AHP model is often used to tackle complex decision making that calls for subjective judgment on the basis of logical reasoning rather than simple feeling or intuition (Zhang and Zou, 2007).

The conventional AHP method is incapable of handling the uncertainty and vagueness involved in the mapping of one's preference to an exact number or ratio. The major difficulty with classical AHP is its inability in mapping human judgments. In recent years it has been observed that due to confusion in decision makers mind probable deviations should be integrated to the decision making process. In Fuzzy-AHP, pair wise comparisons are done using fuzzy linguistic preference scale ranging from 0 to 10. For simplicity, the reciprocal fuzzy numbers are replaced by individual TFN's in the pair wise comparison matrix. (Chatterjee, 2010).

Li and Zou (2011) had developed Fuzzy AHP based risk assessment methodology for Public Private Partnership projects and also proposed fuzzy AHP and straight-AHP indicate that fuzzy AHP can improve the risk assessment accuracy and reduce the respondents' subjectivity. To extend the application of the fuzzy AHP, more studies should be conducted.

II. METHODOLOGY

The responses obtained from the questionnaire survey responded by about 51 experts were in a risk rating scale of 0 to 1, where "0" indicates low risky situation and "1" indicates very high risky situation causing huge time and cost over-run of the project. For computational simplicity, we have converted risk rating values obtained from questionnaire survey into "Satty Scale" (1,3,5,7,9) with the help of which pair-wise comparison matrix was constructed both for Likelihood and Impact reviews. Then synthesised matrix is constructed both for Likelihood and Impact reviews. The outcomes of synthesized matrix were priority vectors. These were obtained by summing up the elements in each row of the synthesized matrix and then dividing by the number of the elements in that row.

III. CASE STUDY

The case study considered for this work is Bangalore elevated metro rail corridor construction. The construction is being executed by IL & FS Company Limited starting from the Nayandahalli to RV college station. The length of the section under study is 4.2 km. There are 4 elevated stations. Total 133 piers and 540 piles would be constructed. The weight of each segment is 14 tons.For this section, IL & FS Company Limited will produce, erect and launch 1180 segments for the viaduct from Nayandahalli to RV college station. The methodology of research work was formulation of questionnaire. Firstly to identify the major activities / risks involved from beginning to handing over the project and survey where the replies of the 51 experts from the metro rail corridor projects were used as inputs for expressing the risk severity ranks. Hence two rounds of discussions with metro officials and staff including machine operators, foreman, supervisors, and engineers, site in charges, managers, and deputy general managers. Discussions with consultants and chief engineer were also carried out for the finalisation of questionnaire, rating scales and their responses. The risk

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assessment is carried out in terms of risk severity index and their ranks.

IV. Result of the Research

The priority vectors of likelihood and impact obtained from AHP method for all 22 major risk categories were used as inputs for Fuzzy method by using Matlab software. Five Membership functions and 25 rules were created in software. The outputs are obtained for all 22 major risk categories as risk severity value. All values are calculated and four major activities of Bangalore metro rail project is tabulated in Table I.

TABLE I
Priority Vectors for Major Activities

Sr. No.	Activity	Priority Vectors of Likelihood	Priority Vectors of Impact
1	Risks in casting yard setup	0.033	0.035
2	Risks in Traffic and utility diversion	0.044	0.038
3	Pile and Pier work	0.041	0.038
4	Risks in segment casting	0.046	0.042

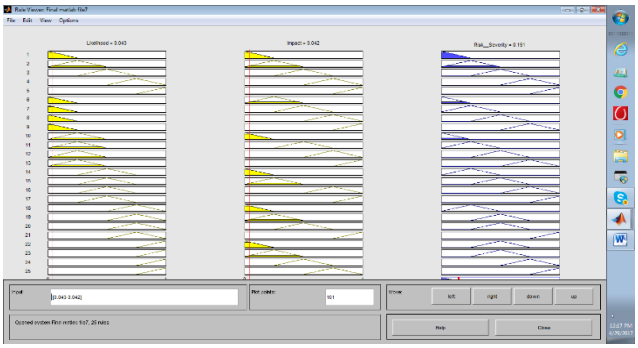


Fig. 1Matlab Representation for Risk Severity for Activity "Segment Casting"

TABLE III
Final Risk Severity values, Risk Index and Ranks by FAHP for the Elevated Corridor Project of Bangalore

Sr. no.	Activity	Final Risk Severity (FuzzyAHP Value)		Normalized Weight	Final Risk Severity Index (Final Risk Severity x Normalized Weight)	Fuzzy MAHP Ranking
		Quantitative	Qualitative			
1	Risks in tender and award of contract	0.168	Very High Risk	0.055	0.00924	1
2	Feasibility and DPR risks	0.162	Very High Risk	0.05	0.00742	2
3	Risks in Land handover	0.159	Very High Risk	0.04	0.00715	3
4	Risks in Traffic and utility diversion	0.152	Very High Risk	0.04	0.00654	4

V. Discussion and Interpretation

The final risk severity value, final risk index and Fuzzy MAHP rankings for all 22 major risk categories of an elevated metro corridor project obtained from Fuzzy MAHP are calculated and first four major activities are tabulated in Table II

In this table,4 major risk categories of an elevated metro corridor project are tabulated starting from ranking 1 to 4 w.r.t final risk severity index values obtained by Fuzzy MAHP method.

By Fuzzy MAHP method, Risks in tender and award of contract activity is very high both quantitative and qualitative and ranking is 1.

VI. Conclusion

There is distinct range of Risk severity quantitative values and Risk index values obtained by Fuzzy MAHP method for all 22 activities.Hence Fuzzy MAHP is a very good method for risk management tool for any Elevated corridor metro rail project.AHP is a well-structured technique and by incorporating Fuzzy as wellas normalised weights in AHP method helps in getting more reliable risk severities indices and ranks, hence proper risk mitigation measures can be formulated.

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Industrial Water Audit

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***Abstract*-A water audit is an on-site survey and assessment of water-using hardware, fixtures, equipment, landscaping, and management practices to determine the efficiency of water use and to develop recommendations for improving water-use efficiency. The selected Industry for Industrial Water Audit is Sanjay Techno Pvt. Ltd, MIDC, Waluj, Aurangabad. The study reveals that the systematic approach towards water audit helps the industry to conserve the water and savings of water through appropriate measures. Reduction in leakages, carrying out roof top rain water harvesting works, making consumers aware about water consumption and allied water loss and expenses help the judicious utilization of water . The nature of water audit technique may differ from industry to industry as per quality and quantity of consumed water, processes carried out in industry, number of personnel in the industry, water using hardware and generated waste water.**

***Keywords*-**

1. **MIDC-Maharashtra Industrial Development Corporation**
2. **CETP- Common Effluent Treatment Plant**
3. **RTRH- Roof Top Rainwater Harvesting**
4. **STPL-Sanjay Techno Private Ltd.**
5. **3P Stages- Pre Audit, Process Audit and Post Audit.**

I. INTRODUCTION

Water is a precious natural national resource with almost fixed quantum of availability. With continuous growth in country's population, per capita availability of utilizable water is going down. Unabated discharge of industrial effluents into water bodies is further aggravating the situation of scarcity of water of acceptable quality. The highly variable rainfall in Maharashtra ranging from 400 to 6000mm occurs in 4 months period. Declaring water conservation a national mission, in June 2003, the Prime Minister of India, appealed to all countrymen to collectively address the problem of alarmingly progressive water shortage, by conserving every drop of water and suggested for conducting water audit for all sectors of water use.

II. WATER AUDIT

A. Introduction-

Water audit is a qualitative and quantitative analysis of water consumption to identify means of reducing, reusing and recycling of water. Water audit determines the amount of water lost from a distribution system due to leakage and other reasons such as theft, unauthorized or illegal withdrawals from the systems and the cost of such losses to the utility. Elements of water audit include a record of the amount of water supplied and stored by various sources, water consumption, water delivered to unmetered users, water loss and suggested measures to address water loss, waste water generated and treated etc..

Industrial water use audit examines the major areas which includes water used by industrial process, human consumption, personal hygiene & sanitation, washing, cleaning, , gardening etc.. In Aurangabad, according to recent study; for Maharashtra Industrial Development Corporation (MIDC) area, water rate supplied by MIDC is Rs.16/m^3.

B. Benefits of Water Audit-

1. Water audit improves the knowledge and documentation of the distribution system, problem and risk areas and also better understanding of what is happening to the water after it leaves the source point.

2. Leak detection programs help in minimizing leakages and tacking small problems before they become major ones.

These programs lead to:

a. Reduced water losses.
b. Improved financial performance.
c. Improved reliability of supply system.
d. Enhanced knowledge of the distribution system.
e. Efficient use of existing supplies.
f. Better safeguard to public health and property.
g. g. Reduced disruption, thereby improving level of service to customers.

3. Water audit creates the foundation for a broader plan.

C. Approach and Methodology for Water Audit-

The water audit is completed in 3P stages. These stages are:

1. Pre audit includes collection of primary data regarding sources of water, water consumption of various purposes, waste water generated, etc.

Steps followed in pre audit are:

a. Water supply and usage study.
b. Process study.

2. Process audit is the examination of system to determine whether the water is being consumed efficiently and effectively.

3. Post audit includes following steps.

a. Awareness in system about water conservation.
b. Documentation of Water consumption and time to time remedial measures

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III. CASE STUDY

The selected Industry for "Industrial Water Audit" is Sanjay Techno Pvt. Ltd, MIDC, Waluj, Aurangabad.

A. Pre Audit:

1. Basic information about industry;

Sanjay Techno Pvt. Ltd. is located in the MIDC Waluj of Aurangabad district in the state of Maharashtra according to the state administrative boundary. The industry is spread over an area of 18,000 ft^2.Sanjay Techno Products Pvt. Ltd. deals with manufacturing of plastic products and various plastic molding works.

2. Water Supply to the Industry;

Sanjay Techno Pvt. Ltd. has water supply from the Maharashtra Industrial Development Corporation (MIDC), Waluj, Aurangabad and it acts as a primary source of water. Majority of water requirement is fulfilled by MIDC water supply and the remaining is supplemented by private water tankers.

Generally, in the period of March to June, water supply by MIDC is lowered and hence requirement of private water tankers is increased. Approximately, 25 tankers of 5000 lit each are required per month during this period. The incoming water from MIDC is measured by the 'water flow meter' available at the entrance of the industry.

B. Process Audit:

1. Water Consumption of Industry;

In this industry, water is required for following purposes:

a. For Industrial Processing:

The industry requires water for the purpose of chilling the heated components (chilling process). 2500 liters is a water evaporation loss per day for this process; thus, 75m^3 per month water is lost as evaporation.

Wash out of recycled water is 8m^3 per month.

Hence, total water consumed for industrial processing is 83m^3 per month .

TABLE I

INCOMING WATER QUANTITY (IN M^3)

Source	Aug-16	Sept-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	March-17	April-17	May-17	June-17	July-17
MIDC	432	283	478	402	326	256	295	174	244	326	217	334
Tanker	-	-	-	-	-	-	-	125	125	125	125	-
Roof Top Rainwater Harvesting	Only 20 ft. * 20ft. area used for this purpose. Other area is yet to be used.											

b. For Domestic Use:

The company runs in three shifts. Total number of persons working in the industry is 180. The domestic demand of water includes water requirement for the toilets, basins, urinals, drinking, etc.

a. Toilets – 9 Nos.
b. Urinals – 7 Nos.
c. Basins – 7 Nos.

Various types of taps are used for consumption of water by personnel. The leakages through taps are related with type of taps and habits of workers. The various types of water taps are shown in Table No.2

TABLE II

SPECIFICATION OF TAPS USED IN IMDUSTRY

Source	Quantity	Type of Tap
Basins	7	Rounded cap
Urinals	7	Push button
Latrines	9	Single lever handle

The water required for the domestic use is assessed by discussion with consumers. Considering the water consumption for drinking, washing of hands and toilet purpose, the average consumption works out to 20litre/day/person. Thus 20 x 180 =3600 lit/day water is consumed for domestic purpose.

Hence approximately 108m^3 of water is consumed for domestic use per month.

c. For Other Purposes:

It includes water requirement for the gardening, washing, etc.

Garden area is about 110 sq m.. Number of plants in the factory premises is 70.

For the purpose of gardening, the water is provided three times per week. Water from the MIDC is used for the purpose of gardening. Thus, 30m^3 water is required for gardening purpose per month. Therefore, Total average water consumption per month works out to 221m^3.

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TABLE III

EXPENDITURE INCURRED FOR INCOMING WATER (IN RS)

Source	Rate	Aug-16	Sept 16	Oct- 16	Nov-16	Dec-16	Jan -17	Feb -17	Mar-17	Apr-17	May-17	June-17	July-17
MIDC	Rs16 /m^3	7392	5008	8128	6912	5696	4576	5200	2597	4384	7899	7952	8079
Tanker	Rs 90 /m^3	-	-	-	-	-	-	-	11250	11250	11250	11250	-

2. Observed Water Loss Due to Leakage;

From 4 washrooms:

1. Tap of Urinal:
   Leakage = 32.12 lit/hour (23.563 m^3/month)
2. Tap of Toilet:
   Leakage = 32.12 lit/hour (23.563 m^3/month)
3. 3 Taps at Urinal:
   Leakage = 3 lit/hour (2.160 m^3/month)
4. 3 Taps at Toilets:
   Leakage = 3 lit/hour (2.160 m^3/month)
5. At Water loader:
   Leakage = 4.2 lit/hour (3.024 m^3/month)

Thus total leakage is 63.109 m^3/month.

Water rate= Rs 16/ m^3

Thus total Cost of leakage water is Rs 1376.86 per month i.e. Rs 16,522.32 per year. Though the amount seems to be meager, considering the fact that each drop of water is precious, we can save huge quantity of water by prohibiting the leakages of water through taps for entire industrial area.

On an average, this wasted quantity of water can fulfill monthly water requirement of 3 to 4 families.

3. Total Water (Consumption + Leakage);

From the incoming water details of industry, it is observed that, average incoming water is 306m^3 per month.

From above details, total consumed water = 221m^3.

Total leakage of water = 64m^3.

Following pie chart shows the details of water consumption.

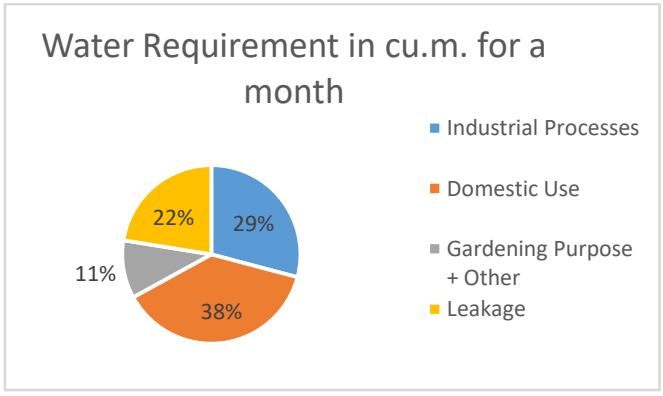


Fig.3 Details of Water Consumption

4. Sources of wastewater;

a. Processed water obtained after the chilling process
b. Processed water obtained from the annealing tank.
c. Domestic sewage water obtained from the basins, toilets, urinals, etc.

The wastewater is sent to the common effluent treatment plant (CETP) of the Waluj, MIDC area.

C. Post Audit:

1. Awareness in system regarding water conservation;

For accurate understanding of water consumption by each individual in the industry, a survey is conducted regarding details of daily water usage.

Following actions are taken for optimal use of water:

a. Posters and stickers are pasted at proper places which has created awareness among workers and staff. These posters are made in local language and the pictures on the same has made the consumers to save water and use it judiciously.
b. Numbers were assigned to every taps and tanks so that the tap can be identified easily for repair purpose. Similarly, each toilet, taps, tanks, general drinking water taps, etc. are numbered.
c. Workers are briefed about importance of water conservation.

2. Suggestions for water conservation;

Following suggestions are given to the administration of the industry. These suggestions are more or less applicable to all industries for water auditing and water savings.

a. The water leakages through taps can be minimized by fixing the problems in plumbing system.
b. Push taps can be provided in basins/toilets to minimize water use.
c. Drip irrigation can be taken into practice for the purpose of gardening, to optimize the consumption of water.
d. Roof Top Rainwater Harvesting (RTRH) works shall be completed on top priority.

IV. CONCLUSION

Water audit is a qualitative and quantitative analysis of water consumption to identify means of reducing, reusing and

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recycling of water. Water audit is important for the management of water usage for industries. With the help of water audit one can find the leakage and calculate the losses in the system.

As per the need of industry Sanjay Techno Private Ltd., (STPL) Waluj, Aurangabad, Pro-forma for water audit is developed. With the help of this pro-forma the information is collected. The data is useful for water auditing and allied measures. Primary data regarding sources of water for the industry, consumption of water for various purposes, leakages in the system, etc. is collected and analyzed. Monthly consumption of water in the industry is about 306 cum. The leakages observed are about 64 cum per month. The water audit can help to reduce the water losses in the industry as well as to save the expenditure.

Awareness program is conducted among staff of the industry to aware about water conservation and water savings. Along with awareness, remedial measures are taken and suggested. Roof Top Rainwater Harvesting is suggested. The leakages were detected and repaired. The posters and symbols are installed within the industry to save water. The numbering system for water storage tanks and taps is done, which will be useful to industry for maintenance of water tanks and taps in future.

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A Review of Contractual Framework for Public-Private-Partnership Models in Road Projects of Gujarat

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Abstract: **Infrastructure has become the new standard for development of countries worldwide, however governments of different countries find it difficult to build and sustain large infrastructure projects. In response there is a growing trend of involving private partners for developing and maintaining such mega infrastructure projects. Public-Private-Partnership (PPP) has become one of the best methods to develop infrastructure. Many public-private-partnership models are working in different sectors for Indian infrastructure development. PPP models can vary according to the type of infrastructure being built, duration of the project capital, financing structure etc. This paper is an attempt to review the available literature pertaining to the contractual framework of the PPP models used for development of road infrastructure in Gujarat state. Road sector is a major thrust area for infrastructure development in Gujarat. Generally a used mode of PPP includes Build Operate Transfer (BOT), Design Build Finance Operate and Transfer (DBFOT), Build Operate Lease and Transfer (BOLT), etc. for road sector within Gujarat. The current study compares BOT-Toll, BOT-Annuity and DBFOT for their theoretical considerations. Important factors such as financial structure and model concessionaire agreements, operation and maintenance across different PPP models were studied to compare and develop a better understanding. Furthermore the outcome of these study i.e. positive aspects of different existing PPP models also presented recommendations for developing a new PPP model for development of Road Infrastructure projects for Gujarat which could be used by National Highway Authority of India (NHAI) for future projects.**

Keywords **— Concessioner Agreement, Build-Operate-Transfer (tall), Design-Build-Finance-Operate-Transfer**

I. INTRODUCTION

Rapid urbanization in many countries has led to a massive demand for investment in infrastructure (WB, 2006). All over the world, governments have been engaging in public-private-partnership (PPP) provisions for the growth of infrastructure. In each country, primary type of infrastructure is road sector and for which few procurement model has been adopted e.g., the Indiana toll road, the Chicago skyway, and Pennsylvania Turnpike in the United States. The PPP contractual model is defined as national legislation (Decree-Law No. 86/2003) "the contract or union of contracts by which private entities, nominated by private partners, in the long term are compelled to assure, before a public partner, that the development is aimed at satisfying a collective need, and where funding and responsibility for investment and operation and maintenance obligations belong, in whole or in part, to the private partner." The emergent trend for the project finance is ruder in Asia as economic and currency crunch increases. A Public–private partnership (PPP or 3P) is a commercial legal relationship defined by the Government of India in 2011 as "An arrangement between a government/statutory entity/government owned entity on one side and a private sector entity on the other, for the provision of public assets and/or public services, through investments being made and/or management being undertaken by the private sector entity, for a specified period of time, where there is well defined allocation of risk between the private sector and the public entity and the private entity receives performance linked payments that conform (or are benchmarked) to specified and pre-determined performance standards, measurable by the public entity or its representative."

Today, there are hundreds of PPP projects in various stages of implementation throughout the country. As outlined in 12th Five Year Plan (2012-2017), India has an ambitious target of infrastructure investment (estimated at US$1 trillion). In the face of such an enormous investment the Government of India is actively promoting PPPs in many sectors of the economy. India has the second largest road network in the world, spanning a total of 4.87 million kilometers. Roads in India transport over 60 per cent of all goods and 85 per cent of total passenger traffic. The National Highways account for 1.9 per cent of the total road network in India and are expected to reach 100,000 kms by the end of the 2017 from 97,135 kms in FY15. The Government of India has formulated a seven-phase programme, 'National Highway Development Project (NHDP)', vested with National Highways Authority of India (NHAI), for the development of National Highways in the country. The private sector has emerged as a key player in the development of road infrastructure in India. Increased industrial activities, along with increasing number of two and four wheelers have supported the growth in the road transport infrastructure projects. The government's policy to increase private sector participation has proved to be a boon for the infrastructure industry with a large number of private players entering the business through the public-private partnership (PPP) model. During the next five years, investment through PPP is expected to be US$ 31 billion. With the Government

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permitting 100 per cent foreign direct investment (FDI) in the road sector, several foreign companies have formed partnerships with Indian players to capitalise on the sector's growth.

One of the main characteristics of PPP agreements is related to the financing model of the projects. Although project finance is sometimes used as a synonym for PPP, this is not entirely accurate. The question of risk sharing is undoubtedly one of the most critical issues for the success of the model. It is through an effective risk-sharing agreement that value for money (VFM) can indeed be delivered. Contracts permitting the use of certain assets, facilities and rights like leases, licenses, concessions. The choice of the format for PPP should be decided by the concerned governmental authority after evaluating factors such as: felt need for a particular infrastructure facility which determines the output/performance parameters; felt need for private participation in the development and operation of that facility including the value for money proposition; most efficient way of developing and operating that facility; and balance between viability, welfare objectives and public policy needs.

II. LITERATURE REVIEW

According to UK government, who made first attempt to push private sector for financing any infrastructure projects under PFI, launched in the UK in 1991[10]. As suggested by [4] a functional specific definition of PPP is more focus on financing, construction and operation and maintenance are key features with bi-dimensional view of mutuality and organization identity. Sarkar and Patel (2012) made an attempt to develop a project risk management model for the PPP highways projects. Their model addresses most of the challenges faced by the PPP highway projects in India. The identified risks were analyzed and suitable mitigation measures were suggested. Therefore, as an integrated perspective, PPP can be defined as a strategy that is utilized to provide quality infrastructure facilities and services with high efficiency (as purpose and function), based on a long-term contractual arrangement between public and private parties (as basis of formal governance of the relationship), through the synergetic cooperation between the public and private partners (as means and key feature) [14]. The cycle of PPP is start from development stage and ending with operation while going through intermediate stage of realization. A framework is developed to act as the lens for the institutional analysis of PPP project transactions, as shown in Fig.1. The micro process is mainly concern with resource allocation and employment during project execution when rules are contractual and designed to regulate participation (Level 4 in Fig. 2). The contractual arrangement, formal and informal, includes perception of PPP, constitutions, laws and regulations, etc. As it can be seen from fig.1 that constraints influence transaction process and it can mainly governed by rules as at this stage it follows legal framework. The institutional and contractual rules, with their interactions with each other, constitute the governance system of the whole PPP project [14].

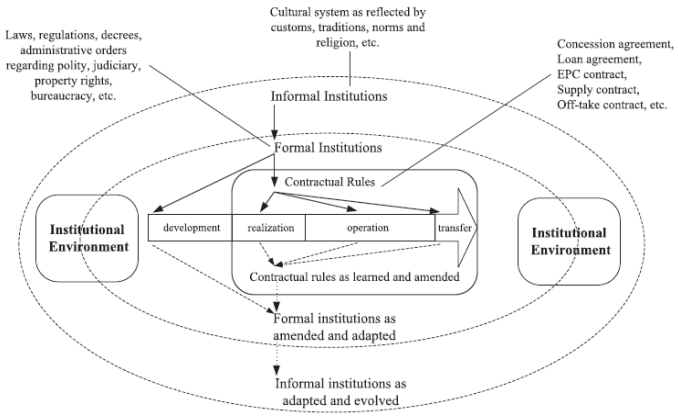


Fig. 1.Institutional framework for PPP development (Zhang et al. 2014)

There are numbers of examples of PPP failures caused by government actions, which are indicated by poor understanding in PPP concept such as: lack of government support and guarantees, unclear contract provisions, an inappropriate of assurance from government. Concession contracts are connector between two parties involves and it is not only solution to prevent the project failure. As there are many numbers of problems occurred during the implementation of the contractual agreement [5]. Central feature of PPP's is the contractual arrangement. Private investor is sharing equity participation and financial risk for long term contracts [3]. Innovative long term approaches and traditional shorter term are new range of contractual forms. The few forms of the different contracts are: Service Contract, Leases, Management contracts, Concession contracts, Privatization, Joint Ventures. As explain in Fig 2, there are five types in which private parties can involve in different PPP forms.

Agreement of concession is covering main five major aspect of basic agreement, pre-construction, construction, operation and termination as shown in fig. 3. Both the parties have rights to put their view in agreement except content against law, which is used for enforcement the agreement [2].

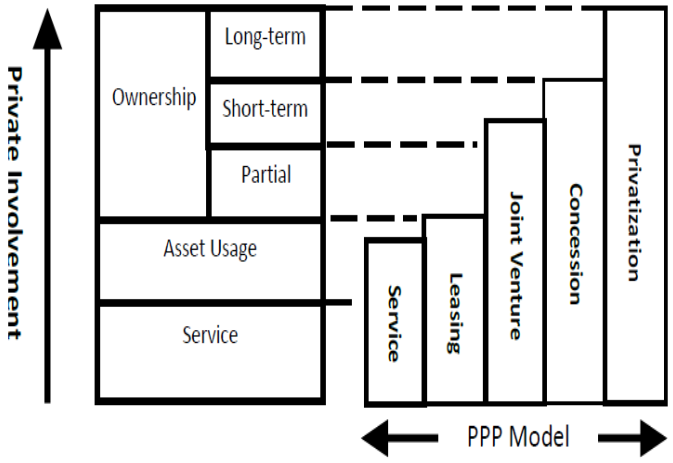


Fig. 2.Spectrum of PPP model [1]

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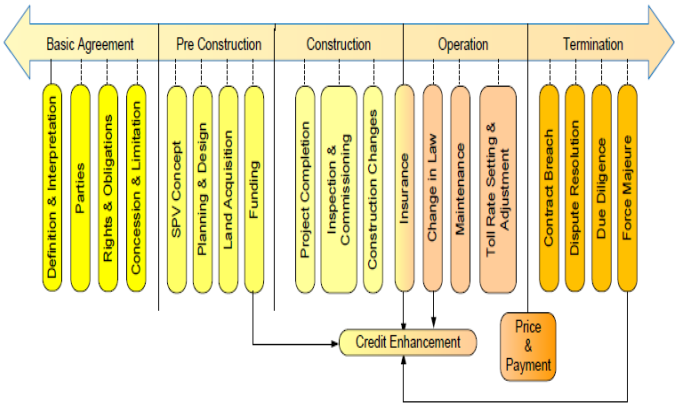


Fig. 3 five major scope of concession agreements [2]

III. CASE STUDY

For the case study authors are selected two projects within Gujarat which lies under NHAI and known as NH-8. There two different cases are taken for study of concessioner agreement which is made for each project and following points are consider for discussion.

A. *Project: 1* – This project is extension of existing four lane highway to six-lane highway for the patch of Surat-Dahisar under NHDP Phase-5. Total length of the project is 239.00 km and it is connecting two state Gujarat and Maharashtra. This project develop under BOT (tall) concessioner agreement pattern.

B. *Project: 2* – This project is also extension and improvement of six-laning of existing road under NHDP Phase-5. The total length of this project is 102.00 km and expressway is also existing beside the route. This project is develop under DBFOT (tall) base concessioner agreement.

C. POINTS OF COMPARISON

1) OBLIGATIONS OF THE CONCESSIONAIRE AND AUTHORITY: Concessionaire has authority to draft all the project agreements for its review and commence, and authority shall also have rights, but not the obligations to undertake such review and provide its comments, to the concessionaire within 15 days of the receipt of draft and within 7 days of execution of project agreement. The concessionaire has to submit a true copy duly signed by director of the concessionaire to the authority for record. Authority shall make the best endeavor to procure that no local tax, toll or charge is imposed on the use of whole or any part of the project subject to accordance with applicable laws, grant to the concessionaire the authority to regulate traffic. The Concessionaire shall have obtained all Central Government clearances and permits under the applicable laws relating to environmental protection and conservation from the Ministry of Environment and Forest.

2)RISK SHARING AND CHANGE IN SCOPE: All risks related to the project are shared almost equally by concessionaire and the authority in BOT (tall) and in BOT (annuity) all risks related to the project are majorly borne by authority as each year they have to pay concessionaire regardless of the annual traffic. For the change in the scope the concessionaire shall inform to the authority and after approval if the change is more than 0.25% of the total project cost and it shall be borne by the concessionaire end if it exceeds further more than 5% of the total scope of the project in any continuous 3 years during construction than amount must not increase more than 20% during whole concession period. During the Construction Period, which is beyond the scope of the Project as contemplated by this Agreement ("Change of Scope"), provided such changes do not require any increase/ reduction in expenditure exceeding 10 % of the Total Project Cost and do not adversely affect the COD. All such changes shall be made by NHAI by an order (the 'Change of Scope Order") issued in accordance with the Procedure.

3)FINANCIAL C[1]*LOSER AND CONCESSION FEES:* Concessionaire has to agree to achieve Financial close within 180 days from the date of agreement and in case of delay concessionaire has to pay 0.1% of the performance security each day. In case of financial closer the concessionaire has to submit report to the authority at least two days prior to the financial closer. The concession agreement shall be deemed to have been terminated by mutual agreement of the parties, and upon termination performance security is encased as damage. Concessionaire agrees to pay fees for the 1st year of the concession period. A premium in the form of an additional concession fees equal to 38% of the total realisable fees during that particular year. Premium shall be determined by increasing the proportion of total realisable fees during that year by an additional 1% as compared to the immediately preceding year.

4)TERMINATION: Concessionaire fails to deliver project within stipulated date or date of commencement or fails to breach the maintenance requirements. Concessionaire fails to make payment to authority within time period specified also when the escrow default has occurred and the concessionaire fails to cure the default within cure period of 15 days. Concessionaire when declares bankruptcy etc. Authority if fails to cure their default within 90 days of cure period. The Concessionaire fails to achieve any Project milestone other than Scheduled Project Completion Date within the period set forth and fails to cure such default within a period of 180 days from the date of its occurrence. The Concessionaire is adjudged bankrupt or insolvent or if a trustee or receiver is appointed for the Concessionaire or for any of its property that has a material hearing on the Project.

IV. CONCLUSION

After studying different concessionaire agreement of the PPP models applied for Indian Highway projects it has been observed that BOT toll models appear to be most feasible model. There are some notable features of the BOT (toll) project concession agreement such like ownership of road, acceleration of construction, risk transfer, value of money, long and complex tendering process, etc. The BOT (annuity) projects are also feasible in certain conditions where the fluctuation of the

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forecasted traffic and actual traffic flow is quite high. Finally, it can be recommended that, on considering concessionaire's financial model the project authorities may consider BOT (toll) if the financial backup of the organization is good. Otherwise concessionaire may also go for BOT (annuity) due to its neutral traffic risk.

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Investigation and Performance Analysis of Triple-Effect Solar Still Coupled with Evacuated Tubes

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Abstract: **- Drinkable water is one of the most essential requirements for humanity, and the rise in human population growth has to lead to water pollution to the river and underground water reservoirs. To overcome the demand concerning about potable water, many researchers from all around the world have tried various new technologies. Solar distillation is the simple and cost-effective technology for changing of contaminated water to potable water. In this present research work, efforts are applied to make solar still with enhanced distillate output with the help of attachment of Evacuated tubes. Hence, triple effect solar still has been fabricated and tested to see its performance. Experiments on the present solar still have been carried out for three days in climate conditions of Patan, Gujarat. From the research work, it has been evaluated that, the increment of distillate water production and energy payback time found 700% and 72 days only. It has also found that the present solar still is capable of producing 20 litres of distillate production of water from saline or brackish water. Hence, it is the best solar still for potable water requirement.**

***Keywords*: Triple effect solar still, Evacuated tubes, output**

I. INTRODUCTION

As we all know that, the prime requirement for survival for the human being is Water. The faster economic growth and pressure on value and amount of water reservoirs, mainly in developing country shows the urgent requirement of safe and fresh drinking water. Rapid industrialization is one of the significant causes of contamination of water bodies due to direct discharge of untreated sewage and wastewater into the rivers and lakes. Drinkable water availability is becoming a primary issue in many areas of the world. Use of emerging technologies for the treatment of contaminated water is essential. At in present rising scenario, solar distillation is one of the promising technology have made possible way to gain potable water. In the natural distillation process, solar radiation falls on the water bodies and the water get enough heat to evaporate. Evaporated water to rise high above the surface of the earth and this vapour once cooled then, it results in condensation. Hence, evaporation and condensation are two primary processes responsible for the production of potable water. [1-6].

Solar still is one of cheapest material by which we can get clean water by the process of solar distillation. In other words, merely solar distillation used the heat means (the solar radiation which directly comes from the sun) in equipment to treat and purified the water. This apparatus is called as a solar still, the structure of solar still is elementary, it consists of two things one is shallow basin and a thin glass cover. When solar radiation falls on the water which is present in a basin it heats the water; the water gets evaporated by the evaporation process. [7-10].

The vapours raise (in the form of moisture) it collects and condenses on the glass cover, and these vapours are collected. All the inorganic and organic contaminant including microorganisms are left in the basin. The process of manufacturing a solar still is a cost-effective method and also the cheapest way to get clean water. Solar still is one of the long-lasting techniques to purify contaminated water, by merely built the solar still we can get filtered water in a low cost if it is manufactured and maintained carefully. The operation process of solar still is very easy. Hence no new workforce is required. [11-12].

Solar still is a single basin solar still this is a famous device which is used in solar distillation and desalination for the conversion of available blackish water or wastewater into potable water **[12]. Panchal et al. [13]** found improvement in efficiency and productivity many materials were used like-coupling with reflectors has been used. Parameters can play the vital role in location, solar radiation intensity, and wind velocity, water depth in the basin, solar angle, wind, inclination and most significant heat capacity of still. Whereas active solar still requires the different type of mechanical support for maximum output by making the essential improvement to get the better rate of heat transfer we can obtain enhancement in the distilled production. **Abdel-Rahim and Lasheen [14]** proved that coupling of solar still with parabolic through collector focal pipe heat collector increases the production of solar still 18%. **Rai and Tiwari [15]** have worked on the solar still integrated with flat plate and concentrating collector to improve the efficiency around 24% compared with conventional solar still. **Tiris et al. [16]** proved that coupling of flat plate collector with single basin increases the efficiency 51% compare with single basin. The effect of coupling a flat-plate collector on the solar still productivity in desalination, work was investigated by **Barden et al. [17].** They found enhancement of around 29%

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compared with conventional solar still. **Velmurgan and Srithar [18]** integrated solar pond with conventional solar still to enhance water temperature inside basin. They found 26.6% increment of distillate output compared with conventional solar still. They have also carried out theoretical analysis and compared with experimental study and found impressive similarity in results. **Dimri et al. [19]** evaluated that, the integration of flat plate collector with higher thermal conductivity materials improve the distilled output compare with the single slope solar still. To reduce inner glass cover temperature was determined by **Kumar and Bai [20]** gained that 30% improvement in distillate output compared with conventional solar still. Integration of black wire helical springs have used by **Khaled and Eldalil, [21]** and found 32% increment.

Panchal et al. [22] proved that coupling of flat plate collector with single basin increases the 29%. Single sloped solar still using Lauric acid (PCM) increases the output 36% proved by **Voropoulus et al. [23].** Solar still integration with evacuated tube collector increases the output 40% solar still. An experimental investigation on single basin solar still the improvement with evacuated pipes have used by **Sampathkumar [24].** He found 49.7% increment in the production of water compared with conventional solar still.

From the literature review, it has been found that the distillate output improvement is required in solar still. Many researchers have introduced various devices like flat plat collector, Evacuated tubes, parabolic trough collector etc. But the design of solar still requires attention along with the use of above tools with it. Hence, the primary aim of the present research work is to fabricate triple effect solar still with Evacuated tubes and tested in climate conditions of Patan to see its performance and increase distillate output.

II. OPERATING PRINCIPLES

During day time solar radiation falling on the solar still as well as evacuated tubes. Lower basin of solar still supplies cold water into the evacuated tubes, hence it will undergo hot water from the evacuated pipes and hot water would go to the lower basin. This process will be continuing for producing hot water in the lower basin.

Lower basin water evaporated into water vapour and condensed in the lower stacked tray and produces potable water. Latent heat of lower basin will evaporate water inside the middle basin, and water vapour of central basin condenses on the lower portion of the upper stacked tray. Some amount of latent heat will evaporate water inside the upper basin, in which solar rays are also entrapped for producing steam and potable water. In all basins, raw water quantity remains same all time. Hence, distillate output is obtained from all three basins.

2.1 Experimental Procedure

During starting of research work on solar still, water is filled in the storage tank after that basin is filled up to 3 cm of height on night time through the inlet pipe which is directly connected to the upper basin. The glass, which covers the top basin, is cleaned daily in the morning for removal of extra dust and particles which is deposited on the upper surface of glass before stating the setup. The experiment setup was set in the November and March month from 10 to 24 November 2015 and 10 to 30 March in 2016. The reading was recorded and taken from morning 9 am to evening 6 pm. The important variables in present research work like basins water temperature (Tw), the upper surface temperature of glass (To), evacuated tube outside temperature(Teo), ambient temperature (Ta) and solar radiation on the still (Ig) and output.



Fig. 1. Pictorial view of experimental setup

2.2 Experimental Structure

The experimental structure was assembled in the Solar energy laboratory developed by Government Engineering College Patan, Gujarat. Primary elements mandatory for the experimental structure are triple effect solar still with evacuated pipes. Fig.1 exhibits the Pictorial view of triple basin solar still with evacuated tubes. The water in the solar still is gained heat by two kinds of heat causes. One cause is the Evacuated tubes attached to lower side of solar still with dimensions of Φ0.1 m ×1.88 m, and the other is the black colour paint coating on the upper surface of the top stacked tray which can absorb the sunlight and heat the water. An insulation of glass wool is provided at the outer side of the basin to prevent the heat loss as it is good to control loss of heat. Distilled water inner and outer side was condensed by glass cover with 4 mm thickness, and the glass cover was toughened by black colour silicon tap with solar still to prevent the heat loss by the sides of solar still. Condensed distilled output was collected in the collecting tanks. Which is represented by extracted output 1, purified output 2 and distilled output 3. Total 3 holes are made in three basins for the thermocouples. Here, 25 evacuated tubes are coupled in the lower basin. Plastic cone cups are used to attach the

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evacuated tubes with stand. Range, accuracy and percentage of errors of measuring instruments are taken from reference [26].

III. RESULT AND DISCUSSION

An experimental setup was set in the month of November 10/11/2015 to 24/11/2015 and in March 20/03/2016 to 30/03/2016. The observation was monitored and analyzed on daily basis Daily Total by 15 days regular monitoring in November show that the maximum distilled output was recorded 15, 16 and 17 November, 2015. The main reason for choosing of three days is that; the average global solar radiations are found nearly same during above said three days. 10 days routine monitoring in March shows that the maximum distilled output was recorded in 23, 24 and 25 March. Therefore, for further study, these three days in November consider for detail study.

3.1 Effect of Ambient temperature and solar intensity with time on triple basin solar still.

Solar still distilled output is directly depending upon the weather condition of that place and time. The ambient temperature and solar intensity play a key role in the distillation process. Figure 2

The basin temperature was recorded maximum at 12 pm to 3 pm. The solar radiation gradually increases from early morning to 1 pm due to brilliant sun and then cut back towards evening due to low sunshine. It gets to maximum value of 900 W/m^2 on 17/11/2015 at 1:00 pm. But the variation in ambient temperature was found as its minimum 17°C at early 9 am morning in 17/11/2015 and gained the maximum of 25 °C at 2pm on 16/11/2015 and 26 °C on 17/11/2015, but on 15/11/2015 the ambient temperature was maximum at 1:00 pm found 27 °C.

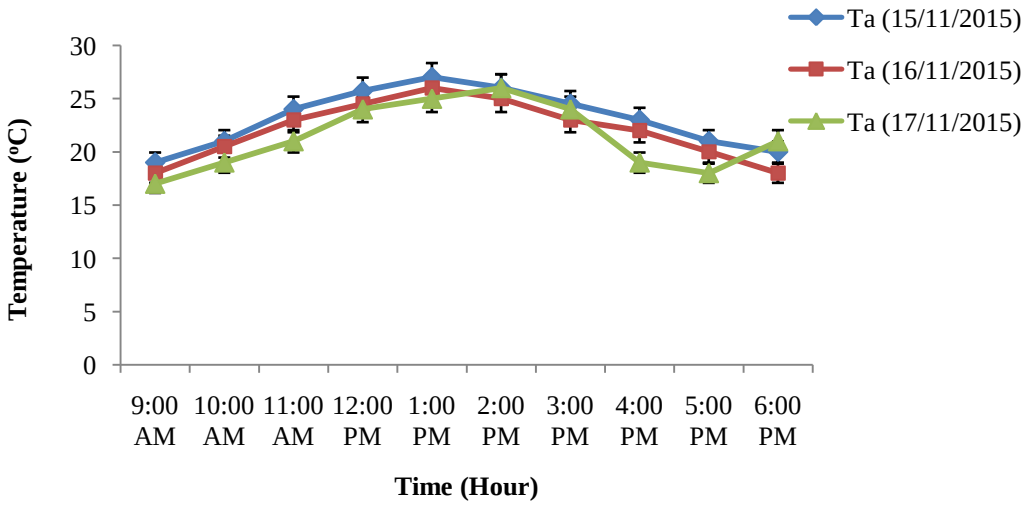


Fig.2 Variation of ambient temperature with time

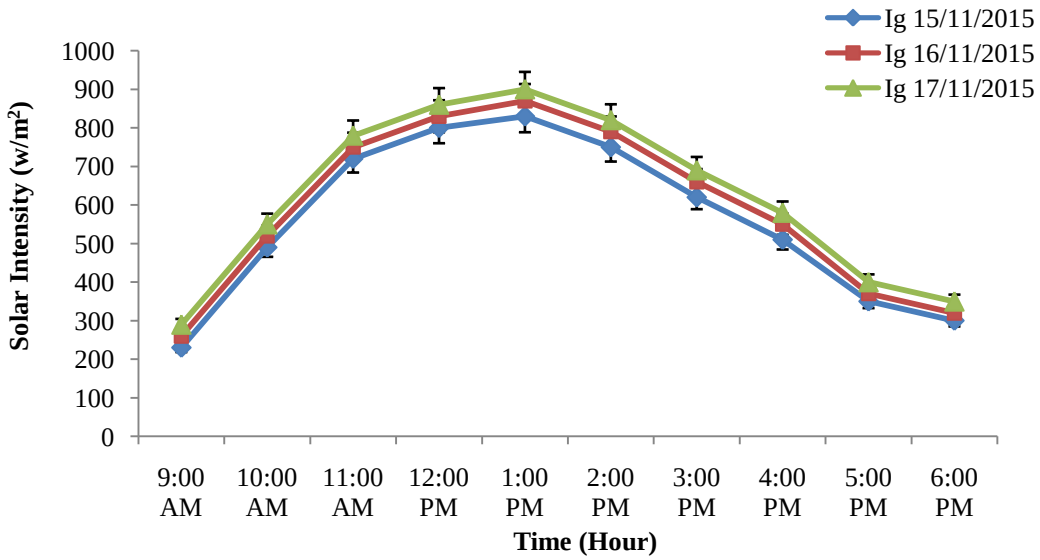


Fig.3 Variation of solar radiation with time

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3.2 Enhancement in the of distilled output coupling with evacuated tubes.

The distillate water increases from 2 pm to 5 pm. It reaches a maximum value of distillate water 1670 mL during 5 pm on 15/11/2015 and the minimum amount of 843 mL during 3 pm on 17/11/2015. The maximum value of water was found on 16/11/2015, and the minimum value of water was found on 17/11/2015.

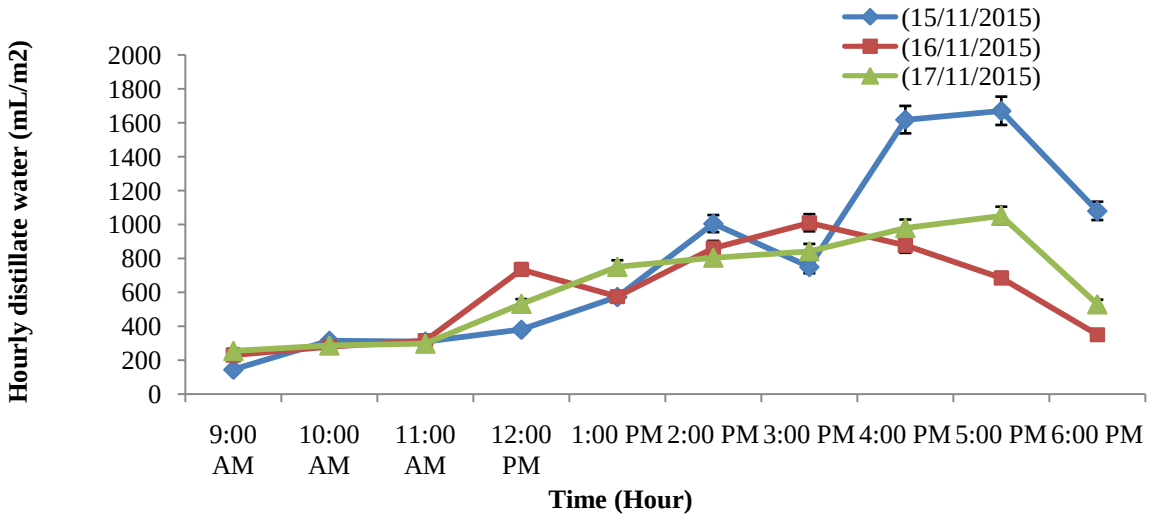


Fig. 4. Hourly variation of distilled output with time

3.3 Total (Day & Night) Distilled water output

The slight variation of distilled output in sun-shine and off-sunshine hours was recorded on 15/11/2015, but in 16/11/2015 and 17/11/2015, the extracted output was maximum at night time

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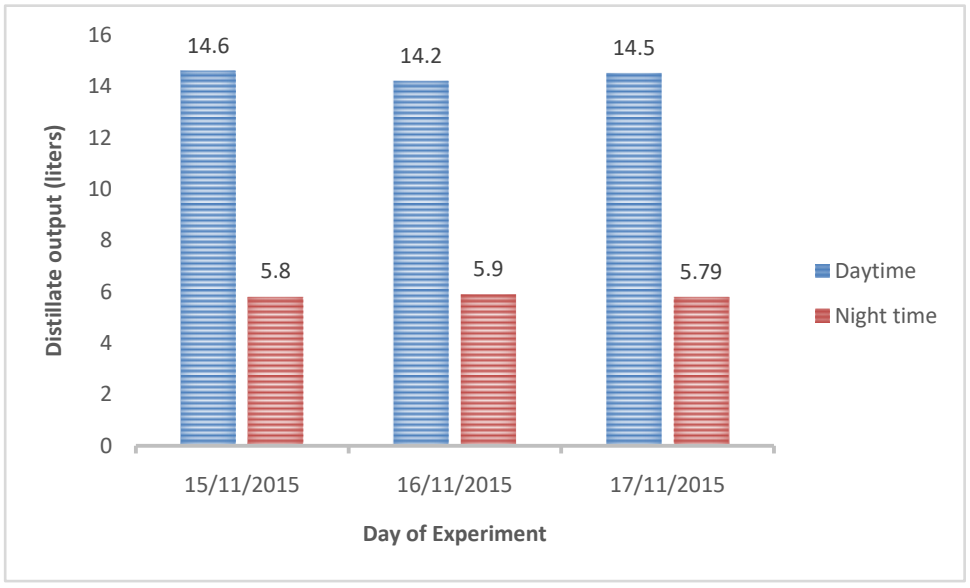


Fig.5. Day and night collection of distilled water

3.4 Comparison of output efficiency of present research work

Before current solar still in the market, the comparison study is required. It gives the idea of present work compared with other researchers work. Table 1 shows the comparison of various researchers works compared to present research work in terms of increase in distillate output of water. For comparison with other researchers work, average distillate output of conventional solar still is take as 3 liters.

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Sr. No.	References	Experiment work Type of Augmentation with solar still	Increase in distillate water (%)
1	Rai *et al*., 1983	Single basin Solar still coupled with Flat plate collector	18
2	Adbel-Rehim *et al.*, 2007	Experimental and Therotical Analysis solar still Augmented with Parabolic collector	24
3.	Velmurgan and Srithar, 2007	Solar still Integrated with a Mini Solar Pond ,	26.6
4	Badran *et al*., 2005	The effect of coupling a flat-plate collector on the solar still productivity. Desalination	29
5	Kumar and Bai, 2008	Solar still condensation	30
6	Srithar, 2010	Solar still coupled with activated carbon and methanol with sponge and sand	32.32
7	Panchal, 2013	Actual performance analysis of flat plate collector coupled with passive solar still with Flat plate collector	36
8	Sampathkumar, 2013	An experimental study on single basin solar still augmented with evacuated tubes	49.7
9	Panchal *et al*., 2014	Enhancement of distillate output of double basin solar still with vacuum tubes	266.67
10	**Present work**	**Triple basin solar still with Evacuated tube collector**	**700**

Table 1 : Comparison of various researchers work on solar still in terms of percentage of distillate output

IV. ECONOMIC ANALYSIS OF THE SOLAR STILL

Payback period of triple basin solar still coupled with evacuated tubes depends on the various cost like- cost of fabrication, cost of feed water maintains and operating cost and also the financial subsidy are offered by the Government. Table 2 Shows the economic analysis of solar still.

₹1 USD	INR. 63 (Assume)
Cost of Fabrication	₹-19640
Cost of Operation	₹-5/day
Cost of Maintenance	₹-5/day
Feed water cost	₹-1
Cost of distilled water	₹12/Litre
Cost of water produced / day	₹-264/day
Subsidized cost given by government	4% = ₹-785
Net profit = (Cost of water produced / day) –Cost of Operation – Cost of Maintenance - Cost of feed water	₹253.
Payback period = (Investment - Subsidized cost) / Net profit	74 Days

Table 2 : Economic analysis of solar still

V. CONCLUSION

In the growing realization of relationship between human wellbeing and water pollution, it is necessary to undertake regular monitoring and surveillance of chief ecosystem to control the pollution. Among the number of treatment technology solar distillation is the best, environmental friendly, reliable and cost-effective way for treatment of contaminated water. Present research work shows design, fabrication and analysis of a new solar still with enhanced condensation surface, which applies the corrugated shape structure to decrease the condensation resistance and increase the freshwater yield and treat the contaminated water from solar energy. From the research work, following points are concluded:

- Design and development of solar still with modified three basins increase the output.
- The present solar still can generate freshwater not only in the daytime but also in the night, with maximum freshwater yield amounting to 20 liter.
- Present solar still is not only producing the distillate water from the lower basin but also from top and middle basin. Hence, distillate output will be remains higher as compared with conventional solar still.
- Evacuated tubes coupled with lower basin, hence lower basin temperature always remain higher compared with middle and upper basin. It provides thermal force to transfer heat from lower basin to middle and top basin to get higher distillate output.
- Presence of maximum amount of solar intensity and ambient temperature increases the distilled output.

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- Present solar still increased distillate output around 700% compared with conventional solar still distillate output.
- Temperature of water is not only remains higher during sunshine hours but also in night time. Hence, present solar still provides continuous supply of fresh water from day to night.
- After the experiment this distilled water can be utilized as potable water.
- This technology can be referred as environmental friendly and low cost technology for water purification

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Study on Ti-8Al-1Mo-1VAlloy (Near Alpha Alloy) Steam Turbine Rotor Blade using FEA

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Abstract: **A steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft. There are two types of steam turbine Impulse steam turbine and Reaction steam turbine. At present, the reaction turbines are widely used, because blades which are used in impulse turbine are symmetrical in shape and in reaction turbine blades they are in aerofoil shape. So reaction turbines are more efficient than impulse turbine. In this present study, blade is made up of titanium alloy (Ti 8Al-1Mo-1V). For this Von mises stress and deformation are carried out. And also modal analysis is carried for blade material and natural frequencies are determined.**

Key words: **Von mises stress, Aerofoil, modal analysis, Ti811, Natural Frequency**

I. INTRODUCTION

A steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft. Its modern manifestation was invented by Sir Charles Parsons in 1884[1]. Steam turbine can classify into two major classes which depend on power output required, one is domestic or utility steam turbine and another one is industrial steam turbine. Domestic or utility steam turbines are mostly used to produce more than 100MW power production power plants like nuclear power sectors and steam power plant etc. These steam turbines will run at speed of 8000-10000 rpm with working temperature and pressure ranging between 540^0-600^0 C and 180-240 bar respectively.

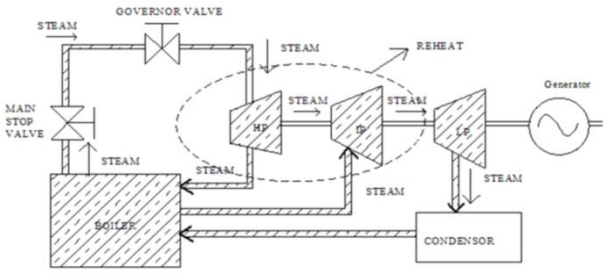


Figure 1: A schematic view of steam turbine

II. LITERATURE SURVEY

The manufacturing of the large capacity steam turbine at low pressure stage is difficult, because so many problems arises i.e. erosion, corrosion effects, corrosion cracking, abrasive & droplet impingement during the operation. But solution is there to replace the material with coating and also some materials will not absorb the wet steam hence so many precautions need to take when wet steam is coming at the operation. Titanium alloys, because of their excellent specific strength/density ratio. In addition to this titanium alloys are excellent in corrosion resistance, high fracture toughness and creep strength up to 600°C. Though a number of alloys are in use, Ti-8AL 1Mo- 1V alloy, due to its advantageous characteristics has been selected for HP compressor blades for different applications. Optimization of chemical composition, forging technology and heat treatment were the main objectives to obtain best combination of properties for the end use. The alloy has been successfully evaluated in accordance with mandatory airworthiness requirements.

III. OBJECTIVES

To carry out the static stress analysis of Ti-8Al-1Mo-1V FEM to calculate Von mises stress and deformation of the rotor blade in maximum force and also to carry the modal analysis, to predict the natural frequencies.

IV. DESIGN OF TURBINE BLADE

The efficiency and reliability depends on proper design of blades, therefore it's necessary for design engineers who involved in steam turbine engineering to have an overview of importance and basics design aspects of steam turbine blades. Hence it involves thermodynamic, material science, aerodynamic, and mechanical disciplines [2]. The below figure 2 shows the geometry of steam turbine blade with varying cross sectional area [3].

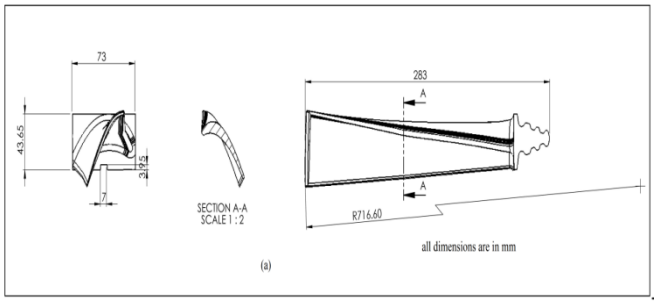


Figure 2: Geometry of Steam Turbine blade

A. Meshed Turbine Blade

Below Figure 3(a) describes the meshed view of Ti 811 blade, here we can observe 50800 nodes, 28936 elements and it is

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been meshed using "ANSYS" with solid 192 elements. Figure 3(b) shows force on turbine blade around 9600N.



Figure 3: Meshed view of steam turbine blade

V. Results & Discussion

A. *Analysis of Ti-8Al-1Mo-1V alloy (Near Alpha alloy) Rotor blade*

Ti811 is a near-alpha alloy and suitable for application at elevated temperature. It contains a relatively large amount of the alpha stabilizer, aluminum (Al). The presence of small amount of the beta-stabilizer (Mo and V) improve workability since these elements broaden the alpha + beta temperature range sufficiently for alpha + beta working and stabilizes only small amount of the beta phase. Although the tensile strength of this alloy is about equal to Ti-6AL-4V alloy, the elevated temperature strength and creep resistance are superior to other commonly available alpha or alpha + beta alloys. It has the highest tensile modulus and lowest density (4.37 g/cc) among the titanium alloys. Chemical composition, physical and mechanical properties are mentioned in following tables [4].

Table I: Chemical composition of Ti 811 in wt%

A1	Mo	V	Fe	C	Ti
7.35	0.75	0.75	0.30	0.08	Bal

Table II: Mechanical and other properties of Ti 811 alloy

Volume	1.723e+005 mm³
Mass	7.5293e-004 t
Density	4.37e-009 tonne mm^-3
Young's Modulus	1.17e+005 MPa
Poisson's Ratio	0.32
Bulk Modulus	1.0833e+005 MPa
Shear Modulus	44318 MPa

B. *Von mises stress and Deformation results of Ti 811 using Ansys*

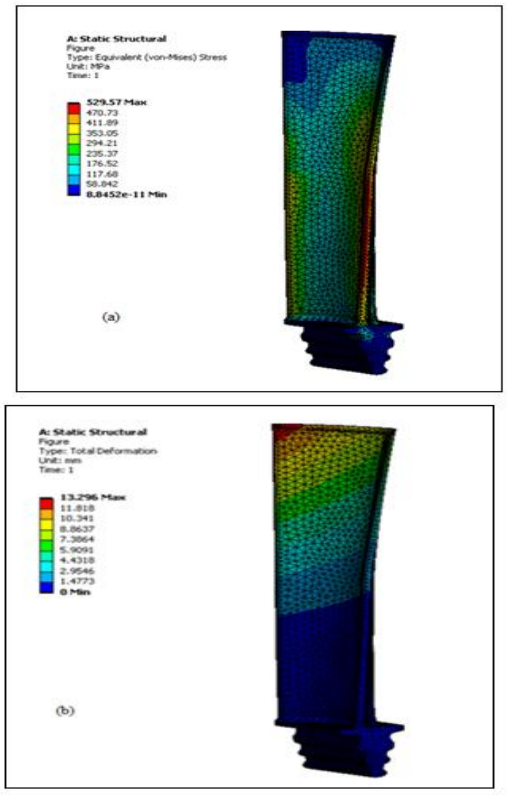


Fig 4: Results of Von mises stress and deformation

On apply of 9600 N force, fig 4(a) shows analysis of Von mises stress results of rotor blade and clearly we can observe a minimum stress induced is 8.815e-11 MPa and maximum stress induced is 529.57MPa. Fig 4(b) shows analysis of deformation results of rotor blade and clearly we can observe a minimum deformation induced is 0 and maximum deformation induced is 13.296mm.

C. *Modal Analysis of Ti 811 using Ansys*

Rotating flexible structures like turbine blades are often idealized as rotating cantilever beams. The procedure followed in ANSYS to perform modal analysis for rotating cantilever beam, respectively are discussed in the below sections. Solid 3D model of the turbine blade was developed and analyzed using ANSYS. Using SOLID 192 element, hexahedral mesh was generated The FE model was used to obtain the mode shapes and natural frequencies for the turbine blade in a stationary reference frame. The natural frequencies obtained are listed below.

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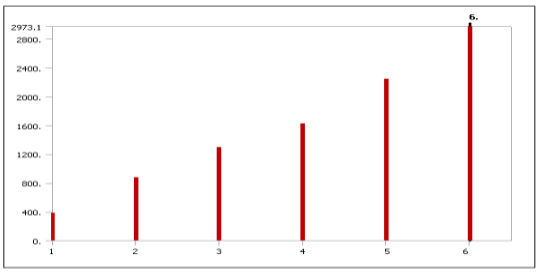


Figure 5: Mode shape v/s Frequency

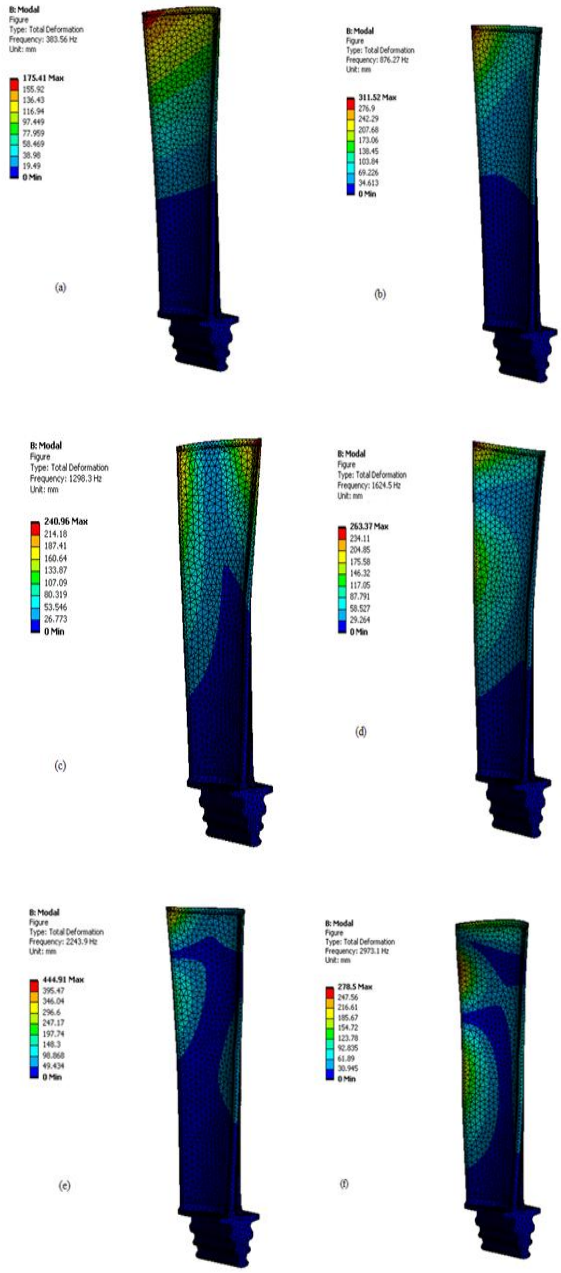


Fig 6: Six different mode shapes of respective frequencies.

The above figure represents different mode shapes obtained from different frequencies. Fig 6(a) shows mode shape 1 of frequency 383 Hz and its minimum deformation is zero and maximum deformation is 175.41mm. Fig 6(b) shows mode shape 2 of frequency 876.27 Hz and its minimum deformation is zero and maximum deformation is 311.52mm. Fig 6(c) shows mode shape 3 of frequency 1298.3Hz and its minimum deformation is zero and maximum deformation is 240.96mm. Fig 6(d) shows mode shape 4 of frequency 1624.5Hz and its minimum deformation is zero and maximum deformation is 263.37mm. Fig 6(e) shows mode shape 5 of frequency 2243.4 Hz and its minimum deformation is zero and maximum deformation is 444.91mm. Fig 6(f) shows mode shape 6 of frequency 2973.1 Hz and its minimum deformation is zero and maximum deformation is 278.5mm.

VI. Conclusion

Since, blades suffer from different types of loading from centrifugal force and steam flow, which intern leads to different stresses like tensile and bending. To overcome this, in our present work we have varied blades cross sectional area and Ti811 alloy is used as a blade material. We observed 529.57Mpa maximum stress induced by Vonmises stress analysis and 13.296mm deformation can be observed by applying 9600N force. Also we carried out modal analysis to predict natural frequencies and six different mode shapes.

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Method of Optimum Spring Energy Selection for Circuit Breaker Operating Mechanisms

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***Abstract*—Circuit breakers (CBs) are one of the most indispensable elements of power systems. Failure in operation of a CB can make all protection policies, designed to protect various parts of a system, futile. So, to ensure proper functioning of a CB, it is necessary to have reliable operating mechanism, as all CBs run on operating mechanism. Failures of CBs can generally be reduced by selecting proper operating mechanism energy and its connection with the drive linkage. This paper discusses the optimization of the energy required for spring charged operating mechanism using the mathematical model and how to illuminate measurement results.**

***Keywords*—Circuit Breaker, operating mechanism, Mathematical Model, Energy Balancing, Torque Balancing.**

I. INTRODUCTION

A circuit breaker is a device which is used to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to interrupt current flow after relays detect faults condition. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Two basic operations done by CB are closing and opening operations.

• *Opening operation:*Operation of disconnecting two electrical contacts to open or switch off the circuit is called opening operation.

• *Closing operation:*Operation of connecting two electrical contacts to close or switch on the circuit is called closing or making operation.

Components of Circuit Breaker

Major components of Circuit breaker are-

*1. Pole assembly:*It consists of vacuum interrupter, *terminal plates and insulating rod assembly.*

*2. Intermediate drive chamber:*It consists of kinematic linkage, which is the only transfer mechanism of motion from operating mechanism to VI.

*3. Breaker cabinet:*It consists of operating mechanism, harness and control board.

*4. Support Structure:*It is required to give rigid support to CB and to mount CB on certain height.

Fig. 1(b) shows all these components.

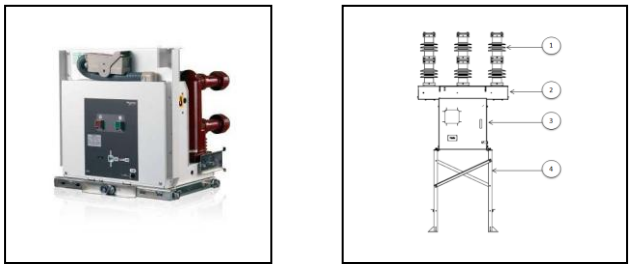


Fig. 1 (a) and (b) Components of medium voltage indoor and outdoor circuit breaker [14]

Main components of circuit breaker are-

1. Vacuum Interrupter (VI): The interruption of current in vacuum is the ideal switching technology in the medium voltage range. It is a portion in a circuit breaker where current conduction and interruption in the power circuit occurs. VI is a vacuum bottle with a fixed and a moving contact. As the main function of CB is done by VI, it is called as the heart of CB.

*2. Operating Mechanism:*Energy is required for the motion of the moving contacts with respect to fixed contact. This energy needs to be provided by the mechanism that can drive the moving contact to close and open the circuit breaker. The mechanism required for driving the moving contact is of great importance if closing and opening of connection is achieved through mechanical motion. It acts as the driving force also responsible to attain desired parameters of vacuum interrupter.

*3. Operating kinematic linkages:*It is the connection between operating mechanism and moving contact of VI.

*4. Opening spring:*Energy for tripping operation is provided by tripping spring. It gets charged during closing operation.

*5. Contact loading spring:*It helps in providing additional force to VI contacts in closed condition and helps in opening operation.

*6. Closing spring:*Energy for closing operation is provided by closing spring. It gets charged manually or by electric motor. A part of closing energy is used for charging contact loading and tripping springs.

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*7. Damper:*A damper is required to damp unbalanced forces at the end of tripping operation to avoid bouncing of contacts.

*8. Auxiliary Switch:*An auxiliary switch is a single-pole, double-throw electromechanical switch operated by the movable contact arm assembly. It is used to remotely indicate the position of the main circuit breaker contacts, whether open or closed.

II. SPRING CHARGED OPERATING MECHANISM

All the components are directly or indirectly attached to output shaft of the driving mechanism. One of the CB architecture is shown in Fig. 2.

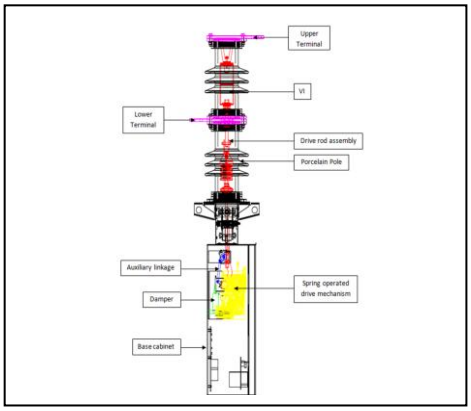


Fig. 2 Schematic diagram of circuit breaker [13]

Kinematic linkage is the only transfer mechanism of motion from driving mechanism to VI. The CB working of the circuit breaker is shown in Fig. 3.

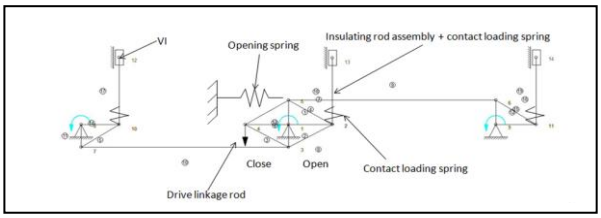


Fig. 3 CB operation with existing kinematic linkage (Concept-1)

For a CB with spring operated drive mechanism, there are three types of springs namely, closing spring, opening spring and contact loading spring. From which, closing spring is present inside the operating mechanism but the opening and contact loading spring should be attached to the kinematic linkages. Thearrangement is such that opening and contact loading spring gets charged during closing operation. And during the same, closing spring gets discharged. Contact loading spring gets compressed after the contacts are closed to apply extra force on closed contacts which is necessary from electrical point of view. Generally, contact loading spring is attached below the insulating rod assembly.

III. DESIGN AND SELECTION OF OPERATING MECHANISM

For the spring, operated drive mechanism, energy is defined by the energy stored in closing springs. First, it is necessary to study relation between different energies which affects CB operation. So, for that, an existing outdoor VCB is taken. After that, calculation of spring energies has been done for each type. As, all springs are helical compression springs, energy of spring is given by equation (1),

$$E=1/2\times k\times x^2 \ldots (1)$$

Where,

k = spring constant
x = amount of compression (relative to equilibrium position)
For every spring, operated mechanism of CB, it is necessary to look for following factors-

1. Energy Balancing
2. Torque Balancing

IV. ENERGY BALANCING

For this, it is necessary to know operation of CB during opening and closing. So, it can help to Fig. out energy variation of all springs during the travel. Total travel depends on the type of VI used in the CB. Total travel is the summation of stroke and snatch gap. The variation of energy (CSE-EX) during closing with respect to total travel for existing outdoor VCB is shown in the Fig.4. It is done by using MS-Excel.

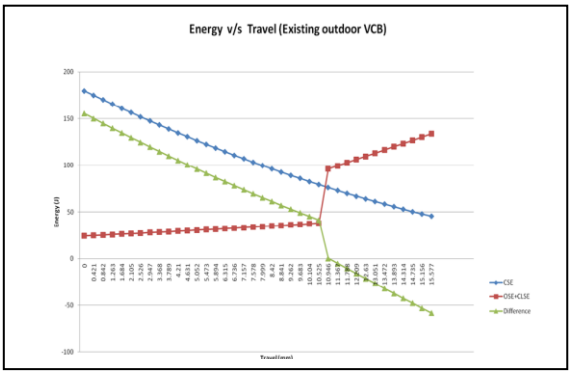


Fig. 4 Energy variation curve for existing outdoor VCB

ABOUT NEW SPRING OPERATED DRIVE MECHANISM

The new spring operated drive mechanism which is to be designed for outdoor VCB; come with energy varies from 16 J to 96.5 J. It consists of helical compression springs. It is very compact in size compared to current operating mechanism. It consists of two internal opening springs. As, manual charging operation for this is less tedious than existing; it will provide advantage for the same. For ease of calculations, there is selection of four variants distinguished by equal energy difference such as CSE-1 < CSE-2 < CSE-3 < CSE-4. The variation of closing spring energy is calculated for all four variants. As, there are internal opening springs inside the mechanism; there is elimination of that much amount of

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energy from existing opening springs. Also, optimization of contact loading spring has been done, as existing product is using overdesigned contact loading spring. With all this input, variation of energy during closing with respect to total travel is plotted for the new mechanism. The plot is shown in Fig. 5.

(Here, CSE-EX >> CSE-4)

In the Fig. 5, it can be observed that the closing spring energy is always higher than the opening spring energy. This is to make surety of successful closing of CB. The sudden hike in OSE+CLSE curve is because of compression of contact loading spring in the snatch gap. The difference between the spring potential energy at each point is utilized to obtain desired performance parameters for CB.

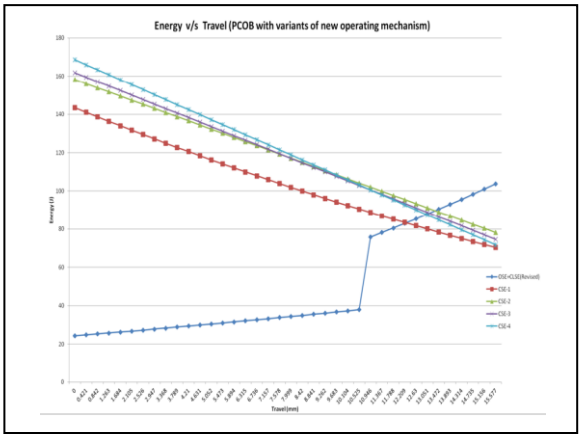


Fig. 5 Energy variation curve for outdoor VCB with new operating mechanism

From this plots, it is concluded that the new operating mechanism is much better than existing due to overlapping of CSE and OSE+CLSE curves within the limits. Overlapping results are shown in Table I.

Table I
Overlapping results of force balancing curve

Operating Mechanism	Overlap at last % of total travel
Existing CSE-EX	29.7297
New CSE-1	21.6216
New CSE-2	16.2162
New CSE-3	17
New CSE-4	17

It is clear that new operating mechanism with CSE-2, 3 and 4 are suitable for the outdoor VCB as overlap in within last 20% of total travel is assumed to be good based on experimental data.

V. TORQUE BALANCING

For operating mechanism to be designed for CB, it must satisfy the conditions of torque balancing curve. To calculate the applied torque from mechanism, it is required to do kinematic analysis of mechanism. New operating mechanism consists of no. of links. So, for ease of calculation, it is necessary to convert it into simpler four bar mechanism. Following Fig. 6 and 7 show open and close positions of four bar mechanism respectively.

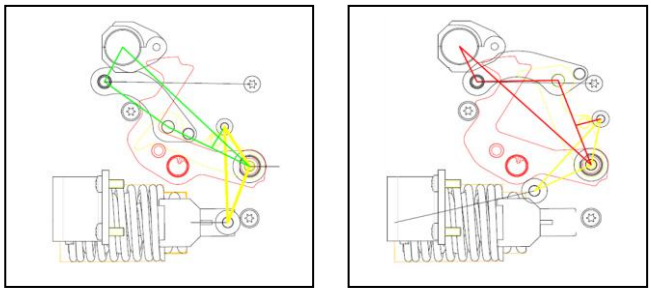


Fig 6 and 7 CB is in open and close position respectively.

Fig. 8 shows the kinematic linkage diagram with dimensions for the new mechanism.

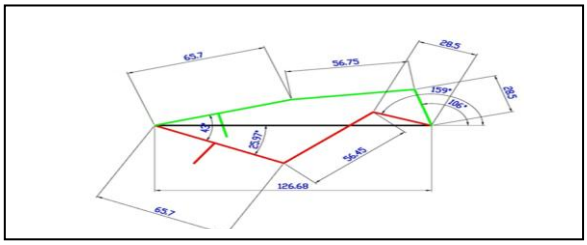


Fig. 8 Four bar linkage diagram with dimensions

Here, the input angular velocity is not known. Hence, the experiment has been carried out to get the angular velocity of output shaft of operating mechanism. So, angular velocity of output link is known. This will help to carry kinematic analysis of operating mechanism.

VI. KINEMATIC ANALYSIS

Kinematic analysis has been done for the operating mechanism which is in open position initially. Fig. 9 shows open position of CB operating mechanism.

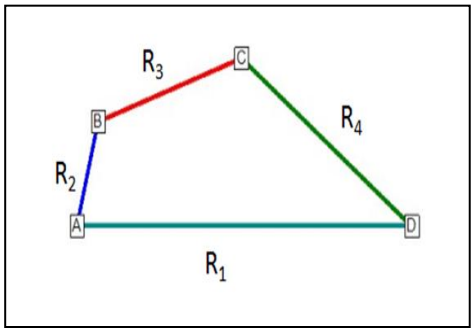


Fig. 9 CB is in open position

Known Data:

Input parameters are shown in following Table II.

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Table II
Input parameters for operating mechanism

Link No.	Link length (R)	Angular displacement of link (Θ)	Angular velocity of link (ω)
1	126.68 mm	0°	0 rad/s
2	28.5 mm	74°	70.58 rad/s
3	56.75 mm	-	-
4	65.7 mm	-	-

A.Displacement Analysis

The vector loop equation is written as,

$R_1e^{i\Theta1}+R_2e^{i\Theta2}+R_3e^{i\Theta3}+R_4e^{i\Theta4} = 0$

Or

$R_1(cos\Theta_1+i.sin\Theta_1) + R_2(cos\Theta_2+i.sin\Theta_2) + R_3(cos\Theta_3+i.sin\Theta_3) + R_4(cos\Theta_4+i.sin\Theta_4) = 0$

Collecting real and imaginary parts yields,

Real: $R_1cos\Theta_1+R_2cos\Theta_2+R_3cos\Theta_3+R_4cos\Theta_4 = 0$ … (2)

Imaginary: $R_1sin\Theta_1+R_2sin\Theta_2+R_3sin\Theta_3+R_4sin\Theta_4 = 0$ … (3)

The two unknown Θ_3 and Θ_4 are found using the above Equations (2) and (3).

Hence, we get,

$\Theta_3 = 17.16°$

$\Theta_4 = 85.93°$

B. Velocity Analysis

Taking time derivative of the position vector $R = R.e^{i\Theta4}$ in general yields,

$dR/dt = V = (V + iR\omega)\, e^{i\Theta}$

Where, ω is known as the angular velocity of the link.

Hence, taking time derivative of the vector loop equation (1) results in,

$V_1 + (V_2+iR_2\omega_2)\, e^{i\Theta2} + (V_3+iR_3\omega_3)\, e^{i\Theta3} + (V_4+iR_4\omega_4)\, e^{i\Theta4} = 0$

$V_1 = 0$, and $V_2 = V_3 = V_4 = 0$, since V_1 is frame, and the lengths of links 2, 3 and 4 are fixed.

Collecting real and imaginary parts then yields,

Real: $-R_2\omega_2sin\Theta_2-R_3\omega_3sin\Theta_3-R_4\omega_4sin\Theta_4 = 0$ … (4)

Imaginary: $R_2\omega_2cos\Theta_2+R_3\omega_3cos\Theta_3+R_4\omega_4cos\Theta_4 = 0$ … (5)

The problem of the velocity analysis is defined as,

Given: all R's and Θ's, and ω_2

Find: ω_3, ω_4

The two unknown ω_3 and ω_4 are found using the above Equations (4) and (5).

Here, a positive ω indicates counter-clock wise (ccw) rotation and a negative ω indicates clock wise (cw) rotation.

Hence, we get,

$\omega_3 = 7.86$ *rad/s*

$\omega_4 = 27.50$ *rad/s*

C. Acceleration Analysis

Taking time derivative of the velocity vector Ŕ in general yields,

$dV/dt = A = (A+i2V\omega+iR\alpha-R\omega^2)\, e^{i\Theta}$

Where, α is the angular acceleration of the link.

Hence, taking time derivative of the above velocity equation (4) results in,

$A_1+(A_2+i2V_2\omega_2+iR_2\alpha_2-R_2\omega_2^2).e^{i\Theta2}+(A_3+i2V_3\omega_3+iR_3\alpha_3-R_3\omega_3^2).e^{i\Theta3}+(A_4+i2V_4\omega_4+iR_4\alpha_4-R_4\omega_4^2).e^{i\Theta4} = 0$

Where, $A_1 = 0$, and $V_2 = A_2 = V_3 = A_3 = V_4 = A_4 = 0$, since R_1 is frame, and the lengths of links 2, 3 and 4 are fixed.

Collecting real and imaginary parts then yields,

Real:
$-R_2\alpha_2sin\Theta_2-R_2\omega_2^2cos\Theta_2-R_3\alpha_3sin\Theta_3-R_3\omega_3^2cos\Theta_3-R_4\alpha_4sin\Theta_4-R_4\omega_4^2cos\Theta_4=0$ … (6)

Imaginary:
$R_2\alpha_2cos\Theta_2-R_2\omega_2^2sin\Theta_2+R_3\alpha_3cos\Theta_3-R_3\omega_3^2sin\Theta_3+R_4\alpha_4cos\Theta_4-R_4\omega_4^2sin\Theta_4=0$...(7)

The problem of the acceleration analysis is defined as,

Given: All *R*'s, Θ's, and ω's, and α_2

Find: α_3, α_4

The two unknown α_3 and $\alpha_4$are found using the above Equations (6) and (7).

Here, that a positive α indicates ccw angular acceleration and a negative α indicates cw angular acceleration.

Hence, we get,

$\alpha_3 = 1710.92$ *rad/s*^{2}

$\alpha_4 = 1031.80$ *rad/s*^{2}

Kinematic analysis has been done mainly to get values of angular accelerations because it will help in dynamic analysis of the mechanism.

VII. DYNAMIC ANALYSIS

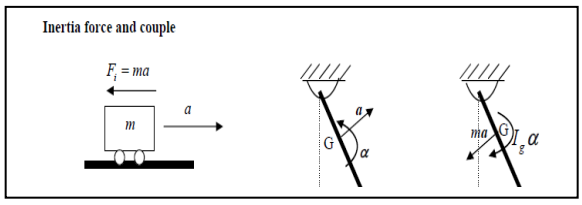


Fig. 10 Illustration of inertia force (i) a translating body (ii) a compound pendulum (iii) inertia force and couple on compound pendulum.

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When the inertia forces are considered in the analysis of the mechanism, the analysis is known as dynamic force analysis. Now applying D'Alembert principle one may reduce a dynamic system into an equivalent static system and use the techniques used in static force analysis to study the system.

Consider a body of mass m moving with acceleration A as shown in Fig.10(i). As per D 'Alembert Principle, the body can be brought to equilibrium position by applying a force equal to $F = mA$ and in a direction opposite to the direction of acceleration. Fig.10(ii) shows a compound pendulum of mass m, moment of inertia $I_g$about center of mass G while rotating at its center of mass has a linear acceleration of A and angular acceleration of α. Fig.10(iii) shows the inertia force and couple acting on the pendulum.

Dynamic analysis is required to calculate the torque applied by mechanism on output shaft. Before that it is important to know The FBD of mechanism linkages is shown in Fig.11.

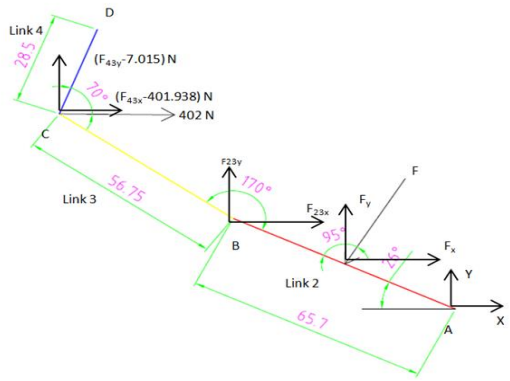


Fig.11 FBD of mechanism linkages

Operating mechanism is consisted of linkages which are joined by pin joint. So, at every joint, there is a loss due to friction between pin and linkages. Also, we can't ignore the loss due to tolerances provided. From, reference [13], for pin joint, there is 1.8 % frictional loss and 0.15 % loss due to tolerances at joints. Hence, total 1.95 % of efficiency loss is considered at every joint in the mechanism.

From FBD, force equations and moment equations are written as follows,

For link 2,

Force Equations:

$-F_x+F_{12x}+F_{32x}= 0$

$-F_y+F_{12y}+F_{32y}= 0$

Moment Equations:

Moment about A,

$-F_x\,(30.55sin\Theta_2)\; -F_y\,(30.55cos\Theta_2)\; +F_{32x}\,(65.7sin\Theta_2)\; +F_{32y}\,(65.7cos\Theta_2) = I_2\alpha_2$ ... (8)

Where, $F_x$and $F_y$are the components of force F from closing spring.

For link 3,

Force Equations:

$F_{23x}+F_{43x}+401.938 = 0$

$F_{23y}+F_{43y}-7.015 = 0$

Moment Equations:

Moment about C,

$-F_{23x}(56.75sin\Theta_3)-F_{23y}(56.75cos\Theta_3) = I_3\alpha_3$ … (9)

I_2 and I_3 are known for the linkages (from CAD model).

Hence, by solving Eqs (8) and (9), we get values for $F_{23x}$and F_{23y}. From this, we can get force on link 4 with consideration of forces from two internal tripping springs.

And finally, from the resultant force on link 4, we can get torque provided by mechanism. As, $T = F.r$

Torque is calculated for total travel of PCOB with new spring charged operating mechanism.

VIII. MOVING MASS CALCULATION

Moving mass calculation is required before calculating resistant torque. For that it is required to have knowledge about opposing forces which act during operating mechanism. Opposing Forces List of opposing forces that act during operating mechanism are given as-

1.*Electromagnetic forces between contacts:*Electromagnetic forces exist only during closing operation. During closing operation when contact touches, electromagnetic forces appear. These forces are large during short circuit conditions. Operating mechanism should overcome these forces and close the circuit breaker.

2**.** *Inertia of the moving subassembly***:** Inertia forces occur because of masses of the component.

3**.** *Vacuum pressure:*Vacuum used for quenching the arc exerts pressure on the face of moving contact and needs to be considered.

4.*Static and Dynamic Friction:*Mechanism consists of series of linkages connected by revolute and sliding joints. Friction exists between pair of linkages connected by revolute and sliding joints and needs to be taken into consideration.

5.*Damping force:*It provides opposing force to stop the linkage after completion of close / open operation.

So, for calculating dynamic forces, masses of different moving elements which are connected to moving contact of VI are-

Mass of insulating rod assembly: 1.9 kg

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Mass of drive linkage rod: 1.7 kg

This will help in calculating force due to insulating rod assembly and drive linkage rod. Torque variation during operating mechanism travel has been calculated for each variant. Now, it is required to calculate resistant torque on other side during total travel.

Net resistant force during closing, F_{RC} is given by,

F_{RC}=Force due to opening spring + Force due to insulating rod assembly – Force due to drive linkage rod - Force due to VI

Force due to opening spring is calculated from opening spring travel specifications. Force due to VI is calculated from addition of force from vacuum and mass of moving contact. This data is obtained from the VI data sheet.

For getting 20 mm travel on mechanism side, length of lever is designed for 53° rotational stroke of operating mechanism and it is calculated as 26 mm. From F_{RC}, we can get resistant torque. Energy margin is the difference in the energy between the closing springs and energy required to close the breaker against the opening and contact loading spring force. The energy margin should always be positive during each step of closing. The energy margin is considered in this case by the torque margin available i.e. graph is plotted for the torque on the moving arm due the force from the closing springs and opposing torque coming from the contact system (Fig. 12). If the torque coming from the contacts system is more at some instance than the torque coming from the closing springs the breaker may not close. Energy margin during closing and opening (Dynamic) to decide the spring forces required for our mechanism. As, $T = F.r$. Hence, Net resistant torque is calculated. As, CSE-4 is with higher energy among them, it will easily satisfy torque balancing curve. To make optimized decision, there is selection of operating mechanism with CSE-2 and CSE-3 for torque balancing. So, plot of net resistant torque and mechanism applied torque over total travel is drawn to have better idea about torque balancing. Torque v/s travel curve is plotted (using MS-Excel) for operating mechanism with CSE-2 and 3 as shown in Fig.12.

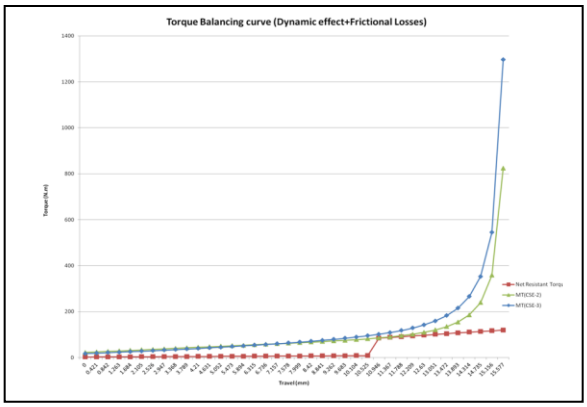


Fig. 12 Torque balancing curve for CB with new operating mechanism

From torque balancing curve Fig. 12, it is concluded that operating mechanism with CSE-3 is satisfying the condition as operating mechanism with CSE-2 fails to overcome net resistant torque. Hence, operating mechanism with CSE-3 is selected for outdoor VCB.

IX. OPTIMIZATION OF ENERGY OF SPRING CHARGED OPERATING MECHANISM

The existing CB uses the kinematic linkage-1 as shown in Fig. 13. As, kinematic linkage is the driving connection between VI moving contact and operating mechanism, hence it's modification can result into energy optimization.

The mechanical advantage for kinematic linkage-1 is explained as follows,

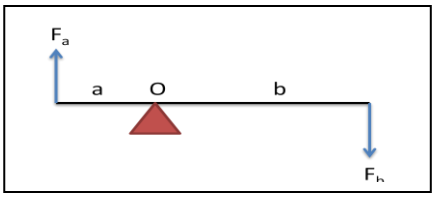


Fig. 13 FBD for kinematic linkage-1

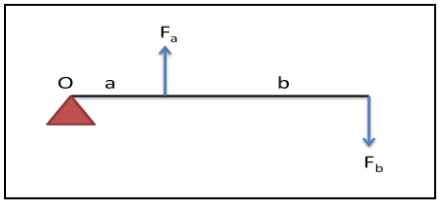


Fig. 14 FBD for kinematic linkage-2, 3

From, Fig.13,

Moment about O:

$F_a \times a = F_b \times b$

As, $a < b$

So, $F_a > F_b$

In existing design, a=b

So, $F_a = F_b$

For new kinematic linkage design, shifting of pivot point has been done. The mechanical advantage for the same is explained as follows-

From, Fig. 14,

Moment about O:

$F_a \times a = F_b \times (a+b)$

As, $a < b$

So, $F_a >> F_b$

As, from above equations, it is seen that new kinematic linkage will help in energy optimization. Based on this, new

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concepts have been made. Fig.15 and 16 are showing the kinematic linkage concept-2 and concept-3 respectively. Concept-2 consists of single shaft having levers to transfer forces to RYB connections. And in concept-3, there is just shift of pivot in existing kinematic linkage. a:b is calculated for both concepts to get required travel.

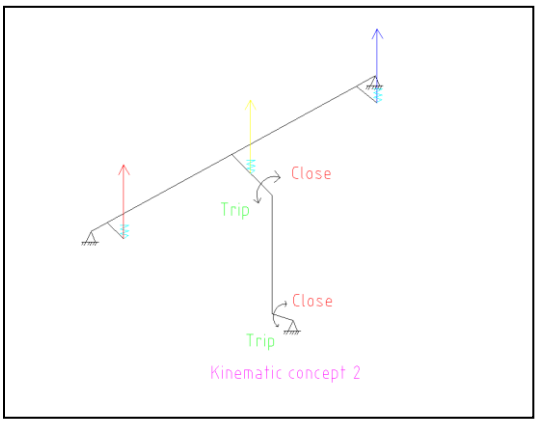


Fig. 15 Kinematic linkage (Concept-2)

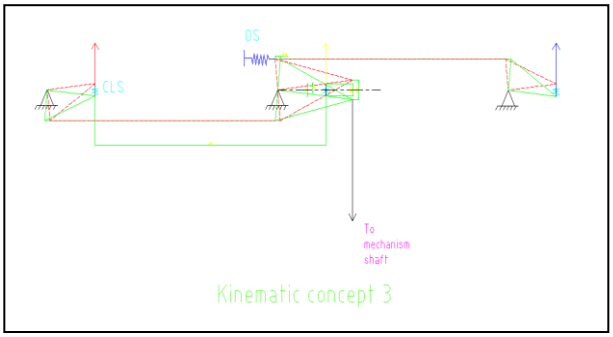


Fig. 16 Kinematic linkage (Concept-3)

The similar procedure of energy and torque balancing has been followed for concept-2 and concept-3. The torque balancing curves for the same are plotted. It is shown in Fig. 17 and 18.

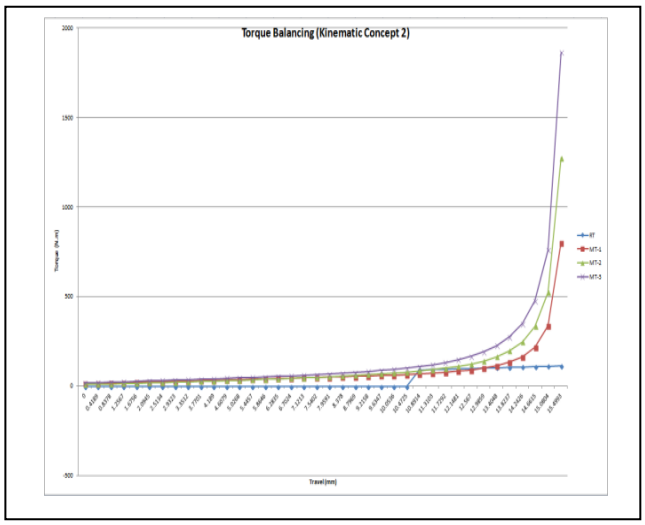


Fig. 17: Torque balancing curve (Concept-2)

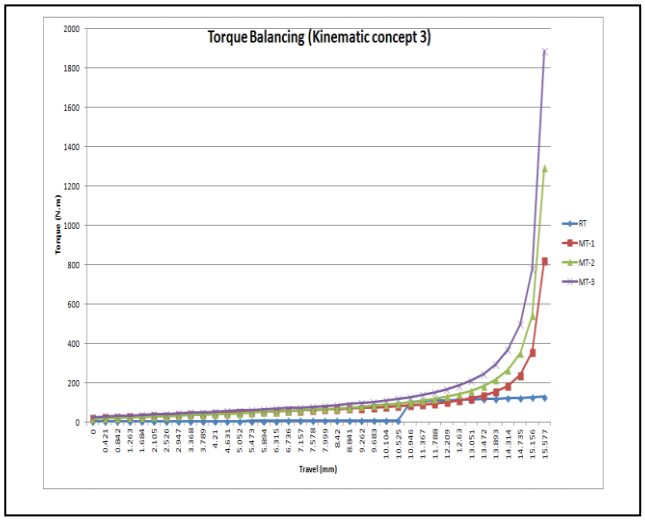


Fig. 18 Torque balancing curve (Concept-3)

X. OBSERVATION

By studying torque balancing curves for all three concepts, observations have been done. Table III is showing the respective observations.

TABLE III
Operating mechanism energy requirement

CB with Kinematic linkage	Operating mechanism Energy
Concept-1 (Existing)	CSE-3
Concept-2	CSE-2
Concept-3	CSE-2

XI. CONCLUSIONS

In this paper, study of CB architecture, various operating mechanism and CB working have been done. Thorough study of selection of operating mechanism for CB has been performed. The kinematic and dynamic analysis of new operating mechanism has been carried out. In order to select proper operating mechanism, energy and torque balancing for the same have been done. Design of kinematic pair has been performed for proper working of CB over large no. of operations. By modifying kinematic linkage, energy required for operating mechanism has been reduced. There is 35% of energy optimization by implementing new kinematic linkage design. As, energy is reduced, it will improve the durability of spring charged operating mechanism.

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Design and Development of Overhead Travelling Pesticides Spraying Machine by using Hybrid Energy Concept

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Abstract: **- As India is a land of agriculture and ranked 2nd worldwide in farm outputs. Agriculture is required to be resonated to escalate GDP of the country by improving productivity. The productivity of the crops can be increased with the help of pest control. Spraying of pesticides with suitable technique is mandatory step in cultivation of the crops. The project deals with design and development of overhead travelling pesticides spraying machine by using hybrid energy concept. The main purpose of this concept is to cover the target with maximum efficiency and minimum efforts to keep the pest under control as well as minimum contamination of non-targets. It is beneficial for the farmers in terms of cost, time consumption, movement, effort and hazard. The machine ensures the spraying of the field in single go hence saving time of the farmers.**

Keywords**: Indian farming, Pesticide spraying machine, Agriculture, Hybridization**

I. INTRODUCTION

This chapter contains the brief description of Indian farming, agriculture and their contribution towards economy. Further it also explains the advantages, disadvantages, various techniques and classification with applications of using pesticides in various irrigation methods.

1.1 Agriculture and Indian economy:

- In India, agriculture contributes about sixteen percent (16%) of total GDP and ten percent (10%) of total exports.
- Over 60 % of India's land area is arable making it the second largest country in terms of total arable land.
- In 2013, India exported agricultural products valuing around 39 billion dollars.
- According to 2001 census, over 56.6% of the main workers in India are engaged in agricultural and allied activities.
- India ranks 2nd worldwide in farm output.
- India ranks 2nd largest producer of wheat and rice in the world.
- India is also a major exporter of rice and wheat to countries like Nepal, Bangladesh, Africa and others.
- Its gross irrigated crop area of 82.6 million hectares (215.6 million acres) is the largest in the world.

1.2 Agriculture

- The science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool, and other products

1.3 Irrigation

- Irrigation is the method in which water is supplied to plants at regular intervals for agriculture. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and vegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

1.4 Pesticides

- Pesticide is a substance or a mixture that kills a pest, or it prevents or reduces the damage a pest may cause.
- Pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest.

1.5 Why pesticide?

- Pesticide is used to modify a plant's growth or act as a drying agent.
- Pesticides are usually chemicals, but they can also be made from natural materials such as animals, plants, bacteria, etc.
- Pesticides can prevent sickness in humans that could be caused by moldy food or diseased produce.
- Pests can be insects, mice or other animals, unwanted plants (weeds), fungi, bacteria or viruses.

1.6 The success of pest control operations by pesticide application greatly depends on the following factors

- Quality of pesticide.

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- Timing of application.
- Quality of application and coverage.
- Advantages and Disadvantages of pesticides.

Table 1.1: Pesticides spraying method and working range:

S no	Method	Working range
1	High volume spraying	300-500 L/ha.
2	Low volume spraying	50 to 150 L/ha
3	Ultra low volume spraying	Less than 5 L/ha

Table 1.2: Drawbacks of various spraying techniques

S no	Spraying techniques	Drawbacks
1.	Backpack spraying	Heavy to carry and causes fatigue to labor and hence reduces the human capacity
.2.	Engine operated spraying equipment	Needs fuel which increase its operational cost.
3.	Aerial spraying	Wastage of fertilizer and some crops are not totally covered.
4.	Fuel operated vehicles	Pollutes the crops.

1.7 Benefits of overhead travelling pesticides spraying machine:

- Adjustable according to the height of plants.
- Reduces labor cost.
- Time saving.
- Boom made up of stainless steel or PVC.
- Automatic operation.
- Environment friendly.
- Ensures safety of workers

1.8 A step towards hybridization

- The machine is designed as per the concept of hybridization. The machine will work by direct electricity as well as by solar power. The concept will help farmers to save much electricity in areas where poor supply of electricity is still a big issue.

1.8.1 Solar power concept

- Solar power is the conversion of the energy from the sun to usable electricity. The most common source of solar power utilizes photovoltaic cells to convert sunlight into electricity. Photovoltaic utilizes a semi-conductor to absorb the radiation from the sun, when the semi-conductor absorbs this radiation it emits electrons, which are harnessed as electricity.

II. IMPLEMENTATION

Table 2.1 Components and specifications

S NO.	COMPONENT	SPECIFICATIONS
1.	Centrifugal pump	Pressure: 100 PSI (6.8Bar) Flow: 4.0 LPM AMPS: 3.0 A Volts: 12 V
2.	DC motor	Speed: 10 rpm AMPS: 0.5 A Volts: 12V
3.	Wheels	Diameter: 50mm Width: 20mm
4.	Switches	6 Point PDV
5.	Solar panel	SES 1270 Max power: 70Wp Voltage at max power: 17.48 V Current at max power: 4.05 A Open circuit voltage: 21.25 V Short circuit current: 4.24 A
6.	Nozzles	Spraying cone angle:80º Operating pressure: 2 bar

2.1 Creo model of overhead travelling pesticides spraying machine:

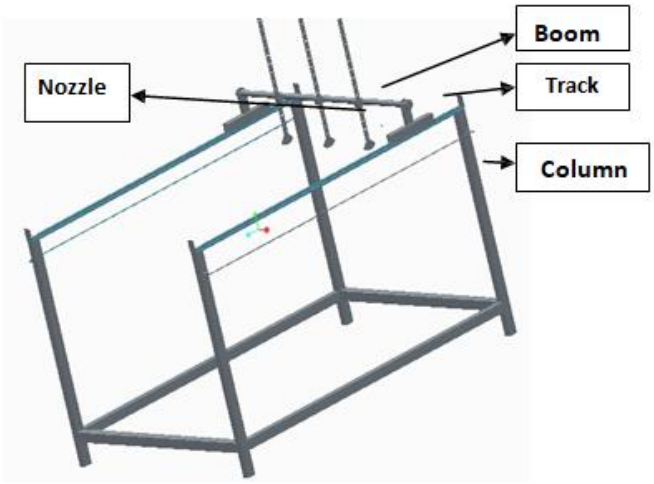


Fig: 1

2.2 Dimension of supporting structure

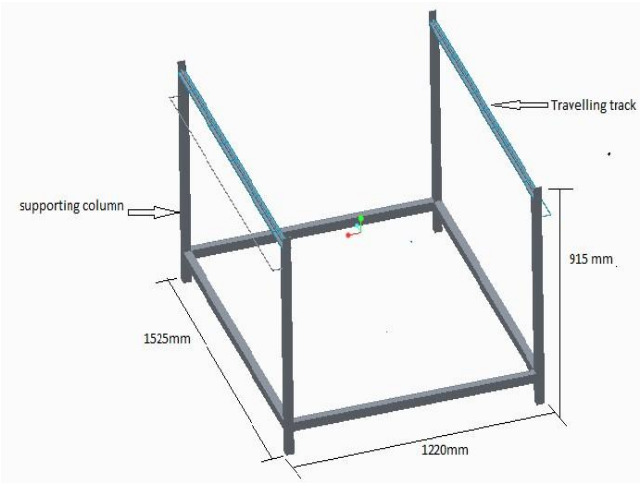


Fig: 2

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2.3 Analysis of structure

2.3.1 Loading condition on structure

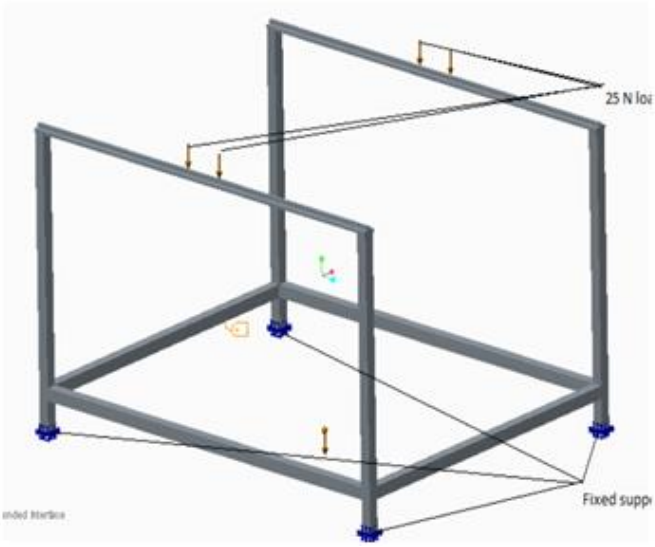


Fig: 3

3.3.2 Stress results

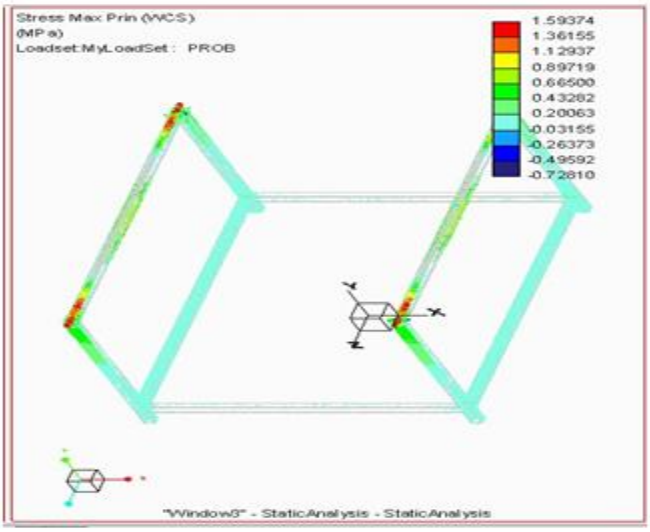


Fig: 4

Stress	Value (Mpa)
Maximum stress	1.59374
Minimum stress	-0.72810

The red part in the fig shows area under maximum stress, as we move downward from the point of contact the stress value gets reduce and goes negative at which shows the compression is induced in that part. So the material of the structure should be able to withstand the compressive stresses.

Table 2.2 Stress analysis

no	Stress (Mpa)
Maximum ess	1.59374
Minimum ess	-0.72810

2.3.3 Deflection results

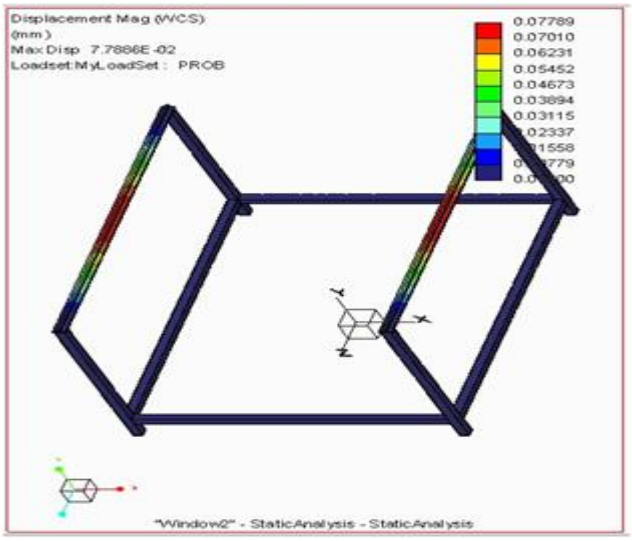


Fig: 5

This analysis shows the deflection of the track by applying the load of 25 N at each point as shown in the fig. As shown in the fig the red part shows the area under maximum deflection which is in the middle section and the value of deflection reduces with increase in distance from the mid – section.

III. FINAL FABRICATION

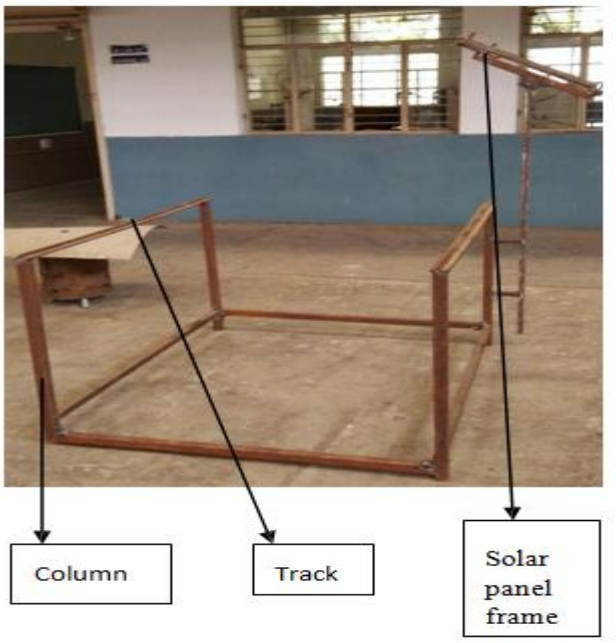


Fig: 6

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IV. BOOM ASSEMBLY

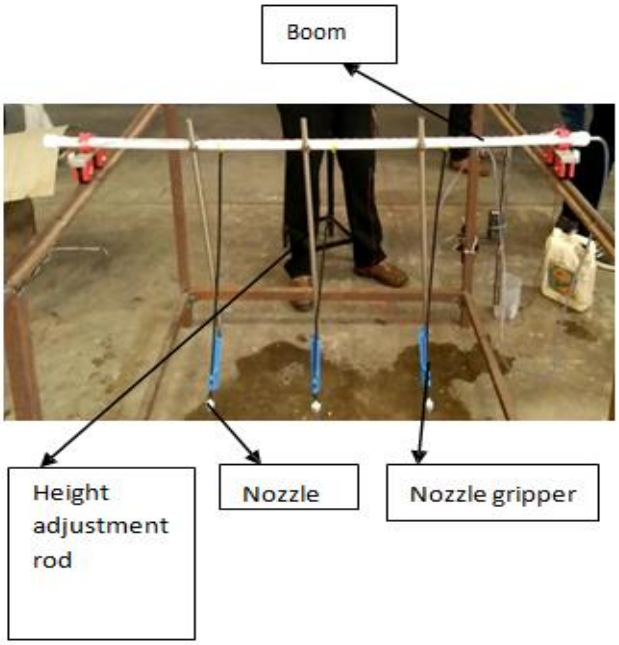


Fig: 7

The figure shows the boom assembly with height adjustment rods, nozzle gripper, nozzles and wheel with motor. Nozzle gripper provides required angle for effective spraying on field. Height adjustment rods are provided to adjust height according to the height of the plant

V. FINAL FABRICATED SETUP

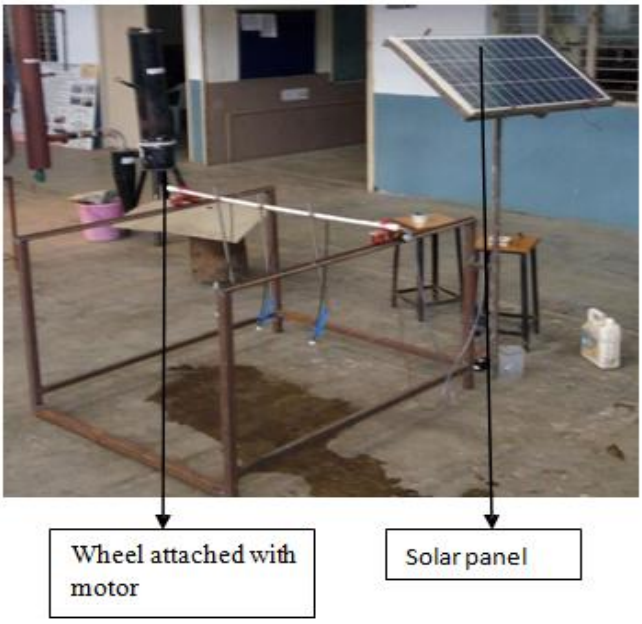


Fig: 8

VI. RESULTS

1. As per structure analysis of supporting structure, maximum stress induced on beam is 1.59374 Mpa and maximum deflection is 0.007789 mm.\
2. Voltage obtained from 70 Watt solar panel is 18.76V and 4.05 A.
3. Actual time taken by boom to travel track is 45 sec.

VII. CONCLUSION

1. Proper adjustment facility in the setup with respect to crop helps to avoid excessive use of pesticides which result into less pollution.
2. The proposed setup can spray the field in single go hence reduces time consumption and labor fatigue
3. This setup can also be used for cooling of the crops.
4. Our setup eliminates the backpack, labor cost and human efforts.
5. Actual time taken by setup to spray 5 X 4 feet sq. area is 45 sec

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Study of Mechanical and Corrosive Behaviour of Metal Alloy Composites-Ingrained with Micro and Hybrid Reinforcement

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***Abstract* – Today composites have brought to diversity of changes towards development in the field of marine, aerospace and automobile industries in virtue of their appealing properties like high mechanical strength, better corrosion and temperature resistance, etc. The Metal alloy hybrid composites (MAHCs) are more auspicious and are capable of full-filling the needs of modernistic evolutions in various fields. The actual selection of materials depends on the type of usage which will make a composite free from error. The current paper scrutinizes various classes of metal matrix composites (MMCs) ingrained with micro and hybrid reinforcements that alters the mechanical and corrosion properties of a composite that makes them reasonable for their use in marine, ship hull, automotive parts and other heavy duty applications.**

***Key Words:* Metal alloy hybrid composites, Micro and Hybrid Reinforcement, Mechanical properties, Corrosion behaviour.**

I.BACKGROUND INFORMATION

For the past few decades, the selection of materials had switched to more prominence developments in the field of aerospace, automobiles and other heavy duty applications in order to achieve reduced weight, eco-friendly, better quality and performance of material at low cost. In the early 1980s, the prototype of developed materials began to change drastically.

Metal matrix composites filled with monofilaments like Boron Carbide (B_4C), Silicon Carbide (SiC), Zirconia (Zr) are very permissible since early 1960s because of their high mechanical strength. The major section of research was made for defence and automotive applications such as missiles, space crafts, vehicles etc. [1].

Comparable to the current usage, metal alloy composites (MACs) has drew attention towards growing activities in automobile parts, space shuttle, aircraft industries etc. because of their enhanced properties due to addition of secondary phase material called reinforcement.

II. INTRODUCTION

Metal matrix composites (MMCs)are constructive fusion of two or more than two materials with dominant material as metal whereas the other material may or may not be metallic and possess the properties of the dominant material. The dominant material used is called matrix and is generally continuous in nature and the other material used is called reinforcement and it can be continuous or discontinuous in nature. The function of matrix is to cover the reinforcement and bind them adhesively. The reinforcements ingrained can be in the form of fibers, macro / micro / nano particle, whiskers, flakes, laminates etc. The main purpose of reinforcement is to enhance the properties of the composite material such as mechanical, physical and tribological properties [2].

The modern composites are different from the traditional monolithic composites due to metal alloys used as matrix and hybrid reinforcements which enhance the overall properties of a composite.When the reinforcements ingrained are two or more than two, then the composite is called hybrid composite or hybrid reinforced composite [3].

2.1 Fabrication methodology

There is various fabrication techniques used in the processing of MMCs. The appropriate method for the fabrication of MMCs depends on various factors such as different types of matrix used, different classes of reinforcements and their particle size and also area of application. Fabrication techniques required in composites targets in achieving composites with better microstructural, mechanical, corrosion, and other properties.

The fabrication techniques can be broadly divided into two different categories:-

- Liquid state technique
- Solid state technique

a) Liquid state fabrication technique

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In the liquid state technique the particles are regularly dispersed well within the molten metal before being casted and then solidified. The methods involved in liquid state techniques are generally cost effective and are more efficient and feasible [4].

Stir Casting

Stir casting have been the most suitable method of fabricating metal based composites up to 30% wt. fractions of reinforcements. The reinforcement is stirred with the help of a stirrer into the molten metal at appropriate temperature. It involves the use of a proper stirring system in order to obtain desirable fusion of reinforcement in to the molten metal.

Dissemination of ingrained particle into the molten metal depends on the temperature of the molten metal, particle size, and geometry of the stirrer and also on the physical and chemical properties of the molten metal. Molten metal after stirring is then cast by traditional casting method. If the distribution of the ingrained (reinforcements) is not proper then there are chances of reinforcements to get accumulated in some specific regions and form clusters. To overcome this situation the reinforcements are injected along with inert gases into the molten metal which enables proper diffusion of reinforcements. The figure below shows stir casting method having inert gas injected with the reinforcement [4].

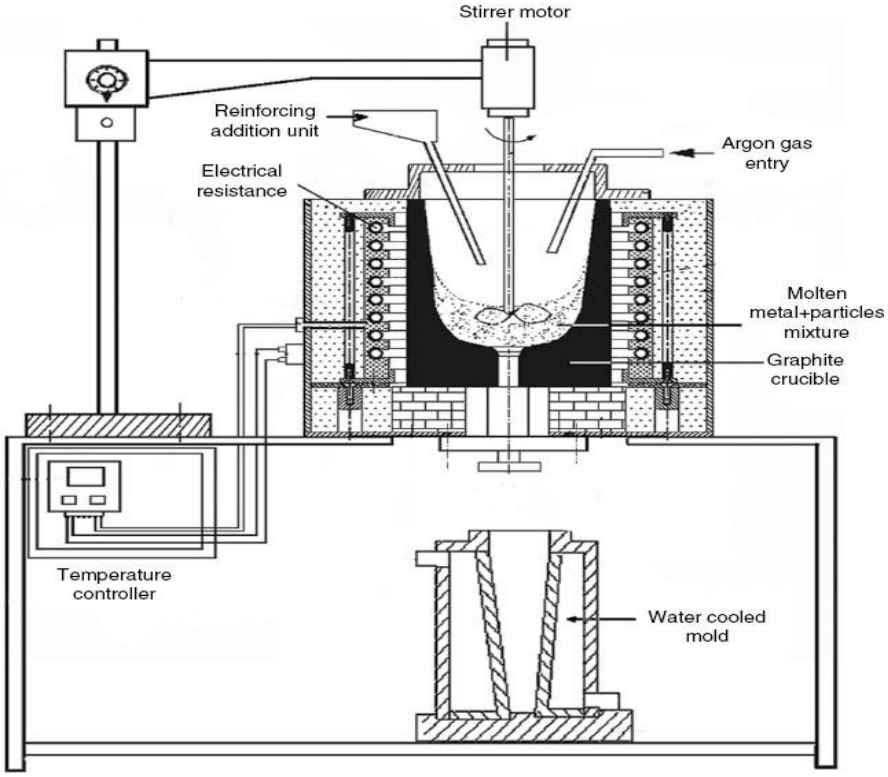


Fig 1: Stir casting machine equipped with inert gas source [4]

Compo Casting

Wettability and dispersion of micro / nano size ingrained reinforcements are very challenging in case of stir casting because when reinforcement having very fine particles then they acquire more surface energy as well as surface area which results in accumulation of particles. In order to attain regular dispersion, negligible accumulation and effective adhesive bonding between the matrix and ingrained reinforcement particle we prefer compo casting. In compo casting the reinforced particles are mechanically entangled into the semi-solid slurry at semi solid temperature and thus protect the composite from gravity segregation. As the size of the reinforced particle is decreased the ductility of the composites increases in case when composites are compo casted. Since semi molten metal is operated at low temperature in compo casting, longer tool life is attained.

Squeeze Casting

The idea of squeeze casting was introduced by Chernov in 1878 by using high steam pressure over molten metal during solidification. The above fig. shows that within the closed die halves high pressure is produced and movable mould parts are used for employing pressure over the molten metal andthus the molten metal is pressed forcefully to move into the preformed cavity in the lower mould and then after solidification upper half die is removed. Squeeze casted components have better weldability, surface finish as well as dimensional accuracy.

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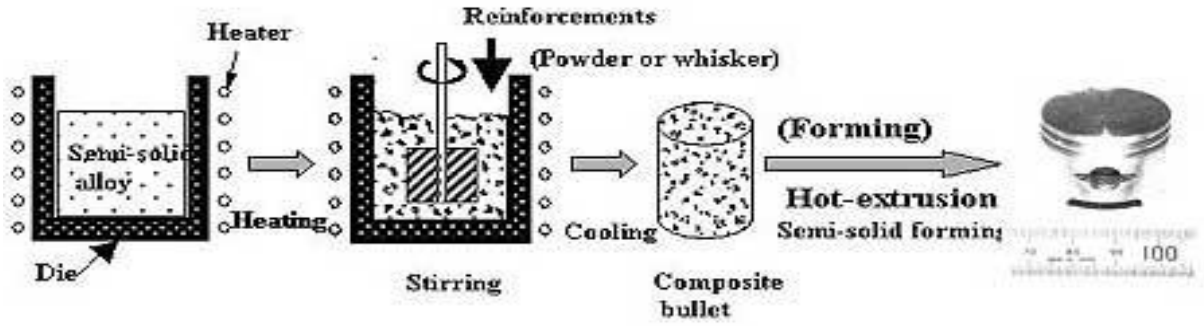


Fig 2: Schematic diagram of compo casting of a piston [4]

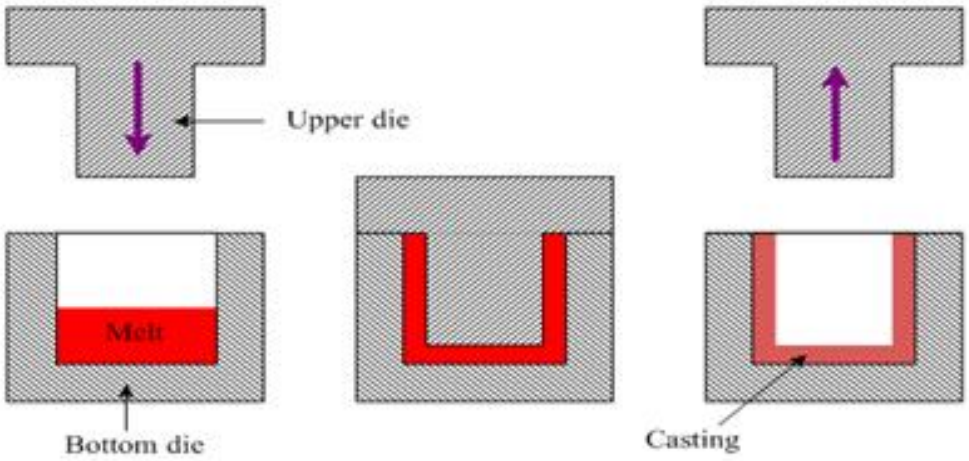


Fig 3: Schematic diagram for Squeeze Casting process

Spray forming process

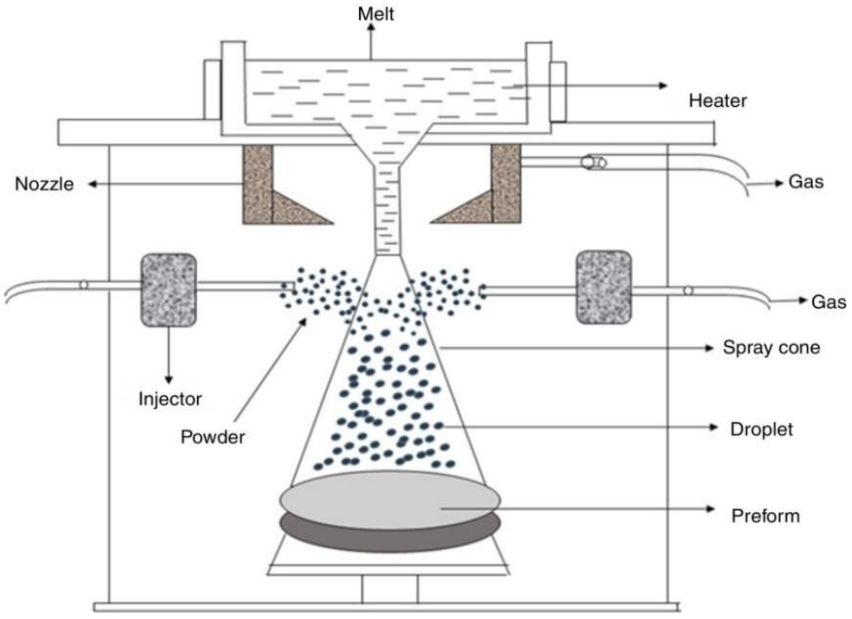


Fig 4: Schematic diagram of spray forming process [4]

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Spray forming fabrication technique employ melting of alloy or metal and then molten metal is forced to pass through the small cavity, passing a steam of inert gas under pressure and injecting reinforced particles through jet on the molten metal. In this method the dispersion of reinforcements is inappropriate in the molten metal and thus the properties of overall composite are affected. The composites fabricated by this method are inexpensive.

b). Solid State Fabrication Technique

In solid state fabrication technique, both the matrix and the reinforcement are used in powder (micro / nano) form i.e. no melting is required and thus there are no chances of developing any chemical reaction. In this method distribution of reinforced particles are generally uniform. This method is not very economical and also complicated and thus liquid state fabrication technique is generally preferred.

Powder Metallurgy

Manufacturing of metal matrix composites by powder metallurgy involves mingling of reinforced particles with the metal (or metal alloy) in powder form and then degassing the obtained product under vacuum to make it free from unwanted or excess gases, sintering is done under high temperature and pressure. One of the main disadvantages of this process is that it squeezes the nano particles and exploits the grain boundary strengthening potential. This technique is very economical for making complex parts with accurate dimensional tolerances and minimum remnants but is inappropriate in large scale production.

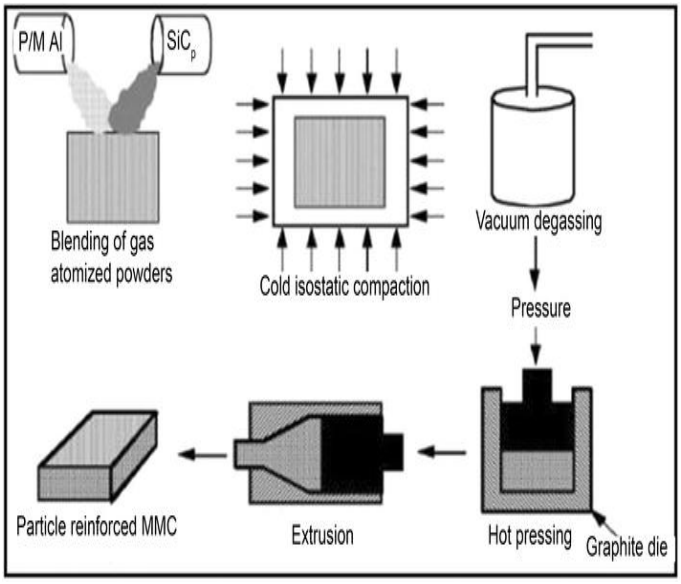


Fig 5: Schematic Diagram of powder metallurgy fabrication technique [4]

TABLE 1:

COMPARISON OF DIFFERENT FABRICATION TECHNIQUES AND THEIR APPLICATIONS

S. No.	*Fabrication* ***Method***	*Economic* ***Condition***	***Application***	***Note***
1	Stir Casting	Least expensive	Commercially most appropriate technique for large scale production, especially used for fabricating aluminium based composites.	Rely on the properties of the materials and most appropriate for grainy type of reinforcements employed in MMCs or MAHCs.
2	Compo casting	Low	Extensively used in aerospace industries and manufacturing of automobile parts.	Best for fabrication of composites especially in case of discontinuous fibres or flake, whiskers, particulate reinforcements.
3	Squeeze casting	Medium	Extensively used in automobile industries for making parts of automobiles.	Relevant for fabricating MMCs with all types of reinforcement and can be utilized for large scale production.
4	Spray casting	Medium	Employed to yield frictional materials, electrical brushes, and electrical contacts as well as grinding tool.	Materials with high density can be produced and reinforcements in particulate are used.
5	Powder metallurgy	Medium	For generating small and cylindrical objects like pistons bolts, valves, improved strength and materials resistant to heat.	Matrix and reinforcements both are used in the form of powder, melting of materials are not required

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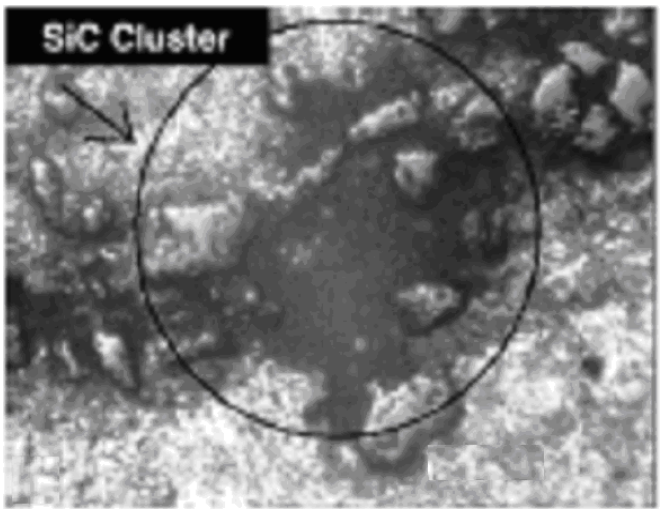


Fig 6: Micrograph of sample without stirring [5]

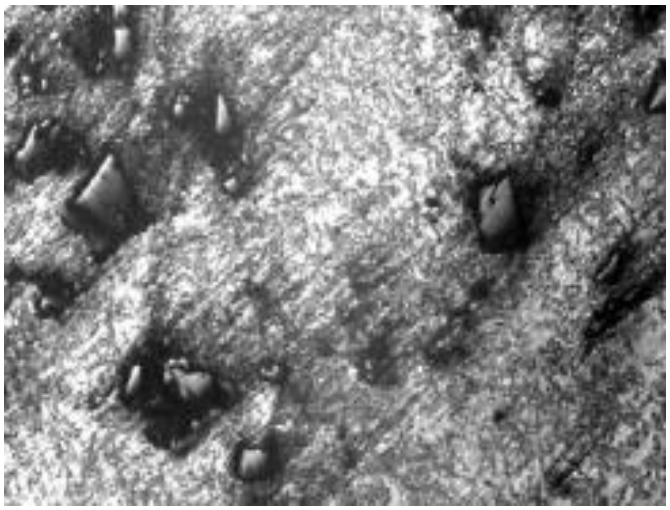


Fig 7: Micrograph of sample with manual stirring [5]

The fig. above shows that, Manoj Singla et. al. in his work, fabricated composite by two methods i.e. first without stirring and second with manual stirring and found that during fabrication of silicon carbide filled composite without stirring accumulation of SiC particle takes places i.e. there was no proper dispersion of reinforcement which leads to weak microstructural strengthening

Now on manual stirring of SiC particle in the molten metal, SiC particle were mixed but on stopping the stirrer, the particles approached the surface again and some of the particles got tucked with each other to form cluster. This problem was encountered due to poor wettability between the SiC particles and molten metal [5].

III. LITERATURE REVIEW

The aim of this literature survey is to study regarding recent developments in the fields of composites basically metal matrix composite (MMCs) as well as metal alloy hybrid composites (MAHCs) and investigating the behavior of different types of ingrained particles (reinforcements) on different classes of metal based composites.

Under this literature survey generally following investigations are made:-

- Role of ingrained particles on the mechanical properties of metal matrix composites (MMCs) and metal alloy hybrid composites(MAHCs).
- Role of ingrained particles on the corrosive nature of metal matrix composites (MMCs) and MAHCs.
- Role of hybrid ingrained particles on the mechanical as well as corrosive behavior of hybrid metal matrix composites (MMCs) and metal alloy hybrid composites (MAHCs).

(a) Role of the ingrained particles on the mechanical properties of the MMCs and MAHCs

TABLE 2:

ANALYSIS OF REINFORCEMENTS AND EFFECT ON MECHANICAL BEHAVIOUR OF MMCS AND MAHCS.

S. No.	Matrix/ Alloy	Reinfor-cement	Wt.%	Fabrication Technique	Testings'	Results	Application	Ref No.
1	Al	SiC &TiB_2	10 0.5	Stir Casting	Hardness & wear test	Increase in TiB_2 increases the wear resistance	Aerospace & Automotive	6
2	Al 7075	SiC + Al_2O_3	0+0 5+5 10+1015+ 15	Stir casting	Hardness & wear test	Increased mechanical properties, HVN=112 at 15%	Structural aerospace Marine	7
3	Al 6061	SiC &SiC + Grhybrid	5-15	Stir casting	Tensile test & SEM analysis	UTS for hybrid 144.73-192.45 MPa & SiC 132.32 150.95MPa	Piston, connecting rod, brake disk	8
4	AZX915 Mg alloy	TiC	12	Stir casting	Dry sliding test,Micro hardness test	Coefficient of friction = 0.068 ± 0.03HVN = 88.74 ± 5.93	Automotive and aerospace	11
5	Al6061	SiC (500grit	25	Stir casting	Mechanical testing &	Yield strength increased from (88.66 – 294.7) Mpa	Design of Actuator cylinder	12

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		size)			microstructure studies			
6	Al (pure)	SiC	402530	Stir casting	Tensile,hardness test and Temperature analysis using ANSYS	Al+SiC has less tensile strength than C70, hardness nearer to C70, it withstand more temp. than C70	Connectingrod	13
7	MgAZ91 D	B_4C+Gr	0+01.5+0 1.5+1.5	Stir Casting	Wear, hardness, tensile	Wear resistance, BHN & UTS is max. at 1.5% B_4C+0% Gr	Automobile marine and aerospace	14
8	Al	SiC	3,6,9,12,1 5	Stir casting	Hardness & MechanicalTestin g	Compressed 30%, at 15% SiC : BHN=53 MPa	Automobile	15

(b) Role of ingrained particles on the corrosive nature of the MMCS and MAHCs

Corrosion is the deterioration of a material due to chemical reactions with its surrounding. Corrosion is broadly classified into different classes according to the type of environment, material and morphology of the corrosion damage. Reinforcements are added generally to reduce corrosion rate as much as possible. Corrosions results in the massive degradation or erosion of the metals which results in the failure of the material. Thus in order to avoid this loss various method are adopted and therefore the reinforcements that are highly resistant to corrosive environments are reinforced with the matrix material so as to obtain composite that offers good resistant to corrosion.

TABLE 3:

ANALYSIS OF REINFORCEMENTS AND THEIR ROLE ON CORROSIVE NATURE OF MMCS AND MAHCS.

S. No.	***Matrix/ Alloy***	***Reinforce ment***	***Wt.%***	***Fabrication Technique***	***Testing***	***Result***	***Application***	***Ref No.***
1	Al 6061	B_4C & Gr	5+5 10+10 15+15	Stir casting	Corrosion study with 4, 8, 12 wt.% NaCl solution at room temperature	Excellent corrosion resistance	Automotive industries especially in brake pads and brake rotors	16
2	Al 6061	ZrO_2-n	0 2.5 5 7.5	Stir casting	Corrosion test and micro-structural analysis	Corrosion resistance increases and good interfacial bond	Aerospace, sub-marines	17
3	Al	SiC	25	Stir casting	Corrosion hardness and impact test	Corrosion rate= 4.9 mm/month BHN=44.8	Marines and automobiles	18
4	LM 13 Al alloy	SiC	10	Stir casting	Corrosion test in NaCl solution, hardness test	Corrosion rate = 0.0063 mmpy in 5% NaCl solution, hardness increased	Marine bodies, aerospace	19
5	Zn pure	Gr	1 3 5	Powder metallurgy	Corrosion test in HCl solution	Best corrosion resistance with 1% Gr	Aircraft and aerospace vehicles	20
6	Al	MoO_3	10	Stir casting	Corrosion test	Improved corrosion resistance	Transportation and aerospace	21
7	Al	SiC (11,6, 3 μm)	15	Powder metallurgy	Corrosion test in 3.5% NaCl solution and microstructural analysis	With smaller particle size of SiC corrosion rate decreases	Structural material	22
8	Al 7075	SiC	2 4 6	Liquid melt metallurgy technique using vortex method	Weight loss corrosion test, open circuit potential test in 0.035, 0.35, 3.5% solution of NaCl	Corrosion rate decreases with increase in reinforcement content	Automobile aircraft and marine industries	23

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9	Al 7075	SiC TiC	2.5+2.5 5+5 7.5+7.5	Stir casting	Corrosion testing in 3.5% NaCl and mechanical testing	Highest corrosion resistance with 15% of hybrid MMCs, better mechanical properties	Ship body	24
10	Al 6063	Al_2O_3	6, 9, 15, 18	Stir casting	Corrosion test in NaCl, NaOH, H_2SO_4 media	Better corrosion resistance in H_2SO_4	Marine industries	25
11	Al 6061	SiC	10, 20	Stir casting	Electro-chemical test in 3.5% NaCl solution	Corrosion resistance decreases with increasing SiC	Brake drum, shaft	26

(c) Role of the ingrained particles on the mechanical as well as corrosive nature of the MMCs and MAHCs

The study of mechanical properties and corrosive nature of the MMCs are significant on adding reinforcement. On enhancing mechanical properties, corrosion rate may tend to decrease or increase depending on the type of reinforcement added and vice-versa. On adding reinforcement mechanical as well as corrosion behaviour of the composite is altered.

TABLE 4:

ANALYSIS OF REINFORCEMENT AND THEIR EFFECT ON THE MECHANICAL AS WELL AS CORROSIVE BEHAVIOUR OF MMCS AND MAHCS.

S. No.	***Matrix / alloy***	***Reinforcement***	***Wt.%***	***Fabrication technique***	***Tests***	***Results***	***Application***	***Ref. no.***
1	Al 6061	SiC	0.5 1 1.5 2 2.5	Stir casting	Corrosion, flexural strength (EI) and hardness	Flexural strength & hardness is increasing continuously	Marine	27
2	Ti Alloy	B_4C	0510	Powder metallurgy	Corrosion and mechanical testing	Hardness and corrosion resistance increases with increase in B_4C, wear rate decreases	Aerospace and automobile	28
3	Cu	Steel chips and Al_2O_3	5 7.5 10 10	Stir casting	Hardness, wear, tensile, corrosion test and optical microscopy	Improved mechanical properties and wear resistance, better corrosion resistant in 3.5% NaCl solution	Electrical appliances	29
4	Al 2011	TiB_2	5, 10	Stir casting	Corrosion, mechanical, microstructural study	Improved tensile, hardness, better corrosion resistant	Sports, marines & automobile	30

IV. CONCLUSION

This paper draws attention towards some extraordinary metal and metal alloy composites reinforced with micro/nano hybrid reinforcements and their fabrication techniques that have intensifying properties and can withstand major applications such as biomedical, marines, automobiles, and aerospace etc.

Stir casting is the most acceptable method of fabricating metal alloy hybrid composite because of its satisfactory cost and convenience. Aluminium alloy based composites are the most advisable matrix material because of its favorable properties in different areas due to high strength to weight ratio. The hardness of the aluminium can be increased from 50 HVN to 112 HVN and corrosion rate can be decreased from 4.9 mm/month to 0.0063 mm/ month on adding silicon carbide (SiC) and zirconium dioxide (ZrO_2) and hardness and corrosion can further be enhanced on decreasing the particle size. Corrosion test can be performed in NaCl, NaOH and H_2SO_4 media. Corrosion property of the material is adversely affected on adding graphite (Gr) as reinforcement and also corrosion rate is increased on on increasing the wt.% of the graphite.

Such properties in the materials and further enhancement in their overall properties make them unique and most acceptable material for their used in the various developing field

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Developed an Algorithm for Dimensional Accuracy in Fused Deposition Modelling Process: A Novel Approach

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***Abstract*_ Additive Manufacturing attends widely impact on Engineering Side. As in Additive manufacturing the element is made in layer wise manner. So it's reduced the wastage and save the material (can consider as Environmental friendly process). Fused Deposition Modeling (FDM) is very useful and simple technique in Additive manufacturing. Only problem with FDM is there dimensionally accuracy and surface finish, so to overcome this problem a novel approach has been proposed by using an algorithm in this Research work. Also Conclude by using that algorithm better surface finish may achieve. By using Multi-disciplinary concept is this main aim of this Research work.**

Keywords—Additive Manufacturing, FDM

I. INTRODUCTION

Additive Manufacturing is a layer by layer process for making prototype as well as nowadays it is also used for making fully densed parts. As in additive manufacturing the part is made by using layer by layer manner unlikely in conventional the part is made by doing machining or by removing material. Due to elegance in building structure, in layer by layer manner, additive manufacturing has pulled the all eyes towards them and shine like a revolutionary Industrial manufacturing process. As consumer are the driver of the such kind of market, as in early stages some industries making an creative and three dimensional printers for thermoplastic materials, by introducing approach of "DO-IT-YOURSELF" plastic three dimensional modeling became an good approach for consumers[1]. Sine industries also[2] take a benefit of customer design approach, as they provide online modeling tool and customized them. As the customer can be modeler and industries will build part in a customized manner. From the industrial prospect, additive manufacturing have significant impact on traditional approach for production of models. Multinationals interested for commercializing of metal based manufacturing technique for the purpose if re-manufacturing process. Apart of them still this process is in Developing phase. Surface finishing and dimensional accuracy are two major constraint. This paper stated in following sections: 1.Fused Deposition modelling, 2.Litrature Review, 3.Methodology, 4.CVLT Algorithm, 5.conclusion

II. FUSED DEPOSITION MODELLING

Fused deposition Modelling is a solid base additive manufacturing technique, as in additive manufacturing the component is made in layer by layer process. As shown in Figure1 the schematic diagram of Fused deposition modelling process. Also in Figure 2 the clear view is shown for the deposition of layer from the nozzle. In FDM process the input material is wire form and that wire passes through the nozzle. In high temperature nozzle the wire will Melt and the extrusion process will takes place. According to the Computer

Controlled process, the path of the wire diagram will follow. (programming path) Generally FDM is very popular for it's simplicity in Additive Manufacturing process. Thermoplastic are the mainly used material is FDM process. In that ABS is mainly used.

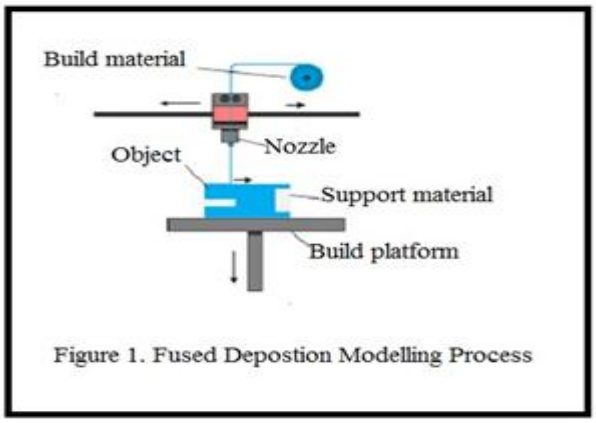


Figure 1. Fused Depostion Modelling Process

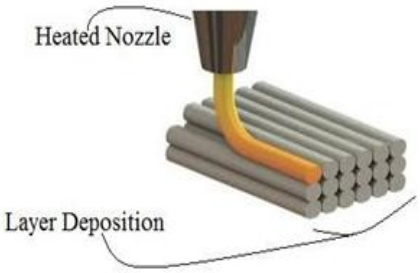


Figure 2. Layer depostion in FDM

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III. LITERATURE REVIEW

B.V.Reddy et.al.[3] Performed 3 level Box-behnken experimental design for 3 process variable like nozzle temp.,chamber temp.,& road gap on interroad & inter layer bond strength in addition to bond strenght & surface roughness. P.J.Nuhez et.al.[4] used dimension elite 3D printer with ABS plus P430 thermoplastic,study analyzed dimensional precision,flatness error & surface texture obtaion with this material in order to establish quality range for professional 3D printing. Vijay B. Nidagundi et.al.[5] used Taguchis L9 orthogonal array using ANOVA to optimize process parameter like layer thickness, part orientation angle,fill angle & gives values & effect on UTS,surface roughness,dimensional accuracy and manufacuturing time. Tobias Lieneke et.al.[6] Investigate regarding dimensional accuracies were performed within project dimensional tolerances for additive manu.(DT-AM).A new method was developed that can be used systematically analyzed geometrical accuracies.finally derived tolerance value were compared to values reached by conventional manufacturing Techniques. Chil-chyuan kuo et.al.[7] developed acetone vapor polishing system for precision surface polishing of ABS parts fabricate by FDM.The surface roughness measure after and before polishing treatment using optical microscopy. C.A.Griffiths et.al.[8] shown an approaches to analyse the effect of machine build parameters on final properties of build part as well as on the effect of efficiency factors such as material usage & build time.build parameters are orientation, infill %,no. of shell(boarder printed for each layer),layer height(thickness) & output para. are 1.efficiency- build time,energy consumption, part weight,scrap weight&2. performance- tensile strength,young's modulus.used PLA filament of 1.75 mm diameter of material. Caterina Casavola et.al.[9] used classical laminate theory(CLT) to describe mech.behaviour of FDM printed part. Values of elastic modulus in longi.& transverse direction to fibre,shear modulus& poission's ratio experimentally determined. Finally comparision between CLT and experimental result. conduct on ABS and PLA has been carried out on symmetric and balanced speciman. in short orthotropic mech.properties fo FDM part by CLT. Yu-an Jin Hui Li Yong He Jian-zhong Fu[10] carried out quantitative analysis of surface profile in FDM.A new approach to characterize surface profile of FDM.Mathematical models for both top surface & side surface are developed.critical parameters are categorized into pre process parameter like layer thickness, stratification angle and fabrication parameter like ration between flowrate and feedrate to investigate their impact on surface profile. and then optimize the process parameter to enhance the surface quality.therefore much more desirable surface achieved in FDM after investigating surface profile. Vishal Francis et.al.[11] carried out experimental investigation on FDM of polymer-layered silicate nanocomposite.used OMMT(Cloisite 30B) material.The melt intercalation process used for developing nanocomposite.to investigate the interfacial interaction between nano clay &polymer,SEM(scanning electron microscopy) images were taken.DSC(differential scanning calorimetry) & TGA analysis carried out to examine thermal behaviour.3 different proportion of master batch were taken the find and compare the vales of tensile and yield strength,elongation at break, modulus & in part fabrication-effect on compressive strength, hardness, porosity and neck size. Nevin hill et.al.[12] proposed that orientation plays a major role in failure mechanism for FD polycarbonate parts.tensile speciman in horizontal orientation alone is considered in study & speciman varied from 0-90' in intervals of 15'.vertical and horizontal orientation are not considered in study. Sarat Singamneti et.al.[13] studied the mesostructure of curved layer deposition for thin shell like parts. The study reveals that the masostructure of FDM build parts plays a significant role in load bearing capacity. Sood et.al.[14] studied the compressive strength of FDM built ABS parts by considering parameters like layer thickness, part build orientation, raster angle, raster width,air gap. however author built the speciman only in horizontal orientation by varying the raster angle w.r.t. base of build table. Ahn et.al.[15] rep5rted the anisotropic strength of FDM parts depends on parameters like raster orientation, raster width,air gap,build temp.The research was carried out in varying the raster fill pattern of specimen in horizontal orientation but not considering other orientation.

So far in most of Research the main aim is to increase the dimensional accuracy and improve surface roughness. Most of researchers have done work on either changing the material or they have optimized the process parameters. There are very little Research in way of making an proper methodology or an programmable tool they can work according to user requirement on finishing parameters. So in this work that Research gap have been adopted.

IV. METHODOLOGY

As from literature or previous Research work it had been conclude that for better surface finish some better methodology required. As From literature we can conclude that for better surface finish, Layer thickness became critical parameter. So in this work we had define an algorithm which generally this problem and by using this algorithm we can made an tool for future work. As layer thickness can be varying for top surface and side surface, so we can not use the same layer thickness for top and side surface for better surface finish[4]. This point might be not in touch with previous Researchers, so in this paper a novel approach is derived for the same.

V. CVLT ALGORITHM

Continuous Variable Layer Thickness(CVLT) is an systematic approach for getting better surface finish and surface quality. CVLT is mainly based on the way layer thickness varying for top surface and side surface. So in this algorithm it sensed the surface and according to that the layer thickness will varying. As shown in fig1. The flowchart of CVLT, the basic of that

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algorithm is to identify the layer thickness for proper surface i.e. top surface or side surface.

As initial step is always to slicing the part file and defined the layer thickness for side surface and top surface. After that the tool with scan the full length of the object and according to that the object will divided in number of small element and also it will scan height of the object as well. For this work we have consider the object at zero degree orientation i.e. at horizontal position. So this is initial procedure that been done before initialize layer deposition process.

As shown in fig.1 after that the layer deposition process may begin. For that also the condition is used for the selection of proper layer thickness in the same. As initially the two layer thickness is defined as:

T1 = Layer thickness for top Surface

T2 = Layer thickness for side surface

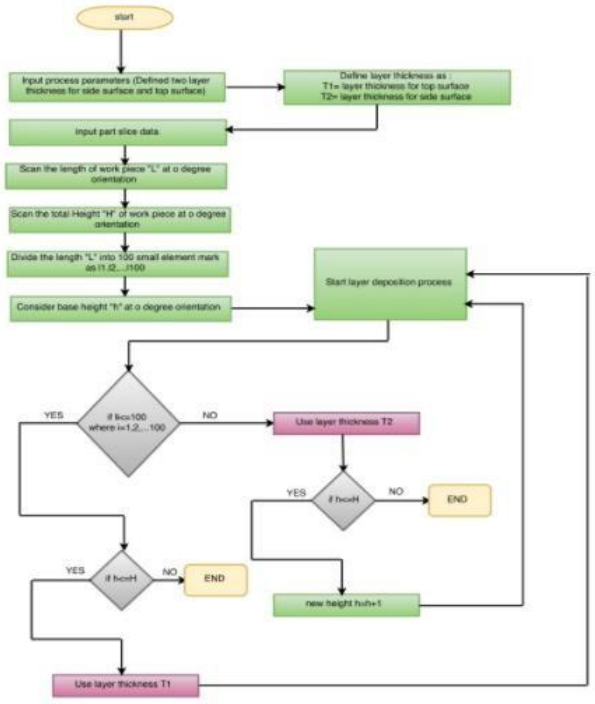


Fig.3 Flow chart of CVLT Algorithm

After that layer deposition process takes place. The condition is given that if the element is in arrange of top surface element, (it can be identified as top surface) and also that element having lower size than height H, so means it is top surface of the element and so that we have to use the T1 layer thickness. And after that again layer deposition process start. Another condition is shown in flow chart that if the above mentioned condition failed, so it means as the element or node is of side surface so the tool will change its layer thickness as T2. And as after that again layer deposition process takes place. So this process is repeated up to the total height of object H. as show in flow chart when the condition of In<H (n=1,2…) false the process will stop.

VI. CONCLUSION

In this Research work we had derived a new algorithm called "Continuous Variable Layer Thickness" in that the layer thickness of the deposited material is continuously varying according to the surface of the Component i.e. top surface or side surface. After defined that algorithm we can conclude that a novel approach may be lead to the new sight in Surface finish and surface quality or surface accuracy. Design a tool which work on that algorithm can be taken as future work.

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A Review of Micro Particles Filled Metal Matrix Composite and Effect on Tribological Properties

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***Abstract*-Now a day's lot of light is focuses in the field of development of advanced material. We need some special qualities in materials that can be utilized for specific purposes. Metal matrix composites (MMCs) have fascinating properties like higher thermal and electrical stability, better physical, chemical and mechanical properties compared to ancient monolithic materials. So the composite materials are one of the best suited materials for a wide range of engineering applications such as automobile industries, airbuses, artificial limbs, electrical appliances, space subtle etc. This paper amalgamates the different mechanical and tribological properties of micro reinforced metal alloy composites (MACs) that put such materials into the top priority of 'selection of material' process.**

Key Words: **Metal matrix composites, Micro reinforcement, Mechanical properties, Tribological properties.**

I.INTRODUCTION

In modern era the composites have the widespread applications in various fields like sports, house hold equipment, vehicles, airlines, structures, artificial satellites, etc. Currently the aluminium metal and its alloys are being used very much in the field of development of metal matrix composite because aluminium have the fascinating properties like higher thermal conductivity, higher strength to weight ratio, higher electrical conductivity etc. But some restrictions are also present in the application of aluminium based materials like lower stiffness, low melting point, lower wear resistance and other surface properties etc. These restrictions provoke the researchers to exceed these limits by doing some smart work like adding some foreign materials into base material (matrix) [1].

Composite material is the result of bonding between dissimilar materials having different chemical as well as physical properties. The properties of composite material lie in between the properties of their constituents which are mixed together. The major proportion of constituent is called matrix and the minor proportion of the constituent is called reinforcement. Since the matrix is in majority so it surrounds and binds the reinforcements together by adhesion and cohesion property. The primary purpose of the reinforcement is to achieve the desirable properties for some specific purposes [2]. The desirable properties of MMCs are controlled by the amalgamation of matrix-reinforcement, and the characteristics are determined by analyzing the microstructure, internal interfaces. These characteristics are influenced by the production techniques which are used to make them. The microstructure analysis covers the study of grains, chemical composition, atomic imperfections, etc. The famous hard reinforcements are alumina, silicon carbide etc., and graphite is considered as soft reinforcement. These reinforcing materials when mixed with base material perform different roles in strengthening mechanism. So a lot of researches have been done and still progressing to obtain the optimumresult of desirable properties (mechanical strengths, wear behavior etc.) [3]. The wear resistance and good strength of MMCs can be utilized in various engineering applications especially the places where there is contact between two surfaces and having relative motion between each other. There are various factors are considered which affect the sliding wear behavior and that are quantity and quality of reinforcement, phase of reinforcement, particle size of reinforcement, sliding speed and distance, hardness of the counter face etc. [4]

Wearing or rubbing is a major issue in most of the machinery components which is greatly affected by load, speed and environmental condition. Wear causes a lot of expenditure for repairing or replacing the wear out components [4]. Since currently we are facing the problems of wear in mechanical components so we need some advance technique to get victory on this problem. This paper is an attempt to understand the smart solution to override on wearing property.

II. LITERATURE REVIEW

This literature explains the novel works which have been done on different metals taking discrete reinforcements which results in several aggrandized mechanicals, physical, chemical and wear properties. In this literature survey the main focuses is on mechanical and wears characteristics of metal matrix composite.

2.1 Effect of reinforcement on mechanical and wear behavior of composite.

Wear is the loss of material due mechanical abrasion when two surfaces are in physical contact and having relative motion between each other. The above table is the brief

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explanation of mechanical and wear property of particle reinforced metal matrix composite.

1. Kesavulu, *et.al.* investigated the Aluminium alloy matrix composite (AMMC) which is in grained by an industrial waste (fly ash), and found the hardness has increased, the tensile strength increases up to 15% addition of reinforcement. [5]
2. V.Balaji, et.al. used silicon carbide particles (SiC) as reinforcement to add in aluminium alloy (Al-7075) 6-10% by eight and tested the composite for mechanical and wear properties. The properties of composite are found much better mechanical & tribologicalproperties than that of Al-7075 itself, and can be used for making gear. [6]
3. Jitendra K., et.al. investigated copper matrix in filled by graphite powder and the result of testings' shows that wear resistance has increased, but the strength was decreased. [9]
4. M.Ramachandra et.al. characterizes the aluminium matrix composite ingrained with zirconium-di-oxide (ZrO2) and found the increased hardness and wear resistance and this composite can be the substitute of currently working Piston, Cylinder liners and connecting rods. [13]

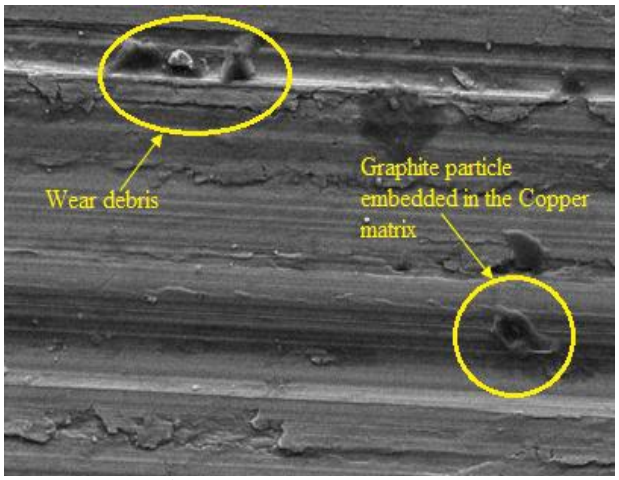


Fig 1: SEM analysis of MMC with 15% graphite and 30 N load (500x). [9]

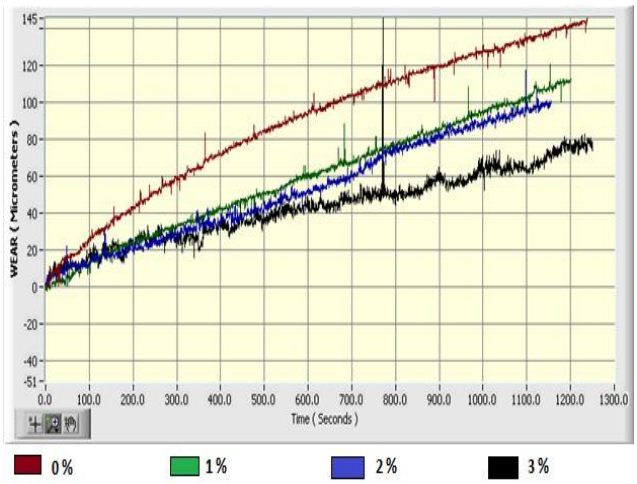


Fig 2: Wear behaviour of Al+ZrO2 composite [13]

TABLE 1:

EFFECT OF REINFORCEMENT ON MECHANICAL AND WEAR BEHAVIOR OF COMPOSITE.

S. No.	Matrix /alloy	Reinforcement	Wt. %	Fabrication Techniques	Testings'	Results	Applications	RefNo.
1	Al Alloy	Fly ash	5, 10, 15, 20	Stir Casting	Tensile, wear & hardness test	HRA continuously increasing, UTS increases up to 15%	Light weight vehicles & aerospace	5
2	Al7075	SiC	6, 10	StirCasting	Mechanical & wear	Better mechanical & tribologicalproperties	Gear	6
3	Al 2024	Gr + B_3N	4 + 4	Stir Casting	Hardness & wear test	Al + Gr have good dry sliding wear resistance than Al + Boron nitride	Centrifugal pump	7
4	Cu	TiC + Gr	5 + 0 10 + 5 15 + 10	Stir Casting	Wear & hardness test	Wear rate decreases	Electrical sliding contact, bearing	8
5	Cu	Gr	5 10 15	Stir casting	Wear & hardness test	Hardness decreases after 5% Gr low strength, wear rate increases	Excellent lubricant electrical wires	9
6	Al 6082	Gr	0 4 8 12	Stir casting	Wear & Hardness test	Hardness decreases on increasing graphiteVHN = 49.5 - 44 BHN = 31.6 - 28.3	Bearing	10
7	Al	SiC + Cu	3 + 0.56 +0.75 9 + 0.1	Stir casting	Wear test, micro-structuralStudy	Wear resistance increases continuously	Aerospace, automotive & structural	11

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8	Cu	SiC	20 40 60	Sintering and forging	Dry sliding wear & hardness test	Wear rate decreases & hardness increases	Electrical appliances & aerofoil	12
9	Al	ZrO2	1 2 3 4	Powder metallurgy	Hardness, wear & micro structural analysis	Hardness & wear resistance increased	Piston, cylinder liner, connecting rod	13
10	Ti-6Al-4V	B_4C	0 5 10	Powder metallurgy	Mechanical & corrosion testing	Density decreases hardness & corrosion resistance increases with increase in B_4C, Wear rate decreases	Aerospace & automotive	14

1. Shaaz A. et.al. investigated the copper metal as matrix and hybrid reinforcement of SiC and Alumina (Al2O3) and found very good enhancement in tensile strength and hardness both. [16].
2. Anil K.B. et.al., investigated for a hybrid AMMC reinforced with SiC and Boron Carbide (B4C), the properties are found as increase in micro hardness as increase in amount of reinforcement. [20]
3. K. Yoganandamet.al., found that reinforcing the TiO2 (titanium dioxide) into aluminium alloy (Al 6082) improves the mechanical properties and as the amount of TiO2 increases in aluminium alloy, the mechanical properties continuously increases.

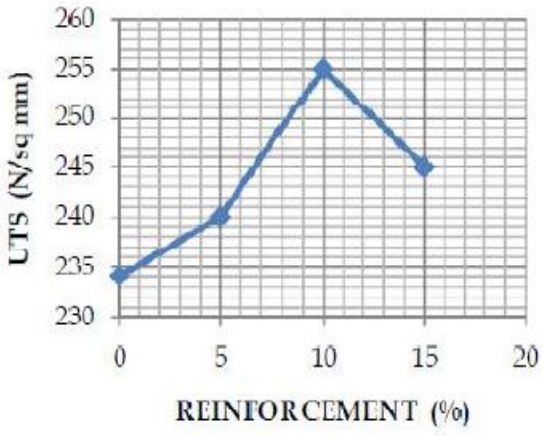


Fig 3: Ultimate tensile strength curve for different combinationsof reinforcement [16]

TABLE 2:

EFFECT OF REINFORCEMENT ON MECHANICAL PROPERTIES OF BASE CONSTITUENT.

S.N.	Matrix /alloy	Reinforcement	Wt. %	Fabrication Techniques	Testings'	Results	Applications	Ref No.
11	Al 6061	SiC	25	Stir Casting	Mechanical testing & micro-structural Studies	Stainless steel cylinder can be replaced, wt. reduction = 65.73 %	Hydraulic Actuator	15
12	Cu	SiC + Al_2O_3	2.5+2.5 5+5 7.5+7.5	Stir Casting	Tensile and hardness test	UTS increases but after 10% decreases, hardness increases electrical & thermal conductivity increases	Electrical appliances	16
13	Al 6082	TiO_2	0 3 6 9	Semi solid compo casting	Hardness & tensile test	Mechanical properties increases on increasing TiO_2	Automotive Application	17
14	Al 6061	ZrO_2	0 2.5 5 7.5	Stir casting	Hardness, tensile & impact test	Tensile strength = 157 (MPa) Elongation % = 3.8 HRB = 26 (MPa) at 7.5 wt. %	Aerospace, structural, marine	18
15	Al 1100	ZrO_2	0.5 0.75 1	Accumulation roll bonding	Tensile, compressive & hardness test	Tensile & compressive strength increased	Naval ship	19
16	Al	SiC + B_4C	8+2 5+5 3+7	Sintering of mechanical alloyed power (ball milling) in powder metallurgy process	Hardness Test	Micro hardness of MMC increased VHN % = 21.2 22.36 32.7	automotive industries	20

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III. CONCLUSION

The main focuses of this paper is about the mechanical and wear behavior of metal matrix composite. Composites are precluded to have essential applications in automobile, aerospace, machinery components, sports, electrical appliances (where variable resistance (rheostat) is used), etc. The agglomeration and clustering of reinforcement restrict the slipping of molecular planes and this imparts a great strength in composite. The reinforcement like SiC, Al2O3, etc. imparts the mechanical strength; reinforcement like graphite enhances the wear resistance properties by acting as solid lubricant.

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Extraction and Characterization of Pectin from Sweet Lime

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Abstract: **- Pectin a naturally occurring polysaccharide, methylated ester of polygalacturonic acid has in recent years gained increased importance. This research emphasized on pectin extraction and characterizations from sweet lime peel. In general, the research had been divided into two parts namely effect on pectin yield at different pH and characterization of pectin. The outcome of the present work highlighted that the sweet lime peels are good source of pectin and have the potential to become important raw material for food processing industries. These results demonstrate the successful extraction of pectin, providing potential benefits for industrial extraction of pectin from an economic and environmental point of view.**

Keywords: **- Pectin, Polysaccharide, Polygalacturonic acid, Pharmaceutical**

I. INTRODUCTION

Plants and their products have always been a source of various drugs and excipients used in pharmaceutical formulations. Pectin, a naturally occurring polysaccharide, has in recent years gained increase importance. Pectin is the methylated ester of polygalacturonic acid and it is commercially extracted from citrus peels and apple pomace under mild acidic conditions. This broader class of pectic substances has been studied extensively both in regard to its biosynthesis and its involvement in the structure of plant tissues. Many of these materials contain very substantial amounts of a range of neutral sugars, especially arbinose and galactose, with smaller amounts of rhamnose, xylose and glucose, and they are frequently closely associated with other polymers containing entirely neutral sugars. In contrast, the pectins are characterized by a high content of galacturonic acid, and this has become part of the definition for pectin used as food additives or for pharmaceutical purposes. This requirement in itself limits the potential sources of food and pharmaceutical pectins. Such pectins contain a linear backbone of galacturonic acid units interrupted by occasional neutral sugar residues. The intervening regions of the chain are claimed to be very largely composed of galacturonic acid with up to 4/5 of the acid groups esterified with methanol.

Pectin, a multifunctional constituent of cell wall is a high value functional food ingredient widely used as gelling agent and as stabilizer. It is produced commercially in form of white to light brown powder, mainly extracted from citrus fruits, and is used in food as gelling agent particularly in jams and jellies. It is also used in fillings, sweets, as a stabilizer in fruit juices and milk drinks and as a source of dietary fibre. Consumption of pectin has been shown to reduce blood cholesterol levels.

II. CLASSIFICATION

Pectins are generally classified based on their degree of esterifications or degree of methylation of contained carboxyl groups with methanol. The percentage of ester group is called degree of esterification.

Two main classes and several subclasses of pectin exist. High Methyl Ester (HM-) pectin is the first general class of pectin. High methyl ester pectins are classified in groups according to their gelling temp as rapid set to slow set pectins. In this type of pectin, a high portion (>50%) of carboxyl groups exists as a methyl ester. The remaining carboxyl groups exist as the free acid, ammonium, sodium, calcium, or other rarer salts.

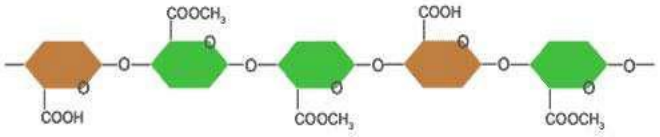


Fig no.1: High methyl ester pectin formulae

Low Methyl Ester (LM-) pectin is the second general type. For this type of pectin, less than 50% of the carboxyl groups exist as the methyl ester variant. Modification of the extraction process or continued acid treatment will yield low methyl ester pectin.

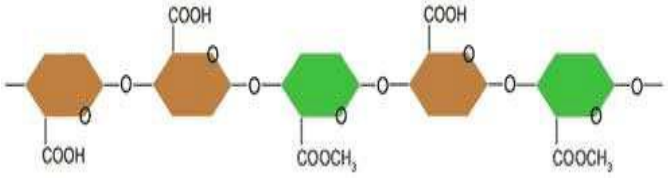


Fig no.2: Low methyl pectin formulae

III. METHOD OF PRODUCTION

The raw material taken under examination for extraction of pectin is sweet lime. Peels are removed from fresh sweet limes which are procured from local market and which were harvested in the month of December 2014 to February 2015.

Initially peels are dried and ground it into fine powder. Hydrochloric acid in distilled water solutions of

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desired pH values 1, 2 and 3 are prepared. Sweet lime peel samples weighing 10gm each are dipped in to the solution and heated at 80 °C for 15 minutes. After cooling the solution, it is filtered using Whatmann filter paper. Ethanol is added to the filtered solution to facilitate filtration of pectin. The solution is filtered using centrifuge at 3500 rpm for 15 minutes at 10°C to separate jelly pectin which is dried under vacuum at 50°C for two hours.

Dried pectin is thus obtained.

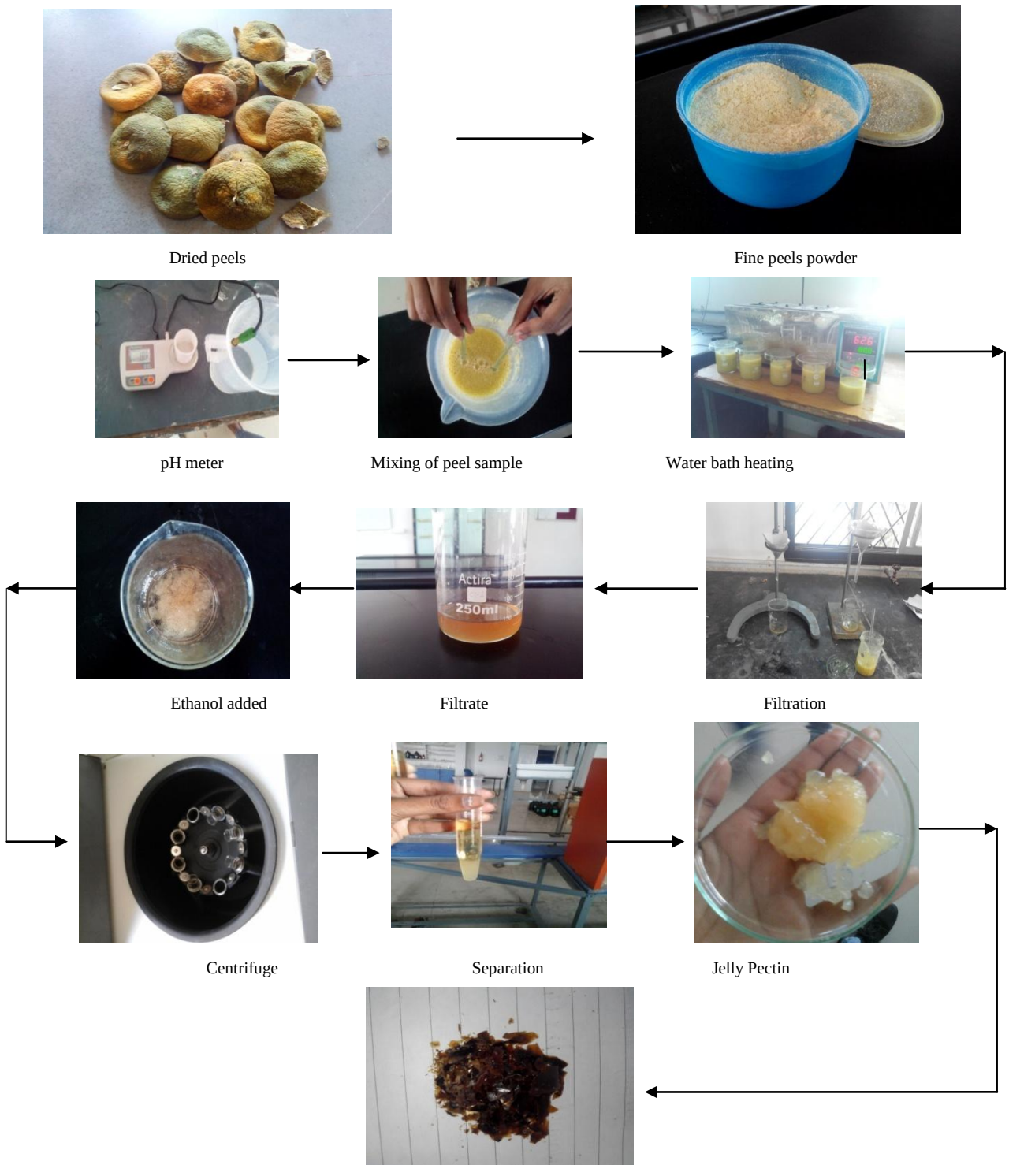


Fig no.3: Pictorial presentation of the process

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IV. CHARACTERIZATION OF PECTIN

Years of pectin research have produced several important commercial analytical measures. The dried pectin obtained from the peels of sweet lime was subjected to the following qualitative and quantitative test to characterize them.

A. *Qualitative tests*

1. *Colour:*

   This was done by visual observation;

2. *Solubility of dry pectin in cold and hot water:*

   (0.25%) of the pectin samples were separately placed in a conical flask with 10 ml of 95% ethanol added followed by 50 ml distilled water. The mixture was shaken vigorously to form a suspension which was then heated at 85-95°C for 15 min;

3. *Solubility of pectin solution in cold and hot alkali (NaOH):*

   1 ml and 0.1 N NaOH was added 5ml pectin solution and then heated at 85-90°C for 15 min;

Qualitative test observation:

Parameter	Sweet lime pectin
Colour	Brown
Solubility in cold water	Dissolved slightly after vigorous shaking
Solubility in hot water	The mixture dissolves
Solubility of pectin suspension in cold alkali	Suspension forms yellow precipitate
Solubility of pectin suspension in hot alkali	Suspension dissolves and turns milky

Table no.1: Color and solubility of pectin at different conditions in water and alkali

B. *Quantitative tests:*

1. *pectin yield:* pectin yield is calculated as

   Pectin (g/100g) =

$$\frac{weight(g) of\ dried\ pectin}{weight(g) of\ dried\ peel\ powder\ \ taken\ for\ extraction} \times 100;$$

2. *Determination of moisture content:* A dried empty petri dish was dried in an oven, cooled in a dessicator and weighed. Five grams of the pectin sample was transferred into the crucibles in the oven which was set at 130°C for 1 h thereafter the petri dish was removed, cooled in a dessicator and weighed. This process was repeated once. The moisture content was calculated using formula

   Moisture content % =

$$100 - \frac{weight\ of\ residue}{weight\ of\ sample} \times 100;$$

3. *Determination of ash content:* Five grams of each of the sample was accurately weighed into a weighed empty crucible separately. The crucible was transferred to a furnace set at 60°C to burn off all the organic matter. The carbon charred and then burnt off as carbon dioxide, leaving a dark ash; this process lasted for 24 h. The crucible was taken out of the furnace and placed in a desiccator to cool. The crucible after cooling was reweighed again. This was calculated using formula

   Ash content (%) =

$$\frac{weight\ of\ ash}{weight\ of\ sample} \times 100;$$

4. *Determination of equivalent weight:* Equivalent weight is a very important physical property of pectin. It is the most important characteristic in determining the functional behavior of pectin. Gelling abilities of individual pectin's are tied very closely with equivalent weight. Equivalent weight was determined by Ranganna's method. 0.5 g sample was taken in a 250 ml conical flask and 5 ml ethanol was added. 1 g of sodium chloride and 100 ml of distilled water were added. Finally 6 drops of phenol red was added and titrated against 0.1 N NaOH. Titration point was indicated by pink color. This neutralized solution was stored for determination of methoxyl content.

   Equivalent weight was calculated by following formula

   Equivalent weight =

$$\frac{weight\ of\ sample \times 1000}{ml\ of\ alkali \times normality\ \ of\ alkali};$$

5. *Determination of methoxyl content (MeO) :* Determination of MeO was done by using the Ranganna's method (1995). The neutral solution was collected from determination of equivalent weight, and 25 ml of sodium hydroxide (0.25 N) was added. The mixed solution was stirred thoroughly and kept at room temperature for 30 min. After 30 min 25 ml of 0.25 N hydrochloric acid was added and titrated against 0.1 N NaOH. Methoxyl content was calculated by following formula

   Methoxyl content % =

$$\frac{ml\ of\ alkali \times normality\ \ of\ alkali \times 3.1}{weight\ of\ sample};$$

6. *Determination of total anhydrouronic acid content (AUA):* Total AUA of pectin was obtained by the following formula

   % of AUA =

$$\frac{176 \times 0.1z \times 100}{w \times 1000} + \frac{176 \times 0.1y \times 100}{w \times 1000}$$

   Where;

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z = ml of NaOH from equivalent weight determination.

y = ml of NaOH from methoxyl content determination.

w = weight of sample.

7. *Determination of degree of esterification (DE):* The DE of pectin was measured on the basis methoxyl and AUA content and calculated by flowing formula

$$\% \text{ DE} = \frac{176 \times \%MeO}{31 \times \%AUA} \times 100 ;$$

C. Quantitative test calculations:

1. *Yield of pectin*

$$\text{Pectin (g/100gm)} = \frac{\text{Weight (g) of dried pectin}}{\text{Weight (g) of dried peel powder taken for extraction}} \times 100$$

$$\text{Pectin (g/100gm)} = \frac{4}{10} \times 100$$

$$= 40 ;$$

2. *Determination of equivalent weight*

$$\text{Equivalent weight} = \frac{\text{Weight of sample} \times 1000}{\text{ml of alkali} \times \text{normality of alkali}}$$

$$= \frac{0.5 \times 1000}{7.2 \times 0.1}$$

$$= 694.44;$$



Fig no.4: Eq.wt determination

3. *Determination of methoxyl content*

$$\text{Methoxyl content \%} = \frac{\text{ml of alkali} \times \text{normality of alkali} \times 3.1}{\text{Wt of sample}}$$

$$= \frac{15 \times 0.1 \times 3.1}{0.5}$$

$$= 9.3;$$

4. *Determination of total anhydrouronic acid content*

$$\% \text{ of AUA} = \frac{176 \times 0.1z \times 100}{w \times 1000} + \frac{176 \times 0.1y \times 100}{w \times 1000}$$

$$= \frac{176 \times 0.1 \times 7.2 \times 100}{0.5 \times 1000} + \frac{176 \times 0.1 \times 15 \times 100}{0.5 \times 1000}$$

$$= 78.1;$$

5. *Determination of degree of esterification*

$$\% \text{ DE} = \frac{176 \times \%MeO}{31 \times \%AUA} \times 100$$

$$= \frac{176 \times 9.3}{31 \times 78.14} \times 100$$

$$= 67.57;$$

6. *Determination of moisture content:*

$$\text{Moisture content \%} = 100 - ((Wt\ of\ residue | Wt\ of\ sample) \times 100)$$

$$= 10;$$

7. *Determination of ash content:*

$$\text{Ash content\%} = \frac{Wt\ of\ ash}{wt\ of\ sample} \times 100$$

$$= 12.5;$$

IV. RESULT AND DISCUSSION

Physiochemical characteristics of pectin at different pH

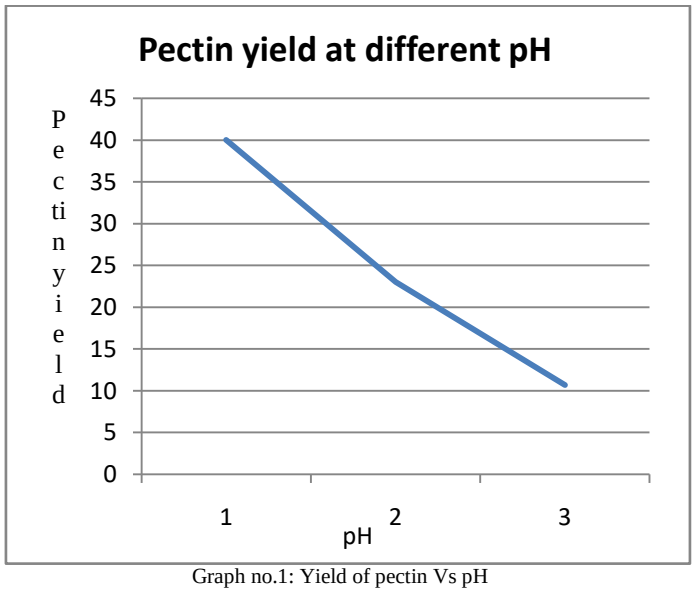
Following table shows various physiochemical characteristics of pectin at different pH conditions:

pH	1	2	3
Yield (%)	40	23	10.7
Equivalent Wt	694.44	657.39	634.17
Methoxyl content (%)	9.3	8.9	8.23
AUA (%)	78.14	69.38	67.76
Degree of esterification (%)	67.57	63.15	57.17
Moisture content (%)	10	9.1	8.3
Ash content (%)	12.5	10.8	8.1

Table no.2: Physiochemical characteristics of pectin at different pH

GRAPHICAL REPRESENTATION

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Graph no.1: Yield of pectin Vs pH

Yield of pectin decreases with increase in pH of the solution. Yield of pectin is highest at pH 1 which is 40%, and decreases to 23% at pH 2 and 10.7% at pH 3. Therefore pH plays a significant role in yield of pectin. The yield of pectin becomes negligible when the pH goes on increasing above 5.

V. DISCUSSION

A. Moisture content

Moisture content decreases as the pH increases. At pH 1 moisture content is highest that is 10 %. It decreases to 9.1 % at pH 2 and 8.1 at pH 3. For commercial pectin the value of moisture content lies in between 9.4 % to 11.3 %. The pectin is very hygroscopic, for this reason, it must be preserved in closed dry atmosphere.

B. Ash content

Ash content for given pectin at pH 1, 2, 3 was found to be 12.5%, 10.8%, 8.1% respectively. The upper limit of ash content for good-quality pectin is considered to be 15.2% from the view point gel formation. Therefore, with respect to this parameter, the pectin isolated in this study may be considered to be of satisfactorily good quality.

C. Equivalent weight

Equivalent weight is a very important physical property of pectin. It is the most important characteristic in determining the functional behavior of pectin. Gelling abilities of individual pectins are tied very closely with equivalent weight. Equivalent weight for pectin extracted was found to be 694.44, 657.39, and 634.17. This parameter as reported in literature varies in a wide range depending on the method and the nature of the citrus fruits used for extraction. High equivalent weight would have higher gel forming effect. The lower equivalent weight could be higher partial degradation of pectin. The increased or decreased of the equivalent weight might be also dependent upon the amount of free acid.

D. Methoxyl content

Methoxyl content is an important molecular index for pectin classification that describes the extent to which carboxyl groups in pectin molecules exist as the methyl ester in ratio to all esterified groups. Methoxyl content is an important factor in controlling the setting time of pectins and the ability of the pectin to form gels. Methoxyl content for extracted pectin was found to be 9.3%, 8.9% and 8.23% respectively for pH 1, 2 and 3. Spreading quality and sugar binding capacity of pectin are increased with increase methoxyl content.

E. Anhydrouronic acid content

AUA is important to the gelling capabilities of given pectin. The AUA indicates the purity of the extracted pectin and its value should not be less than 65%. The value of AUA in the given sample of extracted pectin was found to be 78.14%, 69.38% and 67.76% for pH values of 1, 2 and 3 respectively. Low value of AUA means that the extracted pectin might have a high amount of protein.

F. Degree of esterification

DE is an important molecular index for pectin classification that describes the extent to which carboxyl groups in pectin molecules exist as the methyl ester. The degree of esterification for given samples of extracted pectin was found to be 67.57%, 63.15% and 57.17% respectively for pH 1, 2 and 3. In this study, the pectin can be categorized as high methoxyl pectin (HMP) because it has a % DE that is higher than 50%.Degree of esterification decreased with the increase of maturity. DE actually depends on species, tissue and stages of maturity.

VI. CONCLUSION

This research emphasized on pectin extraction and characterizations from sweet lime peel. In general, the research had been divided into two parts namely effect on pectin yield by different pH and characterization of pectin. The results indicated that different pH effect on the extraction yield. The best condition were, extracting temperature at 80°C at 1pH for 15min and using hydrochloric acid as the extracting solvent. This gave a yield of 40.

The overall results demonstrated that the premature sweet lime peels may be as a rich source of pectin as well as extracted pectin might be used as the functional food ingredients domestically and industrially.

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Synthesis of Hydrogels

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***Abstract*-Hydrogels are polymeric networks possessing the ability to uptake a large amount of water in their gel structure. These gels can respond to stimuli under the influence of their environment, making them of potential use in wide range of applications, be it for controlled release of drugs or healing of wounds. The report gives a brief introduction about hydrogels followed by their broad classification. The methods of synthesis are discussed in brief. In order to improve upon the swelling properties and to avoid the hydrogel from getting dissolved in water instead of absorbing the water, several types of cross-linking can be performed on the polymers. Superabsorbent hydrogel can be prepared by copolymerizing acrylamide with acrylic acid using cross-linker. FT-IR spectra for poly (acrylamide –co- acrylic acid) is obtained to identify the chemical bonds present.**

***Keywords*- Gel, polymer, swelling, crosslinks, characterization**

I. INTRODUCTION

Hydrogels are polymeric three-dimensional networks having cross links in their structure. These are hydrophilic gels as they have the capacity to hold large amounts of water, causing them to swell. This property of hydrogels to uptake water is due to the hydrophilic functional groups attached to the polymeric chain. Due to the cross-linking between the network chains, they have the ability to retain water in their structure without getting dissolved. Synthetic hydrogels possess a higher water absorption capacity as opposed to natural hydrogels. Varying amounts of water can be contained by any hydrogel, at equilibrium, based on the polymer's properties and network's density[1].

In the polymer chains, cross linking is done by physical or chemical interactions. Because of single cross linked network, the structure lacks mechanical properties. Therefore, multiple networks are formed to toughen the hydrogels. It is proven that these kind of hydrogels can be produced by incorporating physical and chemical network together [2].

If there is no significant entanglement of network chains, hydrogels follow Newtonian behavior. On further introduction of cross-links, they exhibit elastic and viscoelastic nature. Hydrogels must be biologically compatible and should have low toxicity potential after degradation. Modification of the properties of degradation products can be done by selecting the proper raw materials or monomers for preparing the hydrogel according to the application [3].

Some hydrogels are required to be stable under changing pH or temperature. An example for such hydrogel is the biomaterial used in contact lenses. On the other hand, gels used for drug delivery applications need to be degradable so that they do not persist in the body for long. In pharmaceutical applications, naturally derived hydrogels might not possess much of the mechanical properties, but they most certainly are biologically compatible, biodegradable and consist of biological moieties assisting cellular activities. Synthetic hydrogels do not inherently possess such properties, instead, their definite structure is improved to yield desired degradability and functionality [4].

II. CLASSIFICATION of HYDROGELS

Hydrogels may be classified in following number of ways. The schematic diagram in Fig. 1 shows the most common classes of hydrogels.

A. On the Basis of Source

Hydrogels, based on their origin, are either natural, synthetic or semi-synthetic. Synthetic polymers are prepared from vinyl monomers by conventional polymerization, whereas natural hydrogels are obtained from natural sources such as animals and plants. Over the years, natural hydrogels are getting replaced by synthetic ones, which have higher water absorption capacity, longer life, and higher gel strength. Moreover, they can be tailored to have particular desirable properties and remain stable under extremes of temperature fluctuations.

B. On the Basis of Polymeric Composition

According to the composition of polymer, hydrogels can be categorized into three classes, namely, homo-polymeric, co-polymeric and multi interpenetrating polymeric hydrogel (IPN).

- Homo-polymeric hydrogels have a single species astheir monomer. Based on the technique of polymer-ization and monomer's nature, the homo-polymers may have cross-linked structure.
- Co-polymeric hydrogels consist of two or greater than two different monomers, at least one of them being hydrophilic. This hydrophilic group might be arranged in a random fashion, alternating or block configuration along the network chain.
- Multi-polymer IPN hydrogel involves two independent and cross-linked chains of polymers, either natural or synthetic, placed in a network fashion. Semi-IPN polymer is made up of one cross-linked and the other chain is non-cross linked polymer.

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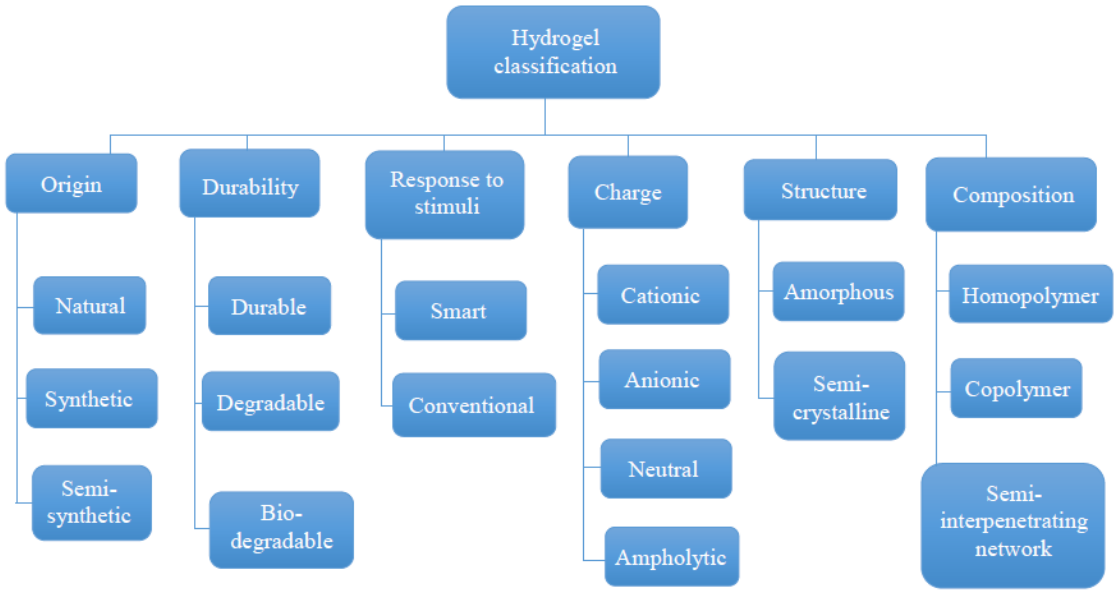


Fig. 1 Hydrogel Classification [4]

C. On the Basis of Configuration or Structure

Based on the physical configuration and chemical composition, hydrogels are classified as amorphous, semi-crystalline or crystalline.

D. On the Basis of Type of Cross Linking

Depending on the nature of the cross-links, hydrogels can be classified as the one with chemical cross-links or physical cross-links. Chemically crosslinked chains have permanent bonds as they are formed by chemical reaction with the polymer chain. Physically, crosslinking can be done through entanglements of polymer chains, hydrophobic interactions, or physical interactions like ionic and hydrogen bond. Thus the physically crosslinked have temporary junction as opposed to permanent junction in chemical cross links. Further, cross-links are discussed in Section III.

E. On the Basis of Network Electrical Charge

Cross linked chains have some electrical charge attached to them. On this basis they can be classified as follows:

- *Neutral (non-ionic)*

  These kind of hydrogels respond to the temperature changes which caused them to swell or de-swell. They have permanent linkages in their polymer networks, which are irreversible.

- *Ionic (anionic or cationic)*

  Ionization leads to the development of fixed charges on the gel so formed. The amount of solvent absorbed in the network increases due to electrostatic repulsions.

  Anionic hydrogels are made up of acidic pendant groups, hence, ionization takes place when the pH of the environment goes above the pK_a of the groups which can be ionized. An increase in the pH results in an increase in the degree of ionization, hence, the quantity of fixed charges rises, causing electrostatic repulsions between the polymeric network chains. This in turn proliferates the water loving nature of the hydrogels leading to higher swelling ratios.

  Cationic hydrogels are made up of basic pendant groups, for example, amines, which undergo ionization at pH lower than the pK_b of the ionizable groups. In this case, as the pH is decreased, the electrostatic repulsions increase and cause increased swelling [5].

- *Ampholytic (amphoteric electrolyte)*

  They consist of both acidic and basic groups containing monomers. Their properties are reliant on ionic groups attached to the chains. They can be attracted to solutions containing opposite charge, thus, they may have either inter-ionic or intra-ionic interactions.

- *Zwitterionic*

  Zwitterionic hydrogels are also known as polybetaines, and they comprise of both anionic and cationic groups in each of its monomers.

F. On the Basis of Durability

Hydrogels, on the basis of their durability which is required according to specific application, are classified into durable and biodegradable. Generally, the durable ones are synthetic and the biodegradable ones are natural hydrogels.

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Further, degradable polymers may be classified on the basis of nature of the bond breaking. They can either break due to hydrolytic or enzymatic action resulting in the breaking of sensitive bonds.

G. On the Basis of Response to Stimuli

The swelling or de-swelling characteristic of hydrogels are subject to external conditions of the environment. They experience a volume collapse or change of phase corresponding to the response to various physical or chemical stimuli.Fig. 2 shows the various physical and chemical stimuli leading to the swelling or de-swelling of hydrogel.

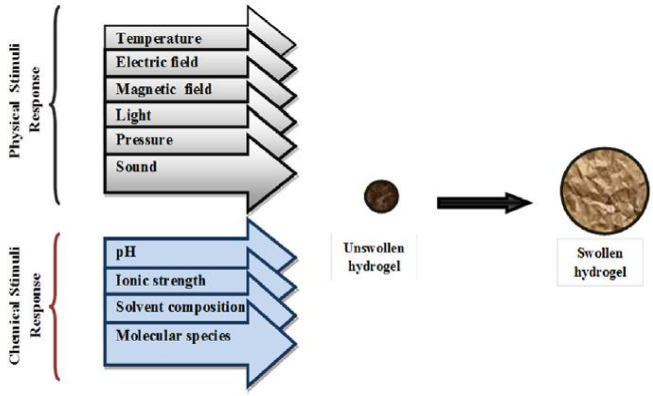


Fig. 2 Response of hydrogel to physical and chemical stimuli [1]

III. TYPES of CROSS-LINKS

A. Physical Cross-linking

- By hydrogen bond

Polyethylene glycol can be added to form hydrogen bonds. The bond is formed between the oxygen of polyethylene glycol and the hydrophilic group.

- *By crystallisation*

  Aqueous solution of polyvinyl alcohol when crystallised forms a tougher hydrogel as compared to when it is prepared at room temperature.

- *By ionic interaction*

  With the help of calcium ions, cross-linking can be done in alginate. It is done at a particular pH and room temperature.

B. Chemical Cross-linking

- *By chemical reactions*

  Hydrogels have different hydrophilic groups like amine, carboxylic acid, etc. On these groups reactions can be carried out to form cross-links. Aldehydes can be used to cross link. PVA can be cross linked through glutaraldehyde. Gelatin and albumin are some other examples.

  Addition and condensation reaction can be used to form cross links. Dextran is cross linked by addition reaction.

- *By high energy radiation*

  Gamma rays or any other high energy beam can be used to form cross linking in an unsaturated molecule.

- *By free radical polymerisation*

  The polymers are mixed with an initiator and then with the help of UV radiation, hydrogels are cross linked. Hydrogels can also be degraded with UV radiations and this has application in drug delivery.

IV. TECHNOLOGIES for HYDROGEL PREPARATION

Generally, hydrogels are prepared from hydrophilic monomers, but to meet certain specifications hydrophobic monomers are also used. Synthetic polymers are hydrophobic and provides mechanical strength. This strength results in slow degradation rate and durability. Thus, these differing properties must be balanced. Cross-linking provides an elastic structure to hydrogels.

Hydrogels can be cross linked by:

- Linking polymeric chains by reaction
- By means of ionized radiation to produce free radicals that on recombining creates cross-links.
- Entanglements, electrostatics and crystalline formation.

The three main components to make hydrogels are monomer, cross linker and initiator. Diluents like water is used to control the heat of reaction.

A. Polymerization Techniques

- *Bulk polymerization*

The reaction is initiated with the help of radiation or catalysts. Small amount of cross-linking agent is added. Hydrogels can be produced in forms of membranes, rod or particles. Due to higher concentration of monomer, the reaction rate is higher. Through this method, homogenous hydrogel is produced, that is hard, but softens and flexible when immersed in water.

- *Solution polymerization*

Hydrogels produced by this technique are heterogeneous in nature. Solvent in the reaction acts as a heat sink. The gel is then washed with distilled water to remove unreacted mixture and other impurities.

V. APPLICATIONS

Hydrogels closely resemble natural tissues since they are porous and have soft consistency. This resemblance gives many prospects for hydrogels to be used in biomedical applications such as for the production of contact lenses, drug

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delivery systems, wound dressings, tissue engineering or a variety of hygiene products.

According to the application, physical or chemical gels might be used. Physical gels are reversible in nature since they get dissolved in response to environmental conditions like pH or temperature. In contrast to them, chemical gels are permanent and stable, and can go through changes in volume in presence of electric field. Chemical hydrogels are prepared in two manners, first, three dimensional polymerization, and second, water soluble polymers are directly cross-linked. A schematic representation of both methods are as shown in Fig. 3 and 4 respectively[6].

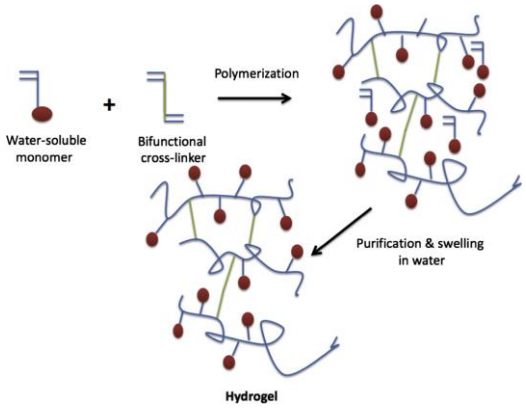


Fig. 3 Three-dimensional polymerization method for hydrogel synthesis

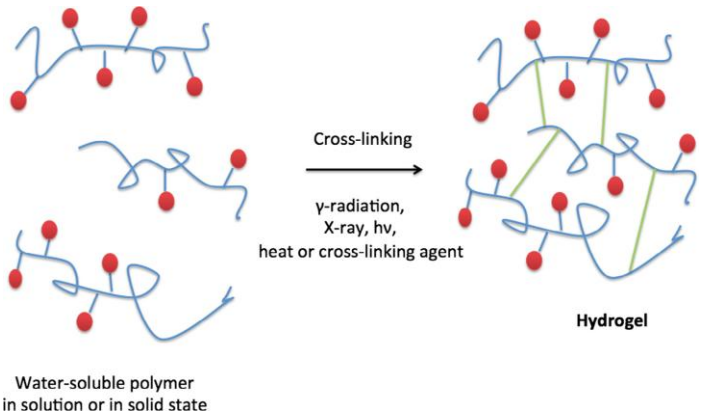


Fig. 4 Direct cross-linking of water soluble polymers for hydrogel synthesis

A. *Contact Lenses*

Contact lenses are categorized as hard and soft on the basis of their elastic nature. Although, hard lenses might last longer, they are not comfortable enough to be adapted by the consumer. Hard contact lenses consist predominantly of hydrophobic polymers, such as PMMA (Poly Methyl Methacrylate), HFIM(hexa-fluoro isopropyl methacrylate), whereas, soft contact lenses contain hydrogels like PHEMA(Poly-2-hydroxy ethyl methacrylate), which was the first hydrogel to be used for any commercial application.

Techniques for the production of soft contact lenses are spin-casting, mold-casting or lathe-cutting technique. In the method of spin-casting and mold-casting, the monomers are placed in concave or convex molds respectively to give shape to the optical lens. Lathe cutting is depicted in the following Fig. 5.

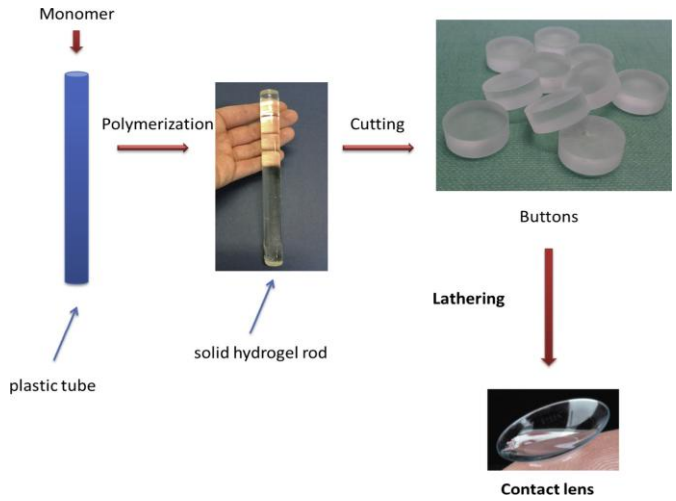


Fig. 5 Lathe-cutting technique

For hydrogels to be eligible for use in contact lenses application, given below are the prerequisites:

- Minimum 95%value of luminous transmittance, determines the transparency of the lens.
- Refractive index values of hydrogel should be around 1.7-1.38, though the values of human cornea may change.
- Sufficient amount of oxygen should be permeable through the lens. It is directly proportional to the amount of water held in the hydrogel and inversely proportional to the thickness of the lens.
- Biocompatibility
- Stability
- Excellent mechanical properties

VI. EXPERIMENT

A. *Synthesis of Polyacrylamide Hydrogels*

1) *Materials:* Acrylamide (AAm), N, N, N', N'-Tetramethylene ethylene diamine (TEMED), Potassium peroxodisulfate (KPS), N, N'-methylene bis (acrylamide) (MBA), Methanol, distilled water.

2) *Synthesis:* A solution of acrylamide (5 gm) was prepared in distilled water (50 mL). Then, TEMED (1 mL) was mixed in the solution. The solution was stirred for 20 minutes and maintaining the temperature at 60 ^{o}C. After 30 minutes, 0.1 gm KPS (in 10 mL distilled water) was added to this

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solution. The reaction was carried out for 2 hours. Then, by pouring excess methanol drop by drop, the polymerization reaction was stopped, and a white solid, sticky mass was obtained. The mass so formed is cut into pieces and immersed in methanol for one day, while changing the methanol after regular intervals. Methanol is drained away and the pieces are further dried under the sun. These white solid pieces become brittle and are crushed in mortar and pestle to form powder.

TABLE I

AMOUNTof REACTANTS FOR DIFFERENT BATCHES of POLYACRYLAMIDE PREPARATION

Acrylamide (gms)	KPS (gms)	TEMED (mL)	MBA (gms)	Result
5	0.1	1	0	Polyacrylamide is water soluble as it dissolves in water due to absence of cross-links.
10	0.2	2	0	
20	0.4	4	0	
10	0.2	2	0.2	Weak structured hydrogel formed

For the preparation of crosslinked polyacrylamide hydrogel, MBA is introduced in the reaction mixture after an hour of the reaction for the above mentioned process.

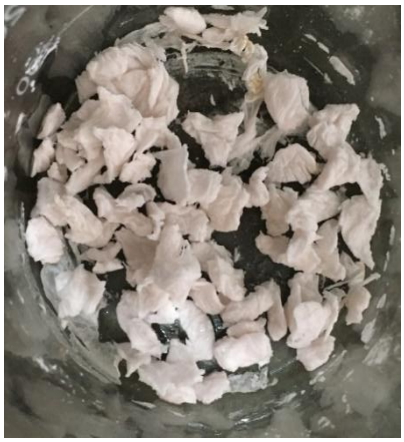


Fig. 6 Preparation of polyacrylamide and polymer after drying in methanol

B. Synthesis of Polyacrylic acid hydrogel

1) *Materials:*Acrylic acid (AAc), N, N, N', N'-Tetramethylene ethylene diamine (TEMED), Potassium peroxodisulfate (KPS), Methanol, distilled water.

2) *Synthesis:*Acrylic acid (4.76 mL) is polymerized by following the procedure mentioned in Section VI.A.2 and replacing acrylamide with acrylic acid.



Fig. 7Polyacrylic acid hydrogel

The solid mass formed was sticky, elastic and results were not similar as that in case of polyacrylamide.

C. Synthesis of Poly(acrylamide-co-acrylic acid)

1) *Materials:* Acrylamide (AAm), Acrylic acid (AAc), N, N, N', N'-Tetramethylene ethylene diamine (TEMED), Potassium peroxodisulfate (KPS), N, N'-methylene bis (acrylamide) (MBA), Methanol, distilled water.
2) *Synthesis:* Acrylamide (5 gm) is added to 100 mL distilled water to form a solution. The activator, TEMED (1 mL) is added and this solution is allowed to stir for 20 minutes. Maintain a temperature of 60 ^{o}C throughout the reaction. Then, acrylic acid (0.5 gm) and MBA, which is the cross-linker, are introduced while the contents of the beaker are constantly being stirred. The initiator KPS (0.1 gm) is added after 30 minutes. This drop by drop addition of the initiator would result in the formation of a highly viscous translucent gel as shown in Fig. 8.

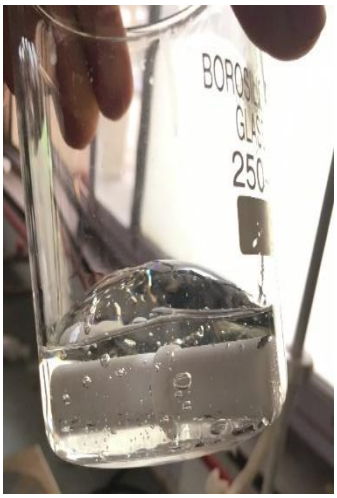


Fig. 8 Highly viscous gel formed after adding KPS

TABLE II

AMOUNT of REACTANTS for BATCHES of POLY(ACRYLAMIDE-CO-ACRYLIC ACID) PREPARATION

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Acryla mide (gm)	Acrylic acid (mL)	KPS (gm)	MBA (gm)	Result
5	0.5	0.1	0.05	High viscosity gel formed
5	0.6	0.1	0.05	
5	0.9	0.1	0.05	



Fig. 9 Poly(acrylamide-co-acrylic acid) hydrogel

The prepared hydrogel in Fig. 9 is cut into pieces and immersed in methanol for dehydration and finally, dried under the sun to obtain the dried hydrogel.

3) *Swelling measurement:* In order to know the water absorption capacity of the hydrogel, a sample of the prepared hydrogel (0.5 gm) was put in 100 mLdistilled water for 16-18hours and the initial weight of the hydrogel is compared with the final weight. The degree of swelling is found by the swelling ratio (R_s).

$$R_s = \frac{W_s - W_d}{W_d}$$

TABLE III

SWELLING MEASUREMENT OF PREPARED HYDROGELS

Sr. No.	Initial weight (gm)	Final weight (gm)	Swelling ratio (%)
1.	0.5	Hydrogel dissolved	-
2.	0.4	14.36	34.90
3.	0.4	16.1	39.25

D. Synthesis of Poly(acrylamide-co-acrylic acid) of varyingcompositions

The materials required and synthesis method remain same as discussed in Section VI.C.1 and Section VI.C.2except that acrylamide solution was prepared in 50 mL distilled water.

TABLE IV

PROPORTIONS of MONOMERS in PREPARED HYDROGELS

Mole Ratio	AAm (gms)	AAc (gms)	AAc (mL)	AAm(wt/wt %)
90/10	6.39	0.7206	0.68628571	89.86583411
80/20	5.68	1.4412	1.37257143	79.76183789
70/30	4.97	2.1618	2.05885714	69.68787683
60/40	4.26	2.8824	2.74514286	59.6438172
50/50	3.55	3.603	3.43142857	49.62952607
40/60	2.84	4.3236	4.11771429	39.64487129
30/70	2.13	5.0442	4.804	29.6897215
20/80	1.42	5.7648	5.49028571	19.76394611

1)*Swelling measurements*

TABLE V

SWELLING MEASUREMENTS of VARIOUS BATCHES for 24 HOURS

Batch	W_d (gms)	W_s gms)	Swelling ratio	Swelling (%)
80/20	0.5	70.2	139.4	13940
	0.5	49.29	97.58	9758
	0.5	51.48	101.96	10196
70/30	0.5	57.33	113.66	11366
	0.5	66.18	131.36	13136
	0.5	66.18	131.36	13136
60/40	0.5	51.98	102.96	10296
	0.5	29.65	58.3	5830
	0.5	51.88	102.76	10276
50/50	0.5	51.77	102.54	10254
	0.5	30.04	59.08	5908
	0.5	64.01	127.02	12702

The amount of water absorbed after every hour till 22 hours was noted to study the kinetics of swelling of hydrogel. For this, 0.1 gm of the prepared polymer with monomer ratio 70/30 was put in 500 mL distilled water for given number of hours as in Table VI.

TABLE VI

KINETICS STUDY of SWELLING of HYDROGEL

Time (hours)	W_d (grams)	W_s (grams)	Swelling ratio
0	0.1	0.1	0
1	0.1	6.68	65.8
2	0.1	11.51	114.1
3	0.1	12.23	121.3
4	0.1	13	129
5	0.1	11.17	110.7
6	0.1	13.59	134.9

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17	0.1	16.1	160
18	0.1	17.04	169.4
19	0.1	16.96	168.6
20	0.1	14.71	146.1
21	0.1	14.77	146.7
22	0.1	17.82	177.2

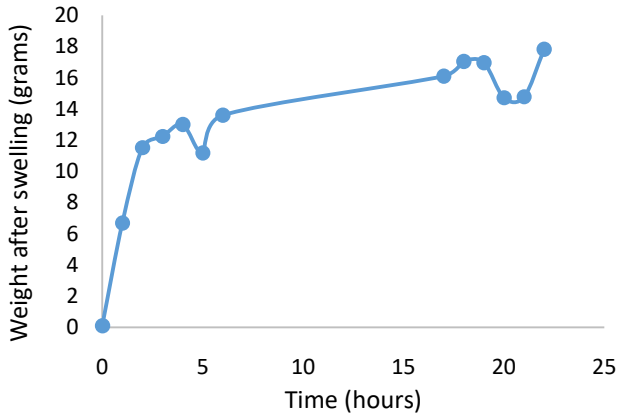


Fig. 10 Weight after swelling v/s time curve

E.Swelling Characteristics

1) *Effect of pH:* The polymer with monomer ratio of acrylamide to acrylic acid 70:30 was taken and immersed in 500 mL solutions of pH ranging from 3.75 to 9.6. The pH of distilled water was modified either by adding HCl to decrease pH or NaOH to increase the pH. After 24 hours, the final weight of the hydrogel was noted after draining the excess water. The swelling ratio is observed to increase with increasing pH of the solution.

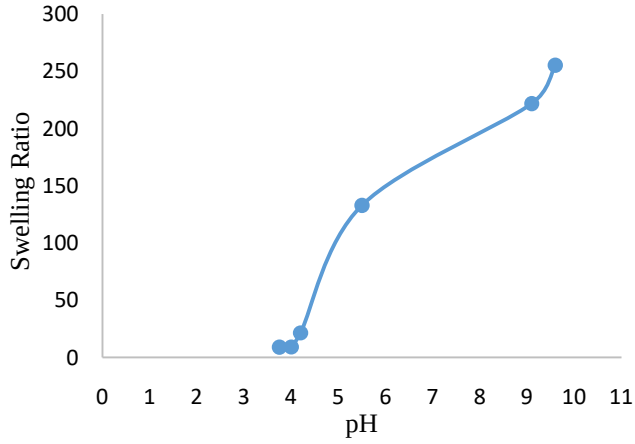


Fig. 11 pH effect on swelling ratio

The cause for the increasing trend is due to the phenomena of dissociation of ions in certain pH conditions. At lower pH, carboxylic acid in the copolymer structure turns into protonated form of carboxylic acid. Hence, the hydrogel in acidic environment gets less water to absorb and hence the swelling ratio decreases at lower pH. At higher pH, the carboxylic acid group gets transformed into its basic salt form. This increases the number of fixed charges on the gel network, due to which electrostatic repulsions take place, resulting in increased potential to absorb water into the polymer network structure. Thus, swelling ratio is found to increase at high pH.

2) *Effect of temperature:* The copolymer with monomer ratio 70/30 of acrylamide and acrylic acid was synthesized by maintaining reaction temperatures of 50 °C, 60 °C and 70 °C. Two to three batches were prepared for each temperature. 0.5 gm of each sample were put in 500 mL distilled water for a period of 24 hours.

TABLE VII

SWELLING RATIOS of DIFFERENT REACTION TEMPERATURE

Temperature (°C)	W_d (g)	W_s (g)	Swelling Ratio
50	0.5	106.43	211.86
	0.5	84.05	167.1
	0.5	56.62	112.24
60	0.5	57.33	113.66
	0.5	66.18	131.36
	0.5	66.18	131.36
70	0.5	45.42	89.84
	0.5	102.18	203.36

3) *Effect of cross-linker concentration:* For preparing 70/30 monomer ratio, amount of MBA was increased to 0.06, 0.07 and 0.08 g and the swelling ratios were noted for all the samples.

TABLE VIII

SWELLING RATIO with DIFFERENT MBA CONCENTRATION

Amount of MBA (g)	W_d (g)	W_s (g)	Swelling ratio
0.06	0.1	31.77	316.7
0.07	0.1	19.72	196.2
0.08	0.1	10.83	107.3

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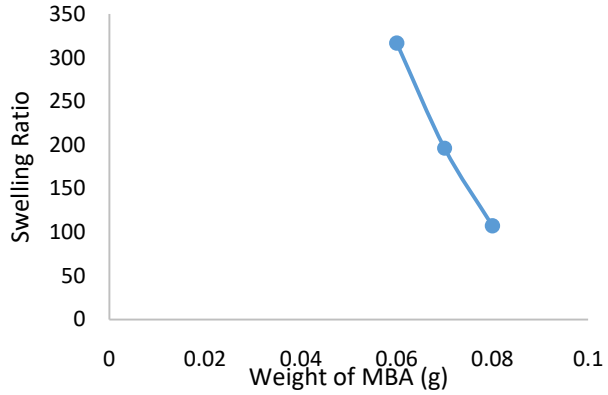


Fig 12. Effect of MBA concentration on swelling ratio

4) *Effect of ionic strength:* A 70/30 sample of polymer was taken and put in different concentrations of salt solution, and the corresponding swelling was reported.

TABLE IX
SWELLING RATIO of POLYMER in DIFFERENT STRENGTHS of NACL SOLUTION

Ionic strength (M)	W_d (gm)	W_s (gm)	Swelling ratio
0.1	0.1	3.54	34.4
0.3	0.1	2.68	25.8
0.5	0.1	2.59	24.9
0.7	0.1	1.44	13.4
0.9	0.1	4.17	40.7

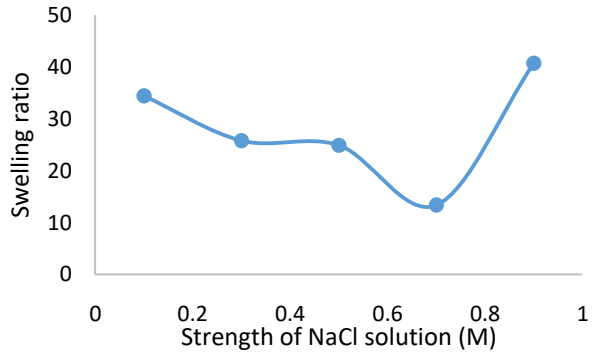


Fig. 13 Effect of strength of NaCl solution on swelling

VII. CHARACTERIZATION

F. FT-IR

The FT-IR (Fourier Transform-Infrared Spectroscopy) of a sample of poly(acrylamide-co-acrylic acid) of 70/30 mole ratio was obtained using spectrophotometer FT/IR-6100typeA using powdered KBr post complete drying in infrared radiation.

In the spectra in Fig. 14, the peaks at 3491.49 cm^{-1} resemble the N-H stretching of acrylamide while those at 2931.27 cm^{-1} represent the C-H stretching of acrylic acid unit. The band 1560.13 cm^{-1} – 1701.87 cm^{-1} corresponds to C=O group. The peaks near 1249.65 cm^{-1} are due to C-N vibration. The C-O group is represented by peaks in the range 1070.3 cm^{-1} – 1249.65 cm^{-1}.

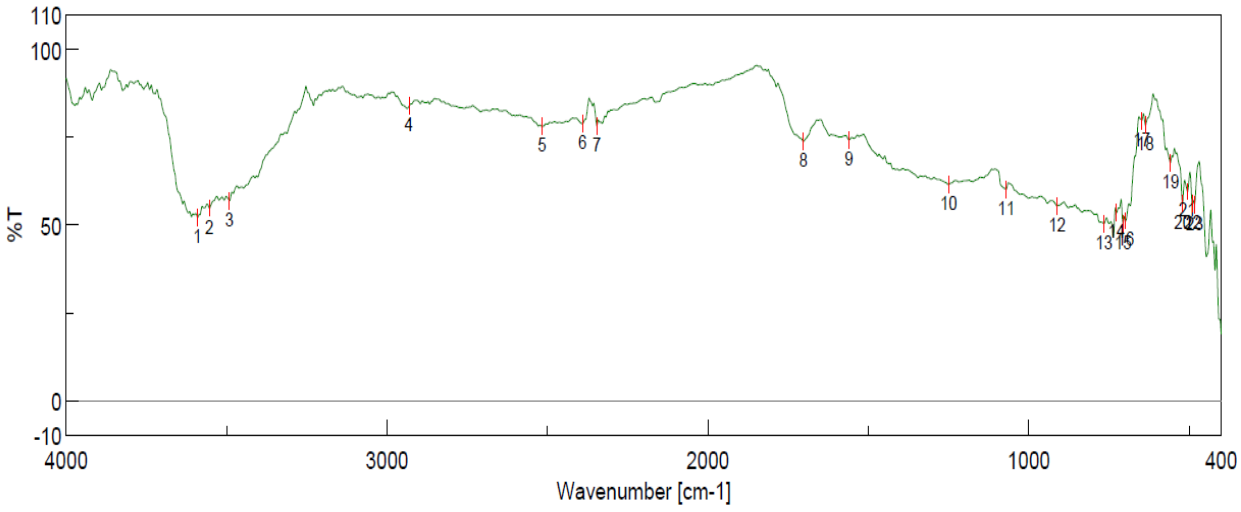


Fig. 14 FT-IR spectrum of 70/30 sample of poly (acrylamide-co-acrylic acid)

VIII. RESULTS

The preparation of homo-polymers Polyacrylamide (PAAm) and Poly acrylic acid is carried out by monomers acrylamide and acrylic acid respectively. Polyacrylamide is formed successfully whereas poly acrylic acid could not be formed under similar reaction conditions. Upon immersion in distilled water, the polyacrylamide hydrogel gets dissolved.

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To assist in the absorption of water, cross-linking agent is added during the polymerization reaction to form cross-linked PAAm hydrogel. It absorbs water but only up to some extent, otherwise gets dissolved too. In order to strengthen the hydrogel, cross-linking is carried out between two monomers, AAm and AAc. Hence, copolymers of various monomer ratios are synthesized successfully. A highly viscous gel was formed upon the addition of initiator, potassium persulfate, in the reaction mixture. Swelling measurements of the powdered hydrogel indicated the absorption of considerably high amount of water. While noting the weight of the hydrogel on an hourly basis, thecommon trend observed was that the weight of swollen hydrogel generally increases with time.

As the pH of the solution increases, the amount of swelling increases. This is because the number of fixed charges on the gel increases as more carboxylic groups get converted to their basic salt form. This increases electrostatic repulsion between the polymer chains and allows more water to get absorbed.

The variation of reaction temperature does not give a definite trend in swelling, though varying swelling ratios have been observed at different compositions.

With increase in concentration of the crosslinker MBA, the swelling decreases since the density of cross linking increases and available spaces for water absorption become lesser.

The ionic strength of the solution in which hydrogel is immersed also has an impact on absorption capacity. The electrostatic repulsion between crosslinked chains decreases with increasing NaCl concentration as it tends to partially neutralize the carboxylic acid attached to polymer chains. Hence, lesser amount of water is absorbed at high strength.

From the FT-IR spectra it can be inferred that the polymer was synthesized properly and the peaks obtained correspond to that of poly (acrylamide- co- acrylic acid).

IX. CONCLUSION

The homo-polymer Polyacrylamide is a water soluble since it gets dissolved in water. Addition of cross linking agent is an attempt to strengthen the hydrogel, but only a weak structured hydrogel is formed since most of it gets dissolved. The copolymer of acrylamide and acrylic acid is superabsorbent in nature as it has high water retention capacity without getting dissolved readily. Hydrogels prepared according to various proportions of the monomers, acrylamide and acrylic acid, have different swelling properties. The swelling ratios of various batches largely depends on the ratio of monomers taken in the reaction mixture, but does not entirely depend on it. So, it might get affected due to variation in reaction conditions such as temperature or the concentrations of monomer, initiator, activator and cross-linking agent, or loss of mass or simply an error in measurement of weight. Also, the general trend, while studying the absorption of water with time, is that the weight of swollen hydrogel increases as more water gets absorbed. However, it might decrease after reaching a peak swelling point, since the hydrogel can deform and begin to dissolve in water.

The effect of pH and ionic strength shows that hydrogels respond to change in environment during swelling. The swelling ratio increases with increase in pH and with increase in ionic strength, the swelling decreases as electrostatic attraction increases between the chains. Also, while preparation of polymer changing reaction conditions leads to different swelling in samples. Decrease in concentration of cross linker leads to increased swelling in the polymer but its strength decreases.

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Efficient Utilization of Waste Biomass and Waste Paper for the Production of Ecofriendly Fuel

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***Abstract*: With the increase in urbanization and industrialization, coal, a non renewable source of energy is getting exhausted day by day. Moreover the fossil fuels produce much of green house gases which are the main sources of health problems. The objective of this work is to deal with this major problem of today's scenario and to find solution to replace the non renewable source with a renewable and more potential form of energy like biomass briquettes. Biomass briquettes were made with different percentage of paper paste and equal mixture by mass of green waste like rice husk (RH), Straw of pulses (SP), sugarcane bagasse (SB) and saw dust (SD). Percentage volatile matter and ash content was determined and their calorific value was also evaluated. It was found that the calorific value increased with increase in the percentage of paper paste. Moreover the percentage of ash content decreased with increase in paper waste. Such biomass briquettes can be created domestically. Therefore, constantly rising fuel prices will be less significant in an economy if sources of fuel can be easily produced domestically.**

***Keywords:* Biomass briquettes, proximate analysis, paper paste, ecofriendly fuel**

I. INTRODUCTION

The most imperative factor in the development of any country is energy. The unrestrained consumption of fossil fuel has made a huge gap between demand and supply of energy. This gap can be filled by substituting the solid fossil fuel with renewable and greener biomass waste briquettes. It is available in various type of raw material available easily in bulk. For developing country like India where there is huge availability of agro-forestry waste such initiatives will be a boon for the people. By this we can even generate revenue from agro-forestry waste thus leading to the production of an ecofriendly renewable green energy.

Briquettes can be made by either piston press which give a solid cylindrical form of briquettes or by screw press in which a hole is there in the centre of briquettes. According to [1] researchers the screw press form is more efficient as fuel as it increases surface area of log and assists efficient combustion. Much work has been carried out in making biomass briquettes using agricultural, industrial, municipal waste etc.

India holds second position in the production of sugarcane. For each tonne of sugarcane crushed, about 300 kg of bagasse is reclaimed. On the other hand India produces 200 million tonnes of paddy and each tonne of paddy gives 300 kg of rice husk, likewise India is the largest producer and consumer of pulses. Out of million tonnes of agricultural waste produced only half of it is used as fodder. Saw dust in another waste obtained in bulk during the cutting of woods. These raw materials are already used in making briquettes [2 – 7] and binders have also been used during compression [8 and 9]. Tonnes of waste paper which has been recycled five to six times are generated everyday. Disposal of these solid waste is becoming a nuisance to our environment. In the present work these four materials together were mixed with different amount of paper waste to procure briquettes having high calorific value. Thus, this will not only be an answer to their disposal problems but also will help to enhance the heating capacity of ecofriendly fuel.

II. MATERIALS AND METHOD

Rice husk (RH), straw of pulses (SP), saw dust (SD) and sugarcane bagasse (SB) was procured from respective mills. These were dried in hot air oven at 110 ^{o}C for one hour then they were introduced in ball mills in equal proportions by weight. The powdered material so obtained was sieved into two different sizes and was labeled as 0.08 mm and 0.15 mm. Waste paper (WP) was soaked for two weeks in water. This was mashed in mixer and its homogenous paste was obtained. This was then mixed with each sieve in three different proportions of 10%, 20% and 30%. Mixture was homogenized and introduced to screw press type briquette making machine and then again dried. There are inherent binders in the biomass which will come to the surface at a particular temperature and pressure and will bind the material together. Percentage volatile matter and ash content of all the eight types of briquettes was carried out and their calorific value was examined.

III. RESULTS AND DISCUSSIONS

The volatile content evaluated for different briquettes shows a decrease in volatile matter with the decrease in the size of particles which shows that smaller the sieve size more will be the compactness of briquettes and lesser will be the volatile matter released while combustion thus giving rise to proper combustion. It was also seen that the increase in the percentage of WP also decreases the volatile matter content. The percentage of ash also decreases with the decrease in the sieve size and increase in the percentage of WP in briquettes. This shows that small sieve size homogenizes the combustion

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at all sites and presence of WP enhances this quality as WP has lesser ash content than the other contents used in briquettes. Moreover, calorific value calculated shows an increase in the heat capacity of briquettes with the increase in the percentage of WP which proves that WP is the correct substitute if used with the mixture used to prepare briquettes.

Table 1: Percentage of Volatile Matter and Ash present and calorific value of various briquettes

Sample	Sieve Size	Ratio of RH:SP:SB:SD:WP	% Volatile Matter	% Ash	calorific value (kcal/kg)
1.	0.15mm	25:25:25:25:00	47.2	16.22	3700
2.	0.08mm	25:25:25:25:00	45.4	16.00	3858
3.	0.15mm	22.5:22.5:22.5:22.5:10	44.5	14.85	3940
4.	0.08mm	22.5:22.5:22.5:22.5:10	42.8	14.50	4100
5.	0.15mm	20:20:20:20:20	43.0	13.44	4199
6.	0.08mm	20:20:20:20:20	41.7	13.00	4374
7.	0.15mm	17.5:17.5:17.5:17.5:30	37.5	11.68	4598
8.	0.08mm	17.5:17.5:17.5:17.5:30	36.0	11.05	4700

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Metal Complexes Stability Constant Determination by Paper Electrophoresis: The Case of 1:1 Metal-to-Ligand Stoichiometry

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***Abstract*—A paper electrophoretic technique is described for the determination of the stability constants for Cu(II), Ni(II), Zn(II) and Cr(III) metal ion complexes with alizarin as ligand. The stability constants for different metal (II, III)-alizarin complexes indicated the following order of the stabilities of complexes formed between alizarin and metal (II, III) ions. The following values were obtained with a good precision for metal-(II)/(III)-alizarin; $10^{5.14}$, $10^{4.84}$, $10^{4.44}$ and $10^{4.14}$ for Cr(III), Cu(II), Ni(II) and Zn(II) respectively at 35^0C and ionic strength I=0.1 mole dm^{-3} (HClO4). These values are consistent with the literature data, showing paper electrophoresis potential for metal complexes stability constant determination.**

***Keywords*— Metal complexes, overall mobility, paper electrophoretic technique, stability constant(s), metal-alizarin binarysystem.**

I. INTRODUCTION

Coordination chemistry is about tuning properties of metal ions using different ligands. Alizarin with reactive hydroxyl groups in 1 and 2 positions with respect to quinoid oxygen can form coordination compounds with metal ions and stabilizes the complexes via hydrophobic interaction. The essential metals such as Cu, Zn, Ni, and Cr play vital various roles in biological processes in form of complexes and their stability contributes to their efficiency. The roles played by these metal complexes include storage, enzyme catalysing process, analysing metal toxicity at certain concentration. Knowledge of the appropriate stability data is essential in determining whether a particular ligand considered for use in ligand (or chelate) therapy can selectively remove (or reduce the toxic levels of) a given metal ion. The knowledge of stability of metal complexes are known to play an important role in many metabolic and toxicological functions [1]. Furthermore, the metal complex with dye is very important in the textile industry. Alizarin is one of the most known and stable organic dyes and is found as the main component, with purpurin and quinizarin, of the madder lake pigment, known to painters as Rose Madder and Alizarin Crimson. Extracted from Rubiatinctorum roots [2] since 3.000 BC, it has been widely used in Europe during the XVI century in both artistic painting and textiles. Moreover, its capability to form stable complexes with different metal atoms [3]- [4]], also shown by its most common derivatives has led to their use in medicine[5]-[6] and chemical analysis[7]-[8] Thus knowing the stability of the complex decides its applicatory importance. Complexes are always possible, depending on the pH of the system. The actual complex-formation depends on the affinity of the metal ion towards the various ligands present, and the relative concentrations thereof. Kiso [9] has done a comprehensive study on paper electrophoretic migration of metal complexes. A number of methods have been employed for determination of stability constants of metal complexes [10] - [13]. B. B. Tewari [14] studied the quantitative indication of a complex formation comes from the estimation of the stability constants characterizing the equilibria corresponding to the successive addition of ligands. A search of literature indicated that no previous reports are available on stability constant determination by paper electrophoretic technique of aforesaid metal-alizarin complex. In view of this, an attempt was made to establish the optimum conditions for Zn(II), Cu(II), Ni(II) and Cr(III)-alizarin complex formation. In addition, the present paper describes a paper electrophoretic method for the determination of the stability constants of these complexes. For new metal complexes to form, which would be helpful for scientist and researchers in the field of medicine, biological fields, industries etc., the complexes must fulfil some requirements like water solubility, thermodynamic stability etc. In this context, stability constants are determined in given work and comparison is drawn between stability constant of alizarin with different metal cations. Traditionally, in order to study the complexation of ligand with metallic cations, potentiometry, paper electrophoresis, UV-Vis. And mass spectroscopy can be used. In this study, paper electrophoresis was chosen because of its simplicity, low cost, and availability in most laboratories. The factors affecting the mobility of ions like variation in temperature during the experiment, capillary flow on paper, electro osmosis and adsorption are the usual drawbacks of paper electrophoretic technique.

II. EXPERIMENTAL

Instruments:

An electrophoretic apparatus (systronics type 604, India) was used together with the various accessories supplied with the

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instrument. The apparatus consisted of polyvinyl chloride of the cassette type and chromatogram could be run simultaneously on eight paper strips. The power unit capable of yielding a maximum of 300V. In each case electrophoresis was carried out for 1 hour at 220V and at 35^0C. Whatman no.1 paper strips were used with an applied voltage gradient of 9V Cm^{-1}. pH measurements were made with Elico digital pH meter having glass electrode assembly working on 220 volts/ 50 cycles stabilized AC main was used.

Chemicals:

Zn(II), Cu(II), Ni(II) and Cr(III) perchlorates were prepared by precipitating the corresponding carbonates from solutions of nitrate (Anala R grade) with the solution of sodium carbonate, washing the precipitates thoroughly with boiling water and dissolving in a suitable amount of perchloric acid. The resulting solutions were heated to boiling on a water bath and then filtered. The solutions were standardized and diluted with distilled water. As required Anala R/ BDH grade alizarin, NaOH, $HClO_4$, NTA and specific colour developing reagentswere used fordifferent metal ions of binary and ternary system sets for specific colour development. 1-(2-pyridylazo)-2 naphthol(PAN), 0.1% (w/v) in ethanol was used for detecting all the metal ions. A saturated aqueous solution (0.9ml) of silver nitrate was diluted with acetone to 20ml. Glucose was detected by spraying with this solution and then with 2% ethanolic sodium hydroxide, forming a black spot.

Background electrolyte

Stock solution of 5.0 M perchloric acid was prepared by its 70% solution (Anala R grade) 2.0m sodium hydroxide (Anala R grade), 0.5M alizarin (AnalaR grade) were prepared. Each solution was standardized as usual. The background electrolyte used in the study was 0.1M perchloric acid and 0.01M alizarin.

Procedure

The midpoint of each paper was marked and moistened with the background electrolyte. Excess electrolyte was allowed to drain off and papers were mounted on the plate of electrophoretic chamber. A spot of the metal solution was then applied at the marked point with the help of a fine glass capillary. For recording observations of particular metal ion two strips were spotted with the metal ion solution along with additional two spotted with glucose. The electrode compartment was filled with the equal volumes of the desired background electrolyte solutions. The lid of the chamber was then placed. It was left for 10 minutes to ensure wetting of strips. Subsequently a direct 220volts potential was applied between the electrodes. Electrophoresis was carried out for 60 minutes after which these strips were removed from the tanks with a glass rod and dried. The metal ion and glucose spots were detected by specific reagents. The leading and tailing edge were measured from the marked center point and the mean were taken. The distance moved by glucose was subtracted (in case the migration towards anode) toobtain correct path length. Migration towards anode and cathode were designated by negative and positive signs respectively. The actual distance of the sample spot was measured after taking into account the distance travelled by the reference glucose spot. The distance recorded in the duplicated differed within ±5% and the average of two distances was noted. The mobility data were calculated and expressed in $10^3 cm^2 v^{-1} min^{-1}$. The mode of dissociation of pure alizarin is given in figure 2.

III. RESULTS AND DISCUSSION

Several workers [15] - [16] have been employed graphical methods for determination of stability constants of metal complexes using ionic mobility data. Theionophoretic mobility of the metal spot against pH gives a curve with a number of plateaus as is shown in Figure 1. A constant speed over a range of pH is possible only when a particular complex species is overwhelmingly formed. Two plateaus with all the four metal ions are observed. The first plateau in each case corresponds to a region of pH where metal ions are un-complexed. In this low pH protonated form of alizarin is maximum. Further increase in pH from this region onwards which naturally leads to increase in ligating alizarin anion concentration and brings about a progressive decrease in overall ionic mobility of the metal ion species. This decrease indicates formation of complex of the metal ion with the ligand. This is the second plateau which corresponds to a pH region in which 1:1 binary complex of cationic nature is formed.A further increase of pH has no effect on the mobility of metal ions, which indicates no further interaction between the metalions and ligands. It is significant that these studies give clear evidence of the complexation of the anionic species of alizarin with metal ions forming binary complexes of 1:1 in composition

In view of the above observation the complexation of metal ions with these ligands may be represented as

$$M + L \overset{K1}{\leftrightharpoons} ML$$

The metal ion moving under the influence of electrical field, the overall mobility is given by the equation.

$$u = \sum u_n f_n$$

Where, u_n and f_n are mobility and mole fraction, respectively of a particular complex species. This equation is transformed into the following form. On taking into consideration of different equilibria.

$$u = \frac{u_0 + u_1 K_1 [L] + u_2 K_1 K_2 [L]^2 + \ldots\ldots\ldots}{1 + K_1 [L] + K_1 K_2 [L]^2 + \ldots\ldots\ldots\ldots}$$

Where K's(K_1K_2) are the stability constants of complexes and [L] is concentration of alizarin. U's (U_0, U_1, U_2) are the ionic mobilities of different species of the metal ions, which can be accessed from the plateaus of the Fig1. In the region between first and second plateau, the system contains, mixture of free

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metal ion and 1:1 complex. The existence of 1:2 complex can be excluded and hence the third term in the numerator and the denominator of the above equation can be neglected. U would be equal to $(u_0+u_{1/2})$ provided $K_1[L]=1$.

The pH corresponding to the average value of U_0 and U_1 is found from the fig.1 and with the knowledge of the dissociation constant of alizarin (pKa 6.94), the concentration of alizarin ion at this pH is calculated. Its reciprocal gives the stability constant K_1 of the 1:1 complex

The concentration of chelating alizarin anion [L] is determined a

$$[L] = \frac{[L]_{tot}}{1+[H]/K_1 + [H]^2 K_1 K_2}$$

Where $[L]_{tot}$ is the total concentration of the ligand alizarin (0.01M) and K_1 and K_2 are first and second dissociation constants of the alizarin respectively.

The stability constants of metal complexes can be very easily calculated by this technique. The present paper technique is limited to charged species, and the precision of the method is not as accurate as other physicochemical methods. However, uncertainty in the results is (±5%). It is not felt that itcan replace the other methods, yet it is an alternate approach used.

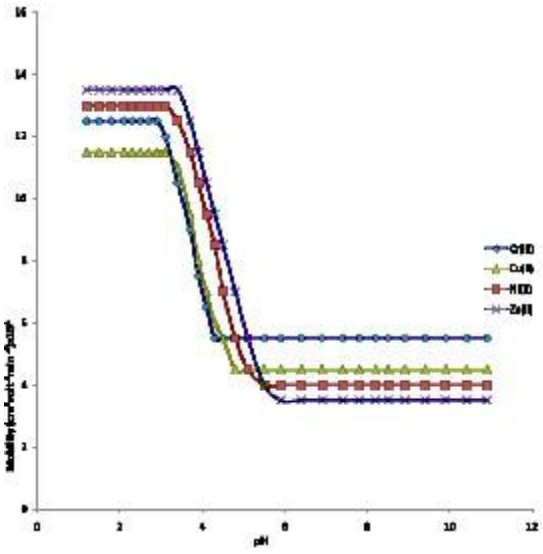


Fig. 1Mobility curves for metal(II)/metal(III)– alizarin systems -◆----. = Cr(III) -alizarn; -▲----=Cu(II)-alizarin;----■---= Ni(II) –alizarin;--x--=Zn(II)-alizarin. The paper strips were spotted with 0.1 µl of sample solution and glucose (for making osmotic correction)

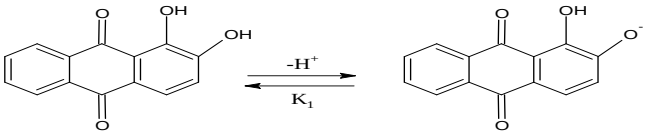


Figure 2. Mode of dissociation of pure alizarin. Ionic strength: 0.01 M. Temperature: 35 °C.

TABLE. 1

STABILITY CONSTANT OF M - ALIZARIN COMPLEXES
Temp. 35^0C Ionic Strength – 0.1M ($HClO_4$

S.No.	Metal ions	Calculated Values log K_1	Literature values log K_1
1	Cr(III)	5.1405	-
2	Cu(II)	4.8407	5.1[17]
3	Ni(II)	4.4415	4.1[17]
4	Zn(II)	4.1433	-

From the table (1) it can be surely deduced that the order of stability constant of various metal ions are as follows:

Cr^{+++}> Cu^{++}> Ni^{++}> Zn^{++}

This is in agreement with general order of the stability of the complexes of these metal ions which is established before by which is in accordance with the Irving Williams[17] and Grinberg and Yatsimiki [18] order for stability constant of the transition metal complexes.

IV. CONCLUSION

Metal complex dye is an important term in textile industry, thus in order to form new metal-dye complex it will be very helpful to have information about their important chemical properties. One of these properties is the stability constant of the metal ligand complex. Thus given conclusion represents new and reassessed stability data that are applicable to a wide range of chemical and biological applications including metal ion detection, quantification and affinity studies of alizarin with Zn(II), Cu(II), Ni(II) and Cr(III) metal ions in a wide pH range. The accuracy of the predicted values of stability constant is equivalent to the experimental uncertainties.

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Comparative Studies on Effect of Activated Carbon from Different Sources as Filler in NBR for Automobile Application

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Abstract: **This study reports usability of activated carbon obtained from areca nut shell, coconut shell, and coconut leaves as filler to prepare NBR based composite for automobile based application. The carbon is activated by H3PO4 as dehydrating agent in the ratio of 1:1 for 300g batch size. It is found that in comparison with commercially available carbon filler, the prepared carbon responded better to the petrol swelling test. Amongst the three sources namely, areca nut shell, coconut shell, and coconut leaves, the carbon obtained from coconut shell source appeared better as far as percent swelling and percent deviation in degree of hardness is concerned. The composite prepared are of 20PHR basis. The results obtained are tried to correlate with reference to proximate analysis.**

Keywords: **Automobile application, Activated carbon, NBR, Composites, Shore -A**

I. INTRODUCTION

Activated carbon is an extremely versatile material with high porosity and surface area. It has become one of the technically important materials for selective separations. The structure of activated carbon is mainly micro porous. Nevertheless, its application fields are restricted due to high cost.

This difficulty has led to search for the use of cheap and efficient alternative materials such as rice husk [1], bamboo [2], sugarcane stalks [3], tamarind kernel powder [4], palm shell [5] babool wood [6], bagasse fly ash [7], ashoka leaf powder [8], coir pith [9] and banana pith [10] etc. Biomass wastes are considered to be a very important feedstock because they are renewable sources. Activate carbon such produced can be used as effective adsorbent because of high adsorptive capacity. However, continues production of activated carbon with reproducibility of characteristics is restricted by the seasonal availability of the starting materials.

This led us to use coconut shell, areca nut shell and coconut leaves, which are available throughout the year irrespective of season as starting materials for carbon preparation. Being in daily use in Indian continent as food ingredients and in some parts on auspicious occasions, the coconut shell is generated enormously. Areca nut is also chewed in Asian continent as mouth freshener and in India on auspicious occasions along with coconut.

Rubber industry is a huge consumer of carbon as reinforcing material. The filler, to impart certain properties to the rubber material such as colour, hardness and strength up to certain extent. However, so far there is no report for the use of activated carbon as filler material in rubber. For activation, the surface of carbon modifies to develop newer reactive cites. There are different agents used for activation of carbon. Each agent imparts different morphology to the resultant carbon. The ratio of lignin to cellulose and the nature of starting material play certain role in the attribution of activity to the resultant carbon. For the treatment with alkali, the surface modification is limited. The acid treatment enhances porosity, and in turn increases the yield of activated carbon. Ours is the activated carbon prepared by acid treatment to the agricultural waste lignocelluloses materials.

Polymer based composite materials have been used widely in home appliances, construction, automotive industry, packaging application, aircraft engine blades due to their excellent specific mechanical and tribological properties for hundreds of years by Guadagno et al. [11].

In this work we are reporting, probably for the first time, the use of activated carbon as filler in rubber industry. The idea behind incorporation of activated carbon is chemical reaction between nitrile rubber and the surface modified carbon imparted with ether, ester linkages on the surface.

In present work various properties of carbon composite prepared from coconut shell, coconut leaves and areca nut shell were compared with commercial carbon composite to check the feasibility for commercial purpose and its application in automobile industry.

II. MATERIALS AND METHODS

2.1 Selection of materials: By finding out the acid soluble and alkali soluble content of the different agricultural wastes, the coconut and the areca nut material were selected pertaining to the availability and the acid hydrolysable content.

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Biomass waste such as coconut shell, areca nut shell and coconut leaves is used as the raw material for preparation of activated carbon. The biomass is first chopped into pieces of 2 cm wide and 5 cm long. Then washed with distilled water to remove dust particles, and then dried at 110^0c. Biomass waste was finally crushed and sieved to 180 mesh size.

Methods -Experimental

2.2 Preparation of Activated Carbon: First preparation of activated carbon was done in three batch sizes of 50 gm, 100 gm, and 300 gm.

H_3PO_4 chemically pure quality [Merck and Co.] was used as activating agent. A known mass of activated agent was mixed with distilled water, and Biomass waste was impregnated in acidic solution. The mass ratio of activating agent to dried material was 1-3.

The impregnated sample was kept for 24hr. After 24hr the residual water was removed and kept in oven for 110^0C A Weighed amount of impregnated samples was kept in muffle furnace for 400^0C. The muffle furnace is purged with high purity nitrogen gas to avoid oxidation .Nitrogen flow was adjusted to 3ml/^{0}c at 400^0C. The activated carbon was subsequently removed from furnace and cooled to room temperature.

After activation the samples, 3M hydrochloric acid used to remove the phosphoric acid compounds. The washed samples were dried at 110^0C for 6hr in oven and then ground to form a porous carbon powder. The equipment was fabricated to hold the raw sample of 30 * 9 * 9 cm size as shown in figure:-1. The Experimental set up of preparation of activated carbon from coconut shell, areca nut shell, and coconut leaves consists of muffle furnace associated with nitrogen gas cylinder is shown in figure no:2

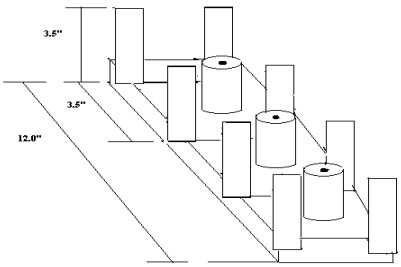


Figure no:-1 Fabricated Equipment to hold the sample

2.3 Analysis of starting material: In order to find out the cellulose content as acid hydrolysable and lignin content as alkali soluble, 73% H_2SO_4 solution and 17% NaOH solutions were used. The pre-weighed sample was first digested in acid at room temperature for 4hrs with constant stirring. Oven dried to constant weight to know the weight difference. The weight difference corresponds to the cellulose and hemicelluloses content. The same sample was digested in NaOH solution at 80^0C for 2 hrs with constant stirring. The sample was oven dried till constant weight and weighed to find the lignin as alkali soluble content.

2.4 Analysis of activated carbon: The Ultimate Analysis of a sample determines the elemental composition of the sample. It is based on the principle of Dumas method which involves the complete and instantaneous oxidation of the sample by flash combustion. The results are in percentage composition of Carbon, Hydrogen, Nitrogen and Sulphur. From these results the oxygen composition is determined by subtracting the sum of Carbon, Hydrogen, Nitrogen, and Sulphur compositions from 100.

2.5 Preparation of Carbon Composite: The compounding of composites is done as reported in Table 1. Rubber chemical such as ZnO, Sulphur and stearic acid were supplied by Sunrise Elastomers, MIDC, Mhallunge, Pune. The blending was carried out using two roll-mill at room temperature. The slabs of 10×10×0.5 cm were developed using compression moulding machine at 140^0C under pressure of 1Mpa for 12 minutes with reference to the rheology results of the material.

The mechanical and tensile properties were calculated using tensile testing machine and hardness tester supplied by 'Microvision Enterprises' Haryana. The composite prepared in the form of slab 10×10×0.2 cm was cut in dumb-bell shape as per ASTM Standard no -D -412-98 for tensile testing. The same sample was used for hardness testing.

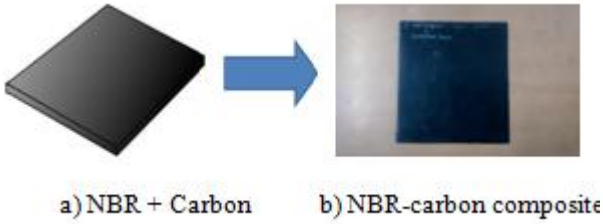


Fig no: 2 NBR Composite

Table 1 Composition of Material for different biomass wastes

Arecanut Shell		**Coconut leaves**		**Coconut Shell**	
Material	PHR*	Material	PHR	Material	PHR
NBR	100	NBR	100	NBR	100
ZnO	5	ZnO	5	ZnO	5
Stearic Acid	1	Stearic Acid	1	Stearic Acid	1
Sulphur	1.5	Sulphur	1.5	Sulphur	1.5
MBT	1.5	MBT	1.5	MBT	1.5
Carbon	20	Carbon	20	Carbon	20

PHR* -Parts per hundred of rubber

2.6 Petrol Swelling Behaviour of rubber composite: In order to study the response of formed rubber composite using various filler materials, to the petrol for its application in

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automobile, the composite prepared was tested as per ASTM standard D-471-98 (€).

2.7 Tensile Testing of rubber composite In order to study the tensile property of formed rubber composite using various filler materials, for its application in automobile, the composite prepared was tested as per ASTM standard D-412-98 a reapproved 2002 (€).

III. RESULTS AND DISCUSSION

3.1 Lignocellulose content of the starting material

From the Table no. – 2, it is observed that the acid hydrolysable is more in areca nut shell as compared to the other two materials. Three of the materials present three different classes of lignocellulosics. Coconut shell is the only woody material i.e. more complex and cross linked form of lignocelluloses. Areca nut shell is the material which has combination of fibrous and hard material. Whereas coconut leaves has on major watery content, comparatively simple form of polymer lignocelluloses.

The lignin and cellulose content varies from species to species of the plants. Also, in general the cellulose content is observed to be greater than that in non-dried conditions. It is due to the water portion; that contributes neither to the lignin nor to the cellulose vaporises and too the cellulose and lignin content are expressed on dry weight basis [12].

Table –2: Lignin and cellulose content of the raw material

Sr. No.	Material	Cellulose % (as acid soluble)	Lignin % (as alkali soluble)	Weight of remainder
01	Coco nut shell	36%	16%	48%
02	Coco nut leaves	47%	40%	13%
03	Areca nut shell	58%	16%	26%

The same trend is observed in ultimate analysis results. The coconut shell has got all the value, for ultimate analysis in moderate range as compare areca nut shell and coconut leaves except the % fix carbon content. Which is the highest i.e 81% followed by areca nut shell 75.9% and coconut leaves 75.3%.

The % yield of carbonisation also follows the same trend as shown in above analysis

3.2 Elemental Analysis

The Ultimate Analysis was carried out in a CHNS Analyzer. The sample is fed into the analyzer along with excess supply of oxygen. The reaction of oxygen with other elements (namely carbon, hydrogen, nitrogen, and sulphur, present in the sample, produces carbon dioxide, water, nitrogen dioxide, and sulphur dioxide respectively. The combustion products are separated by a chromatographic column and are detected by the thermal conductivity detector (T.C.D.), which gives an output signal proportional to the concentration of the individual components of the mixture. This determines the equivalent compositions of elements in the sample.

Table 3 presents the values in the terms of Lignocellulosic wastes (wt %) dry basis.

Table no: 3 Ultimate Analysis Results

Parameters	Lignocellulosic wastes (wt%) dry basis		
	Areca nut Shell	Coconut leaves	Coconut Shell
Proximate Analysis			
Moisture	15.46	8.167	11.93
Ash	6.473	2.39	4.90
Fixed Carbon	75.9	75.38	81.44
Volatile Matter	6.47	14.06	4.985
Ultimate Analysis			
Carbon	54.86	23.56	57.62
Hydrogen	4.486	0.916	3.432
Nitrogen	0.475	0.889	0.191
Sulphur	0.251	0.115	0.119

3.3 Petrol Swelling Test

In order to assess the extent of swelling behaviour of composites, Petrol Swelling test ASTM Standard no - D-471-98 was carried. Following are the trends observed in the results. This test provided information on the interface strength, degree of dispersion of carbon and their alignment in the elastomeric matrix. Following results show the swelling index in terms of after ageing and before ageing. Petrol swelling test is also predicted in terms of deviation of density and hardness. From Fig. 3 – 6, it is clear that the coconut shell based activated carbon filled and areca nut shell based activated carbon filled rubber composites show less deviation for the petrol soaking. The coconut leaves based activated carbon filled rubber composite show maximum density deviation. This is because of the maximum portion of lignocelluloses in leaves is water soluble sugars.

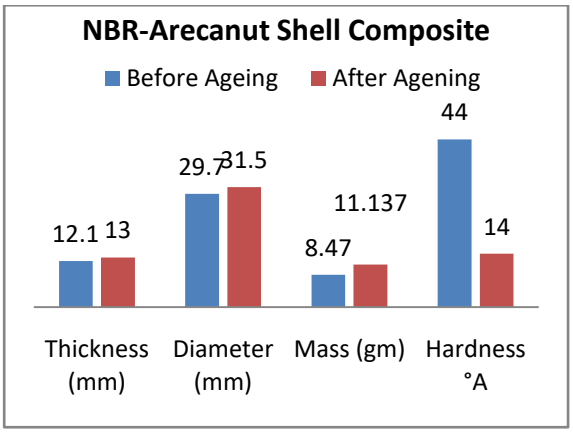


Fig :3 Arecanut- NBR composite

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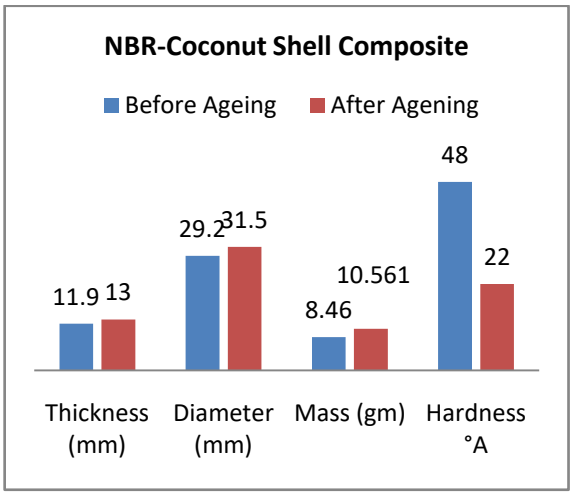


Fig : 4 Coconut shell- NBR composite

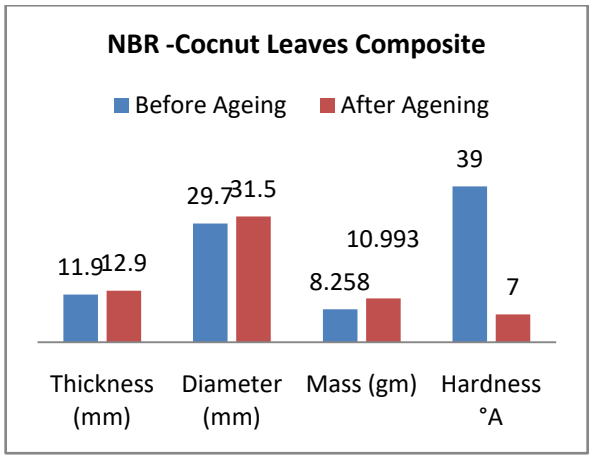


Fig:5 Cocnut leaves - NBR composite

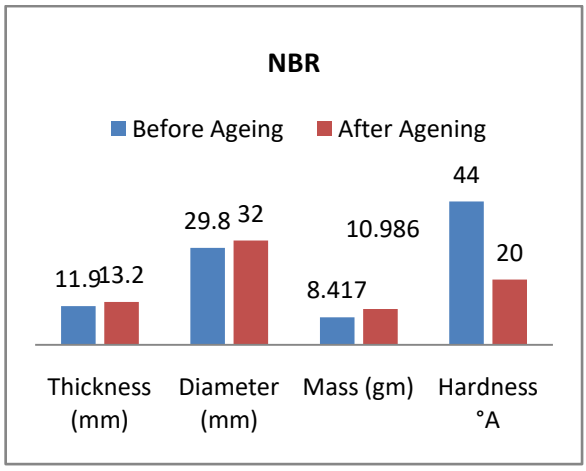


Fig : 6 NBR composite

Thus material was found compatible with commercial carbon based composite. The fuel pipe or hose pipe application was aimed and the composite with commercial matrix were prepared. It is observed from the Fig: 7 AS-NBR and CS-NBR are suitable for use of fuel tube and hose pipe in automobile industry.

Table 4 Result of petrol swelling test hardness, tensile test for NBR, Areca nut Shell, Coconut Shell

Sr. No	Sample	% Deviation in density	% Deviation in hardness	Remark
01	NBR	87.18	54.16	This is matrix material
02	AS-NBR	11	82	This can be used for fuel tube application
03	CS-NBR	28.3	54	This can be used for hose pipe application
04	CL-NBR	61.9	68	Needs to be studied further

3.4 Mechanical Properties of composite

In order to find out the processing condition the blends were tested rheological. Following are the results of the studies.

Table 5 Rheological behaviour of the samples

Sr. No.	Material	TS 1	TS 2	TS 3
01	Coco nut shell	1.21	1.39	1.93
02	Coco nut leaves	0.35	0.41	0.51
03	Areca nut shell	1.07	1.22	1.52

Activated carbon give rise to reinforcing effect and therefore the aggregate is smallest form of a given activated carbon grade well dispersed in an elastomeric that will still keep all the reinforcing capabilities of a filler. Activated carbon aggregates contain internal voids which are capable of absorbing polymer.

More specifically NBR rubber composite filled by activated carbon from Coconut shell and Areca nut shell showed better tensile strength as comparable with tensile strength of composite prepared from commercial carbon and NBR rubber.

For mechanical properties of rubber composites prepared from Coconut shell and areca nut shell activated carbon found improved at lower loading ratio of 20phr. Coconut leaves found very low values of mechanical properties as compared to the Coconut shell and Areca nut shell.

When it was tried to prepare rubber composite using 50phr formulation with commercial blend Elastorene 673 EL (70/30 NBR: PVC, W/W) the material scorched. This is well in

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relation with the results reported earlier by Geyuo et al [13] and Demrihan E. et al [14]. Mechanical properties decrease drastically after 30phr loading except that modulus can increase significantly against at 60 phr loading {Geyuo et al, 2008} but when the loading level is reached to limit value the activated carbon does not act as reinforcing filler {Demrihan E et al., 2007}.

Following are the photographs of the slab and button prepared for testing purpose.



Fig :7 Active Carbon -NBR buttons



Fig No: 8 NBR-PVC Activated Carbon button

Now it is under study to develop the carbon based commercial blend rubber composite for the fuel tube application.

IV. CONCLUSION

From the earlier studies and the results so far, we can conclude:

- Lignocellulose agricultural waste can be a starting material for the preparation of activated carbon.
- Elemental analysis and the BET study have shown surface modification of carbon.
- The coconut shell carbon and areca nut shell carbon were found to be competitive with commercial carbon in formation of rubber based composites for automobile applications.
- Looking at the tensile strength and hardness shown by the raw rubber based composite it is concluded that, acid activation of carbon improves reinforcement properties of the carbon
- There is certain scope to study the relation between chemistry of carbon activation and improved reinforcing ability of the carbon.

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A Study of Some Plants of Economic Importance and their Values in JIET Campus

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***Abstract*—The development of an area of Biosphere is dependent on its vegetation. The term biodiversity is commonly applied to study the variety and variation of biotic components of the ecosystem. The variety and variation in plant species also called as flora of ecosystem is termed as plant diversity.**

One can study the biodiversity in different patterns like Alpha, beta and gamma biodiversity. Human activities play an important role in the development as well as destruction of biodiversity. Environmental factors also play an important role in this aspect.

The present paper is based on our working project running since last 3 years on the survey of plants in JIET college campus, Jodhpur, Rajasthan through identification, characterization and studies of their importance. The plant species were identified and their importance were studied with their category of economic importance.

More than 150 plant species are found in the campus with medicinal, industrial, ethical, economical as well as environmental values. The present paper deals some plants of industrial values.

It should be the moral duty of all concern persons to protect this diversity for the environmental conservation.

***Keywords*— Plant diversity, ecological balance, economic significance, JIET campus, environmental factors.**

I. INTRODUCTION

Plants serve many functions in our life. The most common is as a reliable provision of food through agriculture. Ethnobotany is the study of plant uses by native peoples , Economic botany focuses on cultivated plants in modern era. Plants are used in medicine and provide a number of drugs. This practice is common from the earliest times to the present, and serve as the feedstock for many drugs. Industrial products like timber, a wide range of chemicals and paper are some examples. In addition to above economics plants give pleasure through gardening to us.

Not only in industrial and economic concern plants also play important role in art, mythology, religion, literature and film, issues related to fertility, growth, purity, and rebirth.

A number of valuable products have being extracted from plants as well as animals from ancient time. The knowledge about distribution and presence of valuable products are necessary things which one should know to exploit it. For this aspect the study of variety and variation are required. It also motivate to the person to protect them from adverse effects including natural as well as men made.

Biodiversity also termed as biological diversity, is the systematic studies of variety of plants and animals from a unicellular to well-developed multicellular organism. The common definition is given in terms of the variability within species, between species, and between ecosystems called as genetic, species and ecosystem diversity respectively .

Generally, wasteland plants are called as weeds and a layman considered them as unwanted and undesirable . On the other hand 'Ayurveda' has said, "No plant of this world is useless". So the kknowledge about the useful properties of these plants should be known by each of us. Generally the folk people are well acquainted with the ethical as well as the medicinal properties of their surrounding vegetation particularly for their wellbeing.[1-5]

In our state about 80 percent of people live in the rural areas and cannot afford to the costly modern medicine so they depend on the vegetation surrounding them and make perfect uses of them for their medicinal needs. The present investigations were undertaken for collection of important medicinal plants from different regions of Rajasthan.

Jodhpur is the second largest city in the Indian state Rajasthan and the second metro city of the state. Formerly the capital of the kingdom was known as Marwar. It is famous as a tourist destination, for palaces, forts and temples, the city is named as the "Sun City" for the bright and sunny weather it enjoys all the year round and "Blue City" because of blue coloured houses in old city.

The city is located on the strategic road linking Delhi to Gujarat. Important trades are in opium, copper, silk, sandalwood, date palm and other tradable goods.

Climatic conditions and area of the Jodhpur are some of the important parameters to affect the biodiversity. Each species plays important role in maintaining a productive ecosystem, even for a long time horizon.[7-8]

The above mentioned significance of flora and their threats are kept in mind to implement the project on biodiversity. The present paper describes some of the plants found naturally or grown manually in JIET Campus, Mogra, Jodhpur, Rajasthan with special attention towards their economical values. Mogra Khurd has geographical location in Jodhpur, Rajasthan, India, and Asia with geographical coordinates: 26° 8' 0" North, 73° 3' 0" East.

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II. MATERIAL AND METHODOLOGY

A. Survey of the Literature

A project plan was formed on the theme biodiversity of college campus and adjoining areas. The literature on arid and semi-arid zones were studied from available resources. Local communication was an important part of this study.

B. Survey of the Campus

After the literature survey the campus was divided in different zones, and various plant species were identified with the help of gardeners and subordinates and confirmed through the available resources.

C. Identification of the plants

The plants parts identified by experts and some samples were collected for references. The values were searched using different media as well as with the help of local community.[9-13]

D. Botanical description of the plants

The botanical details of the plants is given in the table.1.

S.NO.	COMMON NAME	BOTANICAL NAME	Family
1.	*Ber*	*Ziziphus mauritiana Linn*	*Rhamnaceae*
2.	*Indian Senna, Tinnervelly Senna,*	*Cassia angustifolia*	*Caeslpinaceae*
3.	*Amla*	*Emblic Myrobalan*	*Phyllanthaceae*
4.	*Ratanjot*	*Jatropha curcas*	*Euphorbiaceae*
5.	*Babool*	*Acacia nilotica sub-species indica*	Mimosaceae
6.	*mulvery*	*Broussonetia papyrifera*	***Moraceae***
7.	*Jamun/black cumin*	*Scyzium cumin*	***Myrteceae***
8.	chamomile/camomile	*Matricaria chamomilla*	composite
9.	*Rohida*	*Tecomella unduluta*	***Bignoniaceae***

E. Economical Values of the plants

The economic importance of selected plants are studied as follows: [11-21]

Ziziphus mauritiana commonly *called as ber* is a small deciduous tree or shrub of height of 5–12 metres with thorny branches. The leaves are green, ovate-acute and 2–7 centimetres long and 1–3 centimetres wide. The fruit is oval drupe 1.5–3 centimetres deep and edible with the taste of an apple and looking like a small date. [14-15]

It tolerates fairly cold winters, about −15 °C so capable to grow in mountain as well as in the desert habitats. Plants can be grown as a hedge. The wood is dense, hard, compact, and tough so widely used for turnery, agricultural implements and also used as an excellent fuel and a good charcoal.

The fruits are being used in Traditional Chinese Medicine for gastrointestinal health and digestion and as sedative, anxiolytic and pain-killer. [16]

Cassia angustifolia is known as *shimbi kul* in Ayurveda is a small erect shrub with pale green smooth and erect stem. It has branches that spread and possess about 4 to 5 pairs of spear shaped pointed apex leaves. Flowers are small, yellow colored developed in a pod of dimensions 1.4-2.8 X 0.8 inch. This pod contains 5 to 7 dark brown colored seeds.

Leaves of this plant contains flavenols like isorhamnetin and kaempfeol and anrathquinones like rhein and emodin with glucosides sennoside A and B. Menitol, sodium potassium tartarte, salisilic acid, crisophenic acid, volatile oils, resins and calcium oxalate are other compounds. In the flowers crisofenic acid is found.It decrease pita in the body and allows free movement of vata in the body. It also stimulates liver for proper secretion of the enzymes and increases the peristaltic movement of the intestines as well as also purifies blood. Tablets of calcium sennosides are common in constipation.[17]

Emblica myrobalan named as the "gooseberry" in English and Amla or amlakai or amlakai in Hindi. It has been reported the best source of vitamin C and antioxidants.

The economic importance of this plant reflects in edible as well as non edible products. Pickles, murabba, chutneys, hair oils, face packs are some of them.[18]

Jatropha curcas or Ratanjot is found wild in the study area. This plant is toxic and has been reported to contain non edible oil. The importance of this plant would be clarified in the field of bio diesels.[19]

Acacia nilotica sub-species indica is a Small tree with spreading branches forming flat or rounded crown; bark thin, rough, fissured, and deep red-brown; spines gray-pubescent, slightly recurved, up to 3 cm long; leaves often with 1–2 petiolar glands. Flowers are bright yellow in colour and pods especially variable, linear, indehiscent. Gum Arabic and gum acacia are some of the vernacular names of the gum obtained from this plant. *Babool* tooth pastes are very commonly applied tooth pastes for cleaning of teeth.[20-21]

Broussonetia papyrifera or *Morus* an edible sweet fruit obtained from tree is also reported in our campus, commonly known as **mulberries.** Mulberries are fast-growing when young, but soon become slow-growing and rarely exceed 10–15 metres tall. The mulberry fruit is a multiple fruit, approximately 2–3 cm long. Immature fruits are white, green, or pale yellow. The fruits turn pink and then red while ripening, then dark purple or black, and have a sweet flavour when fully ripe. Fruits are cultivated for consumption and making juices and other products.[22]

Scyzium cumin /Jamun is a well-known fruit of medicinal as well as industrial applications. The tree is large in size. The fruits are berries and sweetish sour to taste. The ripe fruits are used for health drinks,squashes, jellies and wine. All parts of the tree are used in industries as well as a medicine in home to treat a range of diseases.[23-24]

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Tecomella undulata, a tree species, locally known as rohida is found in Thar Desert regions of India as well as in Pakistan. It is a medium-sized tree and commonly called as Marwar teak because it produces quality timber and main source of timber amongst the indigenous tree species of desert regions of Shekhawati and Marwar in Rajasthan. The wood of this tree is strong, tough and durable and takes a fine finish. The wood is excellent for firewood and charcoal. Cattle and goats eat leaves of the tree. Camels, goats and sheep consume flowers and pods. This plant species plays an important role in ecology. It is considered as the home of birds and provides shelter for the cattle, goats and sheep during summer days.[25]

III. RESULTS AND DISCUSSIONS

The present paper reflects the ancient as well as recent applications of plants and their products in the economic manner. We found that the campus is rich in the plants of economic importance. A variety of valuable products sourced by them. It is necessary to know the importance so that the multiplication and conservation would be emphasized.

The seasonal plants also have the economic values as described and found in the current studies. Although the number of selected species is limited yet the diversity is present in the study area. It is very controversial to tell the botanical details to engineering students but for conservation of our mother earth, plantation is an essential step.

In a nutshell this type of studies might be helpful to those fields where the plants or their products are applicable in economic aspect. More plants should be identified and analyzed to reach the goal.

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Species 1 Ziziphus sp. Plant and fruits




Species 2 Senna and sennosides tablets



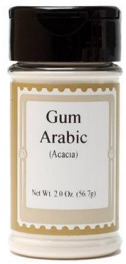

Species 3 Amla plant and pickle



Species 4 Ratanjot plant herbarium



A school bus run by Jatropha Biodiesel

Species 5 Acacia and gum acacia




Species 6. Mulberry and jam of fruit




Species 7. Jamun and seed oils




Species 8. Chamomilla plants and garland made by flowers




Species 9. Rohida Plant and handicraft from the wood

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Big Data Mining for Web Usage Mining (WUM)

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***Abstract*— Big Data is a term used to identify the datasets, whose size is beyond the ability of typical database software tools to store, manage and analyse. Web mining techniques primarily focuses on deciphering and scrutinizing the navigational behaviour of user form various aspects and ascertaining the hidden knowledge from these web logs. Log files incorporate traits of user behaviour, therefore it is essential to analyse log data and acquire knowledge from it. In this paper we explain different big data mining techniques.**

***Keywords* – Web Usage Mining (WUM), Hadoop, MapReduce, Cloud computing, HDFS, Big Data, Visual Web Mining (VWM), Web Bot.**

I. INTRODUCTION

Big data is used to identify the datasets that whose size is beyond the ability of typical database software tools to store, manage and analyse. Web mining is the application of data mining techniques to extract useful knowledge from web data that includes web documents, hyperlinks between documents, usage logs of web sites, etc. This technique enables an individual or a company to promote business, understanding marketing dynamics, new promotions floating on the Internet, etc. [1]. The goal of Web Usage Mining (WUM) is to understand the behaviour of web site users through the process of data mining of web access data. Knowledge obtained from web usage mining can be used to enhance web design, introduce personalization service and facilitate more effective browsing [2].

Web Data Mining is not only focused to gain business information but is also used by various organizational departments to make the right predictions and decisions for things like business development, work flow, production processes and more by going through the business models derived from the web data mining as lots is available on the World Wide Web. It can find characteristics and rules of the users' visiting behaviour to improve the service quality to users.

A user profile is often used to classify a given user into predefined user segments (e.g., by demographics or tastes) or to capture the online behaviour of the user including the user's private interests and preferences. In scientific way, we can call cloud computing is an alternative word for distributed computing over a wired or wireless network; it relies on the shared resource to accomplish coherence and scale of economies as similar to utilize the resource over a network, and means the ability to run program or any application on cluster of many computers simultaneously.

As we observed, the Internet has now changed from computing to cloud computing. MapReduce is a great programming model in cloud computing that was introduced at Google. MapReduce is a programming model and an associated implementation for processing and generating large data sets [4].

The Visual Web Mining (VWM) is as the application of Information Visualization techniques on results of Web Mining in order to further amplify the. Perception of extracted patterns, rules and regularities, or to visually explore new ones in web domain [5]. Big data is a heterogeneous collection of both structured and unstructured data [6]. In this paper we are introducing the Web data mining technique and its implementation for handling the big amount web data with VWM and Apache Hadoop MapReduce framework and also cloud computing to handle big data.

II. RELATED WORK

In [1] they analyse the web data of today's advanced world. Internet becomes an important part of many of all organizations, businesspersons and daily individuals. As a web logs are available in different formats,So it is important to mine meaningful data from that. In this paper we have studied two effective technique to mine big data one with Apache Hadoop MapReduce and second with visualization based technique called as Visual Web Mining (VWM).

In [2] it observed that the knowledge obtained from web usage mining can be used to enhance web design, introduce personalization service and facilitate more effective browsing.

They also provide review of pattern discovery algorithms which utilize association rules, sequencial patterns and classification.

In [3] they had a find new approach through comparing the two tests, the experimental result shows that the new approach can improve the execution efficiency and reduce the execution time. The new algorithm can work well and there is no association rule lost. It can be well used in business. Also noticed that they can aim to find a more accurate and faster approach for Web data mining that is based on cloud computing.

In [4] they observed first, the model is easy to use, even for programmers without experience with parallel and distributed systems, since it hides the details of parallelization, fault-tolerance, locality optimization, and load balancing and secondly a large variety of problems are easily expressible as MapReduce computations.

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In [5] they analysed portrays for the users browsing pattern and summarizes the outcome into a graphical report which depicts most visited web pages, browsing session and trending keywords. Hadoop MapReduce framework provides parallel distributed processing and reliable data storage for large volumes of log files. In order to manage such log files, Hadoop MapReduce plays a key role by proficient management of data and decreases the response time. The proposed system with the help of Hadoop MapReduce analyses the log files and segregates the fields of the log files using regular expression mechanism. Regex not only reduces the code length but also reduces the overhead of usage of string functions. The segregated and structured fields are stored in the database in accordance with Hadoop thereby enabling ease of data retrieval.

In [6] they had reviewed that the amounts of data is growing exponentially worldwide due to the explosion of social networking sites, search and retrieval engines, media sharing sites, stock trading sites, news sources and so on. They discuss issues and challenges related to big data mining and analyse that data with tools like Map Reduce over Hadoop.HDFS which helps organizations to better understand their customers and the marketplace and to take better decisions and also helps researchers and scientists to extract useful knowledge out of Big data.

In [7] Web analysis involves the transformation and interpretation of the Web log records to find out the hidden information or predictive pattern by the data mining and knowledge discovery technique. In this paper they tried to give a clear understanding of the data preparation process and pattern discovery process. Web usage patterns and data mining can be the basis for a great deal of future research. More research needs to be done in ECommerce, Bioinformatics, Computer Security, Web Intelligence, Intelligent Learning, Database Systems, Finance, Marketing, Healthcare and Telecommunications by using Web usage mining.

In [8] they analyze that Web usage mining is a task of data mining of web data that extract knowledge about web users and how these users interacting with the web site. Our motive of web usage mining is to provide web intelligence by discovering users' access patterns of web pages, such as frequently visited hyperlinks, frequently accessed web pages, popular access sequence of web pages, and users grouping etc. automatically and quickly from the huge sever access log records.

In this paper we reviwed few techniques for mining large volume of web data. Hadoop MapReduce architecture is one of these techniques to process distributedly on large datasets.The other technique Cloud computing works with the Internet,Hadware and software to store big data.At the same time one visual application of information is also there to find meaningful patterns from web log data and explore it to new domain.

III. TECHNIQUES FOR BIG DATA MINING

A. Cloud Computing

Cloud computing is for long-held dream of computing as a utility which has recently emerged as a commercial reality [3]. Cloud computing refers to both the application delivered as services over the Internet and the hardware and system software in the data centres that provide these services. Cloud computing is at the pick in the computer world these days, as the usage show it is too big of a buzz, cloud computing is stand for

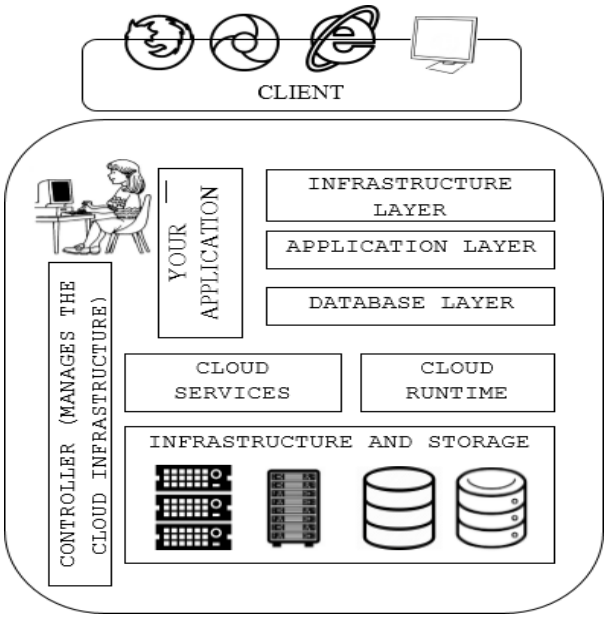


Fig. 1 Cloud Computing Architecture.

different things to different people, it is so much vast and versatile, not only for branch of IT [9]. Research firm IDC thinks that, by 2020, cloud spending will reach $203.4 billion worldwide [11]. Cloud computing started with a risk-free concept: Let someone else take the ownership of setting up of IT infrastructure and let end-users tap into it, paying only for what is been used. A service offering computation resources is frequently referred to as Infrastructure as a Service (IaaS) and the applications as Software as a Service (SaaS). An environment used for construction, deployment, and management of applications is called PaaS (Platform as a Service) [10].

B. Hadoop MapReduce

Hadoop is an open source distributed computing framework which is used for distributed processing of large data sets and designed to satisfy clusters scaled from a single server to thousands of servers. Hadoop is the most widely used cloud computing platform in recent years and has been adopted by major Internet companies and research institutions. A Hadoop cluster is composed of two parts: first is the Hadoop Distributed File System (HDFS) and second is the MapReduce. Hadoop is the optimal choice to realize our approach. Hadoop MapReduce is a software framework for easily writing applications which process vast amounts of data (multi-terabyte data-sets) in-

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parallel on large clusters (thousands of nodes) of commodity hardware in a reliable, fault-tolerant manner. A MapReduce job usually splits the input data-set into independent chunks which are processed by the map tasks in a completely parallel manner. The framework sorts the outputs of the maps, which are then input to the reduce tasks. Typically both the input and the output of the job are stored in a file-system. The framework takes care of scheduling tasks, monitoring them and re-executes the failed tasks.

The Hadoop and MapReduce communities have developed a powerful framework for performing predictive analytics against complex distributed information sources [5].

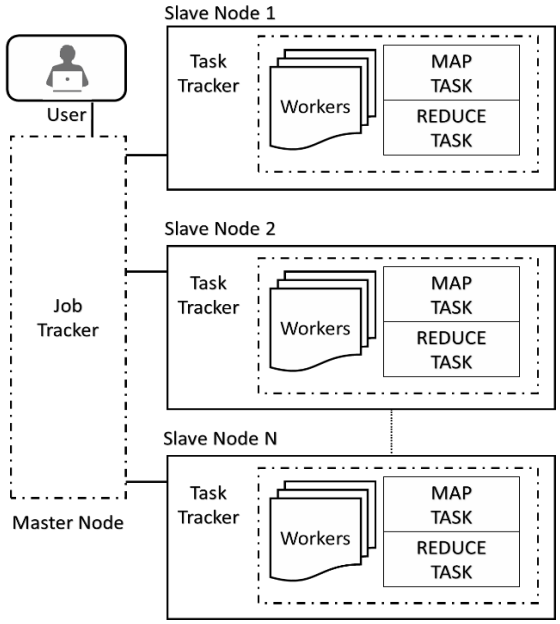


Fig. 2 Hadoop MapReduce Programming Model.

C. *Visual Web Mining Architecture*

The Architecture of implementing the Visual Web Mining (VWM) is shown below in Figure 3. Visual Web Mining (VWM) as application of Information Visualization techniques on results of Web Mining in order to further amplify the perception of extracted patterns and visually explore new ones in web domain[12].

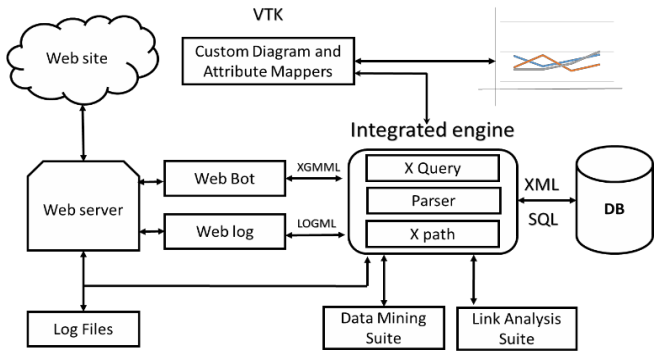


Fig. 3 Visual Web Mining Architecture.

Analysis of web site usage data involves two significant challenges: firstly the volume of data, arising from the growth of the web, and secondly, the structural complexity of web sites. We target one or a group of websites for analysis. Input of the system consists of web pages and web server log files. Access to web log is done by the local file system, or by downloading it from a remote web server. A web robot (Web Bot [12]) is used to retrieve the pages of the website. In parallel, Web Server Log files are downloaded and processed through a sessionizer and a Log Markup Language (LOGML) file is generated.

IV. CONCLUSIONS

Now in digital world amount of web data is increasing much faster day by day, so it is necessary to justify that which data are useful and which are not. To overcome this situation we have done analysis of different solutions. Big data analysis tools like MapReduce over Hadoop and HDFS which helps organizations to better understand their customers and the marketplace and to take better.

The main objective of cloud computing is to make better use of distributed resources and to solve large scale computation problems. We noticed that this technique is also faster and accurate for web data mining. The drawbacks of existing system is can be solved by Hadoop and MapReduce framework. Cloud computing uses the same framework that plays a key role by proficient management of data and decreases the response time.

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A Review of Quantifying Contradiction Intensity Techniques in Sentiment Analysis

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***Abstract*—With Social Media becoming the acceptable platform to express emotions and opinions, Sentiment Analysis is trending field for research in area of information retrieval. Among various research issues of sentiment analysis, Contradiction intensity measure is being looked upon with great enthusiasm. This paper puts light on various techniques to measure the contradiction intensity in the field of Sentiment analysis, the problems related to it and various approaches used by researchers.**

***Keywords*— Information Retrieval, Sentiment Analysis, Contradiction Intensity, Corpus, Polarity**

I. INTRODUCTION

A. INTRODUCTION TO INFORMATION RETRIEVAL

"Information retrieval (IR) is finding documents of an unstructured nature (text, multimedia, social media content) that satisfies an information need from large collections stored on computers."[1]. This is preferred area for research by many researchers these days. It mainly deals with resources, corpus and data of unstructured nature like text, image and video. We can illustrate the concept of Information Retrieval by diagram below.



Figure1. Concept of Information Retrieval [2]

The use of Information Retrieval Systems like Web Search engine, for reliability of information and procurement of information, is exponentially increasing.

B.INRODUCTION TO SENTIMENT ANALYSIS

Sentiment Analysis is trending research topic and has huge scope for further research. Sentiment analysis is the practice of applying natural language processing and text analysis techniques to identify and extract subjective information

From text. [3] Main application of sentiment analysis lies in the field of giving structure or rating based approach readable for a laymen. It is ubiquitous, spreading across multiple fields like Social Media analysis, Product Review, decision making of any entity i.e. People, Product or Place.

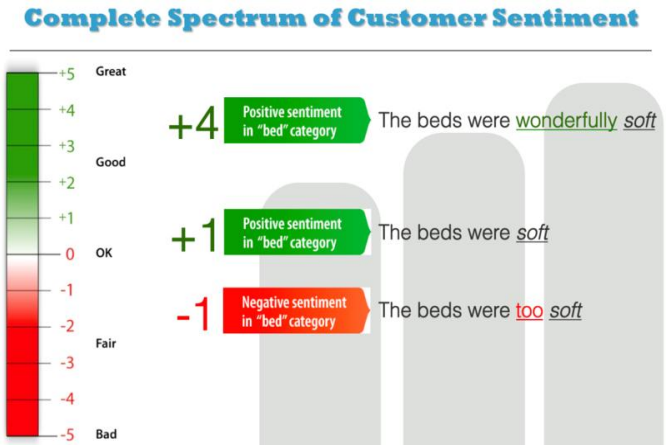


Figure 2. Sentiment Analysis concept, Review of a customer for hotel in "bed" category [4]

Sentiment Analysis comes with its problems and challenges [5]. A few notable ones to list are:-

- Polarity classification
- Sentence analysis
- Semantic analysis
- Detection Of Contradiction
- Measure of Contradiction
- Paid Review detection
- Spam detection
- Enhanced Recommender system
- Feature Extraction
- Troll Detection
- Domain Dependence

C. *INTRODUCTION TO CONTRADICTION INTENSITY*

Among the numerous challenges of Sentiment Analysis, this paper would contain discussion of various approaches and techniques available for quantifying the Contradiction Intensity among reviews and corpus. The figure below, describes the contradiction at its best.

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Figure 3. The description of a Contradiction

Contradiction is defined as two opposite ideas presented in same set of text, whose manifestation is inconsistent. For Eg. The movie review "The movie was good, but it was lengthy". So based on review above, what should be users decision, to go for a movie or not. So in order to do the decision making, a need arises to quantify the impact of the contradiction. Thus a system which organizes unstructured contradictory data into some rating, measure is called contradiction intensity.

II. LITERATURE SURVEY

This section of paper deals with literature survey of various works related to quantifying Contradiction.

[Ismail Badache el al.][6] Detects the contradiction from given data set. Secondly it measures the intensity of contradiction in given data set. Proposed method uses joint dispersion of polarity and rating of reviews containing aspects. Grouping of Reviews as per session and then applying k-means clustering algorithm are main methodologies here. Datasets of MOOC (Massive Open Online Course) Coursera and IMDB are taken into consideration. Results reveal the effectiveness of the proposed approach to detect and quantify contradiction intensity

[Kiran Garimella et al.][7] has a general approach to study topics in any domain. Their approach to quantifying controversy is based on a graph-based three-stage pipeline, which involves (i) building a conversation graph about a topic;(ii) partitioning the conversation graph to identify

Potential sides of the controversy; and (iii) measuring the amount of controversy from characteristics of the graph.

The paper shows an extensive comparison of controversy measures, different graph-building approaches, and data sources. It uses both controversial and non-controversial topics on Twitter, as well as other external datasets.

The paper infers that the new random-walk-based measure outperforms existing ones in capturing the Intuitive notion of controversy, and show that content features are vastly less helpful in this task

[Benjamin Timmermans Et al.][8] define a CAPOTE MODEL which cover all the significant aspects of dataset and also efficient for multifaceted controversies.

[Andrew S. Gallan Et Al] proposes a likelihood recommender model via linear regression analysis. It is related to hospital industry. It takes into consideration the positive ratings yet negative comments about different aspects of hospital like physician,nurse,service.

[M. Al-Ayyoub Et Al] proposes a network based model firstly to remove noise from the tweets collected for a topic and then partitioning the Retweet graph. After that apply various controversy measures. It is domain agnostic approach but language dependent approach as it works majorly on Arabic language.

Thus literature survey shows various methods, techniques and approaches to quantify the contradiction intensity using various corpuses like twitter dataset or live data.

III. COMPARITIVE STUDY OF LITERATURE

Table I Comparative Study of Literature

Sr. No.	Title	Author	Proposed Method	Dataset	Advantages	Research Gap /Limitation
1.	Harnessing Rating And Estimating Contradiction Intensity In Temporal Data	Ismail Badache Et Al. 2017	Joint Dispersion Of Polarity And Rating Of Reviews	-MOOC reviews -IMDB Reviews	-Improved Accuracy	-Dependency On Sentiment Analysis Model -Time Consuming Supervised Approach
2.	Quantifying Controversy On Social Media	Kiran Garimella Et Al 2016	Graph Based Three Stage Pipeline	-Twitter	-Domain Agnostic Approach -Incorporate Content Features -Use Of Seed Hash Tag For Search Improvisation	-Works For Twitter Dataset -Manual Choice Of Search And Data May Be Biased -Overfitting Reliance On Graph Partitioning -Mutisided

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						Controversies Yet To Be Covered
3.	Computational Controversy	Benjamin Timmermans Et Al. 2017	-CAPOTE MODEL -Linear Regression	-Various Literature And Dataset	-Taken All Important Aspects Into Consideration -Can Identify Multifaceted Controversies	-Involves Learning Of Ontology And Topic Modelling -Imbalanced Datasets
4.	Perfect Ratings With Negative Comments: Learning From Contradictory Patient Survey Responses	Andrew S. Gallan Et Al. 2017	-Linear Regression Analysis -Likelihood To Recommend Model -Noise Reduction -Topic Modelling	-Data From 11 Hospitals	-Identification Of Problems Like Lack Of Communication In Hospital System.	-Domain Specific
5.	Measuring The Controversy Level Of Arabic Trending Topics On Twitter	M. Al-Ayyoub Et Al. 2016	-Network Structure Based -Retweet Graph	-Twitter	-Better visualization of result	-Does Not Support Cross Language Domain -Tweet Content Management For Decision Making

IV. CONCLUSIONS

After the comparative study of various literatures, it is concluded that each approach has its own pros and cons. A novel approach, independent of sentiment analysis model, can be thought of. Also, supervised machine learning approach takes long time. It can be replaced by unsupervised approach like clustering. Content based approach limits visualization of end results. So a new hybrid approach, where content and structure are combined, can be devised. Thus choice of corpus, technique, method, approach entirely depends on researcher and this issue of quantifying contradiction intensity for sentiment analysis is open and has scope for new research insights.

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A Survey on Classification Algorithm for Real Time Data Streams using Ensembled Approach

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***Abstract*: -Classification and analysis of data streams are the most promising fields of research and development in Data stream mining. Ensemble based classification approach is one the most challenging flavor of developing an efficient classifier due to large number available base classifiers and increase in the computational time required for training and classification. This research emphasizes on developing an efficient ensemble based classification algorithm for data stream.**

I. INTRODUCTION

An ensemble classifier is a group of classifiers whose individual decisions are merged in some manner to provide, as an output, a consensus decision[1]. The main idea of ensemble methodology is to combine a set of classifiers in order to obtain more accurate estimations than can be achieved by using a single classifier [2]. Broadly speaking, the ensemble methodology attempts to learn from the errors of the base classifiers with the aim of achieving a more accurate final classifier[3].Ensemble techniques increase classification accuracy with the trade-off of increasing computation time[4]. Training a large number of learners can be time-consuming, specially when the dimensionality of the training data is high. Ensemble approaches are best suited to domains where computational complexity is relatively unimportant or where the highest possible classification accuracy is desired. A number of different approaches to building ensemble learners have been proposed. There are numerous ways to build ensemble systems and there are several decisions to be made which affect the performance of the final model [5]:

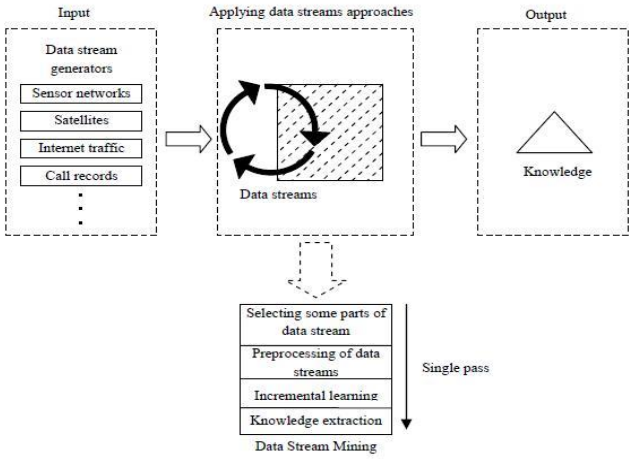
- How are subsets of the training data chosen for each individual learner? Training subsets can be chosen by random selection, by examining which training patterns are difficult to classify and focusing on those, or by other means.
- How are classifications made by the different individual learners combined to form the final prediction? They can be combined by averaging, majority vote, weighted majority vote, etc.
- What types of learners are used to form the ensemble? Do all the learners use the same basic learning mechanism or are there differences? If the learners use the same learning algorithm, then do they use the same initialization parameters?
- What should be the size of ensemble i.e How many component classifier should be used to design the ensemble model.

The only drawback of ensemble methods is that they increase the computational time required for training and classification.[4]

From literature survey it has been concluded that When constructing an ensemble, the ensemble size affects the accuracy of the ensemble. If there are a smaller number of individual classifiers, then the ensemble will not perform properly, whereas if there is a large number of individual classifier, the ensemble accuracy improves but will lead to increase of storage space and computational time.

The volumes of automatically generated data are constantly increasing. According to the Digital Universe Study, over 2.8ZB of data were created and processed in 2012, with a projected increase of 15 times by 2020[6]. This growth in the production of digital data results from our surrounding environment which is being equipped with more and more sensors. This data can be the source of valuable information which can be used in trend analysis for taking strategic decisions and variety of other business and industrial applications. Examples of data streams include computer network traffic, phone conversations, ATM transactions, web searches, and sensor data. A significant part of such data is volatile, which means it needs to be analyzed in real time as it arrives otherwise it is lost forever. Data stream mining is a research field that studies methods and algorithms for extracting knowledge from volatile streaming data.

The general process of data stream mining is depicted in Fig. 1[7].



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There are several applications of data stream classification. For example:

1. Critical astronomical applications.
2. Real time decision support systems in business and industrial applications.
3. Classification and analysis of biosensor measurements around a city for security reasons.
4. Analysis of simulation results for scientific applications.
5. Classification of web log for e-commerce.
6. Classification of data stream for stock markets.

As distinguished from general individual classification methods, including naïve Bayes [23], decision tree [24], and svm [25], the most important idea behind the ensemble methods [26] is the use of a set of base classifiers and combining their predictive capabilities into a single classification task. Through the combination of multiple base classifiers, a more accurate and stronger prediction can be obtained. In recent decades, many researchers have investigated ensemble technology, resulting in a number of outstanding algorithms proposed in the literature, such as bagging [27], adaboost [28], mixture-of-experts [29], and random forest [30]. Nevertheless, there are two primary shortcomings in generic ensemble methods: efficiency and redundant classifiers. According to the survey results reported by Tsoumakas et al. [31], a large-scale ensemble learning task can easily create thousands of base classifiers, or even more.

- Having such a large number of classifiers in an ensemble requires large memory and computational overhead.
- This in turn leads to an increase in the training cost, storage demands, and prediction time.
- In addition, an ensemble with a large number of classifiers does not always generate better prediction results. This is because an ensemble tends to contain redundant classifiers in addition to high-quality ones.

All these factors negatively affect the overall ensemble predictive performance. The research focuses on the issue of improving the efficiency of the classifier in terms of performance and accuracy. From the review of the existing research works we can identify Ensemble selection (i.e., ensemble pruning, ensemble thinning, or classifier selection) is regarded as a type of effective technique to improve the efficiency of the classifier. The goal in ensemble selection is to reduce the memory requirement and accelerate the classification process while preserving or improving the predictive ability [10]. Just as the name implies, ensemble selection refers to the approaches that address the selection of a subset of optimal classifiers from the original ensemble prior to prediction combination. Given an original ensemble with m base classifiers $E = \{C_1, C_2,\ldots, C_m\}$ and a validation (evaluation, pruning, or selection) dataset with k samples $D = \{(x_1, y_1), (x_2, y_2),\ldots, (x_k, y_k)\}$, the objective is to form an optimal subensemble $E' = \{C_1, C_2,\ldots, C_n\}$, where the size of the optimal subensemble, n, is less than or equal to the size of the original ensemble, m ($n \leq m$).

In our research we will discuss about different traditional ensemble based classification methods which will be useful to select the efficient algorithm as per need of situation

We will also provide the details of available approaches which can be used to overcome the above mentioned issues.

. Table: A comparison of investigated research paper

Author(s)	Year	Case	Description	CD?	CE?	Tech	Approach
Aggarwal CC et al.[11]	2006	KDD 99'	Considering only labeled instances of data and Building the classifier through an on-demand classifica-tion process which can dynamically select the appropriate window of past training data.	Y	N	I	Supervised micro-clustering, Cluster-based, Sliding window
Peng Zhang et al.[12]	2010	The Malicious URLs Detection dataset. The Intrusion detection Dataset	Accumulating labeled records and combine them to create a classi-fier according to threshold.	Y	N	E	Semi-supervised, Label propagation in clusters and weighting in updat-ing ensemble frame-work.
Masud et al. [13]	2010	Twitter, ASRS, KDD99', Forest	Considering dynamic feature space and classification and addressing feature-evolution	Y	Y	I	Semi-Supervised, Lossless Homogeniz-ing Conversion for feature-evolution
Xingquan Zhu et al. [14]	2010	Data stream generated by Hyperplane-based synthetic data stream generator	Selecting best instanc-es to determine labels by foreign agent by the purpose of de-creasing classifier ensemble variance.	Y	N	E	Minimum Variance (MV), optimal weighting

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Masud et al. [15]	2011	SynD, SynDE, KDD 99', ASRS	Utilizing both labeled and unlabeled instanc-es to train and update classification model	Y	Y	E	Semi-supervised clus-tering + Label propaga-tion
Abdulsalam et al.[16]	2011	Synthetic dataset, Sloan, Digital Sky Survey, (SDSS)	Considering multiple target class labels.	Y	N	E	entropy-based concept drift detection, Random Forest
Hosseini et al. [17]	2011	Data stream generated by Hyperplane-based synthetic data stream generator, and Email-ing list dataset	Construct a pool of classifier and updating the pool according to new classifier created from new arrived data stream to improve accuracy of the en-semble.	Y	N	E	Bayesian formulation, heuristic methods
Xindong Wua et al.[18]	2012	SEA, STAGGER, KDD'99,Yahoo shopping data,LED	Handling both chal-lenges of concept drifting and unlabeled data streams	Y	N	I	Semi-supervised, k-modes based cluster-ing, statistical approach in detecting concept drifts
Yunyun Wang et al. [19]	2012	Some datasets from UCI repository[31].	Enhancing classifica-tion reliability by consistency check between predictions of two functions. Each instance has likelihood to class labels instead of belonging to only one class.	N	N	I	Semi-supervised, Label membership function, decision function
Dewan Md. Farid et al. [20]	2013	Dewan Md. Farid et al. [9]	Handling concept evolution by consider-ing inter-class distance and intra-class dis-tance.	Y	Y	E	Decision Tree Learn-ing, Similarity Based Clustering
Dariusz Brzezinski[21]	2014	Some datasets from UCI repository	Reacting to different types of concept drift .	Y	N	E	Accuracy-based weighting, Hoeffding Trees
LIU Jing et al. [22]	2014	SynCN, KDD 99'	Data streams classifi-cation with ensemble model based on deci-sion-feedback	Y	Y	E	Novel class label detec-tion, feedback from unsupervised mecha-nisms

II. REVIEW OF LITERATURE

Generally, classification algorithms are grouped in two groups of single and ensemble models. Single models learn incrementally and need new data for updating. The updating process in single models is complicated. Additionally, classification of the data by single models is not one hundred percent reliable. On the other hand, ensemble models are constituted of several single models. In data stream classification, ensemble learning methods enjoy several advantages over other models such as being easily scalable, having parallel function compatibility, and fast change adaptability through pruning of low performance sections. Ensemble classifications also feature high accuracy (Kuncheva, 2004). Under data stream classification, the unlabeled data is fed to the classification system and then assigned with the correct labels. The labeled data can be used to update the classifier model. Data stream classification is always performed at the training stage, as the feedback is the only way to determine concept drift, to adapt, and to update the classification model. An ideal classifier for data streams needs to meet specific features, including: (1) high accuracy, (2)fast change adaptation, (3) low computation and storage load, (4) minimum number of parameters, (5) noise tolerance, and (6) compatibility with new concepts, recursiveness , and optimum use of the past data. Some of these features such as low storage load and recursiveness are controversial and not all these features can be collected in a single system. Due to the specific nature of the data stream, the following requirements must be considered for a data stream classifier (Street and Kim, 2001): (1) all samples are processed only once, (2) limited storage is needed, (3) there is limited data processing time, and (4) the model should provide the best prediction if it stops before the conclusion. The concept adapting very fast decision tree (CVFDT) (Hulten *et al.*, 2001) is an extension to the very fast decision tree algorithm. The algorithm is known for high accuracy and a fast decision tree, showing the capability to detect and respond to change in the process of data sample generation. In fact, CVFDT is capable of detecting and dealing with concept drift. Dynamic weighted majority (DWM) (Kolter and Maloof, 2007) is an ensemble algorithm, which does not use any internal explicit detection method. Concept drift is detected by weighting on the performances of base classifiers.

At first, a classifier is assigned a fixed weight; then, the weight of the classifier is increased/decreased based on its performance and parameter ρ (a factor set by the operator for

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increasing/decreasing weights). When the classifier error exceeds a threshold level, one of the base classifiers is dropped and replaced by another classifier. Eventually, the majority voting is done by implementing a weighting function on the classifiers. OZAboost is a kind of online boosting algorithm (Oza, 2005). OZAboost updates the weight with a Poisson distribution and is a parallel boosting method that follows Adaboost. OZAboost-Adwin is an extension to OZAboost in which drifts are detected using the ADWIN method. Like the DWM method, an accuracy weighted ensemble (AWE) (Wang *et al.*, 2003) generates variation by weighting base classifiers and employs Hoeffding trees for classification. Instead of using a mechanism to detect drift, the method employs a function for weighting. Regardless of drift, the proposed classifier drops classifications with minimum efficiency and generates a new classification based on the data from the last training step. Standard datasets given in the table 1 below will be used here. The data is available in MOA, which enables us to exactly set the point and place of drift. Therefore, the accuracy and error level of the model can be measured when drift is induced. Different types of data were tested.

Table1: Characteristics of Datasets

Dataset	No.of Drifts	No.of Lables	No.of attributes
SEAS	3	4	3
SEAG	9	4	3
HYPERS	4	2	10
HYPERG	8	2	10
LEDM	4	4	5
WAVE	0	3	40
WAVEM	9	3	40

S:sudden drift; G: gradual drift; M:combination of drifts including sudden and gradual drifts. For all the datasets, the number of instances is 1*10^5

We have compared the above discussed algorithms like CVFDT, DWM, OZA, and AWE models regarding accuracy, average required memory, prediction precision, and classification time. Accuracy comparison methods is given in Table 2.

Table 2: Average classification Accuracies (%)

Dataset	DWM	OZA	CVFDT	AWE
SEAS	84.82	82.64	87.71	87.19
SEAG	84.91	83.37	85.00	85.10
HYPERS	88.70	71.65	82.40	87.30
HYPERG	76.84	71.79	71.36	72.17
LEDM	73.95	71.63	68.11	73.58
WAVE	83.82	83.37	83.90	81.57
WAVEM	83.75	83.22	82.71	81.31

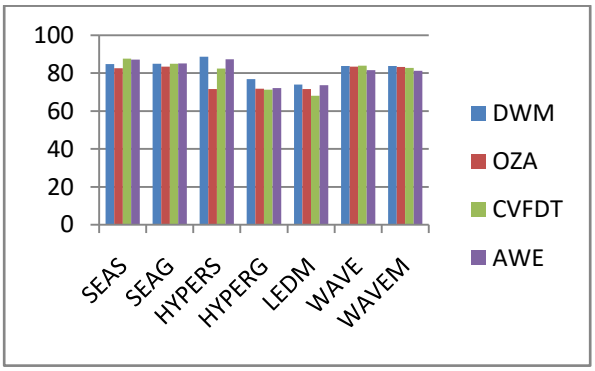
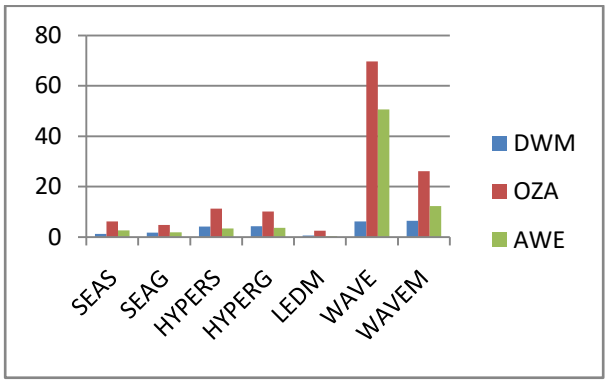


Table 3 lists the memory usage. With only one decision tree, the classifier CVFDT needs smaller memory, which is not listed in the table.

Table 3: Average memory usage

Memory (MB)			
Dataset	DWM	OZA	AWE
SEAS	1.32	6.23	2.66
SEAG	1.73	4.82	1.93
HYPERS	4.24	11.31	3.41
HYPERG	4.37	10.19	3.71
LEDM	0.61	2.56	0.32
WAVE	6.18	69.73	50.63
WAVEM	6.42	26.16	12.29



Precision

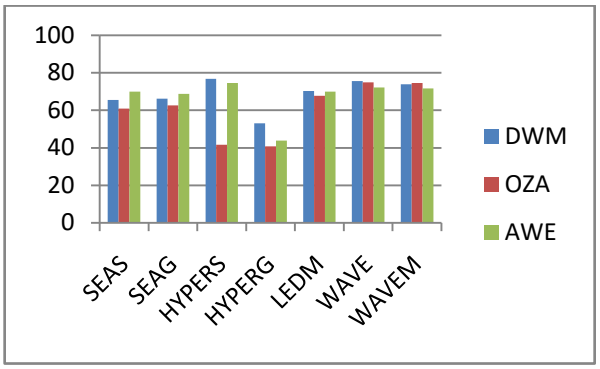
There are different definitions for reliability of an algorithm; here we used precision of classifier, which is composed of smaller elements.

Table 4: Average classification precision

Classification precision(%)			
Dataset	DWM	OZA	AWE
SEAS	65.59	60.92	69.96
SEAG	66.15	62.70	68.72
HYPERS	76.82	41.58	74.59

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HYPERG	53.11	40.81	43.84
LEDM	70.33	67.78	69.92
WAVE	75.63	74.95	72.26
WAVEM	73.86	74.57	71.70

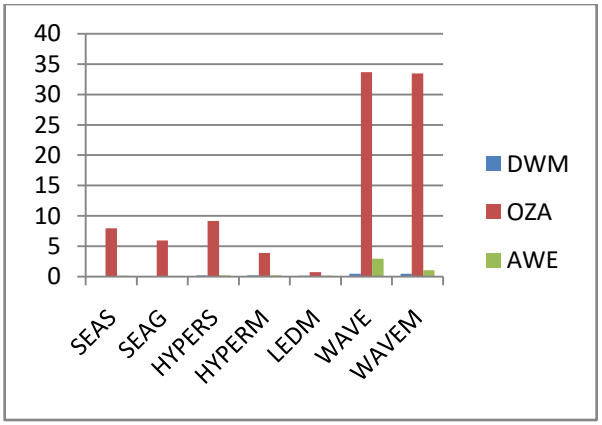


Time

The average run time of the algorithm for 1000 test samples was obtained (Table 5). Due to pre-processing, OZA has a high volume of computation and memory space.

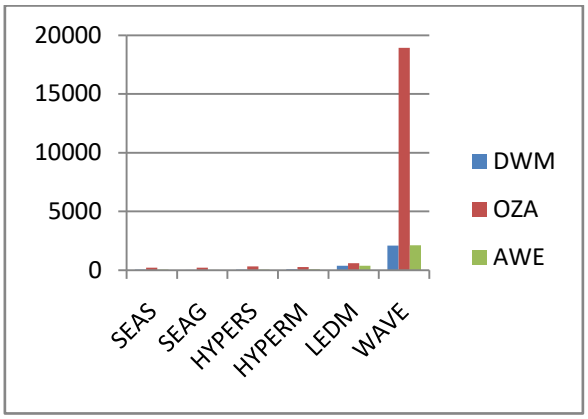
Table 5: Average of time consumption for 1000 test example

Time (s)			
Dataset	DWM	OZA	AWE
SEAS	0.07	7.94	0.14
SEAG	0.06	5.97	0.09
HYPERS	0.20	9.16	0.20
HYPERM	0.21	3.90	0.22
LEDM	0.15	0.75	0.15
WAVE	0.48	33.65	2.97
WAVEM	0.46	33.46	1.05



In Table 6, we compare the three ensemble methods in terms of execution time.

Time (s)			
Dataset	DWM	OZA	AWE
SEAS	41.22	221.09	43.22
SEAG	35.93	206.11	38.66
HYPERS	47.08	327.40	48.73
HYPERM	74.09	260.55	79.09
LEDM	384.77	597.00	369.56
WAVE	2111.20	18932.00	2120.96



III. CONCLUSION

Here we can conclude that among various ensemble based approaches compared here, some algorithm perform better in one criteria while some perform better in other criteria. The performance can be further improved using different methods, databases settings and parameter tuning that can improve the efficiency of the classifier. Efficiency in terms of accuracy, precision, memory usage, execution time etc. This survey aims to examine what and how big impact tuning the methods have on the accuracy and what should be studied and developed to achieve greater accuracy in Data stream classification

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Improve Network Security at Transport Layer

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***Abstract* -As we all know transport security is very crucial for all network or internet based applications. It is application independent and end-to-end security. To secure all the e-commerce, payment, banking, government & business transactions we requires strong security measures and practice. At present SSL and now TLS becomes de-facto standard for network and web security. These standards are developed to ensure confidentiality, integrity & authentication (not compulsory) to upper layer. Till 2013 we all believe that SSL / TLS are secure but in 2013 and 2014 various attacks, vulnerability and threats founds. Major attacks includes MITM attacks, downgrade attacks Lucky 13, renegotiation attack, BEAST, POODLE, RC4, CRIME, TIME and BREACH attacks[4], side channel attacks, attacks on authentication, Implementations errors etc. Further we observed that most attacks due to improper or miss configuration of server and client, using weak cipher suit & weak authentication. In this paper we are discussing various security improvements and measures to make full proof security at least for present and near future.**

***Keywords*— Security, Transport Layer, TLS, SSL, MITM, Authentication.**

I. INTRODUCTION

We all agree that landscape and footprint of IT, its vulnerability and threats are continuously growing and to cope up with all we need strong security technique and mechanism to enable it. TLS/SSL becomes de-facto standard to secure communication over internet/network, it may be for web, email, file transfer or VPN. TLS protocol divided into two sub protocols, 1 TLS handshake protocol responsible to agree upon security parameters before creating secure channel and TLS record protocol transfer data using secure channel [2].As security never say 100% forever but we can make it strong enough at least for present and for near future. Attacks become more and more sophisticated and intelligent and that's why we must keep our security updated and advanced. We have found lots of attacks and vulnerability against TLS/SSL in past few years. One can classify these attacks and vulnerability into three categories, A. use of weak cipher suite B. use of weak authentication mechanism C. miss-configurations of servers and clients.

To make Transport layer secure we need to use strong cipher suite, properly configure servers and clients and use two way strong authentication mechanisms[2]. We will discuss category wise how to strengthen security at transport layer. Here we focus on authentication, the main Transport layer security features [1]. In our earlier review paper we discussed basic security requirements and attacks at Transport layer with classification [1].

II. LITERATURE SURVEY

Various techniques have been developed to secure data during transit, especially at transport layer. We have categorized weakness of TLS into three categories and also mitigate them category wise.

A. Select secure cipher suites:

First of all we should prevent client and server from using weak cipher suites. As TLS protocol provides good flexibility in cipher suites selection attacker take benefits of this flexibility to negotiate weak cipher suites or null encryption during handshake. We must not negotiate null encryption. Further we must not use any cipher suites using RC4 stream cipher due to its cryptographic weakness[3][13]. Avoid using cipher suites uses less than 112 bit of security. Further not use cipher suites that not support forward secrecy like static RSA[2]. We should avoid using compression as it prone to various compression related attacks likes CRIME,TIME, BREACH, [4] etc.

B. Selection of strong authentication mechanism:

Authenticate communicating entity is the most critical task while remote user communicate through network. Majority security issues concerned with authentication and strong and mutual authentication is essential for secure communication [6][5]. Intruders cannot practice phishing, pharming, IP or Server spoofing, Smurf attack, DNS poisoning and some forms of DoS attacks when we use strong mutual authentication mechanism [1][8].

Generally web server uses digital certificate to authenticate them to client but client is not being authenticated with server so lack of two-way authentication. Further digital certificate cost company or institute so many institutes even not use it for server authentication. At present in India only about 15% website have digital certificate and poorly configured servers prone to easy attacks. Lack of security awareness we are the 4th country who faces lot of electronics fraud. Event digital certificate can also forged or generated dummy. Further digital certificate authentication is based on PKI which is very complex, costly and dependent on unknown. How we put such blind trust on third party to which we never meet or know. Current PKI infrastructure for Transport is prone to MITM attacks [15].

Client use login & password to authenticate himself with server and secure server uses digital certificate to authenticate server as genuine. We can use multi factor authentication to make the strong and secure authentication. If authentication break then actually there is no security i.e. if you have ID and

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password of user then you can access whatever the user can. We can use many authentication parameters like what we know (e.g login, password, pin etc), what we have (e.g credit card, smart card, dongle etc.), what we got biological unique traits (e.g. fingerprint, iris, hand geometry etc.) and behavioural (gait, gesture, speak, write, keystroke dynamics etc.). We can even combine many factors to strengthen further by making virtual identity [9].

Biometric authentication has widely used and accepted mechanism to identify an individual. It includes mainly two phase, one biometric features collection and second biometric authentication.

Various techniques have been developed to secure data during transit, especially at transport layer. Authentication is the major security issue when entity communicates remotely. There are many type of authentication mechanism and protocols available employing different cryptographic algorithms and techniques for identification. PAKE protocol used password based weak security parameter for mutual authentication [8]. A secure PAKE protocol must possesses 4 basic properties [10], it must be resistant to offline as well as online attacks, provide known-session security and forward security. PAKE protocol further fortifies using augmented PAKE protocol [9].

To enhance security, more sophisticated technique which uses biometric features was proposed. Biometric based authentication system acquire biometric data of an individual such as fingerprints, iris scan, facial recognition, palm geometric which involve extracting a knowledge (feature sets) from the acquired data and store it as template set in the database in registration phase[2]. While in authentication phase, biometric system acquire individual data, extract features and compare it with stored template in the database.[2] This technique provide high level security as biometric identifiers cannot be shared, and unique identifies individual by nature[3]. In the past years, there are lot of efforts directed toward extracting patterns / features from different biometric like iris, fingerprint, face, palm, images and cryptography. A new system for fingerprint privacy was derived by combining two fingerprints to make virtual identity [4]. The B-AKE protocol keeps biometric credential (knowledge) secure and never reveal to imposter recipients or man-in-the-middle observers [7]. We can also use different biometric information collected during enrolment i.e. iris and fingerprint image. Then hashing is applied to encode extracted points which differentiate users from each other. This way encrypted outputs of two biological templates (patterns) are XOR, and secure input in place of password is created [10].

Another notable work was done to generate Idea Password Authentication Scheme in which both password and fingerprint would be used for mutual authentication. In this scheme author used many servers and many different fingers to implement strong mutual authentication [6]. I agree completely that this will fortify security but the fingerprint itself be recreated – spoofed.

C. Configure server and client securely:

Never negotiate old protocol during handshake process like SSLv2, SSLv3, TLS1.0, TLS1.1 as they are vulnerable to different kind of attack [2].18% Web servers are still supporting insecure SSL 2.0 and SSL 3.0 while 85 -90% website supports insecure cipher while clients uses insecure browser version not support certain mitigations. [Wikipedia tls]

Use Strict TLS to mitigate SSL stripping [1][12].

Some time client fall back to lower versions of protocol after server rejects higher versions,in such situation never fall back to SSLv3 or earlier.

Both clients and servers must implement renegotiation_info extension, if handshake renegotiation is implemented.[11].

Take proper safety care if TLS session resumption is used [2].

Client-Server must negotiate using Encrypt-then-MAC sequence to prevent various future vulnerabilities [14].

III. IMPROVE NETWORK SECURITY AT TRANSPORT LAYER

Security is actually integrated thing and the weakest point in security becomes the bottle neck of complete security system. So selecting secure cipher, configuration proper server and mitigating client and using strong two-way authentication all are same important.

We generally believe that if website uses HTTPS then we are secure and delivering data on secure channel but this is not always true. If you have not configured server and mitigated client browser then you easily becomes victims. So client and server configured properly is the base for strong security. Further we are using shared hosting and in such situation one site becomes vulnerable than other site residing on the same server becomes easily vulnerable.

A. Selecting secure and efficient cipher suite is very crucial for security and resource constraint devices. There are long list of cipher suites from which server and/or client choose. TLS supports many key generation methods, encryption techniques and message authentication for integrity. Cipher suites are made of all these different combination which client-server agrees upon on handshaking before communicating with each other. Base on security and efficiency we just list out two of them for secure communication is as below:

1. Key exchange: before starting communication client and server agree upon symmetric key and cipher to use when encrypt data. We use TLS_DHE (ephemeral diffie-hellman and TLS_ECDHE (ephemeral Elliptic Curve diffie-hellman) as it provide forward secrecy.

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2. Symmetric key algorithm: We will suggest AES GCM as block mode and Chacha20-Poly1305 as stream cipher mode cipher (efficient one).
3. MACData integrity: TLS use MAC for data integrity. We will only use AEAD for Authenticated encryption such as GCM mode.

Use latest browser version for client side mitigations against known attacks likes, POODLE (Padding Oracle On Downgraded Legacy Encryption) attacks [23], RC4 attacks [24], FREAK attack, CRIME and Logjam attacks.

B. Authentication

Secure communication always required two way authentication and confidential communication over public channel. We have studied various authentication techniques but all have their own advantage and draw back. We have not found any perfect authentication method. We believe digital certificate authentication is the best but it also have MITM vulnerability and further trust on unknown authority is also not good. We can use certificate pinning, public key pinning etc techniques to mitigate such attacks though it is complex and resource constraints task[15].

Another popular way is server authenticate with digital certificate while client with login and password (weak authentication). We all know know attacks against password authentication like brute force attach, dictionary attach, solder serving and lost password recovery. Thought if we use strong password with vertical keyboard than its is feasibile way to authenticate using PAKE technique which supports two way secure authentication using DH key exchange.

We can also combine weak secret with strong one like biometric authentication. Like finger print scan, iris scan, palm scanning, voice recognition and face recognition. Biometric authentication can also created duplicated and once compromised hard to change. Further two factor authentication like smart card, USB drive or hardware lock have stolen device attack. Though two factor sure improve security and if combine with other biometric featured to make virtual unique identity and use it for key generation or authentication.

PROPOSED AUTHENTICATION AND KEY GENERATION SCHEME FOR HAKE

In proposed Hybrid Authenticated Key Exchange we are using user Id, password wth virtual id (generated using biomeric method) using secure channel. Further we propose to use strong password (combine digit+alphabet+ special symbols with minimum length of 8 characters) with virtual keyboard. Further we improve biometric parameter using different kind of extraction and merging techniques like scanning two different fingers, then extract data from them and then merge them to make secure template[25]. We use improved biometric methods with strong password to generate unique virtual ID.

There are two phase involves, one is generating master template known as Enrolment. Second phase is authentication, in which user generated template are matched against the corresponding stored master template in the database. The matcher matches both features and if match, we say authentication passed or fails.

Finally such template is used to generate keys [4] which consume in subsequent mutual authentication and establishing secure communication.

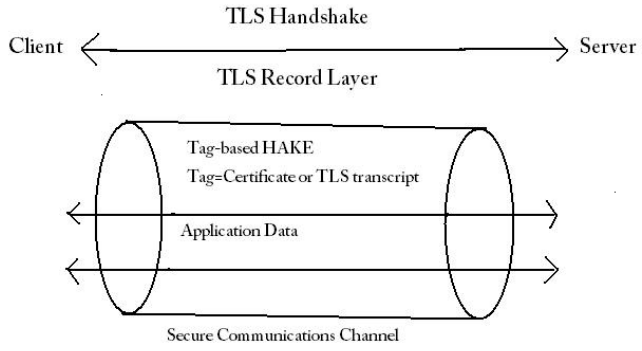


Fig.1 High Level view of HAKE Authentication methods

FUNCTION OF HAKE WITH TLS

As we all know TLS is a multilayer protocol, can group in two different section 1) handshake protocol and 2) record protocol [17]. Record protocol follow handshake and provide secure channel for confidentiality and integrity. The handshake protocol provide entity authentication and security parameters subsequently use in communication security. At present most internet security rely on TLS/SSL to authenticate the server to the client but mutual authentication is an optional and less commonly used, because every client has no certificate [16].

The client initiates the proposed improved Biometric Authenticated Key Exchange protocol following successful completion of the TLS handshake, using the shared secret password and biometric along with a TLS session tag to create cryptographic key used to protect a message sent to the server. If the recipient of the message encrypted by the client does not know the biometric secrete with password, the recipient cannot create the key to decrypt the message and the session terminate without revealing any private client information [18].

Secure TLS session with HAKE steps are as follow:

1) User clicks on an HTTPS link to access server Ex. bank account.
2) Server authenticates to the client in TLS handshake protocol and establishes a session key.
3) User enter strong password along with improved biometric (virtual id) and tag that identity session to create HAKE key using a Diffie-Hellman.

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4) The user encrypt the virtual secret using HAKE key, and account name and the secure payload are send to the server and the server authenticate the user.
5) If the recipient / server is not a man-in-the-middle attacker, then server uses user secrete which previously established with the user account (i.e. password and biometric secret) to derive the same secret key as used by client, and decrypt the client data and authenticates the client. Otherwise, the user secrete has been never revealed to an attacker and cannot response client to confirm knowledge.
6) The server encrypt a key confirmation message using the shared HAKE key, and sends the encrypted message to the user.
7) User decrypts the response and authenticate server. This way secured mutual authentication achieved.
8) The communicating user and server can now communicate using TLS session key with full confidence.

This way we can defeat all latest network and transport attacks like man-in-the-middle, browsed-in-the-middle, FREAK, POODLE, BEAST, Crime and Lucky 13 etc.[19][20][21][22].

C. *Server and client side configuration* for strong and strict secure way as mention above. This is generally seen by server admin or security expert. We can pen test the server for possible vulnerability using wireshark, metasploit and other tools.

IV. CONCLUSIONS

In this research paper we focus and use secure, proven and well accepted mechanisms to secure end to end communication by fortifying transport layer security and especially by using HAKE. We have used novel, strong, hybrid mutual authentication to strengthen security for the future needs. Implementation and experimental details are under way and published shortly. We can also use this protocol without TLS or with TLS. It is best to use HAKE without TLS or PKI, for lightweight, low power, low computing devices. Its performance, efficiency and rate to security are the direction of future research.

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First Zen Architecture Based Commercial Processor

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***Abstract* - AMD has always promised that Zen is core suitable for high-performance server parts. AMD by far has launched Ryzen7 for high-end desktop and Ryzen5 for mainstream consumers. This paper is an overview of AMD Ryzen SKUs. The purpose of this research is to understand architecture used by AMD, Zen architecture. Zen was designed to enhance performance. Based on this architecture, AMD has launched Ryzen stack ranging from Ryzen3 1200 to Ryzen 7 1800X. Also, the study on how improvements are done by AMD on very new version launched is done and compared. The performance of Ryzen 7 1950X: latest Ryzen processor is analyzed. The major drawbacks leading to low demand of Ryzen in market are studied. Intel processors have given a huge competition to AMD Ryzen in terms of performance. The comparison of Ryzen with Intel Xeon shows where Ryzen is lacking in its specifications.This study will give a detailed explanation on AMD Ryzen: its architecture, performance and drawbacks.**

***Keywords:* AMD Ryzen, Threadripper, workstation**

I. INTRODUCTION

Ryzen is a brand name of central processing units and accelerated processing units which is marketed by a microprocessor manufacturing giant, AMD. This was introduced to the commercial market in 2017. This is the first commercial microprocessor implementing Zen microarchitecture. AMD Ryzen is conserved as boon for this era of technology. These chips are more efficient in both the aspects i.e. performance and cost. These are considered to be high performance multi core chips. This is the reason that it has very wide scope of application in various fields like high end gamming, Artificial intelligence, unmanned vehicles, etc. Ryzen results in such high multi core performance and parallel computing only because it uses the Zen microarchitecture. This is the reason Ryzen CPUs offer stronger multi-threaded performance and weaker single-threaded performance, comparable to the Intel's core i7 processor.

II. ARCHITECTURE – ZEN MICROARCHITECTURE

A. Design

Zen is an innovative design that differs completely from the traditional bulldozer architecture (available in IBM, Intel and Oracle processors). Zen based processor uses 14nm FinFET(Fin Field Effect Transistors) process. Thi0s technology allows it to be power efficient and helps it to execute significantly more instructions per cycle. Simultaneous Multithreading (SMT) was introduced in this architecture which allowed each core to run 2 threads. In addition to these changes the cache system has been redesigned.

Zen is based on System on Chip (SoC) design; this integrates all its peripherals onto the same chip. For an instance, SATA, PCIe, memory and USB controllers are integrated onto to the same chip as the cores. This design has advantage in the power efficiency and the bandwidth at the trade-off of chip complicity and the die area. Such design has led to the chance of much wider application of Zen based processors, for example, laptops and small form factor mini PCs.

The major difference between Ryzen CPU and the Zen APU is, the Ryzen relies upon the external GPU unlike that in Zen-which has on chip GPU.

B. Performance

Zen was designed with an aim to develop the performance per core. It is targeting to achieve 40% improvement in the Instructions per Cycle (IPC) than the previously designed traditional architectures.

AMD announced the latest microprocessor to have achieved 52% improvement as compared to the excavator (previous architecture). The major achievement is the inclusion of the SMT technology which allows 2 threads per core, hence increase the performance by 2X only by using the available resources.

Zen microprocessors employ sensors all over the chip to measure dynamically the frequency and voltage levels. This allows adjusting the performance of the chip depending upon the above mention parameter. This helps in the heat efficient performance of the chip.

Zen supports AVX2 instruction sets, but requires 2 clock cycles to complete the same.

C. Memory

Zen based processor supports DDR4 memory specifically upto 8 channels and Error Correction Code Memory (ECC Memory).

Earlier it was planned that the processor could support High Bandwidth Memory (HBM). However, later on it was not included on the first version of the CPU.

The Ryzen has multiple versions and all of them L2 cache memory as 512 KB per core.

III. COMMERCIAL VERSIONS

A. Ryzen 3 – 4 core CPUs (4 threads)

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B. Ryzen 5 - 4 core APUs (8 threads) 8 core APUs (16 threads)
6 core APUs (12 thread) 12 core APUs (24 threads)
C. Ryzen 7 - 8 core APUs (16 thread) 16 core APUs (32 threads)
D. Ryzen Threadripper –

Table 1 RYZEN VERSIONS

Target Segment	Cores (Threads)	Processor Branding & Model		Clock Rate(GHz)		Cache (MB)
				Base	*Boost*	
High-End	16 (32)	Ryzen Threadripper	1950X	3.4	4.0	32
	12 (24)		1920X	3.5		
			1920	3.2	3.8	
	8 (16)		1900X	3.8	4.0	16
Performance	8 (16)	Ryzen 7	1800X	3.6	4.0	16
			1700X	3.4	3.8	
			Pro 1700X	3.5	3.7	
			1700	3.0		
			Pro 1700			
Mainstream	6 (12)	Ryzen 5	1600X	3.6	4.0	16
			1600	3.2	3.6	
			Pro 1600			
	4 (8)		1500X	3.5	3.7	
			Pro 1500			
			1400	3.2	3.4	8
Entry-Level	4 (4)	Ryzen 3	1300X	3.5	3.7	8
			Pro 1300			
			1200	3.1	3.4	
			Pro 1200			

IV. PERFORMANCE ANALYSIS

A. Performance

This analysis shows the performance of AMD Ryzen TR 1950X – The high version of the AMD Ryzen series of processors. Threadripper can boost single threaded performance to 4.0 GHz with an extra 200MHz extended frequency range (XFR) allowance. This also has the flexibility to clock and modify all cores on this processor to 4.0 GHz. All Ryzen processors support auto-overclocking system. This helps it get twice than the usual boost (100MHz overclock vs. 50MHz overclock).

Additionally XFR values are doubled on Threadripper CPUs having 200MHz in X models rather than the usual 100MHz.Also, it provides further flexibility to tweaking. The clock speed can be taken to 4.1 GHz or 4.2 GHz, but this requires high voltage range like 1.4 volt. This on the contrary leads to heat and energy consumption. This tread-off should be kept in mind while designing the most efficient processor.It may not have a good experience of gaming on it as compared to its counter- part. Instead it can easily be improves by interfacing a GPU with faster clock to it externally.

B. Memory

It has Double Data Rate 4 (i.e. DDR4) with 3200Hz of memory access speed which is sufficient enough for any Task. The 1950X has 4 memory channels, this might be little slower as the bandwidth increases in high end tasks. This, however, does not affect much upon the expected tasks which it is capable of performing.

C. Power

The 14 nm FinFET architecture acquires Thermal Design Power (TDP) of around 180 Watts (this is highest in its kind). A PC mounted with Ryzen TR 1950X at idle will acquire 95 Watts of power with its dedicated GPU. If we work on it with some other GPU then it will increase the power consumption significantly, but this will be least as compared to any of its 16 core counter- part in the same scenario.

D. Heat handling capacity

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Ryzen is considered to be one of the most optimum processor in the terms of the TDP. The Zen architecture gives it an upper hand to give less heating effect even at higher performance. AMD has also use a good and efficient cooling technique which further lowers down the TDP. AMD along with Ryzen has introduced a line of stock coolers, the "Wraith Spire", "Wraith Stealth" and "Wraith Max". Amongst these, Stealth is the low end cooling unit used along with lower-end CPUs; it is rated for 65 W of TDP. On the other hand, the Spire is the mainstream cooler with TDP measure of 95 Watt and modest headroom of overclocking, along with the RGB lighting on some of its commercial models. The Wraith Max is a large technological breakthrough; it can handle more intensive overclocking as compared to Spire in higher-end CPUs. This gives AMD Ryzen an upper edge over its other counterparts. This is one of the most important reason, Ryzen can be proves as gamming friendly CPU. Along with the high speed of processing and optimized graphics, it can keep the TDP up to 95W.

E. Compatibility

AMD verifies that Ryzen series has ability to boot windows 7 and windows 10, Microsoft officially supports Ryzen only on windows 10. This restriction can be bypassed by installing an unofficial patch on the unsupported operating system. Also Ryzen is fully compatible on Linux. It suggests that optimum performance can be enabled on kernel version 4.10 and above.

F. Negatives

- The idle power consumption is poorer as compared to its running mode consumption. The 16 core processor has two 8 core processors. When it is kept in idle mode, it means two of the 8 core processors are in idle mode. Each processor has around 45 watts of power consumption at an average. So, this make overall idle power consumption around 90 watts which is significantly high.
- Tweaking of the clocks remains poorer here. We can achieve 4.0 GHz of tweak as discussed earlier. On the contrast, high end Intel processors can tweak their clocks up to 4.5 to 5.0 GHz
- The processor faces system locks when any particular application executes a certain sequence of FMA3 instructions. This issue is expected to be solved in the newer versions

Table 2 COMPARISION

Sr. No.	Specifications	Processors	
		AMD Ryzen TR 1950X	***Intel Xeon Platinum 8180M***
		 Figure 1 AMD Ryzen	 Figure 2 Intel Xeon
1	Total clock speed	16 x 3.4 GHz	28 x 2.5 GHz
2	RAM Speed	2667MHz	2670MHz
3	CPU Threads	32	56
4	Integrated Graphics	No	No
5	Thermal Design Power	180W	205W
6	Supports 64-bit	Yes	Yes
7	Turbo clock speed	4GHz	3.8Ghz
8	Unlocked multiplier(Overclocking)	Yes	No
9	Uses hyper threadingtechnology	No	Yes
10	Dynamic frequency scaling	No	Yes
11	Memory channels	4	6
12	L2 cache	8Mb	28Mb
13	L3 cache	32Mb	38.5Mb

V. CONCLUSION

AMD Ryzen is the first processor designed based on the Zen architecture. It is the series of processors designed by AMD to compete its rival Intel and also so to develop its existing series of processors which were based on the bulldozer architecture. AMD Ryzen has successfully taken an edge over its counter-part of Intel. The processors come with the number of cores ranging from 4 to 16 which was one of its

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kinds in the market. It has successfully adopted the technology of multithreading. This allows 2 processes at a time per core. This design helped it achieve the clock speed of 4.0 GHz and over. AMD used Zen architecture targeting 40% improvement in performance. The latest version of Ryzen helped it achieve 52% of improvement. This improvement is the result of it compatibility with overclocking. Ryzen having all these features and such high end processing capability was expected to get negative points in the subject of power consumption and heat handling capacity. It architectural design and new cooling design helped it achieve TDP of 180W in its higher-end processors, which is less than expected for such high performance processors. These properties put Ryzen in healthy competition with the latest processor developed by Intel – Intel Xeon.Ryzen shows sufficient compatibility with other operating systems for better performance. It does not have on chip GPU, this allows user to interface the GPU depending upon the personal requirement and the processor's compatibility. This gives excellent gaming experience for graphically heavy games.

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Clothing of Bharawad Community of Surendranagar District: A Priceless Heritage

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Abstract **- Clothing is an item of civilization which gives most eloquent expression to the culture and taste of an age which has both practical and aesthetic values of its own. Two main sub groups namely 'Mota Bhai' and 'Nana Bhai' of Bharawad community lives in Gujarat state of India with the particular difference in their clothing. Their costumes are colourful, attractive, catchy, adorable and fascinating. These clothes are available both in draped style and tailored i.e. cut and sewn as per the shape of the body. Traditional clothes are still being used by them. However, these traditional garments are now being gradually displaced by new shapes and forms, colour, motifs and material due to the various developments and modernization. Thus it is necessary to document traditional clothing of Bharawad community for the younger generation to understand their tradition and culture before it is completely change.**

Keywords **- Clothing, Bharawad community, Kediyu, Bori, Kapadu, Zalawad, Surendranagar District, India**

I. INTRODUCTION

Clothing is an art of an expression of personality and symbolises religion, status, occupation, and sex. From centuries the culture, tribes, communities, caste and religion of people have been judged by their costumes. It is possible for any experienced person to identify a person by the kind of dress worn. Clothes worn by people are also expressing their psychology and social beliefs.

India is a country of diversity and there are some similarities as well as differences in clothing of Indian men and women. Gujarat is most beautiful vibrant state of India. Gujarat has a distinct traditional clothing style of its different people of various tribes, castes and communities live in Gujarat. Bharawad community is one such community of Gujarat. They have two main sub groups namely 'Mota Bhai' and 'Nana Bhai'. There is particular difference in clothing of both sub groups of Bharawad community.

The former generation of Bharawad community put great effort to maintain their traditional clothing as priceless heritage. Government also helping them through arrange competition of best traditional costume, best chhatree decoration etc. for Bharwad community in the fair of Taranetar located near Than taluka at Surendranagar District of Gujarat state, India. Fashion designers are also attracted by their costume and inspire to make fashion wear which is lives a glimpse of the clothing of Barawad community.

II. METHODOLOGY

The major objective of the study was to document the process, motifs, colours, type of fabric used for making clothing of Bharawad community of Surendranagar District, Gujarat, India. A descriptive research design was planned. The interview schedule and participatory observation technique were undertaken to get complete and authentic information. The data was collected with the help both interview and observation method. The schedule prepared by open and close ended questions, which was deal with demographic details, process, motifs, colours. Sample selection was done through purposively sampling method. The sample sizes comprised of fifty families, ten family from each city – Wadhawan, Surendranagar. Chotila, Than, Dhrangadhra

III. RESULT AND DISCUSSION

The Bharawad word may derive from the Gujarati word *"badawad"*, constructed from word *"bada"*- sheep and word *"wada"* - a compound. In the Saurasthra region of western Gujarat they exist as two groups, known as the Motabhai and the Nanabhai. Bharawad community is a follower of Lord Krishna, they come from vrindavan, near Mathura, Uttar Pradesh and infiltrated into Gujarat. Bharawad men wear *"Kediyu"* and thick cloth around the waist which is called *"Bori"* and Bharawad women wear backless colourful *"Kapadu"* which is rarely covered by the any veils. *"Ghagharo"* is most attractive garment of Bharawad ladies and it is took approximately two month to done complete embroidery work on it.

A. Children's Clothing

"Dagali"- cloth like *"Kediyu"* and *"Chorano"* are the first garment to be worn to the boy child on the sixth day of birth while *"Sadaro"* and *"Ghaghari"* are the the first garment to be worn to the girl child on the sixth day of birth. There is a ritual in Bharawad community as well as other hindu communities that on the festival of Holli, after the child's birth, the boy is worn to a small *"Kediyu"* and hat, while the girl is dressed in a small blouse and a chundi after which a glimpse of the holly is made.

B. Men's Clothing

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1) Kediyu: Word *"Kediyu"* is derived from the word *"Kad"*. Kathiawadi *"Kediyu"* means the garment that worn on the body till the waist. It is worn by Male of the Maldhari - Bharwad community. At first glance, all the common and uniformly visible *"Kediyu"* has a variety in sewing technique, type of cloth and its colour, embroidery and motifs done for embellishment, etc., used to make it. The respondent said that this variety of *"Kediyu"* is the identity of *"paraganu"* - area of Bharawad men where they were belongs to.

Fig. 1 *"Kediyu"* Front and Back



Fig. 2 Parts of *Kediyu"*

(Collar)



(Sleeve)



(Back Part)



(Front Parts)



The former male of *"Zalawad Parbhana"* worn white coloured *"Kediyu"* made from Khadi and cotton fabric, while male wear worn white *"Kediyu"* made of by polyester cloth. *"Kediyu"* is a sewn cloth. It is made up of seven separate parts, which are composed of two frontal pieces, one back portion, two sleeves, a part of the gher - fullness and a collar. It has non set - in sleeve. The gher -fullness part of *"Kediyu"* is about 5-6 meters to 15 meters and the length of it is 11 - 15 inch. A stand collar is made in *"Kediyu"*. The *"Kediyu"* has a front-end opening and three tie-ups are placed as closures. *"Kediyu"* is decorated with embroidery. Initially hand embroidery was done on *"Kediyu"* for decoration but nowadays it is manipulated by the machine embroidery. The front, back and collar parts are filled with dense embroidery as shown in Figure 1 & 2. There is densely embroidery on the sleeve part till arm-shoulder point and then border has been done on the centre and/ or bottom line of the sleeve, whereas a small border is made on the edges of the fullness of *"Kediyu"*. Mainly the motifs of Lord Krishna, peacock, flower and flower with branch are used in embroidery of *"Kediyu"* along with the geometric shaped borders and some decorative motifs.

2) Bandi: *"Bandi"* is a sleeveless cloth worn on top of body. *"Bandi"* is a sewn cloth with front opening and stand collar. There are four pockets in front of it. It is made of cotton cloth.

Fig 3. *"Bandi"* worn by young men



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Fig. 4 *"Bandi"* worn by young and adult men



Fig. 5 *"Bandi"* worn by adult and old men



The young male wear red (coffee maroon) and blue-coloured *"Bandi"*, the middle-aged male worn white-coloured *"Bandi"* with red-coloured running stitch machine embroidery, while the elderly men wear white-coloured *"Bandi"* with running stitch machine embroidery of white-coloured. *"Bandi"* of young man is decorated with the machine embroidery. Densely embroidery is done on it by motifs of elephants, horses, scorpions, flowers etc. Silver buttons joint with chain used as closures of *"Bandi"*. According to the respondent, as per embroidery done in *"Bandi"*, it is known by different names, in which the price of the *"Guchaliwali Bandi"* / *"Zalawadi Bandi"* is highest.

3) Bori: *"Bori"* is an unstitched cloth which is worn by draping it on the lower part of the body. Zalavadi Bharawad men worn mainly Maroon, Indigo Blue and Green coloured *"Bori"* respectively Green, Maroon and Maroon coloured border on it.

Fig. 6 *"Bori"* Drape around the waist of men



They made some special styled embroidery which gives a batter effect after drape it on the body. A specially they made embroidered centreline border namely *"Danakhili khilvat"* along with motifs of Peacock, Scorpions, Butterfly, Flower etc. on both side of it.

4) Pachhedi: Old men of Bharawad community worn *"Pachhedi"* – a drape cloth for lower part of body – around waist, is about 7 to 8 meter white cotton fabric.

Fig. 7 *"Pachhedi"*



It is similar to *"Bori"* but main difference is that *"Pachhedi"* has more fullness than *"Bori"*.

5) Bhet: *"Bhet"* is a cloth worn on *"Bori"*.

Fig. 8 *"Bhet"*



It is worn by folding it in triangle shape and then made a knot on side waist by knotting with two ends of folded *"Bhet"* cloth.

6) Malir: *"Mlir"* is a black cotton cloth to put it on shoulder. *"Malir"* is also available in red, yellow and white colour.

Fig. 9 *"Malir"*



7) Melkhayu: *"Zalavadi Bharwad"* male worn headdress namely *"Melkhayu"*. It is available in Indigo Blue,

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Red, Yellow and Green colour which is embellished with embroidery and printing

8) Paghadi: *"Paghadi"* is a headdress of Motabhai Bharawad community. They are worn different kind of *"Paghadi"* like *"Lal Paghadi"*, *"Gulkhab ni Paghadi"*, *"Dhotiyavali Paghadi"*, *"Aatiyali Paghadi"*. A specially, Zalavadi Motabhai Bharawad of Surendranagar District is worn *"Chakaradi Padhadi"* and *"Double Paghadi"*.

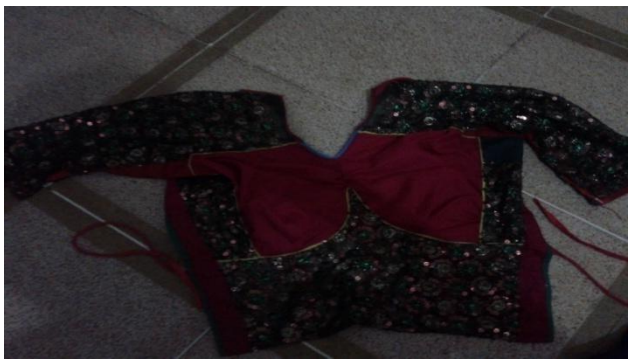
C. Women's Clothing

Fig. 10 Bharawad woman wearing Kapadu, Dhushaloand Chundadi



1) Kapadu: Bharawad woman worn *"Kapadu"* as a bodies cloth.

Fig. 11 *"Kapadu"*



It is a colourful backless and "U" shaped neck line garment with sleeve length till elbow. *"Kapadu"* has a back - end opening and two tie-ups are placed as closures. Younger woman is worn Colourful *"Kapadu"* prepared by different decorative fabrics while Age old woman worn plane coloured cotton fabric.

2) *Ghagharo*: *"Ghagharo"* is the dress of Bharawad women wearing on the lower part of the body. Generally young women wear *"Ghagharo"*. In earlier times, 7 to 8 meter length of fullness was made by Gathers stitch which is now available in six meter length of fullness. Apart from the previous days, *"Gajeyo chhaapelo Ghagharo"*, *"Rabari Bharat no Ghargharo"* was worn by Bharawad women. The design of diamond shape of 9 dots and 12 dots was printed in *"Chhapela Ghaghara"*. These dots were made in Blue, Yellow and White colour. Now the design of *"Chhapela Ghaghara"* was manipulate by the verity of modern designs.

3) *Dhusi*: *"Dhusi"* is worn by adult Motabhai Bharawad women of Surendranagar District. In which the *"Khilvat Sandho"*- seam is made, so that the width of fabric can be increased and the *"Khilvat Sandho"*- joint gives a design look while wearing it.

Fig. 12 *"Dushi"*



Fig. 13 *"Dhusalo"*



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"Dhushi" is a black colour in which red, yellow and white Gul - dots are made by *"Bandhani"* print while *"Dhushalo"* is worn by old leady of Motabhai Bharawad of Surendranagar District. *"Dhushalo"* has lesser weight and thiner than *"Dhusi"*. It is only black fabric along with small white printed border.

4) Tangaliyo: *"Tangalio"* means the garment worn on the lower part of the body.

Fig. 14 *"Tangalio"*



Tangaliyo was traditionally a 10 by 4 cloth which was draped around the waist. The Ramraj Tangalio is a unique kind of motif worn by Motabhai Bharvad community on special occasion.

5) Chundadi: *"Chundadi"* is like a dupatta which is worn with *"Kapadu"* and *"Ghagharo"*/*"Dhushi"*-*"Dhushalo"* by women of motabhai Bharawad community.

Fig. 15 *"Gal mendi"*



Mostly they worn chundadi of cotton fabric embellished by Bandhani printing.some times they use woollen chundadi with embroidery work done by woollen thread called *"Galmendi"*. Bharwad women were also worn *"Borjali"*, *"Galeto"*, *"Galbakadiyu"* as *"Chundadi"* – dupatta on their shoulder.

IV. CONCLUSION

In *"Zalavad parganu"* of Surendranagar District, Motabhai Barawad men wear distinctive short gathered smoke *"Kediyu"* and / or *"Bandi"* with long, tight sleeve along with *"Bori"*- the lower garment, *"Bhet"* and turben/or *"Melkhayu"* while Motabhai Bharawad women wear *"Kapadu"*, *"Ghagharo"*/or *"Dhusi"* with *"Chundadi"*. Traditionally their clothing is made by woollen fabric but now some of their clothes are made by cotton, polyester and or synthetic fabric. Hand embroidery done on their clothing is manipulated by machine embroidery. According to respondent there is saying that if a man doesn't wear their dress, he cases to be Bharwad. One more saying is that Being Bharwad means dressing Bharwad. The people of Bharawad community of Surendranagar district are following their tradition and maintaining their priceless heritage. However younger generation is not so much interested in preserving the same therefore the originality of their traditional clothing is manipulated by the modern designs.

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It is true that world outside is many a times different from what we have perceived. Without the support, guidance, co-operation and inspiration provided by different people this would not be possible. I express my admiration and lots of thank to all respondent for their support for providing fruitful information. I am also thankful to everyone who supported me, for completing my work effectively and moreover on time.

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The Study of Three Body Effects in Phonons using Parameter Free Pseudopotential in Symmetric Directions: Cu as a Test Case

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***Abstract*— In the present study, using parameter free local form of pseudopotential with inclusion of three body effects we have study phonon dispersion curves. The overall agreement with experimental results are fairly well. Further, the temperature variations of Debye-Waller factor and mean square displacement have been calculated by using computed phonon density of states. From present study, we conclude that three body forces in the study of phonons play an important role for the understanding of lattice mechanical properties of transition metals.**

***Keywords*— Phonons in symmetric directions, three body forces, Pseudopotential, Transition metals**

I. INTRODUCTION

Looking to the need of the study of many mechanical and thermodynamical properties at ambient condition and at extreme environment (High Temperature and High Pressure) there is a need of experimental as well as theoretical studies of lattice dynamics of metals, liquid metals and glasses. Experimentally phonon spectra are measured by using neutron scattering experiments. Theoretically phonon spectra has been calculated by using empirical potential pseudopotential and embedded atom method. Very recently with the increasing computational power of modern workstations ab initio calculations of phonons have become possible. The study of phonon spectra helps to understand the peculiarities of interatomic interactions in crystals. An experimental investigation of lattice dynamics together with a theoretical analysis gives the best possibility to study interatomic forces and related phenomena. The theoretical investigations based on density functional theory (DFT) differ, however in the treatment of the tightly bound core electrons and/or in the basis set used for describing the wave functions. Since very accurate full potential calculations (e.g. FLAPW) are very time consuming, even with modern workstations most studies have been restricted to selected phonon modes by using the frozen phonon approach. Baroni and co-workers [1] as well as other groups have used the formalism within a plane-wave basis and with pseudopotentials linearized Muffin Tin (MT) orbital versions and FLAPW versions have also been developed. The embedded atom method is also used for the study of lattice dynamics which is based on empirical assumptions. Tight Binding [TB] method is found to be the most reliable for such study. Phonon anomalies are also observed due to the treatment given to d electrons for the calculation of total energy in this method. Such model contains three or more adjustable parameters which are obtained by favouring some physical properties like elastic constants, phonon frequencies and bulk-modulii etc.

On the other hand, pseudopotentials in its different form, local, non-local and first principles, are used successfully for the description of not only lattice dynamics and lattice mechanical properties but also wide range of physical properties of all types of materials. Among all this forms of the pseudopotential, local pseudopotential method are used widely due to its computational simplicity and physical transparency alongwith transferability to extreme environment even for metals with complicated electronic structure like transition metals, rare earth metals, actinides and lanthanides [2]. Local pseudopotential can be used for the theoretical description of many physical properties with adjustment of valency [3]. Recently using second order perturbation theory sophisticated pseudopotential with proper dielectric function were used for the study of lattice mechanical properties of many transition metals [4-5]. In such research work, the short range d-d electrons interaction is accounted by Born-Mayer type of repulsive potential.

Looking to the aforesaid facts we find that the study of lattice mechanical properties require more adjustable parameter and such study is limited up to second order perturbation theory. The prime aim of the present paper is to carry out the study of lattice dynamics and lattice mechanical properties of FCC Cu as a test case using local form of the pseudopotential without adjustment of any parameters. The pseudopotential used is free from adjustment of parameters it means it is equivalent to first principles pseudopotential. There are several indications that third and fourth order terms play an important role in the lattice mechanical properties of metals [6]. In this context, for the complete description of lattice mechanical properties we also include three body forces which are found to be very rare for such studies. Kumar [7] has proposed local form of the pseudopotentialwith two

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parameters r_c – core radius and r_m – some atomic radius which is discontinuous in r-space has the following form,

$$V_{ion}(r) = \frac{-Ze^2 r}{r_m r_c} \quad for\ 0 < r < r_c$$
$$= \frac{-Ze^2}{r_m} \quad for\ r_c < r < r_m$$
$$= \frac{-Ze^2}{r} \quad for\ r_m < r \tag{1}$$

In the region $r < r_c$, there is no complete cancellation of potential but it decreases linearly and in the region r_c to r_m it remains constant. It possesses pure coulombic behaviour for the region outside r_m. The potential between region r_c to r_m accounts hybridization effects because in case of d-band metals there is no complete cancellation of potential within this range. This local form of the pseudopotential is found to be successful for the description of lattice dynamics of actinide thorium. The Fourier transform of Eq. (1) gives unscreened pseudopotential in momentum space [7]. Such unscreened pseudopotential is screened by using method discussed in Wallace [8]. In the present communication we have computed phonons in Cu in symmetric directions, the temperature variation of Debye-Waller factor (W_T) and mean square displacement ($\overline{U}^2$).

II. Theory

The lattice dynamics of metals has been discussed in complete detail by several authors. The total dynamical matrix $D_{\alpha\beta}(q)$ will consist of two terms,

$$D_{\alpha\beta}(q) = D^C_{\alpha\beta}(q) + D^E_{\alpha\beta}(q) \tag{2}$$

Here superscripts stand for Columbic and Electronic contributions. Also,

$$D^C_{\alpha\beta}(q) = \frac{2}{M}\Big[\sum_Q G_1\big(|\vec{Q}+\vec{q}|\big)\big(\vec{Q}+\vec{q}\big)_\alpha\big(\vec{Q}+\vec{q}\big)_\beta - \sum_Q G_1\big(|\vec{Q}|\big)Q_\alpha Q_\beta + \sum_R \{\varphi_1'(R)\delta_{\alpha\beta} + 2\varphi_1''(R)R_\alpha R_\beta\big(1 - cos\big(\vec{q}.\vec{R}\big)\big)\}\Big] \tag{3}$$

M is the mass of the ion.

$$G_1\big(|\vec{Q}|\big) = \frac{2\pi Z^2 e^2}{\Omega Q^2} e^{-Q^2/4\eta^2} \tag{4}$$

$$\varphi_1(R) = Z^2 e^2 R^{-1} erfc(\eta R) \tag{5}$$

η is an adjustable parameter and erfc(ηR) is a complimentary error function. $\varphi_1'(R)$ and $\varphi_1''(R)$ are first and second order derivatives of $\varphi_1(R)$. $D^E_{\alpha\beta}(q)$ describes electron-ion interaction which is made up of $D^{(2)E}_{\alpha\beta}(q)$ and $D^{(3)E}_{\alpha\beta}(q)$ i.e. second order and third order contributions to $D^E_{\alpha\beta}(q)$ due to pseudopotential, where,

$$D^{(2)E}_{\alpha\beta}(q) = \frac{2}{M}\Big[\sum_Q F\big(|\vec{Q}+\vec{q}|\big)\big(\vec{Q}+\vec{q}\big)_\alpha\big(\vec{Q}+\vec{q}\big)_\beta - \sum_Q{}' F\big(|\vec{Q}|\big)Q_\alpha Q_\beta\Big] \tag{6}$$

$$D^{(3)E}_{\alpha\beta}(q) = \frac{6\Omega}{M}\sum_{\vec{Q}_1,\vec{Q}_2,\vec{Q}_3}[(\vec{q}+\vec{Q}_1)_\alpha\,(\vec{q}+\vec{Q}_2)_\beta\ x\ \Gamma^{(3)}\big(\vec{q}+ Q1,-q-Q2,Q3\ x\ Vionq+Q1Vion-q+Q2VionQ3x \Delta(\vec{Q}_1-\vec{Q}_2+\vec{Q}_3)\big)] \tag{7}$$

$$\Delta\big(\vec{Q}_1-\vec{Q}_2+\vec{Q}_3\big) = 1\ for\ \vec{Q}_1+\vec{Q}_3 = \vec{Q}_2 = 0\ otherwise \tag{8}$$

The expression for $\Gamma^{(3)}\big(\vec{q}+\vec{Q}_1,-\vec{q}-\vec{Q}_2,\vec{Q}_3\big)$ is taken from [7].

III. Results and Discussion

In the present study, r_c is calculated using the formula given in [7] and experimental value of atomic radii is taken as r_m. As suggested by Moriarity, we have selected value of the valency within narrow range 1.1<Z<1.7. First time using above philosophy we have studied phonon dispersion relation including three body effects. The calculated frequencies in symmetric directions along with the experimental points due to [9] is as shown in Fig. 1. It is quite interesting to note here that the overall agreement with the experimental points for all branches are fairly well.

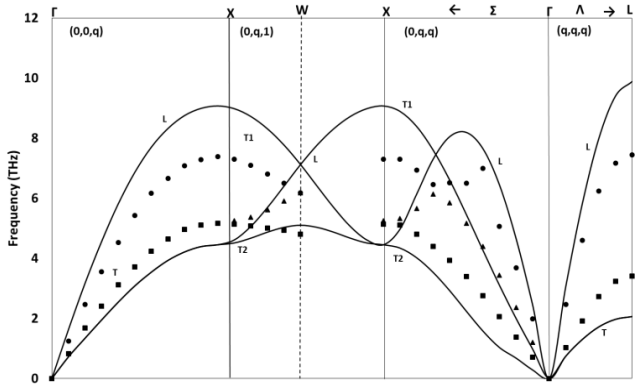


Fig. 1 Phonon dispersion curves of Copper in symmetric directions

paper The maximum deviation observed is less than 25%. Presently calculated results are better in the sense that no

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fitting and re-fitting of potential parameters have been done during the course of calculation to yield better agreement with experimental results at zone boundary. It has been noted by many researchers, for local and non-local pseudopotential, that for transition metals in order to account core-core repulsion, one must use Born-Mayer type of potential. Present calculation is free from adjustments of the parameters and potential itself accounts s, p and d hybridization. In this sense, presently used pseudopotential can be treated as first principles pseudopotential and three body forces do play an important role for the better understanding of phonons. Further in the harmonic approximation, we have computed phonon density of states using root sampling method. In such calculation the mesh of 64000 wavevectors have been taken in the first brillouin zone. With the help of calculated frequency distribution we have computed Debye-Waller factor (W_T) and mean square displacement ($\bar{U}^2$) using expressions described in [3]. The variations of W_T and $\bar{U}^2$ with temperature alongwith experimental points (Δ-W_T and • - $\bar{U}^2$) due to Penget. al. [10] are as shown in Fig. 2. The agreement between experiments and theory are quite well.

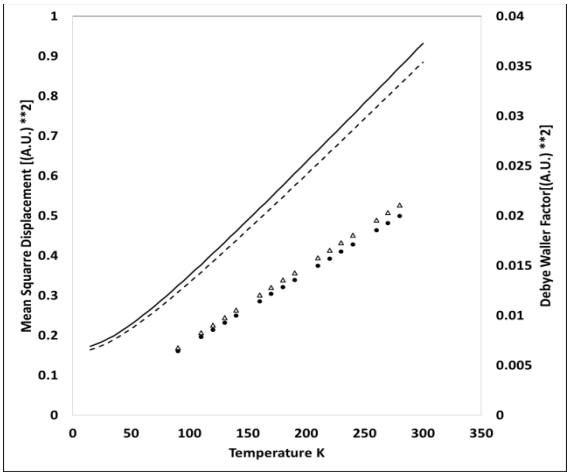


Fig. 2 Temperature variations of W_T and $\bar{U}^2$

IV. Conclusions

From the present study we conclude that even local pseudopotential without adjustments of any parameters with inclusion of three body forces can be used for the study of lattice dynamics and lattice mechanical properties in metals. The three body forces cannot be ignored for the better understanding of ion's vibrations. Such approach of calculation with local form of pseudopotential is equivalent to the study based on first principles pseudopotentials.

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Thermal Expansion and Bulk Modulus of Aluminium at High Temperature: a Mean Field Potential Approach

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***Abstract*— Theoretical calculation of temperature variation of relative volume thermal expansion and isothermal bulk modulus of aluminium (Al) up to melting temperature has been carried out using a conjunction scheme of mean field potential (MFP) and local pseudopotential. At such high temperature, anharmonic effects due to ionic vibrations and thermally excited electrons play an important role. Computed results are found to be in good agreement with experimental and other theoretical results. Such success reveals that anharmonic effects are accounted properly in the presently used conjunction scheme.**

***Keywords*— pseudopotential, mean field potential, anharmonic effects, thermal expansion, bulk modulus.**

I. INTRODUCTION

Study of thermodynamic properties of metals is important to understand their behaviour at simultaneous high temperature and high pressure where anharmonicity due to vibration of lattice ions and thermally excited electrons becomes important. Such research plays a crucial role in the description of many physical phenomenon like phase transition, phase diagram and pressure and thermal ionisation of ionic cores [1-2].

During literature survey, we found that experimental studies of thermodynamic properties of materials at extreme environment are scanty because of the fact that production of simultaneous high temperature and high pressure is very difficult [3]. Moreover, theoretical studies of physical properties of metals using first principles methods are mathematically complex as these methods are based on some well defined approximations.

As an alternative tool, pseudopotential method has proved its applicability in the study of physical properties of metals because of its conceptual simplicity along with computational efficiency and transferability to extreme environment [4-6].

Encouraged by such success of pseudopotential method, in the present study, we have carried out study of binding energy, lattice constant and bulk modulus of Al at 0K along with its relative volume thermal expansion as well as isothermal bulk modulus as a function of temperature up to melting temperature (melting temperature of Al is 933.5 K [7]).

The rest of the paper has been organised as follows. In section II, the construction of MFP in terms of cold energy and anharmonic contribution to the Helmholtz free energy are discussed. In section III, we have compared presently computed results with available experimental and other theoretical results. Paper is concluded in section IV.

II. THEORY

Total Helmholtz free energy for a metal is given by

$$F(\Omega,T) = E_c(\Omega_0) + F_{ion}(\Omega,T) + F_{eg}(\Omega,T) \qquad (1)$$

Here, $E_c(\Omega_0)$ represents cold energy which has been calculated by using pseudopotential in the framework of second order perturbation theory [8]. $F_{ion}(\Omega,T)$ represents vibrational free energy due to nuclear vibrations while $F_{eg}(\Omega,T)$ is contribution due to thermal excitation of electron gas. Recently Wang and Li [9] have proposed a method to calculate $F_{ion}(\Omega,T)$ using mean field potential (MFP) approach which has been constructed in terms of cold energy-E_c. In MFP approach, in the classical limit (i.e. T > Debye temperature-θ_D), a moving ion is supposed to experience the mean potential produced by nearby atoms which has been constructed in terms of cold energy as follows.

$$g(r,\Omega) = \frac{1}{2}[E_c(R_0+r) + E_c(R_0-r) - 2E_c(R_0)] + \left(\frac{\lambda}{2}\right)\left(\frac{r}{R_0}\right)[E_c(R_0+r) - E_c(R_0-r)] \qquad (2)$$

Here, r is deviation of lattice ion from its equilibrium position, R_0 is the lattice constant corresponding to equilibrium volume. The parameter λ is an integer with three possible values -1, 0 and +1 which correspond to three different choices of Gruneisen parameters [9]. We have used constant value of $\lambda = 1$ in the present study because it gives best results of thermal expansion which is also confirmed in other studies [4-6].

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Free energy due to thermally excited electrons is calculated by using by following equation [6, 10-12].

$$F_{eg}(\Omega, T) = E_{eg}(\Omega, T) - TS_{eg}(\Omega, T)$$

Here E_{eg} represents the free- electron kinetic, exchange and correlation energiey, which is already included in cold energy. S_{eg} is the entropy of electron gas.

In the present study, well established local form of the pseudopotential due to Fiolhais et al. [13-14] with universal set of parameters and actual valency (Z=3) has been used to investigate the aforesaid properties.

III. Result and Discussion

Volume variation of binding energy has been shown in Fig. 1.

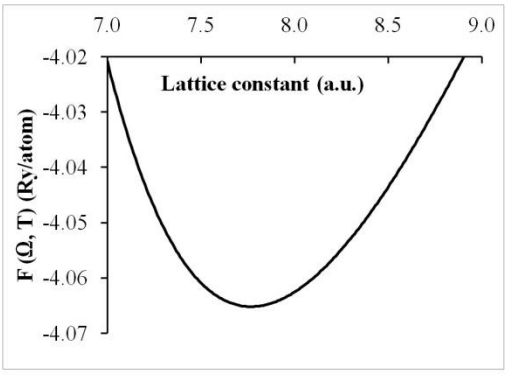


Fig. 1 Cold energy of Al as a function of lattice constant.

Minima of this curve (Fig. 1) gives theoretical results of binding (Cold) energy (E_c) and lattice constant (R_0) at 0K which are displayed in Table 1 along with experimental and other theoretical results. Experimental binding energy has been computed as sum of experimental results of cohesive energy and ionisation energies of valence electrons [15-16]. Experimental result of cohesive energy has been taken from park et al. [17] while ionisation energies have been taken from Ref.[18].

TABLE I
Comparison of Binding Energy, Lattice Constant and Bulk Modulus at 0K with Experimental and Other Theoretical Results

Property	Present	Expt.	Others
$-E_c$ (Ry/atom)	4.065	4.169	4.165[17], 4.1794[9], 4.205[19], 4.2294[a] [20], 4.1574[b][20]
R_0 (a.u.)	7.769	7.599[17]	7.580[17], 7.63[9], 7.5432[19], 7.56[21], 7.50[22]
B_0 (GPa)	81.503	79.4[17]	81.233[17], 82.4[19], 80.0[21], 79.4[22]

Presently computed results of binding energy and lattice constant have 2.49% and 2.24 % variations respectively with experimental results. In the present study, static bulk modulus-B_0 has been calculated as $B_0 = \left[\Omega\left[\frac{d^2E_c(\Omega)}{d\Omega^2}\right]\right]_{\Omega=\Omega_0}$ [9]. Computed Result of bulk modulus (B_0) at 0K is also found to be in good agreement with experimental result (having 2.65% variation) which is shown in Table 1. Park et al.[17] have used five van der Waals density functional (vdW-DF) and five dispersion corrected (DFT-D) vdW functional along with standard DFT functional of local density approximation (LDA) and generalized gradient approximation (GGA).The best results of binding energy, lattice constant and bulk modulus at 0 K are found by park et al. [17] by using optB88vdW, DFT D2 and DFT D3 respectively which are also tabulated in Table 1. Superscripts *a* and *b* in Table 1 represent values corresponding to DFT-LDA and variational Monte Carlo (VMC) methods. Computed results of binding energy, lattice constant and bulk modulus at 0 K are also in good agreement with other theoretical results.

Computed values of $F_{ion}(\Omega, T)$ as a function of temperature are displayed in Fig. 2. From Fig. 2 it is evident that $F_{ion}(\Omega, T)$ is significant above Debye temperature (Debye temperature-θ_D for Al is 428 K [7]). It is due to the fact that MFP approach is unable to account zero point energy as it is based on classical approximations. Moreover, due to increase in temperature, amplitude of oscillation of ions increases which results in the increase in volume of crystal.

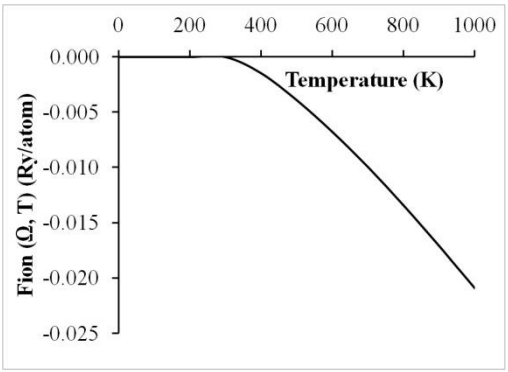


Fig. 2. $F_{ion}(\Omega, T)$ of Al as a function of temperature.

Further, we studied of volume variation of $F(\Omega, T)$ at different temperatures (see Fig.3). Minima of such curves give equilibrium volume (Ω) at given temperature (T).

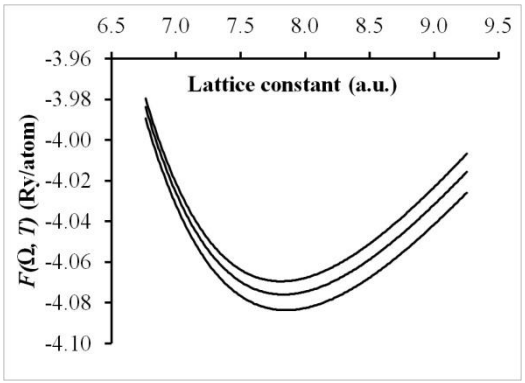


Fig. 3. $F(\Omega, T)$ of Al as a function of lattice constant. From top to bottom graph correspond to temperature 500K, 700K and 900 K respectively.

From Fig. 3, it seems that minima of these curves shift in the increasing direction of lattice constant which indicates that

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volume increases with increase in temperature. Relative volume thermal expansion (Ω/Ω_0) as a function of temperature is presented in Fig. 4 along with other experimental and theoretical results. Here Ω_0 and Ω are atomic volumes at 0K and given temperatures respectively. The presently computed result of relative volume thermal expansion has maximum 3.00% variation at 900K with experimental results due to Touloukian et al. [23] Such good agreement of computed results of relative volume thermal expansion with experiment reveals that anharmonicity has been accounted properly in the presently used conjunction scheme of MFP and local pseudopotential because thermal expansion arises as a consequence of anharmonicity in the inter-atomic potential. Theoretical results of relative volume thermal expansion due to Wang and Li [9] obtained by using first principle methods are better than present results.

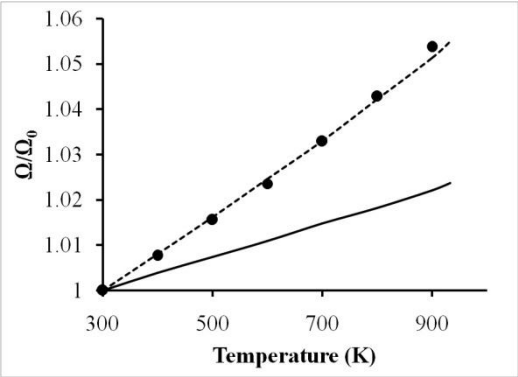


Fig. 4. Relative volume thermal expansion of Al as a function of temperature. Solid and broken line represent presently computed results and theoretical results due to Wang and Li [9] respectively. Solid circles are due to experimental results of Touloukian et. al.[23]

As a further test of predictivity of presently used conjunction scheme, we have studied temperature variation of isothermal bulk modulus of Al up to melting temperature which is defined as $B_T(\Omega,T) = \Omega\left(\frac{\partial^2 F(\Omega,T)}{\partial \Omega^2}\right)_T$ [9]. Bulk modulus is materials ability to resist deformation. Results of B_T obtained presently are shown if Fig. 5 along with experimental and other theoretical results.

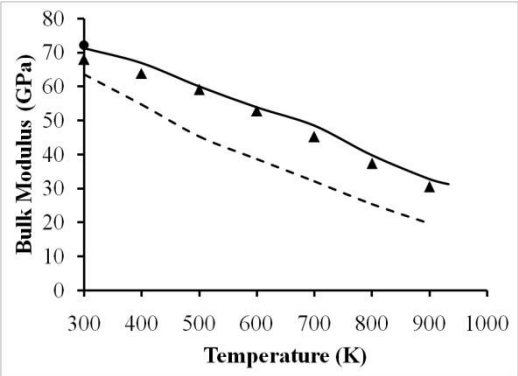


Fig. 5. Isothermal bulk modulus of Al as a function of temperature. Experimental point: solid circle at 300 K is due to Kittel [7] while solid triangles are due to Tallon and Wolfenden [24] respectively. Broken line represents first principle results of Wang and Li [9].

Computed results of isothermal bulk modulus are in good agreement with experimental results. It is observed from Fig. 5 that bulk modulus decreases with increase in temperature. Such trend is also observed in the experimental [24] and other theoretical result [9] of B_T.

IV. Conclusions

Present study confirms that the conjunction scheme of MFP and local pseudopotential is capable to describe thermal vibrations and hence anharmonicity at high temperature. The local pseudopotential due to Fiolhais et al. [13-14] is found to be transferable at high temperature because no fitting/refitting of pseudopotential parameters has been done during calculation to get good results at high temperatures. Calculated results can be improved especially at high temperature by adjusting the parameter λ which appears in MFP (see Equation 2) as a function of volume and temperature [25-27].

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Study of Magnetic Susceptibilities in Liquid Alkali Metals

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***Abstract*— The theoretical study of the magnetic susceptibilities of liquid alkali metals at their melting temperature is reported using a universal model potential proposed by Fiolhais *et al.* Fivedifferent local field correction functions known by Hartree (H), Taylor (T), Ichimaru-Utsumi (IU), Farid *et al.* (F) and Sarkar *et al.* (S) in the present computation for the first time with such model potential and found suitable. It is concluded that, the comparisons of present results with theoretical or experimental findings wherever exists are highly encouraging and found qualitative in nature.**

***Keywords*— Pseudopotential; Magnetic susceptibilities; Liquid alkali metals; Local field correction functions**

I. INTRODUCTION

During the last several decades the concepts of pseudopotential have played an important role in the theory of liquid metals and their alloys [1]-[12]. Baltensperger [3] has calculated the correction due to the electron-ion potential to the Landau diamagnetism in liquid metals, using the theory of the free electron susceptibility from the solid phase to the liquid phase, by employing the pseudopotential perturbation technique. Takahashi and Shimizu [4] have investigated the magnetic susceptibility of liquid metals by taking into account the higher order terms due to the electron-ion potential in the Green's function method. Srivastava [5] and Jani *et al.* [10] have reported on the electronic susceptibility of some simple liquid metals using an approach followed by Timbie and White [6]. The magnetic susceptibilities of some liquid non-transition and transition metals using newly proposed model potential was reported by Baria [11] and found suitable for his study. Also, we have [9] reported magnetic susceptibilities of large number of liquid metals using Ashcroft's empty core [13] single parametric pseudopotential. In the present article, we report the magnetic susceptibilities of liquid alkali metals based on the well-known universal model potential of Fiolhais *et al.* [14]. The theoretical structure factors are computed from the well-known Percus-Yevic (PY) hard sphere model with proper packing density η [15]. Five different types of the local field correction functions proposed by Taylor (T) [16], Ichimaru-Utsumi (IU) [17], Farid *et al.* (F) [18] and Sarkar *et al.* (S) [19] are employed for the first time to investigate the influence of exchange and correlation effects with reference to the static Hartree (H) [20] screening function in the present computations.

II. THEORY

The liquid metal analogy of Glasser's [7] result for the total electronic susceptibility is thus obtained as

$$\chi = \chi_O(1+\Delta), \tag{1}$$

here

$$\Delta = \frac{-3Z}{32\xi_O^2}\int_0^\infty dk\, a(k)W(k)^2 G(k), \tag{2}$$

and

$$G(k) = \frac{2}{k}\left(k^2-1\right)\ln\left|\frac{k+2}{k-2}\right| + \frac{8}{3}\left(\frac{12+7k^2-3k^4}{\left(k^2-4\right)^2}\right). \tag{3}$$

The orbital susceptibility in the liquid phase may be calculated separately in much the same way by omitting the spin term from the Hamiltonian. The relation is given by

$$\chi_L = -\frac{1}{2}\chi_O(1+\Delta_L), \tag{4}$$

with

$$\Delta_L = \frac{-3Z}{32\xi_O^2}\int_0^\infty dk\, a(k)W(k)^2 G_L(k). \tag{5}$$

and

$$G_L(k) = \frac{2}{k}\left(k^2-1\right)\ln\left|\frac{k+2}{k-2}\right| + \frac{8}{3}\left(\frac{24-22k^2+3k^4}{\left(k^2-4\right)^2}\right). \tag{6}$$

$$\chi_P = -\frac{3}{2}\chi_O(1+\Delta_P), \tag{7}$$

with

$$\Delta_P = \frac{-3Z}{32\xi_O^2}\int_0^\infty dk\, a(k)W(k)^2 G_P(k). \tag{8}$$

and

$$G_P(k) = 2\left(k^2-1\right)\ln\left|\frac{k+2}{k-2}\right| + \frac{8k^2}{\left(k^2-4\right)}. \tag{9}$$

Now, by including the exchange and the correlation due to Brueckner and Sawada[8],we get the relation for the total electronic susceptibility of liquid metals [9]

$$\chi_{ele} = -\frac{\chi_O}{1-\Delta_P+\delta_{ex.+corr.}} - \chi_O(1-\Delta_L). \tag{10}$$

with

$$\delta_{ex.+corr.} = \left[-0.166r_S + 0.204r_S^2\left(0.225-0.0676\ln r_S\right)\right]. \tag{11}$$

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Where, the value of r_S can be determined from the relation $r_S = (3\Omega_0/4\pi Z)^{1/3}$ .Also, χ_O the Landau-Pauli free electron susceptibility is computed directly from the given relation.The universal model potential of Fiolhais *et al.* [14] is used in the present computation including five different types of the local field correlation functions [16]-[20].The form factor used in the present investigation is of the form [14],

$$W(q) = \frac{4\pi Z e^2 R^2}{\Omega_O \varepsilon(q)} \left[\frac{-1}{(qR)^2} + \frac{1}{\left[(qR)^2 + \alpha^2\right]} + \frac{2\alpha\beta}{\left[(qR)^2 + \alpha^2\right]^2} + \frac{2A}{\left[(qR)^2 + 1\right]^2} \right] , \quad (12)$$

with $x = r/R$, R being a core decay length, and with $\alpha > 0$. An analyticity condition at $r = 0$ determines the parameters A and β in terms of α as follows,

$$\beta = \frac{\alpha^3 - 2\alpha}{4\left(\alpha^2 - 1\right)} \text{ and } A = \frac{1}{2}\alpha^2 - \alpha\beta . \quad (13)$$

Also, Z is the valence, Ω_O the atomic volume and $\varepsilon(q)$ the modified Hartree dielectric function [20].

III. RESULTS AND DISCUSSION

The input parameters and constants used in the present calculations are tabulated in Table I.Ourpresent investigation of the electronic susceptibility (χ_{ele}/χ_O) and total electronic susceptibility (χ) of alkali metallic elements are narrated in Tables II-III with experimental [1],[6] and theoretical [6],[11],[12] data wherever exists in the literature.

TABLE I
Input parameters and other constants

Metals	Z	Ω_O (au)	T (K)	η	α	R
Li	1	142.47	453	0.46	3.546	0.361
Na	1	254.25	378	0.46	3.074	0.528
K	1	480.84	343	0.46	2.806	0.745
Rb	1	588.98	313	0.43	2.749	0.823
Cs	1	743.53	323	0.43	2.692	0.919

TABLE II
Electronic susceptibility (χ_{ele}/χ_O) for liquid alkali metals

Metals	Present results					Expt. [6]	Others [6, 11, 12]
	H	T	IU	F	S		
Li	2.37	2.40	2.38	2.38	2.38	3.65	1.89, 2.11, 2.25
Na	2.38	2.42	2.39	2.39	2.39	1.88	1.51, 1.71, 1.84
K	2.38	2.42	2.39	2.39	2.39	2.03	1.5, 1.77, 1.95
Rb	2.40	2.45	2.41	2.40	2.40	2.03	1.46, 2.12, 2.34
Cs	2.39	2.45	2.40	2.40	2.40	2.73	1.46, 1.79

TABLE IIII
Total electronic susceptibility (χ) for liquid alkali metals

Metals	Present results					Expt. [1]
	H	T	IU	F	S	
Li	0.7810	0.7697	0.7788	0.7777	0.7786	1.80
Na	0.6484	0.6407	0.6470	0.6471	0.6474	0.63
K	0.5271	0.5219	0.5262	0.5266	0.5267	0.39
Rb	0.4921	0.4865	0.4912	0.4916	0.4917	0.30
Cs	0.4560	0.4512	0.4553	0.4557	0.4558	0.37

From the present study, it is observed that for electronic susceptibility (χ_{ele}/χ_O) for liquid alkali metals among all the employed five local field correction function the H (without exchange and correlation) shows the lowest value while T-function shows highest values. Also for the values of the total electronic susceptibility (χ) for liquid alkali metals, H-function shows higher values than the others. The presently computed data are found in good and qualitative agreement with the available experimental [1], [6] and theoretical [6], [11], [12] yielding. The presently reported magnetic susceptibility of liquid alkali elements have predicted positive values of susceptibility in comparison with negative experimental susceptibilities. Also, certain difference between the theoretically computed values and experimental data are attributed to the exchange enhancement of the conduction-electron spin life time. Also, the ionic potential factors Δ_L and Δ_P are much less important than the electron-electron enhancement factor $\delta_{ex.+corr.}$ used in the present computation [1].The magnetic susceptibility calculations are not particularly sensitive to the exact values of the structure factor of the metallic elements and uncertainties in the results cannot account for the differences between theory and experiment. Also, the numerical values of the magnetic susceptibilities are found to be quite sensitive to the selection of the local field correction functions and showing a minor variation with the change in the functions. Also, the discrepancies of the present results of the magnetic susceptibilities are found because of the principal contributions such as Δ_L and Δ_P which are structural dependent corrections. Also, the diamagnetic term is little affected by local field correction functions, but in real metal it may well be influenced by the distortion of the conduction electron wave function inside the cores which may causes approximately same results of the magnetic susceptibility of metallic elements computed from the various local field correction functions [1],[2].

IV. CONCLUSIONS

It is concluded that, the magnetic susceptibilities of some liquid alkali metals reported for the first time based on a Fiolhais *et al.*'s universal model potential with PY structure factor and H, T, IU, F and S-local field correction functions. Hence, such potential can predict the trend of the potential over the alkali elements.

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Regulating the Room Temperature in Residential Buildings through Houseplants

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Abstract: **Plants are natural sinks of carbon dioxide, it results into the reduction of air temperature. The vegetation is like "air-conditioner" that evaporates water and cools the surrounding. In order to reduce the room temperature and ultimately improving the indoor environmental status, the study was done with the 2 objectives, like to compare the utilization of foliage and succulent houseplants in decreasing the room temperature and to study the impact of houseplants in reducing the room temperature with different variations in the residences.** ***Experimental research design*** **was used in the 10 west facing RHB constructed houses along with the National Highway- 8 of polluted zone, in Udaipur. Four parameters, viz., Variation in houseplants, Placement of houseplants, Variation in days and Variation in habits were selected to be precised. Arithmatic Mean, paired t-test and ANOVA test for statistical analysis were used as per data observed. 4 in 1 Environment Tester was used to measure the temperatures for the study. Under the condition of keeping four succulent plants in drawing room with opened windows have shown that the average room temperature was decreased from 31.61°C to 23.11°C which means a fall in temperature. Further, all the statistical values of impact of houseplants among all the parameters further justifies the credibility of houseplants, hence, enhance the Indoor Air Quality (IAQ).**

Keywords: **Houseplants, Room Temperature, IAQ.**

I. INTRODUCTION

Indoor plants connect the human beings to nature. People, who feel connected to nature, feel happier. Indoor plants make them feel cooler on hot days, especially when they move softly in the breeze from a ceiling fan[1]. Plants are like lungs of the planet. As the plants are natural sinks of carbon dioxide, it results into the reduction of air temperature. Simultaneously, plants maintain the required relative humidity level by transpiring water vapours into the air. The leaves of the plants moves with the air movement, which increases the air flow rate. Thus, these factors in combination ultimately help in decreasing the air temperature[2].

Plants can reduce air temperature by blocking sunlight. Further cooling occurs when water evaporates from the leaf surface. The conversion of water to air vapor - a chemical process- removes heat energy from the air. They can be a natural air conditioner. The evaporation from a plant can produce the cooling effect[3].

The vegetation is like "air-conditioner" that evaporates water and cools the surrounding. But as the plant die, that cooling function disappears. It has the potential to speed global warming worldwide. It was found that plants cool the surroundings by the process called transpiration, which, according to the U.S. Department of Agriculture, decreases air temperature by ten degrees. As per the International Society of Arboriculture, the net cooling effect of young healthy plant is equivalent to room size air conditioner operating 20 hours a day. Proper selection and placement of plant materials can lower heating and cooling costs by as much as 20%. This enthusiastically endorses the use of indoor plants[5].

Houseplants reduce temperatures by using sunlight for photosynthesis, converting the solar energy (heat) into food and life-giving oxygen, and also by evapo-transpiration to cool themselves and the surrounding air. A single healthy plant can transpire up to several gallons of water a day, producing the cooling effect[6].

Most of the researches have been conducted in foreign countries that to in the glass chambers with controlled conditions. So this had been conducted to find out the impact of houseplants on IAQ in the Indian context with day to day routine, without any control on surroundings. Furthermore, in order to reduce the room temperature and ultimately improving the indoor environmental status, following are the objectives:

1) To compare the utilization of foliage and succulent houseplants in decreasing the room temperature.
2) To study the impact of houseplants in reducing the room temperature with different variations in the residences.

II. MATERIALS AND METHODS

A. Research Design:

To achieve the planned objectives the present study was carried out by using *Experimental research design.* The zone selected as sample for the purpose of the present study falls under the polluted zone as per the U.I.T, Udaipur. In this polluted zone, there were 15 west facing houses along with the National Highway- 8 in Udaipur. These houses were constructed by Rajasthan Housing Board (RHB). Out of these 15 houses, 10 houses were selected purposively for conducting all the experiments. The drawing and living/dining rooms of the ten residences selected as sample were purposively utilized for conducting all the experiments.

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In order to be precise in measuring the impact of houseplants on room temperature in residences considering the following **4 parameters**, viz., Variation in houseplants, Placement of houseplants, Variation in days and Variation in habits

- *Variation in houseplants*: The two most common types of houseplants, i.e., foliage and succulent plants had been purposively selected. The varieties of these two types of houseplants are as under:

Type 1: Foliage Plants- Leafy plants grown for their broad, green/ coloured leaves. Varieties of foliage houseplants selected for the experiment were: Alocasia (*Alocasia indica*), Syngonium (*Syngonium podophyllum*), Money-plant (*Scindapsus arboricola*), Dumb cane (*Dieffenbachia amoena*).






Type 2: Succulents- Evergreen attractive plants with fleshy leaves. Varieties of succulents selected for the research were: Kalanchoe *(Klanchoe pinnata*), Mother in-law's tongue (*Sansevieria trifasciata 'Laurentii'*), Devil's backbone *(Pedilanthus tithyloides*), Boat Lily (*Rhoeo spathacea*).






- *Placement of houseplants:* Potted houseplants were placed in the following manner:
  - Single potted plant in one suitable corner of the room,
  - Two single potted plants in two suitable corners of the room,
  - Four single potted plants in four corners of the room.

- *Variation in days:* The time required for conducting each experiment was 3 days.

Day 1 (Pre test) - Before placing the houseplants, to find out the existing status of Room temperatures.

Day 2 (Post test) - Keeping the selected number of houseplants in selected rooms in the residences to judge the impact of houseplants on Room temperatures.

Day 3 (Post test for retention) – After removal of houseplants to identify the retention of changed Room temperatures, if any.

- *Variation in habits:* People generally live with the following practices in their houses, so the same practices were included in the variations for conducting the experiments: **1.)** Opened and closed windows, **2.)** Fan in ON and OFF mode.

B. Conducting the experiments:

To measure the room temperature in selected residential buildings the equipment "4 in 1 Environment Tester" was used. This equipment records four measure, viz., temperature, relative humidity, air flow rate and intensity of light at a time.



4 in 1 Environment Tester

To avoid ambiguity in data collection the following measures were taken:

- ❖ The experiments were conducted in the month of April and May, when the atmospheric ambient temperature was maximum.
- ❖ The ambient temperature each day for the complete duration of the experiments were collected from the data recorded by the office of the daily newspaper, Rajasthan Patrika, published in Udaipur. This measure was taken to help the researcher in avoiding day to day environmental changes, if any in the temperature and indoor readings of temperatures were calculated accordingly.
- ❖ All the readings were taken on day 1, day 2 and day 3 at 3:00 PM.

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- On day 2 houseplants were kept at 10:00 AM.
- On day 3 houseplants were removed at 10:00 AM. Thus the duration of keeping houseplant/s was 24 hours.
- The data was collected with performance of daily routine activities such as normal living conditions, dusting, brooming and mopping and other miscellaneous activities.

C. Analysis of Data

1. To study the role of houseplants in improving the indoor environmental status Arithmatic Mean was calculated.
2. To study the impact of houseplants on the indoor environmental status paired t-test was applied.
3. To analyze the role of different attributes of houseplants in judging the various parameters of the environmental status ANOVA test was used.

III. Results & Discussion

Room Temperature measurement is often collected as part of an IAQ investigation because this parameter affects the perception of comfort in an indoor environment. This parameter of thermal comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments and body temperature. The ideal room temperature for human beings recommended by ASHARE (*American Society of Heating, Air conditioning and Refrigeration Engineers, U.S.*) ranges between 22° C- 24° C.[4]

It can be observed from the data presented in tables 1 and 2 that the use of houseplants in residential buildings have shown a greater impact in improving the IAQ with special reference to regulating room temperature by creating thermal comfort. The tables 1 and 2 shows the comparative mean differences in room temperature prevailing during the time of experiments under various parameters selected for the study to judge the impact of houseplants. All the selected areas had an average room temperature ranging between minimum 22.59°C to maximum 33.47°C during the experiment period irrespective of various parameters. To be more specific about impact of houseplants on IAQ with special reference to room temperature with different parameters, the discussion has been presented under the following heads:

A. Impact of Types of Houseplants on Room Temperature

- *Foliage v/s Succulent plants:*

Among the parameters selected first was to judge the difference between the selected foliage and succulent houseplants and their impact on IAQ with special reference to room temperature. It is apparent from the data presented in tables 1 and 2 that the succulent plants were found to be more effective under all the selected variations, as compared to the foliage plants. Under the condition of keeping four succulent plants in drawing room with opened windows have shown that the average room temperature decreased from 31.61°C to 23.11°C which means a fall in temperature was recorded to be 8.50° C. Whereas, on comparison with four foliage plants under the same condition there was a difference in room temperature from 29.10°C to 22.59°C resulting into a fall in average room temperature up to 6.51°C. The room temperature recorded during the experimentation after keeping houseplants found to be much closer to the ideal range of room temperature (22°C- 24°C). On the contrary, the minimum declination in room temperature was 2.69°C between day one (without any houseplant) and day 2 (after keeping houseplant/s) by keeping only one succulent houseplant in dining/ living room with fan OFF condition.

Likewise, it can also be extrapolated that after removal of houseplant on day three (after removal of houseplant/s), the room temperature started rising (from 23.11°C- 30.20°C) and was reaching almost similar to the average room temperature recorded on day 1, i.e., without keeping any houseplant in the room. Thus, it further emphasizes that the presence of houseplants help in maintaining the ideal range of room temperature for comfort.

Though the foliage plants also helped in regulating the room temperature as per the standards for thermal comfort but the performance was observed to be more significant in case of succulent plants. Overall, it can be concluded that one, two or four succulent plants were more efficient as compared to foliage plants to regulate the room temperature.

B. Impact of Number and Placements of Houseplants on Room Temperature

The second parameter selected was to find out the impact on average room temperature according to the variation in number and placements of houseplants. The average mean difference in declining the room temperature increased as the number of houseplants augmented, in both types of plants. The one succulent plant, in drawing room with fan ON condition, was helpful in decreasing the room temperature with a fall of 3.90°C (30.53°C to 26.63°C). While seeing towards the two or four succulent houseplants under the same conditions there was a fall in room temperature of 5.14°C and 6.24°C, respectively. The same pattern was visible in fall of room temperature in all the experiments with the selected parameters can be visualized. Thus, it can be analyzed that increment in number of plants for keeping indoors can be decided as per the room size. Spacious rooms may require a large number of plants for better IAQ. Hence, number of plants can be increased to improve IES by regulating the room temperature.

C. Impact of Houseplants on Room temperature with Variation in Days

It is noticeable in tables 1 and 2 that the average room temperature in all the conditions was found to be higher when no houseplant/s were kept on day one as compared to average room temperature with houseplant/s on day two. Similarly when houseplant/s were removed on day three the

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average room temperature consequently started rising and reached almost equivalent to day one. The difference in mean room temperature can easily be seen in any of the combination of parameters between day one and day two, and day two and day three to judge the impact of houseplants in reducing the room temperature. The room temperature decreased from day one's temperature 28.81°C to 22.60°C with a fall of 6.21°C after placing the two foliage plants in drawing room on day two. Room temperature of day three came back to average mean room temperature of day one after removing the plants. So there was an increment of 5.00°C in room temperature was observed from 22.60°C to 27.50°C.

D. Impact of Houseplants on Room Temperature with Variation in habits

Perusal of tables 1 and 2 clearly reveals that the people tend to keep the windows opened or closed and fan ON and OFF position. All the experiments were done to find out the impact of houseplants on IES, especially with room temperature, with these habits, so that people can keep the plants indoors accordingly.

❖ *Opened windows v/s Closed windows:* It can be alleged from the horizontal average total of tables 1 and 2 that both types of houseplants helped in maintaining the thermal comfort in both the habits. Further succulents' performance was better in declining the room temperature in both the situations, i.e., 6.69°C (from 32.52°C to 25.83°C) and 7.85°C (from 31.60°C to 23.75°C), respectively as compared to foliage plants with 6.18°C and 7.36°C in opened and closed windows, respectively.

❖ *Fan ON v/s Fan OFF condition:* It was observed in tables 1 and 2 that houseplants again performed well in regulating the room temperature in both the situations. Further, four succulent plants' performance in dining / living room was better with a reduction of 7.08°C in comparison to four foliage plants with a reduction of 6.07°C in the fan OFF situation. On the other hand, the four foliage plants were able to reduce average room temperature up to 7.10°C as compared to four succulent plants with the ability to reduce average room temperature up to 6.13°C in fan ON condition. So, it can be concluded that to make the indoor surroundings comfortable, people can try the combinations of houseplants with variation in their habits by considering the above results.

E. Impact of Houseplants on Room Temperature in selected Rooms of residences

It is clear from the tables 1 and 2 that houseplants regulated the room temperature equally, in both the selected rooms (viz. drawing room and dining/living room). There was no noticeable difference observed. Whatsoever differences were observed they were because of variations in constructional features.

F. Statistical Analysis of Data

❖ Table 3 highlights the differences in Analysis of Variance (ANOVA) values of impact of houseplants among all the parameters further justifies the credibility of houseplants.

❖ Table 4 indicates the paired- t values to find out the day wise impact of houseplants in regulating the room temperature. It may be seen that a highly significant difference at 1% level of significance in judging the effectiveness of houseplants with respect to all the selected parameters.

IV. Summary & Conclusion

A study supported the results that plants are like lungs of the planet. They breathe-in carbon dioxide and breathe-out oxygen. Carbon dioxide is one of the major contributing element to green house effect. Plants trap carbon dioxide from the atmosphere and make carbohydrates that are used for plant growth. They give oxygen in return. As the plants are natural sinks of carbon dioxide, it results into the reduction of air temperature. Simultaneously, plants maintain the required RH level by transpiring water vapours into the air. The leaves of the plants moves with the air movement, which increases the air flow rate. These factors in combination ultimately help in decreasing the air temperature. Hence, it is extrapolated that houseplants have a significant role in maintaining the thermal comfort by regulating the room temperature inside the residential buildings and help in improving the IAQ [4].

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TABLE I

COMPARATIVE MEAN ROOM TEMPERATURE (IN ° C) IN SELECTED ROOMS ACCORDING TO HABITS AND NUMBER OF FOLIAGE PLANTS

Type of houseplants	**Foliage houseplants**																	
Number of houseplants	**One Foliage Plant**						**Two Foliage Plants**						**Four Foliage Plants**					
Rooms	**Drawing Room**			**Dining/ Living Room**			**Drawing Room**			**Dining/ Living Room**			**Drawing Room**			**Dining/ Living Room**		
Days	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Habits																		
Opened Windows	29.14	26.31 ↓2.83	28.82 ↑2.51	29.16	24.51 ↓4.65	28.73 ↑4.22	28.81	22.60 ↓6.21	27.50 ↑5.00	29.20	23.68 ↓5.52	28.79 ↑5.11	29.10	22.59 ↓6.51	27.81 ↑5.22	29.11	23.00 ↓6.18	28.82 ↑2.51
Closed Windows	31.11	26.40 ↓4.71	29.63 ↑3.23	32.66	26.99 ↓5.67	30.95 ↑3.96	31.11	25.72 ↓5.39	30.14 ↑4.42	32.68	25.92 ↓6.76	31.05 ↑5.13	32.68	25.85 ↓6.83	30.90 ↑5.05	31.35	23.99 ↓7.36	29.63 ↑5.64
Fan "ON"	29.08	24.36 ↓4.72	28.67 ↑4.31	29.08	23.76 ↓5.32	28.67 ↑4.91	28.62	24.70 ↓3.92	28.04 ↑3.34	28.94	22.66 ↓6.28	27.41 ↑4.75	28.59	24.00 ↓4.59	27.87 ↑3.87	30.10	23.00 ↓7.10	28.84 ↑5.84
Fan "OFF"	29.14	25.91 ↓3.23	28.82 ↑2.91	29.20	26.28 ↓2.92	28.79 ↑2.51	29.10	23.60 ↓5.50	27.31 ↑3.71	29.16	24.86 ↓4.30	28.73 ↑3.87	29.71	22.59 ↓7.12	27.64 ↑4.95	28.91	22.84 ↓6.07	27.63 ↑4.79

TABLE II

COMPARATIVE MEAN ROOM TEMPERATURE (IN ° C) IN SELECTED ROOMS ACCORDING TO HABITS AND NUMBER OF SUCCULENT PLANTS

Type of houseplants	**Succulent houseplants**																	
Number of houseplants	**One Succulent Plant**						**Two Succulent Plants**						**Four Succulent Plants**					
Rooms	**Drawing Room**			**Dining/ Living Room**			**Drawing Room**			**Dining/ Living Room**			**Drawing Room**			**Dining/ Living Room**		
Days	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Habits																		
Opened Windows	32.52	27.70 ↓4.82	30.42 ↑2.72	31.55	27.16 ↓4.39	30.06 ↑2.90	33.45	27.64 ↓5.81	32.27 ↑4.63	31.51	25.67 ↓5.84	29.26 ↑3.59	31.61	23.11 ↓8.50	30.20 ↑7.09	32.52	25.83 ↓6.69	31.26 ↑5.43
Closed Windows	32.30	27.54 ↓4.76	31.40 ↑3.86	32.30	27.83 ↓4.47	31.33 ↑3.50	30.34	24.74 ↓5.60	29.83 ↑5.09	31.02	24.92 ↓6.10	30.35 ↑5.43	31.35	23.00 ↓8.35	30.65 ↑7.65	31.60	23.75 ↓7.85	30.61 ↑6.86
Fan "ON"	30.53	26.63 ↓3.90	29.61 ↑2.98	30.66	26.82 ↓3.84	29.66 ↑2.84	31.56	26.42 ↓5.14	30.20 ↑3.78	32.64	27.40 ↓5.24	30.89 ↑3.49	30.04	23.80 ↓6.24	28.54 ↑4.74	30.60	24.47 ↓6.13	29.59 ↑5.12
Fan "OFF"	31.07	25.94 ↓5.13	30.32 ↑4.38	31.45	28.76 ↓2.69	30.06 ↑1.30	33.47	26.72 ↓6.75	32.40 ↑5.68	31.56	25.67 ↓5.89	29.32 ↑3.65	32.52	24.56 ↓7.96	31.26 ↑6.70	32.52	25.44 ↓7.08	31.26 ↑5.82

Days- Day 1- Existing Room Temperature without any Houseplant.
Day 2- Room Temperature after keeping the Houseplant/s.
Day 3- Room Temperature after removal the Houseplant/s.

Arrows-
↓- denotes decrease in Room temperature (Temp. of Day 2 was subtracted from the temp. of Day 1).
↑- denotes increase in Room temperature (Temp. of Day 3 was subtracted from the temp. of Day 2).

TABLE III

ANOVA VALUES OF ROOM TEMPERATURE (IN ° C) IN SELECTED ROOMS ACCORDING TO HABITS AND NUMBER OF HOUSEPLANTS

Type of Houseplants	Foliage Houseplants					
No. of Houseplants	One Foliage Plant		Two Foliage Plants		Four Foliage Plants	
Rooms	Drawing Room	Dining/ Living Room	Drawing Room	Dining/ Living Room	Drawing Room	Dining/ Living Room
Habits						
Opened windows	15. 91*	32. 05*	49. 26*	51. 97*	161.65*	34.77*
Closed windows	35. 53*	37. 51*	39. 16*	59. 08*	50.60*	67.01*
Fan ON	46. 71*	64. 38*	37. 62*	103. 43*	33.41*	168.44*
Fan OFF	32. 01*	25. 61*	132. 04*	43.38*	66.75*	46.98*
Type of	Succulent Houseplants					

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Houseplants						
No. of Houseplants	One Succulent Plant		Two Succulent Plants		Four Succulent Plants	
Rooms	Drawing Room	Dining/ Living Room	Drawing Room	Dining/ Living Room	Drawing Room	Dining/ Living Room
Habits Opened windows	25.67*	29.92*	52.01*	46.90*	90.05*	34.66*
Closed windows	35.94*	31.23*	53.87*	36.68*	127.92*	64.28*
Fan ON	30.09*	54.32*	27.76*	40.05*	29.10*	63.32*
Fan OFF	35.15*	19.59*	54.57*	47.93*	53.03*	43.67*

* Significant at 5 % Level of Significance.

TABLE IV

PAIRED- T VALUES OF ROOM TEMPERATURE (IN ° C) IN SELECTED ROOMS ACCORDING TO HABITS AND NUMBER OF HOUSEPLANTS

Type of Houseplants	Foliage plants											
Number of Houseplants	One Foliage Plant				Two Foliage Plants				Four Foliage Plants			
Rooms	Drawing Room		Dining/ Living Room		Drawing Room		Dining/ Living Room		Drawing Room		Dining/ Living Room	
Days	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3
Habits Opened Windows	12.52**	12.07**	13.64**	13.31**	13.50**	10.64**	13.27**	13.10**	15.30**	12.99**	20.92**	7.56**
Closed Windows	12.08**	8.20**	12.97**	7.82**	15.62**	13.00**	20.35**	12.40**	13.05**	7.31**	11.93**	12.37**
Fan "ON"	17.55**	15.56**	18.03**	18.67**	20.42**	17.58**	29.07**	16.38**	7.67**	8.32**	34.13**	24.85**
Fan "OFF"	15.45**	15.40**	9.87**	9.30**	16.77**	8.63**	15.36**	16.54**	12.97**	8.24**	15.64**	10.81**
Type of houseplants	Succulent plants											
Number of Houseplants	One Succulent Plant				Two Succulent Plants				Four Succulent Plants			
Rooms	Drawing Room		Dining/ Living Room		Drawing Room		Dining/ Living Room		Drawing Room		Dining/ Living Room	
Days	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3	D_1-D_2	D_2-D_3
Habits Opened Windows	33.90**	13.67**	20.51**	13.55**	19.89**	14.84**	19.86**	9.97**	46.70**	17.42**	13.22**	4.38**
Closed Windows	15.35**	14.40**	11.67**	9.59**	16.20**	15.71**	12.07**	7.96**	22.51**	20.29**	16.77**	11.34**
Fan "ON"	12.00**	9.77**	11.74**	12.24**	11.68**	6.81**	9.79**	6.78**	16.00**	7.25**	13.36**	10.18**
Fan "OFF"	11.79**	11.29**	21.01**	8.23**	16.87**	14.02**	20.31**	10.14**	20.20**	7.47**	28.89**	6.44**

** Significant at 1 % Level of Significance.

D_1-D_2 – Difference in Room temperature between day 1 and day 2. D_2-D_3 – Difference in Room temperature between day 2 and day 3.

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Technological Empowerment of Farm Women in Terms of Gain in Skill of Selected Animal Husbandry Technologies Related to Drudgery Reduction

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Abstract: **-The present study was conducted in Gonda district of Uttar Pradesh. The purpose of the study was to assess the technological empowerment of farm women in terms of gain in skill in selected drudgery reducing technologies related to animal husbandry. The 100 farm women were randomly selected for technological empowerment through training from two purposively selected panchayatsamities. Personal interview technique was used for collecting data. The findings of the study reveal that very few respondents (4%) could handle the rake correctly before exposure of training. However none of the respondents were able to handle the shovel and moving stool initially. The post training data indicated tremendous gain in skill as majority of the respondents were able to use all the selected animal husbandry technologies as shown by MPS ranging between 84.6-91.0. Intervention further improved knowledge as most of the respondents gained skill in correctly handling the technologies as indicated by MPS of 94.3-97.0.**

I. INTRODUCTION

Agriculture is accounting for 14 per cent of the nation's GDP, about 11 per cent of its exports, about half of the population still relies on agriculture as its principal source of income and it is a source of raw material for a large number of industries. Indian agriculture is predominantly part of a mixed crop-livestock farming system. The livestock sector supplements income of the farmers, provides employment, draught power and manure. The development of livestock sector is more inclusive and can result in a sustainable agriculture system. India is the largest producer of milk in the world, with an estimated milk production of 127.9 million tonnes in 2011-12 (Kekane, 2013).

It is established beyond doubt that women always participated in dairy and animal husbandry activities in addition to their daily household chores. Although the role and contribution of women members of every rural family to dairying is not documented yet is well as known significant. About 75 million women as against 15 million men are engaged in dairying in India (Chander and Thakur 2006).Women play an important role in animal husbandry activities as manager, decision makers and skilled workers. They help in farm operations, take their animals for grazing, look after the sale of milk, and in addition, perform the functions related to house management. Rural woman contributes a share of more than 75 per cent in animal husbandry operations (Census 2011). In many places the entire management of livestock viz., chopping of fodder, feeding, milking, preparation of milk products, cleaning of cattle shed, collection of cow dung for manure pits and their storage is done by women alone. The amount of work done in these activities ranged from 75-100 per cent.

Drudgery is generally conceived as physical and mental strain, agony, monotony and hardship experienced by human being, while all these result in decline in living and working conditions affecting men and women alike. Drudgery is a term used to represent the dissatisfaction experiences that constrain work performance.

Almost all women suffer physical drudgery in various operations like hard physical work in care and management, harvesting, threshing/ processing, marketing and bartering of produce, harvesting by bending, weeding with conventional implements by hand in hot sun, rain and cold for long hours, dehusking/ shelling, pounding, grinding of cereals and pulses by hand, collecting and carrying fuel over long distance, fetching of water from cooking and drinking from distant places.

Most of these tasks performed by women are tedious as well as time consuming. As most of these operations are done manually (using hand, foot or head) or by using traditional tools, they are slow and cause considerable fatigue and drudgery. Also many of these operations are traditionally done in varying body posture some of which if done for long duration are not only inconvenient but also cause body pain. The farm women put in hard physical labour beyond their capacity. All these factors result in physical and mental fatigue, monotony hardship, exploitation, pain, economic stress etc. The plight of the women in this regard is alarming as they are constrained by illiteracy, poor health, unemployment and low technical knowhow and skill. The result is that women's needs for comfortable work participation remain neglected. Drudgery reduction is possible outcome that makes women work with improved productivity capacity and health. A desired change in the life of rural women, which is full of drudgery, can be brought by the use

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of application of simple, scientific and appropriate technologies. Such an outcome needs location specific package of technologies and a systematic approach of intervention.Technological empowerment refers to acquiring awareness, knowledge and understanding about new technologies, obtaining new skills, experience and greater confidence and competence in using these technologies. It can help women to better equip themselves for more fruitful and result oriented participation in different activities.therefore the present study was conducted to access the technological empowerment of farm women in terms of gain in skill of selected animal husbandry technologies related to drudgery reduction.

II. MATERIAL AND METHODS

The study was conducted in two purposively selected panchayatsamities of Gonda district of Uttar Pradesh, namely Paraspur and Jhanjhari. For technological empowerment of farm women in selected drudgery reducing technologies, 3 technologies related to animal husbandry were selected. Five training programme each of 4 days duration were organized for a group of 20 farm women. Thus 100 farm women were covered for technological empowerment of farm women through training. The training were organized at KrishiVigyan Kendra, Gonda as per plan for technological empowerment of farm women through different training methods like interactive lecturette, interactive demonstration and practice session supplemented with leaflets, folders and a film. Post test was conducted to find out gain in skill of farm women in selected drudgery reducing technologies related to animal husbandry. After one month of training intervention was organized. During intervention period all the technologies were given to the women to use for at least 8-10 days.

III. RESULT AND DISCUSSION

Skill in handling a technology or implement is important. If a person acquires skills, he feels very confident in handling an equipment. This helps in taking a decision in favour of adoption of technology. Thus once a person becomes aware of technology and develops a favorable attitude, he wants to try it by using the technology in his own situation. Skill is important in this stage of trial which will lead to conviction and finally, adoption of the technology.

A- Gain in skills of the respondents in using selected drudgery reducing technologies in animal husbandry

Skill test was conducted before training to know initial skills and after training and intervention to find out the gain in skills of the respondents in use of selected drudgery reducing technologies, for which identical skill test was used.

Table: 1.1 Initial, post training and post intervention skill of the respondents about selected drudgery reducing technology related to animal husbandry

n=100

S. No.	Items	Skill(f/%)		
		Initial	Post training	Post intervention
1.	**Rake**			
	a) Holding the upper part of the handle.	4.0	87	95
	b) Move the rake for collecting agriculture waste.			
	c) Putting the dung and fodder in the garbage cottage.	4.0	85	94
		4.0	82	94
2.	**Shovel**			
	a) Holding the upper part of the shovel handle.	0.0	89	94
	b) Move the shovel for collecting cow dung, fodder etc.			
	c) Putting the dung and fodder in the garbage collector/ bin.	0.0	89	95
		0.0	86	94
3.	**Moving stool**			
	a) Proper sitting posture.	0.0	92	97
	b) Move the stool backward and forward according the work.	0.0	90	97

Rake-It can be seen from Table 4.29 very few of the respondents (4%) could handle the rake correctly before training. The post training data reveal that training helped majority of the respondents (82-87%) to correctly perform the steps like holding the upper part of the handle, move the rake for collecting and putting fodder in a garbage bin. The post intervention data show further improvement in skill. Most of the respondents (94-95%) were able to use rake correctly after one month of intervention. For few respondents (5-6%), more practice was required to correctly handle the rake.

Shovel- Data in Table 1.1shows that initial skill of all the respondents regarding shovel was nil. The post training data reveal tremendous gain in skill. Majority of the respondents (86-89%) could able to handle the shovel correctly i.e. Holding the upper part of the shovel handle, move the shovel for collecting cow dung, fodder etc. and putting the dung and fodder in the garbage collector/ bin.After one month of intervention remarkable gain in skill was observed. Most of the respondents (94-95%) could able to handle the shovel correctly. The respondents perceived the benefits of using the shovel, so they were keen to learn about it.

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Moving stool- Perusal of Table 1.1 indicate that none of the respondents were able to handle the moving stool initially. The post training data reveal that most of the respondents (90-92%) could handle the moving stool correctly. The skill required for using moving stool were proper sitting posture and move the stool backward and forward according to work. The post intervention data show that most of the respondents (97%) were able to use moving stoolproperly. Probe into the matter revealed that moving stool helped to avoid wastage of milk, animal attack and drudgery.

B. Overall skill of the respondents in selected drudgery reducing technology related to animal husbandry

Table 1.2 : Categorization of respondents on the basis of their overall skill of selected drudgery reducing technology related to animal husbandry

n=100

S. No.	Technologies	Skill (f/%)								
		Initial			Post training			Post intervention		
		Good	Average	Poor	Good	Average	Poor	Good	Average	Poor
1.	Rake	0.0	0.0	100	86	2.0	12	95	5.0	0.0
2.	Shovel	0.0	0.0	100	89	4.0	9.0	95	5.0	0.0
3.	Manger	0.0	0.0	100	92	0.0	8.0	97	3.0	0.0

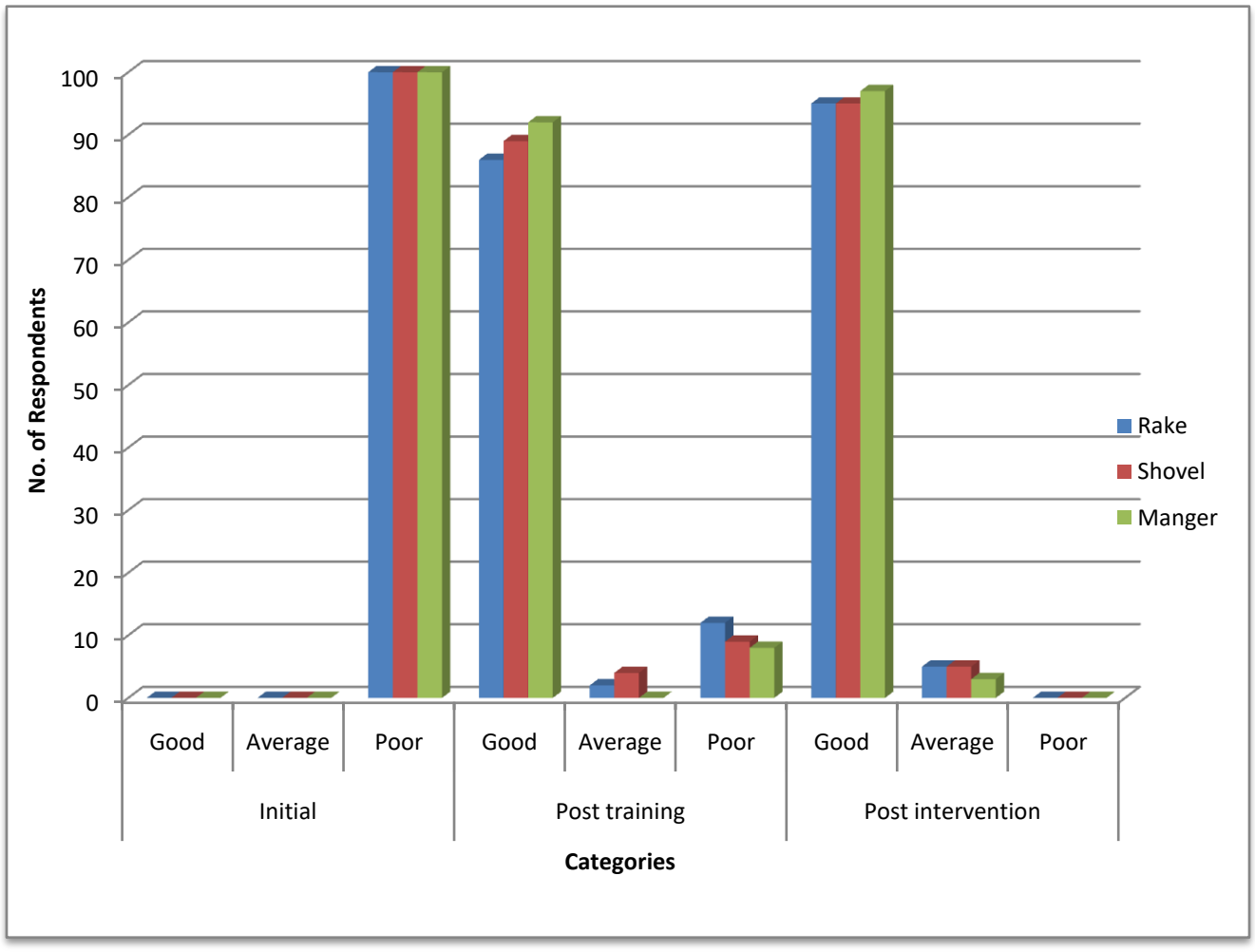


Fig. 1.1 :Categorization of respondents on the basis of their overall skill of selected drudgery reducing technology related to animal husbandry

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Data presented in Table 1.2 regarding the overall skill of the respondents in use of selected drudgery reducing technology related to animal husbandry reveal that initially all the respondents (100%) were in poor skill category. Probe into the matter reveal that some of the respondents were never exposed to such type of animal technology in animal husbandry and had unfavorable attitude towards use of these technology. The post training data reveal tremendous gain in skill after training. Majority of the respondents (86-92%) learnt 'good skill' about rake, shovel and moving stool. Very few of them (8-12%) were in 'poor skill' category and rest of the respondents (2-4%) shifted in average skill category. After intervention, most of the respondents (95-97%) were shifted towards 'good skill' category and rest of them were in 'average skill' category. During intervention it was observed that some of farm women who were resistant towards use of technologies were motivated by other farmwomen (Fig.1.1).

IV. CONCLUSION

It can be concluded from the findings of the present study that initial skill of the respondents regarding all the animal husbandry technologies was poor after exposure of training tremendous gain in knowledge was observed. For improving skill, there is a need to organize skill based training and intervention programme by the Agriculture Department, KrishiVigyan Kendra and other training institution so that farm women are able to use the technologies for drudgery reduction.For exposure of farm women to new technologies, regular visit of farm women should be organized to KrishiVigyan Kendra, Agriculture Technology Information Centre etc.

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Inclusive Economy and Dalit Buddhists: Capitalism as a Tool to Rise above Castes in Post-Globalised India

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Abstract: **- All over the world nowadays people are discussing the problems of marginalized groups-their social, ethnic, economic and cultural problems. By and large, most of the marginalized groups constitute minorities-religious, ethnic, linguistic or otherwise. Invariably they are impoverished people constituting minority groups. They suffer from economic, social or political impoverishment and find themselves estranged from this mainstream. One such group in India is Dalit, the previously known untouchables which were born due to the falsehood of our religious scriptures and been followed through generations as a discriminatory force.**

***Keywords*— Dalit in India, Economic status, Social upliftment**

I. INTRODUCTION

Objective/ Purpose:

Inequality has led Dalits under the guidance of Dr.Ambedkar to follow more generous Buddhist traditions as a revolt of the dominance of Hindu culture. Their existence is by and large peripheral. The marginalized groups of sections are consciously or unconsciously distanced from the power centers. They are scattered here and there and lack cohesiveness and strength. Deprived of economic, political or religious power, they grope in the dark for survival. Accepting Buddhism has led them to a different conscious platform where they were not judged along with Hindus. This shift also provided a slow but steady rise in the status of Dalits in India.

This paper focuses on a path-breaking initiative and its results with the help of a different spiritual base and that of the Buddhist Dalit entrepreneurs in India. Many innovative initiatives have started to motivate Dalit youth to enter the business & industry sector as entrepreneurs and to carve their own niche. Also discussed here is, how the marginalized group with the help of Buddhist ideas and spirituality are encouraged to contribute to the nation's economy through wealth creation and to spread the spirit of enterprise to other fellow members.

II. BUDDHIST IDEOLOGY AND DALIT FAITH

Essentially, according to Buddhist teachings, the ethical and moral principles are governed by examining whether a certain action, whether connected to body or speech is likely to be harmful to one's self or to others and thereby avoiding any actions which are likely to be harmful. In Buddhism, there is much talk of a skilled mind. A mind that is skillful avoids actions that are likely to cause suffering or remorse. A lay Buddhist should cultivate good conduct by training in what is known as the "Five Precepts".

1) To undertake the training to avoid taking the life of beings. This precept applies to all living beings, not just humans. All beings have a right to their lives and that right should be respected.
2) To undertake the training to avoid taking things not given. This precept goes further than mere stealing. One should avoid taking anything unless one can be sure that is intended that it is for you.
3) To undertake the training to avoid sensual misconduct. This precept has covered any overindulgence in any sensual pleasure such as gluttony as well as misconduct of a sexual nature.
4) To undertake the training to refrain from false speech. This precept covers slander as well as speech which is not beneficial to the welfare of others. It is also about avoiding lying and deceiving,
5) To undertake the training to abstain from substances which cause intoxication and heedlessness. This precept is in a special category as it does not infer any intrinsic evil in, say, alcohol itself but indulgence in such a substance could be the cause of breaking the other four precepts.

II. BUDDHIST WORK- ETHICS

The Buddhist work ethic and business and professional ethics would ideally be closely tied to respect for the environment. It is well described in E.F.Schumacher's [1] book "Small is Beautiful":

"While the materialist is mainly interested in goods, the Buddhist is mainly interested in liberation. But Buddhism is the Middle Way and therefore in no way antagonistic to

[1] E. F. Schumacher, Small is Beautiful: a study of economics as if people mattered
Ruth Pearson
First published: April 1975

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physical well being. The keynote of Buddhist economics is simplicity and non-violence. From an economist's point of view, the marvel of the Buddhist way of life is the utter rationality of its pattern - amazingly small means leading to extraordinarily satisfying results."

Ken Jones[2] in a paper called "Buddhism and Social Action" comments: "Schumacher outlines a 'Buddhist economics' in which production would be based on a middle range of material goods (and no more) and on the other a harmony with the natural environment and its resources."

III. DALITS AND BUDDHISM

The Dalit Buddhist movement is a 19th and 20th-century, Buddhist revival movement in India. It received its most substantial impetus from B. R. Ambedkar' s call for the conversion of Dalits to Buddhism, to escape a caste-based society that considered them to be the lowest in the hierarchy. After publishing a series of books and articles arguing that Buddhism was the only way for the Untouchables to gain equality, Ambedkar publicly converted on 14 October 1956.

Dalits who have followed Dr.Ambedkar and got converted to Buddhism have progressed in all the fields of life as compared with Hindu Dalits. Buddhists have changed their occupations by leaving low paid and dirty professions. Better education has opened for the new opportunities for advancement. They give more importance to the education of their children resulting in higher rate of literacy.

They are more self-respecting and assertive in their rights. They have become self-makers, self-dependent and competitive. They have grown intellectually. Their women and children enjoy better status in family and society. They have become enlightened and are saved from religious exploitation and bigotry. Thus Buddhism has definitely liberated them spiritually and materially.

IV. CURRENT SCENARIO

In 2004-2005, according to the NSS[3], in rural India, 34% of Scheduled Caste and 46% of Scheduled Tribe households were in self-employment (with corresponding urban proportions being 29% and 26%). This was a huge untapped workforce which, if get the right direction, can make wonders to not only to their lives but in the Indian economy also. But they had many roadblocks in their ways. The most important barrier to their progress was their marginal social status.

The picture is gradually changing. Although India's Dalits suffer brutal caste-related violence and discrimination in education and the workplace, they have become a powerful political force in recent years as parties have courted them for their votes. Almost one in six Indians are Dalits – 166 million people, many of them concentrated in key states like Punjab and Uttar Pradesh where the Dalit-based BahujanSamaj Party was in power until earlier this year. There are many initiatives taken up by their own community people have tried making difference to their lives in recent times. One such case study is that of DICCI (Dalit Indian Chamber of Commerce and Industry)which works on the motto- "Be Job Givers – Not Job Seekers"

The Pune-based Dalit Indian Chamber of Commerce and Industry (DICCI) was established in 2005 by MilindKamble, a civil engineer, and entrepreneur. While Mr.Kamble is currently the Chairman, the organization has grown with the help of new state chapters. Its membership base is rapidly expanding as more Dalit entrepreneurs become aware of its activities and what it can offer them. The Dalit Indian Chamber of Commerce champions those 'untouchables' and other lower castes who are transforming their families' lives through enterprise. Many have become multimillionaires running successful companies and their slogan is 'fight caste through the capital.'

The activities of its members are quite diversified ranging from manufacturing (sectors such as chemicals, agri-products, frozen foods, plastics, textiles, pest control, metals and metallurgy, marine engineering, solar energy, sugar refining), construction and services (healthcare, hospitality industries, education and international trade).

The Chamber operates with a three-fold mandate:

Bring together all Dalit entrepreneurs under one umbrella

Become a one-stop Resource Center for existing and aspiring Dalit entrepreneurs

Promote entrepreneurship among Dalits as a solution to their socio-economic problems

DICCI focuses on entrepreneurship, as it believes that 'Dalit Capitalism' will help Dalits rise to the top of a social pyramid and will pave the way for the end of the caste system. However, in order to understand the spread of "Dalit Capitalism" it is not enough to focus on the top end of Dalit businesses (the Dalit billionaires), but instead, to investigate the extent and spread of Dalit participation in small businesses, which more accurately reflects the material conditions of millions of Dalits who are not in wage employment.

In India, certain castes and communities have traditionally been business communities, and entrepreneurs from these communities start with clear natural advantages in that they possess insider knowledge, know-how, and strong business networks passed down through the generations. In this context, an important channel of social mobility would be the extent to which marginalized groups, whose traditional occupations have not been business-based, have been able to break into established networks and establish themselves as

[2]"Buddhism and Social Action: An Exploration", by Ken Jones. Access to Insight (BCBS Edition), 30 November 2013, http://www.accesstoinsight.org/lib/authors/jones/wheel285.html .

[3]*Health Policy and Planning*, Volume 24, Issue 2, 1 March 2009, Pages 116–128,https://doi.org/10.1093/heapol/czn046

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entrepreneurs. While this dataset does not have detailed and specific jati (caste) information, the evidence suggests that entrepreneurship as a significant vehicle for social mobility for Dalits is yet to become a reality for India.

As MilindKamble, founder of DCCI argues that "capital is the surest means to fight caste. In Dalits' hands, capital becomes an anti-caste weapon… Dalit capitalism is the answer to that regime of discrimination". Undoubtedly, Dalit's foray into the arena of capitalism defying Manu's dictum is the latest talk of the town. We are being told that from the corporate honchos to the big bosses at the planning commission to the members of India's multi-color polity, everybody is ready to embrace this new breed of entrepreneurs for what they have done against heavy odds and what they intend to achieve.

For the proponents of Dalit capitalism the whole thing is 'full of promises' and 'compelling need for the future of India ' and in fact, is a critical element in 'desegregating the Indian society.' To make it happen Dalits need to get integrated into capital/market.

To confront 'illegitimate dominance of the Caste Hindu Order,' Dalits need to create a middle-class based on education/white collar jobs/professions. It is being declared that public sector with its attendant reserved seats is no more the panacea for the communities problems. Yes, affirmative action should be extended to the private sector but it would be inadequate in producing an effective middle class. The booming small-scale industry presents a possibility before the Dalit middle class to grow into a big economic and social force.

The whole idea and its likely implementation seem to be a 'veritable revolution of sorts' in the ethos perpetuated by Manu Dharma which had prohibited a Dalit from becoming an employer of an-Dalits or becoming a money maker. For an outsider, the logic definitely looks attractive. If millions amongst them become entrepreneurs then thousands amongst them can metamorphose into big-time capitalists. And this way they can chase away Manu Dharma. It is also underlined that without support from state and society it would be impossible to achieve this.

V. LIMITATIONS OF THE STUDY

The questions like the following arise:

1. whether Dalit Capitalism can really liberate/free/emancipate Dalits from the 'illegitimate dominance of caste Hindu order' as it is claimed to be or would further consolidate/strengthen its stranglehold on the exploited and the oppressed with some Dalit billionaires finding space in the list of 'Fortune 500' or 'Forbes 500' and broad masses of the Dalit people left in destitution without any semblance of security?
2. Can it be said that it is THE step needed for the post-Ambedkarite movement to break asunder the chains of servitude and usher us into the much cherished 'economic democracy'?
3. Should one see it as the further extension of the emancipatory project launched by legendary Dr.Ambedkar or its exact opposite leading to further co-option of the radical potential inherent in the Dalit movement?
4. How does one compare the recent experience of Dalit capitalism with that of Black capitalism?
5. Whether capitalism with an adjective - black, Hispanic, Dalit or white - have any import for the situation on the ground, does a black capitalism or Dalit capitalism is more 'bearable' to the 'black' or 'Dalit' toiling masses?

In an ambience where the socialist project - to usher us into a more egalitarian society - has faced tremendous reversals since last two decades, coupled with the historical limitations exhibited by its proponents here to understand the complexity of caste - leading to valid accusations about their 'sociological blindness - it has not been possible for left intellectuals of our times to engage with the issue. The legatees of the Ambedkarite project, who have faced splits after splits have also found themselves, wanting on this occasion as on earlier many occasions.

VI. CONCLUSION

This case study is an example that the economy-caste-progress-society is a newly found nexus and if this equation is possible to solve, it is only because of such bold and daring initiatives taken by the marginal groups themselves. Let all the success be with them.

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A Study to Understand Circular Economy and its Applicability in India

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***Abstract*— This paper is a study about why we need to adopt Circular Economy (CE), the working of CE, its principles, functioning, various business models. This paper also analyzes the benefits of adopting CE to its various stake holders. This goes on to explain the adaptability of this concept to various scenarios especially in the Indian context. It specifically examines the opportunities in the Mobility and Vehicle manufacturing sector in India and also gives suggestions as to how CE businesses can be initiated and implemented in India.**

***Keywords*— industrialization, circular economy, mobility sector, benefits of CE, implementing CE**

I. INTRODUCTION

1.1 Industrial Revolution and the Linear Economy

England embraced Industrial Revolution in 1760's which saw the transformation from man to machines there by immensely improving the productivity and efficiency of industries. In the past 250 years technology has seen tremendous improvement which has facilitated the growth and evolution of humankind in multiple spheres. But the overutilization of natural resources has now brought them to the brink of exhaustion. The following table shows the current consumption rate and availability of 14 metals/elements we use which are majorly non-renewable materials.

Element		Periode of availibility	
		Consumption at present rate (years)	World consumes at 1/2 rate of USA (years)
Ag	silver	29	9
Al	aluminium	1027	510
Au	gold	36	45
Cr	chronium	143	40
Cu	copper	61	38
In	indium	13	4
Ni	nickel	90	57
Pb	lead	42	8
Pt	platinum	360	42
Sb	antimony	30	13
Sn	tin	40	17
Ta	tantalum	116	20
U	uranium	59	19
Zn	zinc	46	34

Table 1: (Source) Consumption rate and availability of 14 elements: David Cohen "Earth's natural wealth: an audit". New Scientist, 23 May 2007, pp. 34-41

The basic underlying principle of the Industrial Revolution is 'Take, Make and Waste'. This is also known as 'Linear Economy'. Linear meaning straight as in, what is produced is optimally used and finally is wasted or dumped. For example, we dispose our old mobile phone when we buy a new one or throw away worn clothes as waste which is more often than not, incinerated.

In the current situation businesses aim to make profits through higher sale of goods and at competitive prices. Few companies also aim for short duration goods in order to keep their sales up and going. So for such company's profits is just another term for sales turnover. This is how Linear Economy functions.

1.2 Problems with the Status-Quo

The costs of industrialization are outweighing the diverse benefits reaped by mankind. The ecological balance is being disturbed and this may affect economic growth of all the countries. The major factors discussed in this section will throw light on why Linear Economy model of production cannot continue in future. They are:

1. Consumption Pattern of Resources
2. CO_2 Emissions
3. Population Explosion
4. Commodity Prices

1. Consumption Pattern:

Man is overusing the resources to such an extent that it will create major risks and challenges not just for companies but for world economy as a whole. This demand is only bound to increase in future if it is not contained. Man's need has increased to such a huge level that there is no time available for replenishment of the natural resources which is depicted in the below Figure 1 which shows that at the current level our sustenance may be at question in a matter of 60 odd years.

2. CO2 Emissions:

According to the ING Economics Survey in 'Rethinking finance in a Circular Economy' (May 2015) developed countries emit on average 15 tonnes of CO_2 per person per year wheras 2-5 tonnes of CO_2 in developing countries. In the recent past there have been multiple policy decisions by major world governments to reduce the ecological/carbon footprint by implementing higher taxes on fossil fuels, CO_2 emission trading, subsidies on renewable energy, etc.

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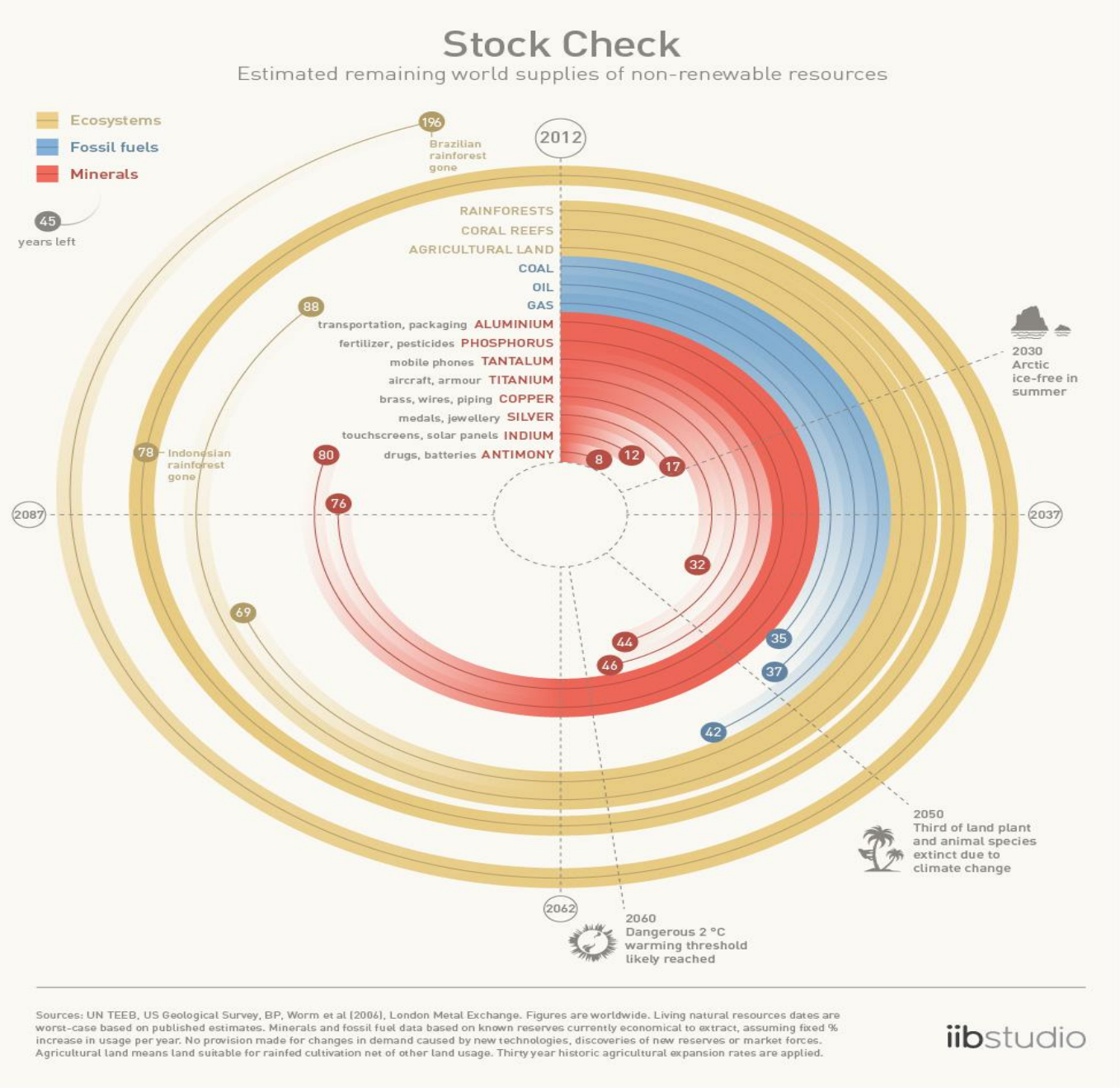


Figure 1: Estimating world supply of non-renewable resources (Source: BBC)

3. Population Explosion:

The global population is ever increasing and according to a recent estimate by United Nations the population will grow from 7.7 billion in 2015 to 9.5 billion in 2050. It also estimates that urbanization would also increase from current 54% to 66% by 2050 leading to increase in the number of people in the middle class and also the dependent population would who would live longer due to better medical facilities and technological advancement. This would increase the pressure upon existing resources which is why we cannot continue with the current methods of usage of resources.

4. Commodity Prices:

According to ING Economics Department, commodity prices have been on an upward trend for the past 15 years, but have fallen substantially since 2011. An actual shortage of raw materials for manufacturing companies has been a rarity but it is rising and volatile prices rather than actual scarcity that worries entrepreneurs most as this could cause the companies to run out of business due to firstly, insufficient availability of

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goods (as raw materials are scarce) and secondly, extremely high prices as the manufacturers will transfer the high cost of raw materials to the consumers who in turn will not buy it due to restricted purchasing power.

Due to the above problems we need to stop following the Linear model of production and switch over to Circular Economy model which might be a solution to finding a sustainable way forward.

1.3 Objective of the paper

This paper tries to mainly analyze three things. Firstly, to understand the working of Circular economy by examining its principles, understanding its working, how it is different from Linear Economy. Secondly, understanding the benefits of Circular Economy for various stakeholders viz. businesses and economies, environment and the citizens as well in India. Thirdly, it tries to analyze the applicability of these concepts to various sectors in India and focuses on Mobility sector and how it could work in that sector. It also gives suggestions to initiate and implement CE business in India.

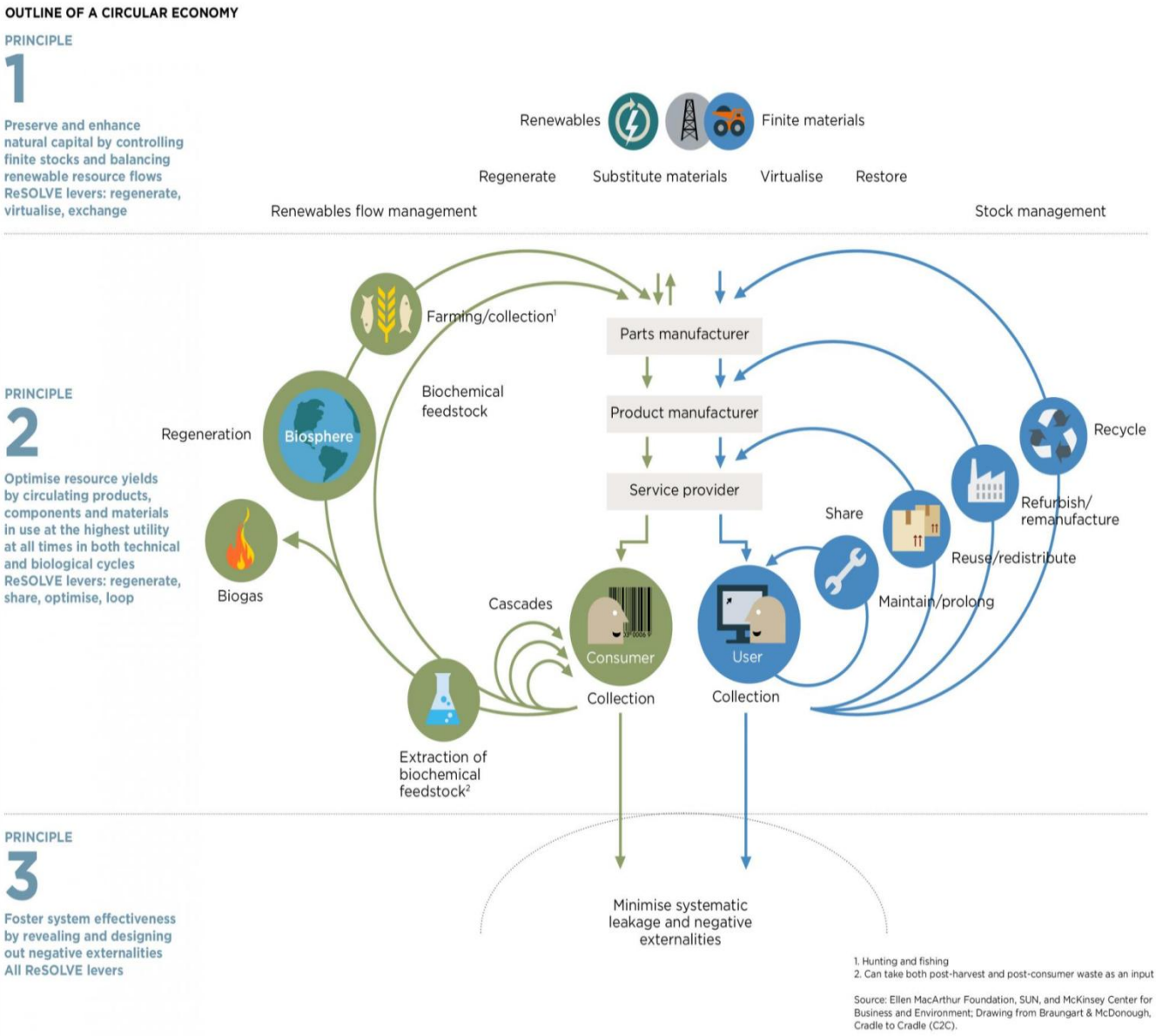


Figure 2: The structure and working of circular economy [1]

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2. Circular Economy: A Sustainable way forward

Circular Economy (CE) runs on the basic principle of 'Reduce, Reuse and Recycle'. This theory shows that economic growth can be achieved without disturbing the ecological balance. Circular Economy in simple words as explained by World Economic Forum, "A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models.

Ellen McArthur Foundation is a pioneer institute spearheading developments in the field of circular economy. It defines CE as "an industrial economy that is restorative by intention. It aims to enable effective flows of materials, energy, labour and information so that natural and social capital can The structure and working of circular economy to reduce energy use per unit of output and accelerate the shiftdesign, treating everything in the economy as a valuable resource."

2.2 Principles of Circular Economy

Principle 1: Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows

A circular economy enhances natural capital by encouraging flows of nutrients within the system and creating the conditions for regeneration of soil and other living systems. Whenever possible, utility is provided virtually or as a service rather than as a physical product. When resources are needed, the circular system favours technologies and processes that use renewable or better-performing resources. The circular economy seeks to address several challenges to natural capital such as threatened stock and variable quality of fresh water, Soil degradation, Loss of biodiversity, Depletion of fish stocks and degradation of marine ecosystems, etc,.

Principle 2: Optimize resource yields by circulating products, components, and materials at their highest utility at all times, in both technical and biological cycles

This requires designing for refurbishing, remanufacturing, and recycling to keep products, components, and materials circulating and contributing to the economy. Circular systems use tighter, inner loops, whenever possible, to preserve energy and economic value. These systems also optimise the reuse of products and extend usage length. Sharing models increase product utilisation. Products are designed and manufactured for easy disassembly at the end of their useful life, allowing for convenient separation of the material flows. Value preservation is maximized firstly by looking into product reuse, subsequently by studying reuse of components, and finally by considering recycling of resources. The circular economy seeks to address several resource challenges such as Materials consumption, Nutrient loss, Waste of products and materials, etc.

Principle 3: Foster system effectiveness by revealing and designing out negative externalities

The negative externalities of economic activity include land degradation; air, water, and noise pollution; release of toxic substances; and Green House Gas (GHG) Emissions. These impacts are seldom reported or accounted for, and their weight is borne by both ecosystems and society.

A circular economy would reveal the cost of these externalities – in other words, outline their risks and potential economic impact. Furthermore, by including feedback that effectively integrates these costs, a circular system would gradually eliminate negative externalities.

2.3 Circular Economy: It's Functioning

In a circular economy, value creation is decoupled from the consumption of finite resources. The model distinguishes between technical and biological cycles, which rely on distinct capital-building strategies.

Resources are regenerated in the biocycle or recovered and restored in the technical cycle. In the biocycle, life processes regenerate disordered materials, despite or without human intervention e.g. through composting or anaerobic digestion – and life processes regenerate the living systems, such as soil, plants, or animals that give rise to materials and other resources. In the technical cycle, with sufficient energy available, human intervention recovers materials and recreates order, on any timescale considered. Technical cycles recover and restore products, components, and materials through strategies like reuse, repair, remanufacture, refurbishment, or (in the last resort) recycling.

WEF[2] they provide three simple yet brilliant analogies to understand circular economy which are explained below:

First, at its core, a circular economy aims to design out waste. Waste does not exist: products are designed and optimized for a cycle of disassembly and reuse. These tight component and product cycles define the circular economy and set it apart from disposal and even recycling, where large amounts of embedded energy and labour are lost.

Second, circularity introduces a strict differentiation between consumable and durable components of a product. Unlike today, consumables in the circular economy are largely made of biological ingredients or 'nutrients' that are at least non-toxic and possibly even beneficial, and can safely be returned to the biosphere, either directly or in a cascade of consecutive uses. Durables such as engines or computers, on the other hand, are made of technical nutrients unsuitable for the biosphere, such as metals and most plastics. These are designed from the start for reuse, and products subject to rapid technological advance are designed for upgrade.

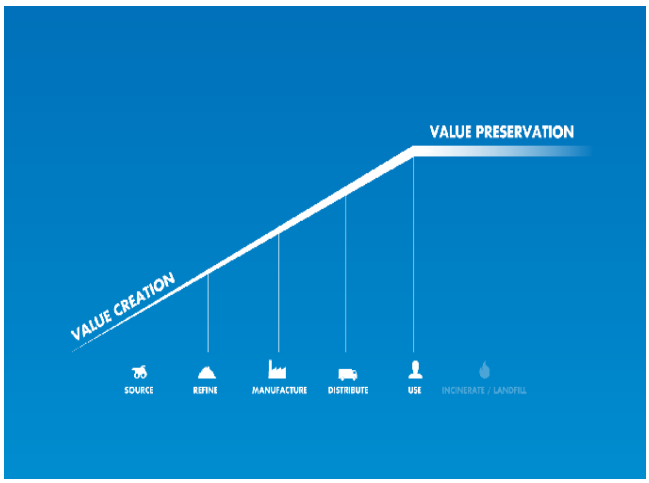
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Third, the energy required to fuel this cycle should be renewable by nature, again to decrease resource dependence and increase systems resilience (to oil shocks, for example). For technical nutrients, the circular economy largely replaces the concept of a consumer with that of a user. This calls for a new contract between businesses and their customers based on product performance. Unlike in today's buy-and-consume economy, durable products are leased, rented or shared wherever possible. If they are sold, there are incentives or agreements in place to ensure the return and thereafter the reuse of the product or its components and materials at the end of its period of primary use.

2.4 Business models of CE

Various business models were analyzed through the literatures and they have been explained in brief here as a lot of materials have already been published on it. The models are: Circular Innovation Models, Circular Use Models and Circular Output Models. Under each category there has been a development of different models according to the varying needs of businesses. Some of the prime elements for value creation have also been discussed which are: Circular Supply chain, Recovery and Recycling, Product Life Extension, Sharing Model, Product as a Service. These have been developed as successful businesses in different countries.

2.5 Linear Vs. Circular Economy



CHARACTERISTICS	LINEAR ECONOMY	CIRCULAR ECONOMY
Attitude towards nature	Forcing nature to produce more	Doing more with what nature can produce
Attitude towards production	Take, make and waste	Reduce, reuse and recycle
Closing loops	One lifetime use of products, components, materials and energy	Materials and energy flow infinitely in cycles through the economy.
Product life extension	Products become obsolete while they are still usable.	Product life is extended in new applications or products serve as valuable inputs for other products.
Performance economy	Consumers buy goods	Accessibility and performance instead of ownership are leading in many consumption markets. Consumers increasingly share products.
Earnings model	Producers determine sales price of products.	Producers charge price for the use of the product.
Multiple values and principles	Money is the dominant value in business models.	Business models are based on multiple values (financial alongside environmental and social values)
Supply chain	Companies improve efficiencies in isolation of each other.	Companies work together to increase value along the supply chain. Risk and benefits are shared upstream and downstream.

Figure 3:Value creation in Linear Economy model

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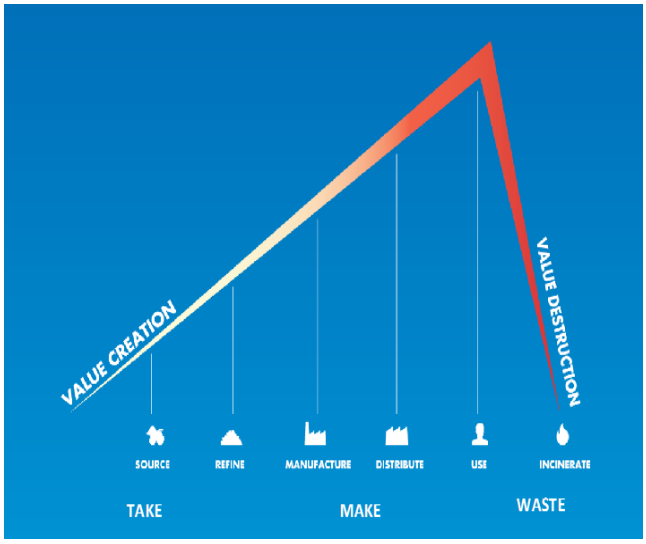


Figure 4:Value creation in Circular Economy model

2.6 Benefits of Circular Economy

Circular economy provides benefits to all its stakeholders who include businesses and economy, environment and also the citizens more so in the Indian context has been explained in this section.

2.6.1 Benefits to Businesses and Economies:

1) *Profit opportunities for businesses through increasing innovation and demand for new business services:*

Adoption and implementation of the CE concept would result in creation of new business services such as reverse logistics, remarketing, remanufacturing, and refurbishment. With the current initiatives such as Digital India and Make in

India chances for CE ideas and businesses can increase. Since CE emphasizes on service model contracts to build long term customer relationship better profit opportunities can be tapped for example to process food waste, better vehicle repair and remanufacture techniques can be developed.

2) *Material cost savings and reduced exposureto resource price volatility*:

CE would significantly lower costs for businesses related to the use of virgin materials. Less material use would also reduce their exposure to volatile raw materials prices and strengthen resilience as explained in section 1.2. Analysis shows that in the CE scenario, consumption and therefore total costs of synthetic fertiliser would be 39% lower in 2030 and 62% lower in 2050 compared with the current development path. India has a growing middle class and in turn would expect more material-intensive consumption . they would stand to benefit if they adopted CE practices from here on which will result in a lot of saving of resources.

3) *Economic Growth*

CE practices are making more productive use of material inputs (including looping of products, components, and materials) and increasing revenue from emerging circular activities. While some sectors (e.g. the material extraction industry) would expect reduced activities, overall more activity would happen across the economy, boosting economic growth. Quantifying the cost savings and the impacts of these practices would require quantitative modelling for the Indian economy. Based on Economic Modelling of Europe the rough figure of savings for India is around Rs. 14 lakh crore which would be around 11% of India's GDP by 2030.

2.6.2 Benefits to Environment:

1) *Lower GHG emissions:*

GHG emissions would be drastically lower in the circular scenario than in the current scenario. Using fewer virgin materials, applying more efficient construction techniques, and reducing electricity use in cooling would reduce GHG emissions 23% in 2030 and 40% in 2050. In the agricultural system, GHG emissions from land and energy use and production of artificial fertiliser would be 21% lower in 2030 and 31% lower in 2050. Overall, Indian GHG emissions would be 436 million tonnes of CO2 equivalent (Mt CO2e) lower in 2030 and 1,042 Mt CO2e lower in 2050[5].

2) *Reduced consumption of virgin, non-renewable materials and energy:*

The extraction of virgin materials and the production of energy from non-renewable sources like coal and oil have significant negative environmental externalities, like GHG emissions, toxic materials, and other pollutants leaking into local environments. Following the CE path would lead to reduced consumption of virgin, non-renewable materials of 25% in 2030 and 38% in 2050 compared with the current scenario.

3) *Increased land productivity and soil health:*

Applying CE principles to the food and agriculture sector would increase land productivity, decrease waste in the food value chain, and return nutrients to the soil. These efforts would enhance the value of land and soil assets by increasing their regenerative potential.

4) *Reduced water use:*

The agricultural system would use 39% less irrigation water in 2030 and 49% less in 2050. City households would use 14% less water in 2050, decreasing pressure on water supply in India's growing urban areas. The amount of water needed to produce virgin materials (especially in the construction industry) would also be significantly lower.

2.6.3 Benefits to Citizens:

1) *Lower cost for products and services*

These declines would decrease the cost for households to access the products and services needed for housing, food,

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and mobility and therefore increase disposable household income. For example, per capita cost to meet the same level of mobility demand would be 24% lower in 2030 and 50% lower in 2050. Analysis of the relationship in Europe between cost savings in the same three systems and disposable household income found that €0.6 trillion (4.5% of the EU's GDP) lower cash-out costs would lead to 10% more disposable household income in 2030.

2) Greater utility and choice:

The additional choice or quality that circular models provide would enhance the utility, or benefit experienced by customers. Choice increases as producers provide systems that enable tailoring products or services to better meet customer needs. For example, applying circular economy principles in mobility would give customers more vehicle options, without increasing the number of vehicles on the road.

3) Reduced negative externalities, e.g. congestion, pollution.

For example, the circular development path would lead to a reduction in vehicle kilometres travelled on roads by 38% in 2050, compared with the current path, decreasing congestion and time spent in traffic. More zero-emission vehicles and regenerative farming techniques that eliminate the need for crop burning, would reduce inner city pollution and the associated negative effects on health and productivity. Less use of pesticides (-76% in 2050) would improve the health of farmers. Detailed modelling of the implications of the two development paths on other externalities and the associated (non-cash) costs (including opportunity cost) exceeds the scope of this report, but would be necessary to estimate more exactly the systemic impact of applying circular economy principles in India.

3. Implementation of CE in India.

There are multiple sectors in India to which we can apply the concepts of CE such as agriculture, cities and construction and one of the most important areas which is tormenting the capital of India, pollution by applying CE to Mobility and Vehicle manufacturing. This paper would majorly focus on Mobility and Vehicle Manufacturing keeping in mind the current problem in Delhi regarding excessive pollution. This section would give suggestions to initiate and implement application of CE in India.

Mobility is the most essential thing which has led to integrating the worl into a global village through globalization. Mobility enables easy access to goods, services, technology and many other opportunities. Applying CE in Mobility sector in India could create benefits upto Rs.31 lakh crore by 2050 compared with the current development scenario. This would also create a mobility sector with fewer negative externalities.

As the Indian economy is booming, the need for mobility is growing substantially. India saw its annual per capita kilometres travelled by rail almost double between 2002 and 2013 and the car ownership rate almost tripled during the same period. The car ownership rate per capita in India averaged 1.6% in 2011. But this is changing at a fast pace. The demand is especially high in cities, as urbanisation is proceeding rapidly. The growing demand presents significant opportunities for the Indian vehicle manufacturing industry, which produced 24 million vehicles in 2015, up from 18 million in 2010.

Indian cities already face challenges with high congestion, pollution, and accident rates that will grow more severe as mobility demand increases. The large, dense population and rapidly growing mobility demand are exacerbating congestion, pollution, and safety issues. The WHO lists Ten Indian Cities among the 20 most polluted in the world.175 The road fatality rate has risen steadily, up 50% between 2000 and 2015. Delhi is facing a huge amount of problem due to excessive pollution and smog. There is the Odd-Even scheme of vehicles brought into force to reduce the number of vehicles on the streets which will reduce pollution and increase reliance on public transport. The Metro facility is very strongly supporting the public transport apart from buses and other non-motorized means of transport.

3.1 Ways to apply CE to Mobility sector in India

Some opportunities which would help innovate the mobility sector by implementing the CE practices are discussed below.

1) Convenient mass transit combined with diverse and adaptive last-mile connectivity

A mass transit system with sufficient capacity, speed and comfort can provide the backbone for mobility in Indian cities especially with the growing scenario of urbanization and over-population. The Metro/Railways require some more feeders, better services. The Smart City Mission launched in India has guidelines such that it forces for integration with better transport systems. Under this mission Jaipur plans to develop "smart multimodal mobility" by integrating various modes of transport, implementing an integrated fleet management system, creating a common ticketing solution via a smart card, providing real-time information and journey planning through mobile apps, and engaging private operators. Hong Kong also has a ver well developed mobility system and is regularly ranked as best-in-class.

2) Vehicles as a service.

In India, auto rickshaws are a well-established form of vehicle as a service, handling 10-20% of motorised trips in major cities. New technologies can diversify and improve this concept to maintain attractiveness to users. Ola, for example, provides a mobile app to book taxis and auto rickshaws. The company is extending the concept to ride-sharing, with Ola Share. In sharing schemes for bikes, scooters, and cars, users rent a vehicle for a short period of time. Car-sharing schemes are also starting to get traction in India, with companies like Zoomcar and Myles offering self-drive car rental services by the hour. Membership jumped from 27,000 in 2014 to

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175,000 in 2015. Car rental companies and manufacturers are already recognizing this business potential.

3) Technological innovation for transport planning and vehicles.

As India's population grows more affluent, the demand for fast, comfortable journeys is increasing. Combined with the right transport options and the availability of vehicles as a service, trip-planning applications would give people mobility, without car ownership, but with similar comfort, quality, and speed.

4) Electric Vehicles

Due to high pollution rates in India, Electric vehicles (EVs, e.g. powered by batteries or fuel cells) reduce pollution and, combined with decarbonised energy, GHG emissions. Companies like Tesla are significantly improving EV performance by investing in research. In 2013 Mahindra launched the Mahindra e2o, an urban electric car that the car-sharing scheme Zoomcar uses (see *Mahindra e2o and Zoomcar*). EVs have lower maintenance costs they are expected to become a more economical option for the Indian market in the coming future.

5) High vehicle durability

India has a high rate of vehicle repair, especially for two and three wheelers, with repairs mainly performed by the informal sector.223 But, as customers shift to cars and the complexity of vehicles increases, these high rates are likely to drop. Designing vehicles to be easily maintained and repaired helps retain their value by keeping them in use longer.

6) Looping of components and materials

Remanufactured parts can be 30-50% less expensive while having the same guarantee and quality control as new parts. Remanufacturing a passenger car engine uses only 23% of the energy used to produce a new engine from raw materials. Businesses that identify ways to close material loops can realise greater profit margins through alternative revenue streams and lower manufacturing costs. Indian companies are starting to recognise these benefits which could provide create resource-effective mobility solutions.

3.2 *Methods to initiate and implement CE in India*

Analyzing the number of circular economy based businesses in the world and their success rate, Dutch countries and Netherlands is the hotspot of circular economy activities. It hosts many innovative circular businesses which use various business models applicable to a circular business. Mud Jeans, Fairphones, Bundles, Dura Vermeer, Interface, Dutch aWEARness, Brambles, Piggy Baggy, Sharetribe are the names of few among the many which were prominent while analyzing literatures for this paper. Each one has a distinct circular product or service to offer and each of them have been surviving in the market for quite some time now.

India is not in that position because firstly, the Dutch/Netherlands adopted these principles back in 2012 which is why they are far ahead than the world. They have immense support from the both the government (financially and legally) as well as the consumers who prioritize circular goods over linear goods as they want their country to be sustainable and be a global hotspot for circular economy just the way Silicon Valley is to Tech start-ups.

India will also need to adopt the principles of CE sooner or later and there is a lot to be done. The following suggestions are aimed to include India in the run towards a sustainable future of the world.

1. A committee or a board needs to be formed in order to promote conversion from linear to circular economy just like we have SEBI to regulate and oversee the capital markets.
2. Funds need to be set aside by the government with a fixed vision to achieve a target in the particular field in fixed time duration.
3. When government recognizes or spots good ideas say, through competitions it should also provide certain amount of financial support.
4. By financial support it always doesn't have to be fixed funding. It can also be provision of credit facilities with certain relaxations.
5. Once a committee is formed then the government should take initiatives to send a group of people to understand the principles and working of the concept from countries like Netherlands or other countries who have a working knowledge about it.
6. Change doesn't come easy to anybody. Businesses need to be made aware firstly about the concept, secondly its need and thirdly the benefits offered by the model for businesses.
7. Awareness needs to be spread among the consumers next as without them accepting the change businesses producing new goods doesn't make any sense. They need to see sense why they should not buy many products, why they need to share, why they should rent rather than buying it. The benefits should be clear to the consumers and only then will they support the change.
8. Awareness should be spread in the rural areas especially as goods like fertilizers should be sustainable and they should also understand the necessity for a change and how the change is in turn going to benefit their own future generations.
9. Just the way FSSAI or Agmark certifies the food products in India. Let the board constituted also certify goods if they are circular or not which becomes a proof to the customers and even the marginally high costs can be justified.
10. People need to understand that in no way it is attacking the social status of a person if he or she reuses a good or is a second hand user of the good. It

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needs to be ingrained into their minds regarding the benefits

11. Lot of entrepreneurial camps and competition held for senior school students to inculcate sustainable thinking among the future generations as they are the leaders of tomorrow.
12. Many training or guidance programs for SME's and MSME's to explain the necessity for change and how it is beneficial for them as well. This is imperative because they are going to face a huge challenge as they do not have enough money for conversion but still they need to shift for the greater good.
13. Set up a Vigilance Committee to oversee the functioning of the board set up to perpetuate the growth of circular businesses. This should also ensure the funds are being utilized efficiently.
14. Make certain laws in order to enforce it in a stronger way in the society after sufficient guidance is given.
15. Provide certain benefits like subsidies, tax exemption, help in exporting circular goods, helping to design circular goods, redesigning the whole product and manufacturing processes which becomes crucial for MSME's.
16. The economic benefit which is reduction of pressure or demand on resources will lead to a reduction in prices and cost benefits to businesses which imply greater profits meaning better and positive growth of economic indicators.
17. The government can also use the support of Private sector in this matter. They could make provisions for businesses to conduct educational camps for the citizens and in the rural areas as a part of their CSR activities which will also reduce the burden from the government.

All these and many other steps can be taken in order to bring India into the forefront with rising global environmental and climatic concerns. It would definitely take up a huge amount of time, man-hours and money but this leap must be taken as it is for the survival of the planet and mankind as a whole.

II. Conclusions

A thorough analysis of the various literatures/secondary sources during this study has led to some findings which are enumerated below:

1. Economy has progressed from agrarian economy to industrial economy, barter to monetized economy and now it is time to move from linear to circular economy with respect to the production methodologies.
2. The industrial revolution has served immense benefits to mankind but now its costs are outweighing the benefits. The current production mindset or methodology is known as Linear Economy which runs by 'take, make and waste'.
3. This has lead to a huge pressure on natural resources as they are depleting at an alarming rate and they are not being replenished as enough time is not allowed for the same. The dearth of resources has been depicted in the early part of the study where there are estimates of how many year might the resources last. This is also evident with the rising commodity prices from the start of the millennium.
4. A plethora of global climatic and environmental problems such as excessive pressure on natural resources, CO_2 and GHG emissions, more waste in landfills, over population, ozone layer depletion, pollution of all sorts and so on which is a prime cause of concern for many countries around the globe.
5. This is the time for change. Countries need to adopt a new production methodology or mindset which is known as Circular Economy which runs on 'reduce, reuse and recycle'.
6. The change shall bring in immense benefits due to its circular nature which is very much against sending goods to dump yards or landfills. This model ensures that the value created is preserved be it in terms of raw materials, intermediate goods, power, labour or energy.
7. The Circular Economy has a diagram portraying the principles it runs on which has been given by MacArthur (2010) which has been analyzed to understand the functioning of the circular economy in terms of its biological cycles and also its technical ones in a separate section in the study.
8. This transition is obviously beneficial to the environment, but it also provides benefits to businesses as it enables cost saving and reduction of pressure on resources and much more which have been mentioned in the study in a detailed manner.
9. There was a comparison made among the two models in terms of their value creation models and their core principles of conducting business. There was a stark difference among the two, which has to be so if the environment is going to benefit from the latter method.
10. Various business models were analyzed and compiled to understand the broad categorization of the models: Circular Innovation Models, Circular Use Models and Circular Output Models. Under each category there has been a development of different models according to the varying needs of businesses. Some of the prime elements for value creation have also been discussed which are: Circular Supply chain, Recovery and Recycling, Product Life Extension, Sharing Model, Product as a Service. These have been developed as successful businesses in a few countries whose examples have been mentioned as well.
11. There also has been an attempt to understand the sectors in which Circular Economy can be

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implemented in India. The sectors where Circular concepts need to be applied are in three major areas which are: Cities and Infrastructure, Food and Agriculture, Mobility and Vehicle manufacturing. These have been further explained in the respective section.

12. Throughout the study, analysis of literatures pointed one thing. The Netherlands and Dutch companies have imbibed it in their economy from early 2013 to become a global hot spot for Circular business ideas and they are leading it as compared to any other country in the world. So suggestions have been provided as to how India can adopt this method and how it has to go about it as the benefits of adopting it has been made evident throughout the study.

The step that the government needs to take and publicize this concept to make sure many businesses adopt this method has been suggested.

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Examining the Association and Strength of Association between the Different Attributes and the Performance of Retail Outlets with Reference to Sales in Suburban by Taking the Customer Purchase Patterns into Consideration

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***Abstract*:- The purpose of the study was to analyze the factors influencing the sales of the retail outlets in the suburban area. It was designed mainly to find the relation between the retail sales and few of the factors like retail location etc, which were not, studied earlier mostly. Consumer purchase patterns were taken into consideration and the study was carried for about a month by taking different samples of various family units randomly. It was found that the factors like retail location, air-condition facility in the retail outlet, behavior of the sales staff in retail outlet, arrangement of the products in the shelf etc were influencing the sales of the retail outlets. There is a good fit between all theses factors as a whole and the product sales of retail outlets.**

Keywords: **Retail sales, Regression analysis, Correlation, influence, residuals**

I. INTRODUCTION

Most of the retailers create a comfortable and convenient environment in the shopping areas, so that the customers can purchase the products which can satisfy their needs and wants. Retailers try to build certain factors which will mostly influence the consumer purchase patterns and add up to the retail sales. Distinguishing the factors like retail location, staff behavior, comfort shopping environment etc makes the retail outlets to position themselves in the minds of the customers. Moreover the mere presence of the products in the retail outlets will not get the sales but they need few complementary factors which will influence the product sales. The samples were selected randomly from the suburban area, Nandyal. In this study the data was analyzed using the correlation of coefficient and regression analysis techniques.

II. REVIEW OF LITERATURE

A Study was done on the factors affecting the sales of retails outlets but it was focused only on the branded products, Dr .S. Frankilin , Mr. J.Anand Christopher (2012)[1].A study was done on the factors influencing the store patronage but it was restricted to Supermarkets, Hypermarkets in Thailand, Wornchanok Chaiyasoonthorn and Watanyoo Suksa-ngiam (2011)[2]. A research was done to study the Factors influencing the consumer purchase decisions at Organized retail stores ,New Delhi , but the factors include availability & variety, ambience, service, price, promotions and quality (2014)[3]. But this study mainly looks at the factors influencing the sales of retail outlets in suburban area where the shopping is not widely modernised. Relationship between income level and branded milk was studied by Dudlicek,james (2009) pushing the line, dairy foods,vol110,issue4,p70-71,2p,1 color photograph.[7] The association between price and location was studied by P. T. L. Popkowski Leszczyc, A. Sinha, and A. Sahgal, "The effect of multi-purpose shopping on pricing and location strategy for grocery stores," Journal of Retailing, vol. 80, no. 2, pp. 85-99, 2004.[5] The factors influencing the destination choice of a grocery store was studied by Recker, W. W., & Kostyniuk, L. P. (1978). Factors influencing destination choice for the urban grocery shopping trip. Transportation, 7(1), 19-33[6]. Hence the Null hypothesis considers that the factors like air condition facility, product arrangement in shelf, space, retail location, Staff dress code, sign boards etc will not influence the sales of the retail outlets, the consumers too will not take anything into consideration at the time of purchase and there is no relation between the above stated factors and sales. The alternative hypothesis states that there is significant effect of the above stated factors on the retail sales and there is a significant relationship between the factors and retail sales and at most of the times the consumers considers the factors in making the purchase at the retail outlets.

III. RESEARCH METHODOLOGY

Objective of the study

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To analyze the factors influencing the retails sales and to study the relationship between the retail outlet sales and the factors as a whole.

Hypothesis

H_0 : Null Hypothesis

There is no relation between the factors and the retail outlet sales i.e., there is no influence of the factors on the retail outlet sales.

H_1 : Alternate Hypothesis

There is a relationship between the factors and the retail outlet sales .i.e., there is influence of the factors on the retail outlet sales.

Respondent Sample

The respondents, i.e., families were selected randomly from the suburban area. The questionnaire was given to nearly 28 families and the persons of age greater than 18 years were selected in each family unit.

Data collection

The sales value of each family unit was collected in a particular time by administering the questionnaire. Questionnaire consisted of different questions referring to different factors where the respondents would consider at the time of purchase of any products at different retail outlets.

Research design

Initially Exploratory study was taken into consideration & Explanatory research design was used to collect and to analyze the data. Questionnaire was used as data collection instrument.

Data analysis and Results

Pearson correlation coefficient and regression analysis was used in data analysis. The retail sales influencing factors were grouped into at different numbers and them the data was analyzed using the regression and person correlation coefficient. Here both of the variables were analyzed quantitatively.

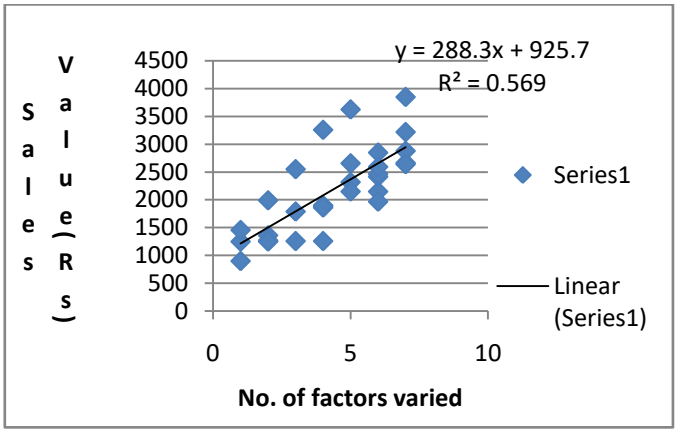
The accuracy of the Pearson correlation coefficient was tested using regression analysis.

Table 3.1 Collected data

No. of Family units/Sample No.	No. of factors varied at each level	Sales Value(Rs.)
1	1	1245
2	5	2642
3	3	1785
4	2	1356
5	7	2660
6	6	2145
7	4	1856
8	3	2547
9	2	1986
10	1	895
11	6	1963
12	5	2314
13	4	3254
14	7	3845
15	2	1265
16	5	3621
17	4	1254
18	6	2411
19	5	2145
20	7	3215
21	6	2845
22	4	1896
23	6	2458
24	3	1254
25	1	1452
26	2	1245
27	4	1879
28	7	2875
29	7	2635
30	6	2589

By analyzing the collected data, following is the scatter plot and regression line for correlation coefficient and regression equation.

Scatter Plot 3.1



From the above scatter plot, we can infer that initially the actual values are near to the predicted line but as the no. of of factors increases the Y- Actual values are moving away from the Y-Predicted values indicating that the it would be better if the sample size is more bigger.

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There is a good fit between the two variables and coming to the coefficients , the consant i.e., 925.7 is the Y-intercept when X=0 and for every unit of change in the X- value the Y changes by an amount of 288.3.From R^2 i.e., coefficient of determination , it can be inferred that 56 % of variation of Y is explained by X , which is a good fit and there is a significant relation between the variables.

The standard error i.e., the distance between the actual Y-values and predicted Y values increases as the no. of factors increases.To minimize this we need to go for a bigger sample size.

The data points are dispresed widely as the factors increases but the R^2 i.e., coefficient of determination shows that 56.9% of variation of Y value is explained by the X value , which is statistically significant.

And even the regression line is of good fit by which one can predict the future Y values for a particular X value.

Table 3.2 Summary Output

Regression Statistics	
Multiple R	0.75
R Square	0.57
Adjusted R Square	0.55
Standard Error	508.24
Observations	30

From the above regression summary output , it can be inferred that Multiple R i.e., Pearson coefficient of correlation is 0.75 ,which shows that the association between the variables is significant.

The R square that is coefficient of determination shows the strenght of association between the variables and that is 0.57 by which we can infer that 57 % of variation in Y value is explained by X value , which is significant too.

Adjusted R Square is 0.55 which will always be less than R square which considers the other associated factors too.

The standard error is the unexplained error or noise or residual error i.e.,508.24 the distance between the actual Y values and predicted Y values , which show that the data pints get dispersed as the no. of varied factors increases.This can be reduced by a bigger smaple size.The no. of observations are 30.

Table 3.3 ANOVA

	df	SS	MS	F	Significance F
Regression	1	9556273.38	9556273.38	37.00	1.46676E-06
Residual	28	7232736.48	258312.02		
Total	29	16789009.87			

From the above ANOVA table , the F Test is significant , Significanc F value is less than 0.05 where 5% chance of occuring randomly.Hence the regression equation is good.

Table 3.4

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	925.78	226.83	4.08	0.00034	461.14	1390.43
No. of factors varied at each level	288.31	47.40	6.08	0.0000015	191.21	385.41

The Y intercept is 925.78 and for every one unit X value the Y value changes by an amount of 288.31.Here the 288.31 is the beta coefficient of independent variable X which is high and which is good indicator of explanation power of independent variable X i.e., the higher the coefficient the higher is the explanatory power.

The standard error show the distance of the actual Y values and predicted Y values, which is a dispersion of the data.

In either case the P-values are lesser than 0.05 , which infers that the test statistic is significant and hence the null hypothesis can be rejected and can accept the alternate hypothesis.

The lower and upper values shows the occurrence of the values.

III. CONCLUSIONS

The research shows that there is a significant relationship between the no. of factors varied and the retail outlet sales as shown by correlation. And through the regression equation one can predict the Y values for a particular X value and the regression analysis explains the strength of relationship between the dependent and independent variables.

IV. LIMITATIONS

The sample size is small but here the market was restricted to suburban area and the no. of retail outlets were less.

The regression analysis is basically concerned with nature and degree of association but it never imply or assume any casuality.

The residual error cannot be explained even by the researcher at initial stages and off course that could be an error in this research.

V. IMPLICATIONS

The retailers once they come to know that there is an association between the sales and the other factors like retail location and so on ,which will be known by Correlation coefficient and then the regression analysis would make them to predict the future sales.

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The change in sales value i.e., Y value will infer the retailer , the most significant change is due to which factor and it would be better fro the retailers to focus on those factors alone. If there is a best fit line then the retailers can make better predictions for a certain X-Value.The retail outlet managers can build certain factors as tested in this research to influence the customers and to increase the purchase value.

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Six Sigma Methods and Formulas for Successful Quality Management

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Abstract: **This paper is about the five phases of Six Sigma which are Define, Measure, Analyze, Improve& Control. The methods used in each phase are discussed in detail and the various tests used in Analyze Phase of Six Sigma are given; Six Sigma can be implemented in an organization by using the methods and formulas used in each phase combined with the help of Statistical Software Minitab 18.**

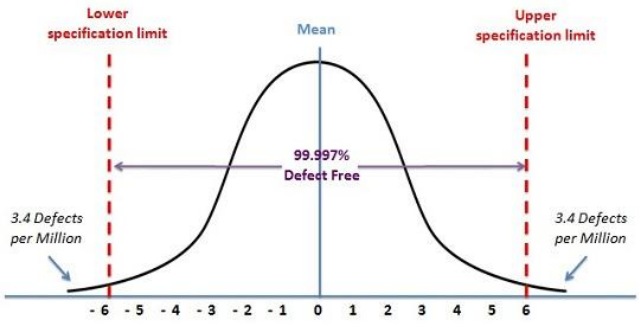
Keywords: **DMAIC, 3.4 Defects, USL, LSL, Standard Deviation, Mean, Anova, Hypothetical Tests**

Six Sigma is basically the application of Statistical formulas and Methods to eliminate defects, variation in a product or a process. For example if you want to find the average height of male population in India, you cannot bring the entire population of more than 2 billion into one room and measure their height for a scenario like this we take samples that is we pick up sample(people) from each state and use statistical formulas to draw the inference about the average height of male population in a population which is more than 2 billion. One more example would be say a company manufactures pistons used in motor cycles the customer demand is that the piston should not a diameter more than 9 cm and less than 5 cm anything manufactured outside this limits is said to be a variation and the six sigma consultant should confirm that the pistons are manufactured within the said limits else if there is variation in the range then the company is not operating at 6 sigma level it is operating at a very low level.

A company is operating at six sigma level implies that there are only 3.4 defects per million opportunities for example an airline company operating at six sigma level means that it loses only 3.4 baggage's per million of the passenger it handles.

Below is Shown the Six Sigma Table and a graph explaining the meaning of various levels of Six Sigma.

Sigma Level	Defect Rate	Yield Percentage
2 σ	308,770 dpmo (Defects Per Million Opportunities)	69.10000 %
3 σ	66,811 dpmo	93.330000 %
4 σ	6,210 dpmo	99.38000 %
5 σ	233 dpmo	99.97700 %
6 σ	3.44dpmo	99.99966 %



Six Sigma is Denoted by the Greek alphabet σ which is shown in the table above and is called as Standard deviation. The father of Six Sigma is Bill Smith who coined the term Six Sigma and implemented it in Motorola in the 1980's.

Six Sigma is implemented in Five Phases which are Define, Measure, Analyze, Improve, Control and we will discuss each phases in brief and the various methods used in Six Sigma.

DEFINE

The objectives within the Define Phase which is first phase in DMAIC framework of Six Sigma are:-

Define the Project Charter

- Define scope, objectives, and schedule
- Define the Process (top-level) and its stake holders
- Select team members
- Obtain Authorization from Sponsor

Assemble and train the team.

Project charters the charter documents the why, how, who and when of a project include the following elements

- Problem Statement
- Project objective or purpose, including the business need addressed
- Scope
- Deliverables
- Sponsor and stakeholder groups
- Team members
- Project schedule (using GANTT or PERT as an attachment)
- Other resources required

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Work break down Structure

It is a process for defining the final and intermediate products of a project and their relationship. Defining Project task is typically complex and accomplished by a series of decomposition followed by a series of aggregations it is also called top down approach and can be used in the Define phase of Six Sigma framework.

Now we will get into the formulas of Six Sigma which is shown in the table below.

Central tendency is defined as the tendency for the values of a random variable to cluster round its mean, mode, or median.

Central Tendency	Population	Sample
Mean/Average	μ =∑ (Xi)^2/N	XBar=∑ (Xi)^2/n
Median	Middle value of Data Most occurring value in the data	
Mode		
Dispersion		
Variance	σ ^2 = ∑(X- μ)^2/ N	S^2 = ∑(Xi- XBar)^2/ n-1
Standard Deviation	σ= √ ∑(Xi- μ)^2/ N	S = √ ∑(Xi- XBar)^2/ n-1
Range	Max-Min	

Where mean is the average for example if you have taken 10 sample of pistons randomly from the factory and measured their diameter the average would be sum of the diameter of the 10 pistons divided by 10 where 10 the number of observations the sum in statistics is denoted by ∑. In the above table X, Xi are the measures of the diameter of the piston and μ ,XBaris the average.

Mode is the most frequently observed measurement in the diameter of the piston that is if 2 pistons out 10 samples collected have the diameter as 6.3 & 6.3 then this is the mode of the sample and median is the midpoint of the observations of the diameter of the piston when arranged in sorted order.

From the example of the piston we find that the formulas of mean, median , mode does not correctly depict variation in the diameter of the piston manufactured by the factory but standard deviation formula helps us to find the variance in the diameter of the piston manufactured which is varying from the customer mentioned upper specification limit and lower specification limit.

The most important equation of Six Sigma is Y = f(x) where Y is the effect and x are the causes so if you remove the causes you remove the effect of the defect. For example headache is the effect and the causes are stress, eye strain, fever if you remove this causes automatically the headache is removed this is implemented in Six Sigma by using the Fishbone or Ishikawa diagram invented by Dr Kaoru Ishikawa.

MEASURE PHASE

In the Measure phase we collect all the data as per the relationship to the voice of customer and relevantly analyze using statistical formulas as given in the above table. Capability analyses is done in measure phase.**The process capability is calculated using the formula CP = USL-LSL/6 * Standard Deviation where CP = process capability index, USL = Upper Specification Limit and LSL = Lower Specification Limit.**

The Process capability measures indicates the following

1. Process is fully capable
2. Process could fail at any time
3. Process is not capable.

When the process is spread well within the customer specification the process is considered to be fully capable that means the CP is more than 2.In this case, the process standard deviation is so small that 6 times of the standard deviation with reference to the means is within the customer specification.

Example: The Specified limits for the diameter of car tires are 15.6 for the upper limit and 15 for the lower limit with a process mean of 15.3 and a standard deviation of 0.09.Find Cp and Cr what can we say about Process Capabilities ?

Cp= USL-LSL/ 6 * Standard deviation = 15.6 – 15 / 6 * 0.09 = 0.6/0.54 = 1.111

Cp= 1.111

Cr = 1/ 1.111 = 0.9

Since Cp is greater than 1 and therefore Cr is less than 1; we can conclude that the process is potentially capable.

ANALYZE PHASE

In this Phase we analyze all the data collected in the measure phase and find the cause of variation. Analyze phase use various tests like parametric tests where the mean and standard deviation of the sample is known and Nonparametric Tests where the data is categorical for example as Excellent, Good, bad etc.

Parametric Hypothesis Test -A hypothesis is a value judgment made about a circumstance, a statement made about a population .Based on experience an engineer can for instance assume that the amount of carbon monoxide emitted by a certain engine is twice the maximum allowed legally. However his assertions can only be ascertained by conducting a test to compare the carbon monoxide generated by the engine with the legal requirements.

If the data used to make the comparison are parametric data that is data that can be used to derive the mean and the standard deviation, the population from which the data are taken are normally distributed they have equal variances. A standard error based hypothesis testing using the t-test can be used to test the validity of the hypothesis made about the population. There are at least 3 steps to follow when conducting hypothesis.

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1. Null Hypothesis: The first step consists of stating the null hypothesis which is the hypothesis being tested. In the case of the engineer making a statement about the level of carbon monoxide generated by the engine , the null hypothesis is
   H0: the level of carbon monoxide generated by the engine is twice as great as the legally required amount. The Null hypothesis is denoted by H0
2. Alternate hypothesis: the alternate (or alternative) hypothesis is the opposite of null hypothesis. It is assumed valid when the null hypothesis is rejected after testing. In the case of the engineer testing the carbon monoxide the alternative hypothesis would be
   H1: The level of carbon monoxide generated by the engine is not twice as great as the legally required amount.
3. Testing the hypothesis: the objective of the test is to generate a sample test statistic that can be used to reject or fail to reject the null hypothesis .The test statistic is derived from Z formula if the samples are greater than 30.

$$Z = Xbar-\mu/\sigma/\sqrt{n}$$

If the samples are less than 30, then the t-test is used

T= X bar -μ/ s/√n where X bar and μ is the mean and s is the standard deviation.

1-Sample t Test (Mean v/s Target) this test is used to compare the mean of a process with a target value such as an ideal goal to determine whether they differ it is often used to determine whether a process is off center

1 Sample Standard Deviation This test is used to compare the standard deviation of the process with a target value such as a benchmark whether they differ often used to evaluate how consistent a process is

2 Sample T (Comparing 2 Means) Two sets of different items are measured each under a different condition there the measurements of one sample are independent of the measurements of other sample.

Paired T The same set of items is measured under 2 different conditions therefore the 2 measurements of the same item are dependent or related to each other.

2-Sample Standard This test is used when comparing 2 standard deviations

Standard Deviation test This Test is used when comparing more than 2 standard deviations

Non Parametric hypothesis Tests are conducted when data is categorical that is when the mean and standard deviation are not known examples are Chi-Square tests, Mann-Whitney U Test, Kruskal Wallis tests & Moods Median Tests.

Anova

If for instance 3 sample means A, B, C are being compared using the t-test is cumbersome for this we can use analysis of variance ANOVA can be used instead of multiple t-tests.

ANOVA is a Hypothesis test used when more than 2 means are being compared.

If K Samples are being tested the null hypothesis will be in the form given below

H0: μ1 = μ2 = ….μk

And the alternate hypothesis will be

H1: At least one sample mean is different from the others

If the data you are analyzing is not normal you have to make it normal using box cox transformation to remove any outliers (data not in sequence with the collected data).Box Cox Transformation can be done using the statistical software Minitab.

IMPROVE PHASE

In the Improve phase we focus on the optimization of the process after the causes are found in the analyze phase we use Design of experiments to remove the junk factors which don't contribute to smooth working of the process that is in the equation Y = f(X) we select only the X's which contribute to the optimal working of the process.

Let us consider the example of an experimenter who is trying to optimize the production of organic foods. After screening to determine the factors that are significant for his experiment he narrows the main factors that affect the production of fruits to "light" and "water". He wants to optimize the time that it takes to produce the fruits. He defines optimum as the minimum time necessary to yield comestible fruits.

To conduct his experiment he runs several tests combining the two factors (water and light) at different levels. To minimize the cost of experiments he decides to use only 2 levels of the factors: high and low. In this case we will have two factors and two levels therefore the number of runs will be 2^2=4. After conducting observations he obtains the results tabulated in the table below.

Factors	Response
Water –High Light High	10 days
Water high – Light low	20 days
Water low – Light high	15 days
Water low – Light low	25 days

CONTROL PHASE

In the Control phase we document all the activities done in all the previous phases and using control charts we monitor and control the phase just to check that our process doesn't go out of control. Control Charts are tools used in Minitab Software to keep a check

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on the variation. All the documentation are kept and archived in a safe place for future reference.

CONCLUSION

From the paper we come to understand that selection of a Six Sigma Project is Critical because we have to know the long term gains in executing these projects and the activities done in each phase the basic building block is the define phase where the problem statement is captured and then in measure phase data is collected systematically against this problem statement which is further analyzed in Analyze phase by performing various hypothesis tests and process optimization in Improve phase by removing the junk factors that is in the equation y = f(x1, x2,x3…….) we remove the causes x1, x2 etc. by the method of Design of Experiments and factorial methods. Finally we can sustain and maintain our process to the optimum by using control charts in Control Phase.

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Suresh has above 24 years' of overall experience in IT, 14 Years in Quality Assurance which includes 5 years in Project Management and 2 years as Six Sigma Black Belt Consultant & Corporate Trainer, 7 Years in ERP Gap & Fit, Implementation, Consulting & Testing for Manufacturing Companies and 3 years as Corporate Trainer.

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Employing Multimedia to Enhance Listening skill in Higher Education

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Abstract: **This paper proposes, theimportanceof a new multimedia applications to improve effective listening skill and discuss its advantages.Recently it was obvious that the importance of the listening skill is growing but simultaneous negligence by the students in the way of giving more attention to this crucial aspect of language.This negligence has a huge effect in the progress of the learners in improving this listening skill.The present study aim at investigation the impact of using multimedia to enhance listening skill so the higher presence of multimedia bring effective motivation , positive aspect to students and they can improve listening skill.Multimedia technology becomes more accessible and its potential as a tool to enhance listening skill, i.e,, text, audio-visual aids, internet and integration of these media may prove to be useful tool for second language learning and to assist in the development of listening skill. So the result of the multimedia was more effective than the traditional teaching technique.**

Key words: **Interactive multimedia, effectiveness, listening skill, self-access, motivation, positive aspect**.

I. INTRODUCTION

Now a days, listening skill is no longer viewed as a passive process**,**there has been studies putting listening before speaking and considering placing speaking before listening in learning language as'' to put the cart before the horse."(Vandergrift, 1999)It is defined as a complex skill that involves many simultaneous processes on diverse levels and engages a mixture of linguistic and non-linguistic knowledge.(Vandergrift & Tafaghodtari, 2010)Listening is the act of hearing attentively. Researchers have demonstrated that adult spend 40-50% with listening,25-30% with speaking, 11-16% reading and 9% with reading. (Vandergrift, 2004)We listen more than we speak. If this listening skill is used in a proper way we can master the tools of communicative skills. Listening is difficult, as human minds tend to distract easily. A person who controls his mind and listens attentively acquires various other skills and is benefited. Listening is defined as the process of identifying and understanding the speech of the speaker of language. It is the language skill that is used frequently. It involves understanding the speaker's accent or pronunciation, speaker's grammar and vocabulary, and comprehension of meaning (Saricoban, 1999).

Good listening makes learners interactive in family, workplace and society. If listening skill is poor someone cannot distinguish between parts of speech so he cannot provide a suitable response to show his apologizing, inviting, empathy, refusing, sense and interaction according to the situation. Further, poor listening skill does not allow person into a profession in communication, management, planning sales etc. According to Hilga 94%of knowledge comes to us through the sense of sight and the sense of hearing. The studies suggest that three days after an event, people retain 10% of what they heard from an oral presentation,35% from visual presentation, and 65% from a visual and oral presentation.(Rautro & Shivkumar, 2012)**.**

Listening skill falls into the three categories.

i) Passive listening: Listening for pleasure or entertainment
ii) Active listening: Listening to learn and retain information.
iii) Critical/Analytical listening: Listening to make judgement about what one has heard. Modern computer based technology fosters listening skills by providing multitude of opportunities for listening to spoken language.

Listening has been developed and advanced especially in media and in learning materials.Now a day the use of multimedia has become important which means that listening comprehension is no longer a cognitive process but an interactive process. There are many differentiations by different scholars concerning multimedia applications even though they share basic concepts.

i) Uses of multimedia are any device which can be used to make the learning experience and more concentrate, more realistic and more dynamic.
ii) Uses of multimedia are anything by means of which learning process may be encouraged or carried on through the sense of hearing or sense of sight.

As multimedia technology i.e., interactive video disc, CD-Rom be comes more accessible to teachers and learners of other languages. And many other technological innovations have taken the place of traditional chalk and board.

II. LITERATURE REVIEW

(Hofstetter, 2000) states that multimedia are the uses of computers to create and combine text, graphics, audio and video that allows users to interact, create and communicate.

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The interactive multimedia mean the interplay between the user and the programme or media it means that there is a reciprocal relationship,the user gives response to the display programmes,in this case the students must be active to take role in this computer assisted learning. According to (Akinwole Olakunle Idris, 2015)Audio-visual aids help completing the triangular process of motivation, clarification and stimulation.(Rusmanto, 2012) argues that the interactive multimedia are things that can make the learning process more interest and motivation to learn.

III. BODY OF THE STUDY

This article reports an exploratory study that aimed to find out whether the listening competences of students improved when technology was deployed in language laboratory.

3.1 Need for Multimedia in Higher Education

Most of the higher education is being implemented through English as a medium of instruction (EMI).(Coleman, 2006)the adaption of English as medium of instruction (EMI) has been sweeping across the higher education landscape worldwide. Students entering higher education have studied from their different vernacular region. There arefewer chances to study higher education in their mother tongue. And also local studies have shown there are a huge communication connection and cultural gaps between students and instructors in a typical classrooms setting of lecture delivery in English language. (Crystal, 2003)Being able to understand English as a second language (ESL) allow to communicate and accomplish higher education successfully therefore use of multimedia will enhance all language skills in higher education effectively and progressively.

3.2 Uses of multimedia to enhance listening skill

(Richards, 1985)listening competency as being comprised of a set of micro skills and they are as follows:

i) **Retention if information in short term memory**: Most current multimedia application allows the students control over the rate of language presentation that is to better understand and remember the aural text.

ii) **Discrimination the sounds of the target language:** The synchronized display of text along with the aural text assists the learner in distinguish phonetic grouping and boundaries.

iii) **iii)Recognize patterns of stress, rhythm, and intonation:** When specific words are stressed and patterns of intonation used learners can be cued to closely examine the visual and spoken reaction of interlocutors in the video presentation.

iv) **iv)Process different speech styles different rates and performance errors:** Rate and style of audio naturally vary according to genre of the video selection. for example; exemplify slowed speech Interlocutors speak slowly and deliberately so the joke can be proceed and understand.

IV. DEVELOPING LISTENING SKILL THROUGH MULTIMEDIA

In this article integrative active listening learning integrated with attitude, knowledge, and behaviour to achieve listening goal. (Arono, 2014) **Flowerderdan miller** paid attention much to integrative listening like pre-listening, while-listening, and post listening. Thompson also described active integrative listening which could be done into some steps like prepare for listening activity and implement new goal in listening activity.

Stage I (pre-listening): There were some preparation like noticing and reflecting key words.

Stage II (While listening): The students did listening process by clarifying meaning and performance effectiveness.

Stage III (post listening):Students reflected listening purpose by deterring whether listening result accept or not accept.

There are many choices of listening material in multimedia such as., text, audio-video technique, internet,etc. (Miller, 2003)Developing listening skills with Authentic materials by Lindsay Miller(2003) specifies the following techniques for developing listening skills.

- **Text**: since multimedia is usually defined as the integration of sound etc strictly it is performance not constructed.
- **Audio-visual technique**: According to (Patil, 2010)"Audio- visual aids gives vicarious experience i.e.,it is beyond doubts that the first-hand experience are the best type of education experience. And it is helpful on attracting attention it is very helpful in creating an appropriate atmosphere for arresting as well as retain the attention and interest of the students in the classroom. (Ikeuchi,'Listening comprehension and the use of Audio-Visual Aids at Home')**.**Audio-visual aids are anything by means of which learning process may be encouraged or carried on through the sense of hearing or sense of sight.(Good & Kappa, 1973).
- **Internet:** with the right software, of using images and audio resources at the same time, combining sounds and images as in communication situations in the real world there is plethora of educational video and audio material available on line, such as google.com.for instances.
- **Skype**: It is an application uses as a part of listening development process throughout the world today. It is an internet –based application that enables voice over internet protocol(VOIP).These are similar on line applications such as MSN messenger and google talk.

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- **Internet TVs and radio**: they can be used to develop listening comprehension skills of a students in an entertaining atmosphere how can there is a relatively new emerging phenomenon i.e., you tube .com**,** television /radio shows news, documentaries ,,music videos and any videos beyond the imagination of people are one click away.
- **BBC:** It has been publishing books,audio/video materials and so on, BBC has prepared an English learning page which is one of the best its kind maintain the publications at **http://www.bbc.co.vk//learning** English. BBC provides the visitors with quizzes,videos ,podcast and games as well as radio archives and voice recording.
- **Music:** songs can be highly useful for developmental process of listening skills of a student Eg: **Karoke**it means it is also beneficial that it requires a recitation which eventually leads to improvement in listening and speaking skills.

V. CONCLUSION

Uses of multimedia as a technology that supports to enhance listening skills development in second language is strong arguments supportive of multimedia processing as a means of listening skills development emphasize.

a) the role of test and visual as media to language processing within the aural test.
b) the motivational aspect of video as an advantages for language instruction is clear, no technology can replicate the linguistic growth derived from human interaction and learning media with interactive multimedia was better to improve students listening skill but two way active negotiation of meaning considered essential to successful language learning is simply not possible via multimedia .

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Locus of Control in Relation to Academic Achievement of College Students in Meghalaya

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***Abstract*- Locus of Control was developed by Julian Rotter, based on the Social Learning Theory the main ideawas that the generalized expectancies of people govern one's belief and act accordingly. Locus of Control plays an important role in motivating learning and developing a better person, which affect the achievement of students. The investigator felt the need to investigate the relationship between Locus of Control and Academic Achievement of college students in Meghalaya. The present study has adopted Descriptive survey method. The sample for the present study consisted of 797 students of bachelor degree of final year, selected by stratified random sampling technique. The tool used for collecting Locus of Control data was constructed and standardised by the investigator. The study found that majority of students have average Internal and External Locus of Control. The study found a significant difference in Internal Locus of Control between urban and rural college students, between Science and Commerce students, between Science and Arts students, but there was no significant difference in Internal Locus of Control between genders and between Commerce and Arts students. The study found no significant difference in External Locus of Control between gender, between locale, between Arts and Commerce students, but there was a significant difference between Science and Commerce and between Science and Arts students. The study found that there was a strong positive correlation between Internal Locus of Control and Academic Achievement among college students from different streams, in both the gender, from colleges of both the locale. The study found that there was a moderate positive correlation between External Locus of Control and Academic Achievement among students from different streams, in both the gender and from colleges of both the locale. The study concluded that in order to help the students to be more successful in life, Internal Locus of Control needs to be encouraged among students, students would work harder for their progress because of the believe one's is responsible for his or her success or failure.**

***Keywords:*Academic Achievement, College Students, External Locus of Control, Internal Locus of Control, Locus of Control**

I. INTROCUCTION

In order to understand the concept of Locus of Control, Rotter's Social Learning Theory (SLT) need to be understood because Locus of Control is based on the Rotter's Social Learning Theory of personality. According to Gale [1], Locus of Control was the brainchild of psychologist Julian Rotter, who based his concept on the Social Learning Theory idea that the generalized expectancies of people govern their actions.

Social learning theory in its earliest formulations was an attempt to integrate the two modern trends in American psychology the stimulus-response or reinforcement theories on the one hand and the cognitive or field theories on the other. Social Learning Theory included both behavioural constructs and internal or subjective constructs; but it required the performance of objectives, indirect operations to measure the subjective constructs. Consequently, the development of social learning has been concerned from the beginning with problems of measurement as cited in [2]. Social Learning Theory is a personality theory brings the reinforcement theories and the cognitive theories together. It included both behavioural and internal or subjective constructs. It involves a description of the schema of individual differences and effect of experience. It has concerned with both methods of measurement and theoretical problems of measurement.

Rotter described [3], when a reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his own action, then, in our culture, it is typically perceived as result of luck, chance, fate, as under the control of powerful others, or as unpredictable because of the great complexity of the forces surrounding him. When the event is interpreted in this way by an individual, we have labelled this a belief in external control. If the person perceives that the event is contingent upon his own behaviour or his own relatively permanent characteristics, we have termed this a belief in internal control. Locus of Control is an epiphenomenon, a mere diagnostic indicator of a person's capacities for achievement; that is, the more intelligent and achieving a person is, the more likely he will perceive himself to be an active, effective person…. It will be apparent that Locus of Control plays a mediating role in determining whether persons become involved in the pursuit of achievement [4].

Locus of Control is concerned with the assignment of responsibility, regardless of behavioural instrumentality. One perceives internal control when one assumes full responsibility for what has happened, even though it was externally caused. One perceives external control if the responsibility for an outcome rests entirely elsewhere, regardless of whether it is the direct consequence of one's own behaviour. One perceives dual control when the responsibility for an outcome is shared by the individual as well as external sources as written by [5].

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In these context, we can say that Locus of Control is one's belief about certain outcomes or rewards in life are a result of one's efforts which termed as Internal Locus of Control or a result of luck, fate, or the actions of others which was termed as External Locus of Control.

Locus of Control plays important role in learning if the students have anInternal Locus of Control students would work harder for their progress because of the believe one's is responsible for his or her success or failure. Internal Locus of Control gives the feeling of responsibility to one self. A student who understands his own self and motivated from within will surely learn better and achieve better scores. This indicates Locus of Control plays important role in developing a better person, which affect the achievement of students. College going students are the important group of people who are energetic, ready to learn, adventures, full of dreams and love changes. These youths in Meghalaya should be encouraged with awareness on their learning and also encourage believing about themselves. Students should be trained to look at anything consciously and critically, enabling them to decide what is wrong or right this will help to produce an effective and responsible person, thinker, leader etc. College students have to be encouraged to develop an Internal locus of control, students with the believe that they are responsible for their failure or success tend to be more aware and alert about the outcome so this lead to the tendency to work hard and become a successful person than the person with External Locus of Control. Thus, the Locus of Control plays important role in helping the person to be a better and successful learner in this way the academic achievement of learner could affect positively. In this context, the researcher felt the need to investigate the relationship between Locus of Control and Academic Achievement of college students of Meghalaya.

II. METHODOLOGY

The present study has adopted descriptive survey method as to describe the Locus of Control and Academic Achievement of college students in Meghalaya. The data was collected from the sample by administered the scale Locus of Control, which was constructed and standardised by the investigator for studying the Locus of Control among the undergraduate students of Meghalaya.Locus of Control Scale has been operationally defined as the belief about whether certain outcomes or rewards in life are a result of internal factors or the external factors. The internal factor is; belief in oneself, Integrity, Alienation, Ego control and external factor are; luck, powerful other, field dependent and social forces. Academic achievement was the marks obtained in the three annual examination of the undergraduate courses – Bachelor of Arts, Bachelor of Science and Bachelor of Commerce conducted by North Eastern Hill University. The sample for the present study consisted of 797 students of the final year in colleges of Meghalaya. They were selected by Stratified random samplingtechnique. The sample was stratified on the basis of streams Arts, Science, and Commerce. Then the sample was drawn randomly.The statistical technique used for analysing the data like frequency, percentage, mean, standard deviation and coefficient of correlation.

III. FINDINGS AND DISCUSSION

A. Objective one, to study the Locus of Control among college students of Meghalaya

Locus of Control has two dimensions i.e. Internal Locus of Control and External Locus of Control. The data of Internal Locus of Control and External Locus of Control of college students has been analysed using frequency and percentage which was shown in Table I and Table II.

From the Table I, it was shown that 67.25 percent of the college students have an average level of Internal Locus of Control. Which means that majority of the college students of Meghalaya have an average level of belief that their success and failure depend on their one-self, integrity, alienation and ego control.

TABLE I

INTERNAL LOCUS OF CONTROL

Z score#	Internal Locus of Control			Level
	Score	Frequency	Percent	
2.1 and above	93 and above	12	1.51	High
1.1 to 2.0	86 – 92	133	16.69	Above average
-1.0 to 1.0	72 – 85	536	67.25	Average
-2.0 to -1.1	65 – 71	105	13.17	Below average
-2.1 and below	64 and below	11	1.38	Low
Total		797	100	

Norm from the constructed scale

From the Table II, it was shown that 63.86 percent of the college students have an average level of External Locus of Control. Which means that majority of the college students of Meghalaya have an average level of belief that their success and failure depend on luck, powerful others, field dependent social forces, and skills.

From the above findings it was understood that majority of college students in Meghalaya has anaverage level in both Internal Locus of Control and External Locus of Control. It means they belief that their success or failure is depend on one-self or own effort and luck or chance.

TABLE II

EXTERNAL LOCUS OF CONTROL

Z score*	External Locus of Control			Level
	Score	Frequency	Percent	
2.1 and above	76 and above	17	2.13	High
1.1 to 2.0	70 – 75	109	13.68	Above average

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-1.0 to 1.0	57-69	509	63.86	Average
-2.0 to -1.1	51-56	149	18.70	Below average
-2.1 and below	50 and below	13	1.38	Low
Total		797	100	

*based from the norm set for the scale

B. Objective two, to find out the difference in Locus of Control and Academic Achievement between the following groups

The data collected has been analysed below using mean, standard deviation and t-value to find out the difference in Locus of Control and Academic Achievement between the following groups

1) Difference in Locus of Control based on Gender: was calculated to find out the difference in Locus of Control based on dimension wise.

TABLE III

DIFFERENCE IN LOCUS OF CONTROL BASED ON GENDER

Locus of Control	Gender	N	Mean	SD	df	*t*-value
Internal Locus of Control	Male	354	78.66	6.693	795	1.28*
	Female	443	79.28	6.875		
External Locus of Control	Male	354	61.82	5.889	795	1.02*
	Female	443	62.26	6.168		

*Not significant at 0.01 level

From the above Table III, it was shown that t-value was 1.28 which was not significant at 0.01 level with df = 795 for Internal Locus of Control and also shown that t-value was 1.02 which was not significant at 0.01 level with df = 795 for External Locus of Control. Thus the null hypotheses were accepted. In the light of this result, it can be interpreted that there was no significant difference in Internal Locus of Control as well in External Locus of Control between male and female college students. This means that the belief of male and female students, that their success or failure depend on their own efforts and also depend on luck and chance are the same.

The finding was dissimilar with the finding by other researchers[6], [7], [8], [9], [10], [11] and similar to the findings of [12], [13] and[14]. Gender does not affect Locus of Control of college students of Meghalaya this may be due to the similar type of bringing up both boy and a girl child in the

2) Difference in Locus of Control based on Locale: Mean, Standard Deviation and t-test of urban and rural college students was calculated to find out the Locus of Control dimension wise.

As shown in Table IV, t-value value was 4.22 which was significant at 0.01 level with df = 795. Thus the null hypothesis was not accepted. In the light of this result, it can be interpreted that there was a significant difference in Internal Locus of Control between urban and rural college students of Meghalaya. The mean difference of 2.1 was in favour of urban college students. This pointed out that students of the urban college have a high Internal Locus of Control as compared to rural college counterparts. This means that urban students have a high belief that their success or failure depends on their one-self, integrity, alienation and ego control as compared to rural students.

The Table IV also shows that t-value is 2.04 which was not significant at 0.01 level with df = 795. Thus the null hypothesis was accepted. In the light of this result, it can be interpreted that there was no significant difference in External Locus of Control between urban and rural college going students of Meghalaya. This pointed out that students of the urban colleges and rural colleges have same External Locus of Control. Which means that urban and rural college students have the same belief that their success or failure depends on luck, powerful others, field dependent, social forces, and skills.

TABLE IV

DIFFERENCE IN LOCUS OF CONTROL BASED ON LOCALE

Locus of Control	Locale	N	Mean	SD	df	*t*-value
Internal Locus of Control	Urban	442	79.91	6.83	795	4.22*
	Rural	355	77.89	6.59		
External Locus of Control	Urban	442	62.45	6.03	795	2.04**
	Rural	355	61.58	6.04		

* Significant at 0.01 level

**Not significant at 0.01 level

The finding was dissimilar with the finding of others researchers [11] and [14]. Locale has an effect on Locus of Control and urban college students have high Internal Locus of Control as compared to rural college students, the investigator agreed to that and the reason might be students studying in the urban are taught to be more goal oriented, but depend on satisfaction that the goal they want to achieve if the goal to be achieved is to satisfied themselves or to fulfil their own happiness then the student would be more internally control but if the goal is to satisfied themselves because of the parent, teachers, society, etc., then the student would be more externally control.

3) Difference in Locus of Control between Science and Commerce stream students: Mean, Standard Deviation and t-test of Science and Commerce students was calculated to find out the Locus of Control dimension wise.

TABLE V

DIFFERENCE IN LOCUS OF CONTROL BETWEEN SCIENCE AND COMMERCE STREAM STUDENTS

Locus of Control	Stream	N	Mean	SD	df	*t*-value
Internal Locus of Control	Science	70	87.43	4.57	138	9.87*
	Commerce	70	77.83	6.74		

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External Locus of Control	Science	70	65.50	5.19	138	4.58*
	Commerce	70	61.19	5.94		

* Significant at 0.01 level

From the above Table V, it was shown that t-value was 9.87 which was significant at 0.01 level with df = 138 for Internal Locus of Control and also shown that t-value was 4.58 which was significant at 0.01 level with df = 138 for External Locus of Control. Thus the null hypotheses were not accepted. In the light of this results, it can be interpreted that there was a significant difference in Internal Locus of Control as well in External Locus of Control between Science and Commerce stream students. The mean difference was in favour of Science stream students in both the cases. This pointed out that students of Science stream have a high Internal Locus of Control as well External Locus of Control when compared to Commerce counterparts. This means that Science students have a high belief that their success and failure depend on their own hard work as well depend on luck and powerful others as compared to commerce students.

4) Difference in Locus of Control between Science and Arts stream students: Mean, Standard Deviation and t-test of Science and Arts students was calculated to find out the Locus of Control dimension wise.

TABLE VI

DIFFERENCE IN LOCUS OF CONTROL BETWEEN SCIENCE AND ARTS STREAM STUDENTS

Locus of Control	Stream	N	Mean	SD	df	*t*- value
Internal Locus of Control	Science	70	87.43	4.57	725	11.72*
	Arts	657	78.24	6.39		
External Locus of Control	Science	70	65.50	5.19	725	4.95*
	Arts	657	61.79	6.033		

*Significant at 0.01 level

From the above table, it was shown that t-value is 11.72 which was significant at 0.01 level with df = 725 for Internal Locus of Control and also shown that t-value is 4.95 which was significant at 0.01 level with df = 725 for External Locus of Control. Thus the null hypotheses were not accepted. In the light of this results, it can be interpreted that there was a significant difference in Internal Locus of Control as well in External Locus of Control between Science and Arts stream students. The mean difference was in favour of Science stream students in both the cases. This pointed out that students of Science stream have a high Internal Locus of Control and also high External Locus of Control when compared to Arts stream counterparts. This means that Science stream students have a high belief that their success or failure depends on their one-self, integrity and also depend on luck, powerful others, field dependent social forces, and skills when compared to Arts stream students. The finding was dissimilar with the finding of [13].

5) Difference in Locus of Control between Commerce and Arts stream students: Mean, Standard Deviation and t-test of Commerce and Arts students was calculated to find out the Locus of Control dimension wise.

TABLE VII

DIFFERENCE IN LOCUS OF CONTROL BETWEEN COMMERCE AND ARTS STREAM STUDENTS

Locus of Control	Stream	N	Mean	SD	df	*t*- value
Internal Locus of Control	Commerce	70	77.83	6.74	725	0.51*
	Arts	657	78.24	6.39		
External Locus of Control	Arts	657	61.79	6.03	725	0.80*
	Commerce	70	61.19	5.94		

*Not significant at 0.01 level

From the above table, it was shown that t-value is 0.51 which was not significant at 0.01 level with df = 725, for Internal Locus of Control and it the table also showed that t-value is 0.80 which was not significant at 0.01 level with df = 725 for External Locus of Control. Thus the null hypotheses were accepted. In the light of this results, it can be interpreted that there was no significant difference in Internal Locus of Control as well as in External Locus of Control between Commerce and Arts stream students. This means that the Commerce and Arts students have same belief that their success or failure depends on their one-self or their own effort and also depend on luck and social forces.

3. Objective three, to find out the relationship between Locus of Control and Academic Achievement of the following groups

The data collected has been analysed using correlation coefficient below to find out the Locus of Control in relation to Academic Achievement of the following groups

1) Relationship Based on Stream: correlations of Locus of Control and Academic Achievement of students from different stream

TABLE VIII

CORRELATIONS OF LOCUS OF CONTROL AND ACADEMIC ACHIEVEMENT OF STUDENTS FROM DIFFERENT STREAM

Stream	Variable	N	r	*p*
Arts	Internal Locus of Control and Academic Achievement	657	.98	Significant at 0.01 level
	External Locus of Control and Academic Achievement	657	.46	
Science	Internal Locus of Control and Academic Achievement	70	.99	
	External Locus of Control and Academic Achievement	70	.39	
Commerce	Internal Locus of Control and Academic Achievement	70	.99	
	External Locus of Controland Academic Achievement	70	.62	

From the Table VIII, it was shown that r values of 0.98, 0.99 and 0.99 were significant at 0.01 level with df = 655, 68 and 68 respectively. Hence the null hypotheses were not accepted. It was concluded that there was a strong positive

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correlation between Internal Locus of Control and Academic Achievement among students belong to Arts, Science, and Commerce stream. This indicated that the higher the level of Internal Locus of Control of the students, higher the Academic Achievement. It highlights the fact that Academic Achievement of any stream students was affected by their Internal Locus of Control. It also indicated that Internal Locus of Control is one of the factors which positively and highly affects the Academic Achievement among students. Which mean that Academic Achievement of the Arts, Science, and Commerce students were affected by their belief that their success or failure depends on their one-self, integrity, alienation and ego control.

From the above table, it was shown that the r values of 0.46, 0.39, and 0.62 were significant at 0.01 level with df = 655, 68 and 68 respectively. Hence the null hypotheses were not accepted. It indicates that there was a moderate and positive correlation between External Locus of Control and Academic Achievement among Arts, Science and Commerce stream students. This indicated that the higher the level of External Locus of Control of the students, higher the Academic Achievement but at moderate. It highlights the fact that Academic Achievement of college students was also affected by their External Locus of Control. It also indicated that External Locus of Control is one of the factors which affects positively on Academic Achievement among college students. Which means that the Academic Achievement of the college students of Meghalaya was moderately affected by their belief in their success or failure depends on luck, powerful others, field dependent social forces, and skills.

2) Relationship Based on Gender: correlations of Locus of Control and Academic Achievement of students based on genders

TABLE IX

CORRELATIONS OF LOCUS OF CONTROL AND ACADEMIC ACHIEVEMENT OF GENDER

Gender	Variable	N	r	*p*
Male	Internal Locus of Control and Academic Achievement	354	.98	Significant at 0.01 level
	External Locus of Control and Academic Achievement	354	.47	
Female	Internal Locus of Control and Academic Achievement	443	.98	
	External Locus of Control and Academic Achievement	443	.51	

From the above table, it was shown that the r values of 0.98 and 0.98 were significant at 0.01 level with df = 352 and 441. Hence the null hypotheses were not accepted. It indicated that there was a significantly strong and positive correlation between Internal Locus of Control and Academic Achievement among students belong to both the genders. This indicated that the higher the level of Internal Locus of Control of the students, higher the Academic Achievement. It highlights the fact that Academic Achievement of college students was affected by their Internal Locus of Control. It also indicated that Internal Locus of Control is one of the factors which affects positively on Academic Achievement students. Which means that Academic Achievement of the college students was affected by their belief in themselves, integrity and own effort.

From the above table, it was seen that the r values of 0.47 and 0.51 were significant at 0.01 level with df = 352 and 441 respectively. Hence the null hypotheses were not accepted. It was concluded that there was a moderate and positive correlation between External Locus of Control and Academic Achievement among students of both the genders. This indicated that the higher the level of External Locus of Control of the students, higher the Academic Achievement but at moderate. It also indicated that External Locus of Control is one of the factors which affects positively on Academic Achievement among students. Which mean that the Academic Achievement of college students of both the genders affects by their belief on luck, powerful others, and God.

3) Relationship Based on Locale: correlations of Locus of Control and Academic Achievement of students based on Locale.

TABLE X

CORRELATIONS COEFFICIENT OF LOCUS OF CONTROL AND ACADEMIC ACHIEVEMENT OF LOCALE

Locale	Locus of Control	N	r	*p*
Rural	Internal Locus of Control and Academic Achievement	355	.98	Significant at 0.01 level
	External Locus of Control and Academic Achievement	355	.48	
Urban	Internal Locus of Control and Academic Achievement	442	.99	
	External Locus of Control and Academic Achievement	442	.50	

*Significant at 0.01 level

From the above table, it was shown that the r values of 0.98 and 0.99 were significant at 0.01 level with df = 353 and 441 respectively. Hence the null hypotheses were not accepted. It indicated that there was a strong and positive correlation between Internal Locus of Control and Academic Achievement among rural as well as urban college students of Meghalaya. This indicated that the higher the level of Internal Locus of Control of the students, higher the Academic Achievement. It highlights the fact that Academic Achievement of rural as well as urban college students was affected by their Internal Locus of Control. It also indicated that Internal Locus of Control is one of the factors which affects positively on Academic Achievement among rural and urban college students.Which mean that Academic Achievement of the rural and urban college students was affected by their belief that their success or failure depends on their own effort and struggle.

From the above table, it was seen that the r values of 0.48 and 0.50 were significant at 0.01 level with df = 353 and

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442 respectively. Hence the null hypotheses were not accepted. It indicated that there was a positive and moderate correlation between External Locus of Control and Academic Achievement among rural as well as urban college students of Meghalaya. This indicated that the higher the level of External Locus of Control of the students, higher the Academic Achievement but at moderate. It highlights the fact that Academic Achievement of rural as well as urban college students was also affected by their External Locus of Control.Which mean that the Academic Achievement of the rural and urban students affected by their belief in luck or chance or because of the effort of powerful other like teachers or parents.

From the above analysed it was understood that there was a high, positive and strong relationship between Internal Locus of Control and Academic Achievement of the students from different streams, gender and locale whereas in case of External Locus of Control and Academic Achievement the relationship was positive but moderate. The finding was dissimilar with the finding of [12] who found no significant relationship between academic performance and locus of control. But the finding was similar to the finding by [5] and [9] found a significant relationship between academic performance and locus of control. Hasan & Khalid, [15], Locus of Control affect the academic achievement of the students.

IV. CONCLUSION

The study found that majority of college going students of Meghalaya have average level Internal and External Locus of Control which means majority has an average level of belief that their success or failure is partly because of their hard work and partly because of luck or chance or God. The study found that gender did not affect Internal and External Locus of Control of college students of Meghalaya. Urban college going students have a high Internal Locus of Control as compared to rural counterparts. Students from Science stream have a high Internal Locus of Control and External Locus of Control as compared toArts and Commerce stream.Internal Locus of Control is one of the factors which positively and strongly affects the Academic Achievement among students of both the gender, locale and from a different stream.External Locus of Control affects the Academic Achievementmoderately and positively among students of both the gender, locale and from different streams.

Internal Locus of Control is stable factors which can provide a strong foundation and support for learning and education. This call for the action on the part of university, colleges, teachers, and students for the development and awareness of an enrichment of Internal Locus of Control among students. The curriculum should focus on the development of self-esteem, self-awareness, and self-confidence among students as it leads to a feeling of well-being as it develops internal factor like belief in oneself, integrity, alienation and ego control. The internal factors are stable as compared to external factor like Luck. The study provides knowledge to the educational administrator to know the need to provide appropriate management style and academic facilities to develop and improve Locus of Control of college students. Healthy college climate should be ensured to encourage students to have more Internal Locus of control. Positive approach help in developing and strengthen Locus of Control. It then focuses on tapping their inner strength. Students should be encouraged to be independent, by understanding their belief in themselves would bring great success. Teachers should consistently use praise and encouragement appropriately, specifically and honestly, especially praise for perseverance and working through a problem should be practiced to help to build Locus of control. Counselling programmes and session should be arranged to improve Internal Locus of Control like encourage responsibility for everyday living. This study assists the student to know the worth of Locus of Control can help them to be a productive and a successful person and it plays important role in their life. The student should develop high inner strength in order to be more productive and successful. They should realise that attitude affects learning they should engage in positive thinking and activities which will lead to the high Internal Locus of Control.

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Enhancing Speaking Skills through Efficacy of Multimedia in Tertiary Education

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Abstract: **The object of the present study is to enhance speaking skills through efficacy of multimedia. Speaking is the most important tool of communication. One of the main concern of language learners is how to improve their speaking proficiency in general and different components of situation. Speaking proficiency such as fluency, accuracy, accent, vocabulary, comprehension which help us speak the language fluently. In the fast developing 21st century various innovative technologies are being introduced to teach speaking skills in the classroom. The present world is driven by technology, which cannot be denied. It is the means to get access with this modernized world. Though technology cannot play the crucial role of a teacher, it can be used as an additional tool for improving speaking skills in classroom i.e., internet, podcast, video conferencing, videos and speech recognition, TELL, are considered to be source of the best tool of teaching speaking skill. Apart from that in tertiary education students come from different back ground therefore use of technology is inevitable. Because of having huge classroom size and lack of facility it is best tool for tertiary education to improve speaking skill.**

Keywords**: Modern technologies, Enhancing Speaking Skill, fluency and tertiary education.**

I. INTRODUCTION

Speaking is considered to be one of the most important skill of a language in learning a second or foreign language. In the rapid developing 21st century various innovative technologies are being introduced to teach English in the classrooms. Students have to update their knowledge by using modern technologies otherwise they will be relegated into real world.

According to (Brown & Yule, 1983) speaking is the skill that the students will be judged upon most in real life situation. (Sokolik, 2010) Observes machines are now used as tools for communication rather than simply as way of delivering automated drills or exercises. The various features involved in speaking we form sentences when we speak, the sentence are made of words, which in turn are combination of syllables.

II. THE MEANING OF FLUENCY

(Balčytytė-Kurtinienė, 2014) holds that fluency means the capacity to use language in real time and accuracy means the ability to avoid error in performance. The stages in physical speech mechanism are presented and are listed as follows:

1. Initiation or Respiration (the lungs provide the energy source);
2. Phonation (the vocal folds convert the energy into an audible sound);
3. The Oronasal Process (the soft palate distributes the audible sound into the oral cavity or nasal cavity);
4. Articulation (the organs of speech transform the sound into an intelligible speech sound)

(Segalowitz, 2010) and (Kormos, 2006) proposes to distinguish between three different senses of the fluency

1) **Cognitive fluency**: refers to the underlying cognitive machinery that transforms the intended message into spoken language. In original metaphor of flow, if this machinery is efficient, the process will be smooth and effortless**.**
2) **Utterance fluency**: refers to the surface properties of speech i.e., rate of speech, pauses, hesitation, repetition, and reformulation.
3) **Perceived fluency**: It focuses on the listener's impressions and the inferences they make about a speaker's cognitive fluency based on their preparation of utterance fluency.

In case of Indian languages the spelling helps us to pronounce the words correctly. But in case of English there is no 1:1 relationship between spelling and sounds, sometimes the same spelling may be used for different sounds. Look at these words: **ch**urch, ma**ch**ine, **ch**orus, the spelling 'ch' in all these words have different sounds. The international Phonetic Association (IPA) has described how each sound is produced, they have also assigned symbols to represent these sounds.

III. TERTIARY EDUCATION/POST-SECONDARY EDUCATION

Tertiary education refers to any type of education beyond the high school level. This includes diplomas, undergraduate and graduate certificates and associates, masters and doctoral degrees.

Aim of Tertiary Education

i) To educate the youth to become active and productive member of society.
ii) It seeks to meet and match industry demand with a competent and globally competitive workforce.

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(Jackson, 2000)For example: In secondary school classes are still small (upto 20-30 students) and you rotate between teachers, classrooms and students. But in tertiary institutions, you are getting certification for what you will spend the rest of your life long. classes can be from 100-500+students with one professor. And teachers/professors will not hold your hand and you are going to be very independent and you may have entire days without classes, one class a day etc .(Varghese, 2014)Focusing on entrepreneurial education technical/vocational as a means of improving the employability of tertiary education graduates.

Two Main Reasons to Select Tertiary Education

i) Tertiary education based on individual and self-learning and it included all technical and vocational educations mostly because its aim is to become active and productive member of society.so technology can be useful more better to tertiary education than secondary education.

ii) Second reason is in tertiary education it is not easy to maintain lecturer to 300 members a class at time and students are followed by their own schedule.so for many reasons multimedia acts as main role to learn language skills and complete their course in English medium as(EMI) successfully. And communicate them to develop speaking fluency skills. In addition that technology gives learners a chance to engage independently, provide opportunities for self-paced interactions, privacy and self-environment where mistakes are corrected and exact feedback is given.so assuredly it is best tool for tertiary education.

IV. LITERATURE REVIEW

(RIGGENBACH & KOPONEN, 2000)) the word 'fluency and fluent' come from the latin word fluens. fluency as the quality of flowing, smoothness. Thomson(2004 p.661) (murray j.munro, 2004)of foreign language speech for a variety of reasons.To be able to improve their language skills use Internet, software programmes . (p.steenkamp, 2013) Students currently studying at tertiary institutions have developed a set of attitudes and aptitudes as a result of growing up in an IT and media rich environment. These attitude and aptitude influence how they learn and in order to be effective lecturers must adapt to address their learning preference and use the online teaching tool. (Katz, 2009))"SMS-Based learning in tertiary education" in this topic he said "The learning of vocabulary and concept of learning ,SMS-Based learning has advanced rapidly and becoming an integral part of the learning process in many universities through world.

V. BODY OF THE STUDY

The availability of a variety of media technologies allows users to use certain videos and audios,as well as record audio-video files in a reasonably leading to learning environment (Odhabi, 2009) The current technology lightens up the mind of the tertiary students to get into the subject with full involvement rather than a complex task to do and language can be learnt by imitation and learnt as they speak in mother tongue.so these following technical tools useful to develop their speaking fluency skill.

Modern Technologies in Developing Speaking Skill

They are: i) Communication lab ii) Video conferencing iii) Video Library iv) CALL (Computer Assisted Language Learning) V) MALL (mobile assisted language learning) vi) Speech recognition software vii) Internet viii)TELL (Technology Enhanced Language Learning) xi) Pod casting x) Video tape xi) Quick Link Pen xii) Quicktionary and The Web.

i. **Communication lab**: Software's are accessible in language lab to improve speaking skills. The students have a chance to play it again and again without feeling boredom. Listening Skills allow the person to understand what other person speaks. So the students feel interest and try to listen ,record and practice through headphones in the labs and create interest to learn and repeat again and again on the subject. (Clark, 1994)

ii. **Video conferencing:** Video Conferencing is the gateway where one can access the speech of others across the universe (Lawson, 2010)It is the live relay programme where students get the best opportunity to post the questions immediately and get a platform to get the answers for their queries from the experts.

iii. **Video library:** It is most helpful for the absentia students. This is vividly helpful for the students who do not attend an important session or lecture. The teaching faculty records the lessons and made available to the learners and the students have a scope to play and listen to them in their leisure time, as many times as they can and understand the concept excellently.

iv. **CALL:** The educational role of Computers in learning a second language and the role of CALL (Computer Assisted Language Learning) is significant The teacher can use the latest technologies, which have the potential to transform the students from passive recipients of information into active participants. CALL is defined as the search for and study of applications of the Computer in language teaching and learning .Computer assisted language learning have been found to promote foreign language learning effectively. These courses can give students flexibility to work independently, at their own pace in order to promote English language acquisition (MUTLU, 2013).

v. **MALL(Mobile Assisted Language Learning):**Mobile phones can also be utilized to enrich vocabulary skills by receiving new words daily. There are many apps which can improve their vocabulary and give

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new words and its origin, thesaurus etc every day. The students' needs to link with the websites in their mobile phones and makes the learners to get chance to learn new words regularly. (Zhang, 2011).

vi. **Speech Recognition Software:** This software helps the student to improve speaking skills, which convert spoken form to machine-readable input. It recognizes the accuracy of the learner and provides feedback and encourages the learner to practice again till they get proficiency. forms, for examples if a student mispronounces a word, the learning tool can immediately spot it and help to correct it. This device can be a very useful device for distance learners because they don't have a teacher who corrects their speech and this device can help improving their speaking skills. (Hornik K, 2010) (Placeholder1).

vii. **Internet**: The use of Internet is widely used by the man across the globe. In the process of learning, students use this aid in the classroom to learn English where they Google the suitable materials for their topics. The teachers also instruct the students to collect the information and participate among the friends for discussions. For these, the students browse the different applications and online teaching aids and materials like Skype, MSM Messenger etc and grow themselves by connecting with friends, other students, teachers, experts and improve their oral proficiency with the native speakers.

viii. **TELL (Technology Enhanced Language Learning):** TELL is the use of computer technology including hardware, software and the Internet to enhance teaching and learning of languages. It helps the students to get access with all the technologies available for the enhancement of English learning. Students are allowed to use online dictionaries, chat, and to view the diverse happenings around the globe.

ix. **Pod casting**: Podcasts helps to upload or download the audio file with the target language and the teacher can use them as useful audio material for the classroom activities like discussions. Besides, these can include pronunciation for learning different accents. It helps the students to improve speaking skills. The students can make use of these files inside and outside the classrooms in the form of entertainment as the part of their education. (Vijayalakshmi, 2009)"as an ideal and very effective tool for language learning.

x. **Video Tapes:** Video Tapes helps the learners to learn drama, one-act play and monologues where scenes from popular English films can be screened first without any running script on the scene. Then the students are asked to find out the words, script etc., Again the scene will be repeated with the scripts on the scene. This kind of telecasting videotape with and without script makes the students to get access with the pronunciation, accent and word usage of English with interest. This method will make the students to repeat it again in their homes voluntarily.

xi. **Quick Link Pen :**Quick Link Pen allows learners to copy and store printed text, Internet links. It helps to transfer the data to computers and enables the reader to get the meaning of the word from a built in dictionary. Accessing this type of machine seems to be a more convenient method. Recent developments in machine translations presents translation engines like GO Translator.

xii. **Quicktionary**: It is a pen-like device. It allows the reader to easily scan the word and get its definition and phonetic translation on its own LCD screen. Technology such as Enounce and Sound-Editor enable learners to adjust the speech rate of listening materials to assist their comprehension, and present spectrum of speech waves and visual depictions of mouth and tongue movement to ease the learning and refine pronunciation. (Chirag, 2003) (O'Reilly, 2013).

xiii. **The web:** There are many "self –exercises "in the internet English exercises online at www.smic.be has over 100 free exercises covering grammar and vocabulary. Another interactive site is www.eslgo.com in this site a student can learn the internet as advancedtool.

VI. CONCLUSION

Web 2.0 offers possibilities to improve speaking fluency skills, self-expression, and comprehension .According to (Brown J. D., 1992), social utilities such as Facebook and Twitter provide many communicative variances for online community development. As a result, the following concluding remarks and recommendations can be recorded i.e., The impact of Technology in the medium of education had become necessary. It can be viewed as an integral part of the activity of speaking skill. Modern technological tools provide fun and allow for learning by motivating the students and help them to improve their speaking skills in a fruitful way. And tertiary education involves all technical and vocational courses so it is best to motivate them into self-learning and self-access.

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Result on Common Fixed Point of Two Continuous Mappings

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***Abstract*— Let X be a closed subspace of a Hilbert Space & $T_1, T_2 : X \to X$ be continuous mappings satisfying the given condition then T_1 & T_2 have unique common fixed point in X.**

***Keywords*— Continuous map, Common Fixed Point, Banach Space, Completeness, Uniqueness.**

I. INTRODUCTION

The study of Existence & Uniqueness of Coincidence Point & Common Fixed Point of Mappings satisfying certain contractive conditions has been an interesting field of Mathematics from 1922, when Banach stated & proved his famous result (Banach Contraction Principle, **[1]**).

In recent years, several authors have been obtained common fixed point results for different classes of mappings on various spaces. In this paper, we prove unique common fixed point theorem for two continuous self mapping satisfying given condition which is generalized & motivated from the results of **[2],[3] and [4].**

II. MAIN RESULT

Theorem :1

Let X be a closed subspace of Hilbert Space and $T_1, T_2 : X \to X$ be continuous mappings such that :

$$\begin{aligned}\|T_1x - T_2y\| \le\ & a_1 \frac{\|x-y\|^p[1+\|y-T_2y\|^p]}{[1+\|x-y\|^p]} \\ & + a_2[\|x-T_1x\|^p + \|y-T_2y\|^p] \\ & + a_3[\|x-T_2y\|^p + \|y-T_1x\|^p] \\ & + a_4\|x-y\|^p\end{aligned}$$

for all $x, y \in X$ with $x \neq y$ and $p \in \mathbb{N}$, where a_1, a_2, a_3, a_4 are non-negative real numbers with $a_1 + 2a_2 + 2^{p+1}a_3 + a_4 < 1$. Then T_1 & T_2 have unique common fixed point in X.

Proof : Let x_0 be an arbitrary point in X and define the sequence $\{x_n\}$ as follows :

$$x_{2n} = T_2x_{2n-1} \quad for\ n = 1,2,3,\ldots$$
$$x_{2n+1} = T_1x_{2n} \quad for\ n = 0,1,2,3,\ldots$$

Suppose that $n = 2m$ for some integer m.Then

$$\|x_{n+1} - x_n\| = \|x_{2m+1} - x_{2m}\| = \|T_1x_{2m} - T_2x_{2m-1}\|$$

From the given condition we have,

$$\begin{aligned}\|x_{n+1} - x_n\|^p &= \|x_{2m+1} - x_{2m}\|^p \\ &= \|T_1x_{2m} - T_2x_{2m-1}\|^p\end{aligned}$$

$$\begin{aligned}\le\ & a_1 \frac{\|x_{2m} - x_{2m-1}\|^p[1+\|x_{2m-1} - T_2x_{2m-1}\|^p]}{[1+\|x_{2m} - x_{2m-1}\|^p]} \\ & + a_2[\|x_{2m} - T_1x_{2m}\|^p + \|x_{2m-1} - T_2x_{2m-1}\|^p] \\ & + a_3[\|x_{2m} - T_2x_{2m-1}\|^p + \|x_{2m-1} - T_1x_{2m}\|^p] \\ & + a_4\|x_{2m} - x_{2m-1}\|^p\end{aligned}$$

This gives

$$\begin{aligned}&[1 - a_2 - 2^p a_3]\|x_{2m+1} - x_{2m}\|^p \\ &\le [a_1 + a_2 + 2^p a_3 + a_4]\|x_{2m} - x_{2m-1}\|^p\end{aligned}$$

$$\therefore\ \|x_{2m+1} - x_{2m}\|^p \le p(m)\|x_{2m} - x_{2m-1}\|^p$$

where

$$p(m) = \frac{[a_1 + a_2 + 2^p a_3 + a_4]}{[1 - a_2 - 2^p a_3]} \quad for\ m = 0,1,2,3,\ldots$$

Clearly

$$p(m) < 1, \forall m \ge 0 \quad as \quad a_1 + 2a_2 + 2^{p+1}a_3 + a_4 < 1$$

Continuing in this way one gets

$$\begin{aligned}\|x_{n+1} - x_n\|^p &= \|x_{2m+1} - x_{2m}\|^p \\ &\le p(m)\|x_{2m} - x_{2m-1}\|^p \\ &\ \vdots \\ &\le p(m)^n\|x_1 - x_0\|^p\end{aligned}$$

By Similar way one can see that above inequality is also true if n is an odd integer. Since $0 \le p(m) < 1$, the sequence $\{x_n\}$ is Cauchy sequence and therefore by completeness of X, one find $\mu \in X$ such that

$$\lim_{n\to\infty} x_n = \mu$$

Since $\{x_{2n}\}\ and\ \{x_{2n+1}\}$ are sub-sequences of $\{x_n\}$ one gets

$$\lim_{n\to\infty} x_{2n} = \mu = \lim_{n\to\infty} x_{2n+1}$$

Next since T_1 & T_2 are continuous one arrives at

$$T_1(\mu) = T_1\left(\lim_{n\to\infty} x_{2n}\right) = \lim_{n\to\infty} T_1x_{2n} = \lim_{n\to\infty} x_{2n+1} = \mu$$

$$T_2(\mu) = T_2\left(\lim_{n\to\infty} x_{2n-1}\right) = \lim_{n\to\infty} T_2x_{2n-1} = \lim_{n\to\infty} x_{2n} = \mu$$

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Hence μ is common fixed point of T_1 & T_2. Now to prove the uniqueness of common fixed point, let us take $\nu(\mu \neq \nu \in X$ to be another common fixed point of *T1 & T2*. While $\|\mu - \nu\| \neq 0$.

Hence it follows that

$$\begin{aligned}\|\mu-\nu\|^p &= \|T_1\mu - T_2\nu\|^p \\ &\leq a_1 \frac{\|\mu-\nu\|^p[1+\|\nu-T_2\nu\|^p]}{[1+\|\mu-\nu\|^p]} \\ &+ a_2[\|\mu-T_1\mu\|^p + \|\nu-T_2\nu\|^p] \\ &+ a_3[\|\mu-T_2\nu\|^p + \|\nu-T_1\mu\|^p] \\ &+ a_4\|\mu-\nu\|^p\end{aligned}$$

$$\therefore \|\mu-\nu\|^p \leq (a_1+2a_3+a_4)\|\mu-\nu\|^p$$

which is a contradiction as

$$\begin{aligned}a_1+2a_3+a_4 &< a_1+2a_2+2^{p+1}a_3+a_4 \\ &< 1\end{aligned}$$

Thus $\mu = \nu$.

Theorem : 2

Let X be a closed subspace of Hilbert Space and $T_1, T_2 : X \to X$ be continuous mappings such that :

$$\begin{aligned}\|T_1x - T_2y\| \leq\ & a_1 \frac{\|x-T_1x\|^p[1+\|y-T_2y\|^p]}{[1+\|x-y\|^p]} \\ &+ a_2 \frac{\|y-T_2y\|^p[1+\|x-T_1x\|^p]}{[1+\|x-y\|^p]} \\ &+ a_3[\|x-T_1x\|^p + \|y-T_2y\|^p] \\ &+ a_4[\|y-T_2y\|^p + \|x-T_1x\|^p]\end{aligned}$$

for all $x, y \in X$ with $x \neq y$ and $p \in \mathbb{N} \cup \{\frac{1}{n} : n \in \mathbb{N}\}$, where a_1, a_2, a_3, a_4 are non-negative real numbers with $a_1 + a_2 + 2(a_3 + a_4) < 1$. Then T_1 & T_2 have unique common fixed point in X.

Proof : Let x_0 be an arbitrary point in X and define the sequence $\{x_n\}$ as follows :

$$\begin{aligned}x_{2n} &= T_2x_{2n-1} \quad for\ n = 1,2,3,\ldots \\ x_{2n+1} &= T_1x_{2n} \quad for\ n = 0,1,2,3,\ldots\end{aligned}$$

Suppose that $n = 2m$ for some integer m.Then

$$\|x_{n+1} - x_n\| = \|x_{2m+1} - x_{2m}\| = \|T_1x_{2m} - T_2x_{2m-1}\|$$

From the given condition we have,

$$\begin{aligned}\|x_{n+1}-x_n\|^p &= \|x_{2m+1}-x_{2m}\|^p \\ &= \|T_1x_{2m} - T_2x_{2m-1}\|^p \\ &\leq a_1 \frac{\|x_{2m}-T_1x_{2m}\|^p[1+\|x_{2m-1}-T_2x_{2m-1}\|^p]}{[1+\|x_{2m}-x_{2m-1}\|^p]} \\ &+ a_2 \frac{\|x_{2m-1}-T_2x_{2m-1}\|^p[1+\|x_{2m}-T_1x_{2m}\|^p]}{[1+\|x_{2m}-x_{2m-1}\|^p]} \\ &+ a_3[\|x_{2m}-T_1x_{2m}\|^p + \|x_{2m-1}-T_2x_{2m-1}\|^p] \\ &+ a_4[\|x_{2m-1}-T_2x_{2m-1}\|^p + \|x_{2m}-T_1x_{2m}\|^p]\end{aligned}$$

This gives

$$\begin{aligned}&[(1-a_1-a_3-a_4)+(1-a_1-a_2-a_3 \\ &\qquad -a_4)\|x_{2m}-x_{2m-1}\|^p]\|x_{2m+1}-x_{2m}\|^p \\ &\leq [(a_2+a_3+a_4)+(a_3 \\ &\qquad +a_4)\|x_{2m}-x_{2m-1}\|^p]\|x_{2m}-x_{2m-1}\|^p\end{aligned}$$

$$\therefore \|x_{2m+1}-x_{2m}\|^p \leq p(m)\|x_{2m}-x_{2m-1}\|^p$$

where

$$p(m) = \frac{(a_2+a_3+a_4)+(a_3+a_4)\|x_{2m}-x_{2m-1}\|^p}{(1-a_1-a_3-a_4)+(1-a_1-a_2-a_3-a_4)\|x_{2m}-x_{2m-1}\|^p}$$
$$for\ m = 0,1,2,3,\ldots$$

Clearly

$$p(m) < 1, \forall m \geq 0 \ \ as\ a_1 + a_2 + 2(a_3 + a_4) < 1$$

Continuing in this way one gets

$$\begin{aligned}\|x_{n+1}-x_n\|^p &= \|x_{2m+1}-x_{2m}\|^p \\ &\leq p(m)\|x_{2m}-x_{2m-1}\|^p \\ &\ \ \vdots \\ &\leq p(m)^n\|x_1-x_0\|^p\end{aligned}$$

By Similar way one can see that above inequality is also true if n is an odd integer. Since $0 \leq p(m) < 1$, the sequence $\{x_n\}$ is Cauchy sequence and therefore by completeness of X, one find $\mu \in X$ such that

$$\lim_{n\to\infty} x_n = \mu$$

Since $\{x_{2n}\}\ and\ \{x_{2n+1}\}$ are sub-sequences of $\{x_n\}$ one gets

$$\lim_{n\to\infty} x_{2n} = \mu = \lim_{n\to\infty} x_{2n+1}$$

Next since T_1 & T_2 are continuous one arrives at

$$T_1(\mu) = T_1\left(\lim_{n\to\infty} x_{2n}\right) = \lim_{n\to\infty} T_1x_{2n} = \lim_{n\to\infty} x_{2n+1} = \mu$$

$$T_2(\mu) = T_2\left(\lim_{n\to\infty} x_{2n-1}\right) = \lim_{n\to\infty} T_2x_{2n-1} = \lim_{n\to\infty} x_{2n} = \mu$$

Hence μ is common fixed point of T_1 & T_2. Now to prove the uniqueness of common fixed point, let us take $\nu(\mu \neq \nu \in X$ to be another common fixed point of *T1 & T2*.

While $\|\mu - \nu\| \neq 0$.

Hence it follows that

$$\begin{aligned}\|\mu-\nu\|^p &= \|T_1\mu - T_2\nu\|^p \\ &\leq a_1 \frac{\|\mu-T_1\mu\|^p[1+\|\nu-T_2\nu\|^p]}{[1+\|\mu-\nu\|^p]} \\ &+ a_2 \frac{\|\nu-T_2\nu\|^p[1+\|\mu-T_1\mu\|^p]}{[1+\|\mu-\nu\|^p]} \\ &+ a_3[\|\mu-T_1\mu\|^p + \|\nu-T_2\nu\|^p] \\ &+ a_4[\|\nu-T_2\nu\|^p + \|\mu-T_1\mu\|^p] \\ &\therefore \|\mu-\nu\|^p \leq 0\end{aligned}$$

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which is a contradiction .

Thus $\mu = \nu$.

III. Conclusions

The method adopted in the proof of common fixed point theorems reveal that yet there are various directions in which the Banach's fixed point theorem can be refined and extended.

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Migration Dynamics of Population Change in India – A Theoretical Investigation Based on NSS Reports

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***Abstract*—Migration is an age old contentious global issue that has been considered as one of the most decisive components of population change in any region. Each and every nation - be it developed, developing or under developed - has experienced the phenomenon of migration being a part of worldwide process of either industrialization, urbanization or globalisation. This paper is an attempt to analyse the nature of internal migration in India based on NSS 55th round, NSS 64th round reports. The major finding of the above study indicates that percentage of migrants to the total population was higher in urban areas than that in rural areas. In both rural and urban areas, females showed a higher propensity to migrate than males. The rate of migration of rural male is much lower than that of urban male which vindicates the fact that males neither from rural areas nor from urban areas have the tendency to migrate to rural areas.**

***Keywords*—rural migration, urban migration, internal migration, immigration, emigration**

I. INTRODUCTION

Migration is an age old contentious global issue that has been considered as one of the most decisive components of population change in any region. According to World Migration Report, 2003 - as at the start of the twenty-first century, one out of every 35 persons worldwide is an international migrant. Each and every nation - be it developed, developing or under developed - has experienced the phenomenon of migration being a part of worldwide process of industrialization, urbanization or globalisation. It is one of the three significant factors affecting population change other than fertility and mortality rate. But whereas both fertility and mortality operate within the biological framework, migration does not. It influences size, composition and distribution of population. More importantly, migration influences the social, political and economic life of the people [3]. It is most volatile component of population growth and most sensitive to economic, political and cultural factors [4].

Migration is being shaped by multiple pull and push factors– primary among them are economic development and its disparities, population trends, the existence of migratory networks, access to information, the ease of travel today, armed conflicts, environmental deterioration and human rights violations. Changes in these factors may be gradual or abrupt and bring corresponding changes in migratory behaviour[8]. Proper understanding of the patterns of migration would help on the estimation of future population redistribution. The reliability and dependability of these estimates depend much on the consideration of all the temporal factors of birth, death and internal migration on which population grows in its finest precision [2].

Meaning of Migration in Context of Census of India and NSSO

Definitions of migration are highly varied in nature because this phenomenon results from distinct political, social, economic and cultural contexts. This makes comparisons difficult not only because statistical criteria differ, but because these differences reflect real variations in migration's social and economic significance, depending on the particular contexts [1].For the sake of uniformity, the United Nationshas proposed that migrant be defined for statistical purposes as a person who enters a country other than that of which he/she isa citizen for at least 12 months, after having been absent for one year or longer [7].

According to Census of India, migration means the phenomenon of people moving in (immigration) or out (emigration) of a country, place or locality for various reasons like employment, education, business, marriage, after birth, family moved etc.

In India as per NSS surveys, those movements which result in change of the usual place of residence (UPR) of the individuals are treated as migration and a household member whose last usual place of residence is different from the present place of enumeration is considered a migrant.

A member of the sample household was treated as a migrant if he/she had stayed continuously for at least six months or more in a place (village/town) other than the village/town where he/she was enumerated. The village/town where the person had stayed continuously for atleast six months or more prior to moving to the place of enumeration (village/town) was referred to as the 'last usual place of residence' of that migrated person. Shifting of residence within village/town was not considered as an event of migration.Historically, information on migration has been collected since 1872. Though census of India is the single largest source of data on migration characteristics for the people of India, various surveys conducted by the NSSO are also equally important sources of studying migration on some critical aspects. To assess the volume and structure of migration in India, starting with the 9th round (May-September, 1955), NSSO conducted a number of surveys to

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collect data on migration as part of its employment and unemployment enquiries.

The present study is exclusively based on NSS 55thRound, Report No. 470*: Migration in India*: 1999-2000 [5] and NSS 64th Round, Report No. 533*: Migration in India*: July 2007 – June 2008 [6].

Internal Migration in India

Although traditionally international migration has always been in the limelight, of late, the focus has been shifted on causes and consequences of internal migration. Internal migration is now recognized as an important factor influencing social and economic development, especially in developing countries [3]. International migration can involve very short distances and culturally very similar populations whereas internal migration can cover vast distances and bring markedly different populations into contact [8].

TABLE I
MIGRATION RATES PER 1000 OF EACH CATEGORY OF PERSONS IN DIFFERENT NSS ROUNDS - ALL-INDIA

Round (year)	Category of persons					
	Rural			Urban		
	Male	Female	Persons	Male	Female	Persons
64 (July 2007 – June 2008)	54	477	261	259	456	354
55 (July 1999 – June 2000)	69	426	244	257	418	334
49 (Jan - June, 1993)	65	401	228	239	382	307
49 (Jan - June, 1993)	74	398	232	268	396	329
38 (Jan - Dec, 1983)	72	351	209	270	366	316

Note: source for the 38th and 43rd rounds: NSS report number 382, for 49th round: NSS report number 430, for 64th round: NSS report number 533

Table 1 presents the internal migration rates per 1000 persons of each category as obtained from various surveys viz. 38th, 43rd, 49th, 55th and the 64th survey of NSSO. At the all-India level, considering all the migrants till the date of survey, the following features are observed from the table: (i) percentage of migrants to the total population was higher in urban areas than that in rural areas; and (ii) in both rural and urban areas, females showed a higher propensity to migrate than males; (iii) the rate of migration of rural male is much lower than that of urban male which indicates that males neither from rural areas nor from urban areas have the tendency to migrate to rural areas.

It is seen from the table 1 that, during the period 1983 to 2000, the percentage of male migrants to the total population ultimately decreased from 7 percent to 5 percent and exhibited a regular variation for rural areas and showed little variation - between 24 to 27 percent - in urban areas. In the case of females, a rising trend is, however, noticeable in percentage of migrants to the total population over the period 1983 to 2008. For rural females, it increased steadily from 35 per cent in 1983 to about 47 per cent in 2007 – 2008, while for urban females the increase was from 37 per cent in 1983 to 46 per cent over the same period.

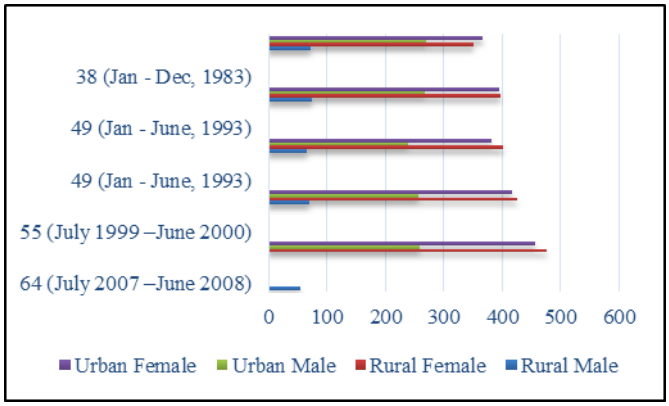


Fig 1. Trends in Migration rates per 1000 of each category of persons in different NSS rounds

It can be observed that in both the rural and urban areas, female migration rates had been gradually increasing whereas male migration rate showed an insignificant change during the period 1983 to 2007-08. The migration rates increased from 21 percent in 1983 to 26 per cent in 2007- 08 in rural areas and from 32 percent in 1983 to 35 percent in 2007-08 in urban areas. However, this increase in migration rate is observed to be primarily due to the increase in migration rates for females. It is observed that the male migration rates have shown a downward trend. In the rural areas, the male migration rate has decreased by 2 percentage points from 7 percent in 1983 to 5 percent in 2007-08, while the migration rate for females has increased by 13 percentage points from 35 percent in 1983 to 48 per cent in 2007-08. The similar trend has been observed in the urban areas, where the male migration rate has decreased by 1 percentage point from 27 percent in 1983 to 26 percent in 2007-08 while female migration rate has increased by 9 percentage points from 37 percent in 1983 to 46 percent in 2007-08. Fig. 1 reveals the same trends with the help of line diagram.

Migration Rate for Different Social Groups

Migration rates for each of the social groups in India for NSS 55thand NSS 64throunds are presented in Table 2. The migration rates in 1999-2000 and 2007-08, among the different social groups in rural India display similar pattern - the migration rate in the rural areas was the lowest among the scheduled tribe (ST) and it was the highest among those classified in the social group as 'others'. In 2007-08, in case of urban areas, the migration rate was lowest among other backward class (OBC) nearly 33 percent, and it was highest among those classified in the social group 'others', nearly 38 percent. Considerable gender differential was found to exist in the migration rates across all the social groups in both the

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rural and urban areas, with male migration rate far lower than female migration rate. It is seen, in rural areas, male and female migration rates were lowest among the ST: it was nearly 5 percent for males and 44 percent for the females. On the other hand, migration rates, for both males and females, in rural areas, were highest among the 'others 'category: it was 7 percent for males and 51 percent for females. In the urban areas, male migration rate was lowest among the other backward class, nearly 23 percent, and it was highest among the ST and 'others' (29 percent each). On the other hand, female migration rate was lowest among the ST (43 percent) and it was highest among the 'others' (48 percent).

Table 2

TABLE 2
NUMBER OF MIGRANTS PER 1000 PERSONS OF EACH SOCIAL GROUP FOR EACH CATEGORY OF PERSONS DURING 55TH ROUND (1999-00) AND 64TH ROUND (2007-08)

Social group	Category of persons					
	Rural			Urban		
	Male	Female	Person	Male	Female	Person
	55th round (1999-2000)					
ST	56	357	204	282	411	345
SC	64	434	244	225	393	305
OBC	65	428	242	237	417	323
Others	81	443	259	276	426	347
All (incl. n.r.)	69	426	244	257	418	334
	64th round (2007-08)					
ST	47	440	238	288	430	356
SC	49	482	260	235	447	337
OBC	51	468	255	230	437	331
Others	68	506	281	290	477	379
All (incl. n.r.)	54	477	261	259	456	354

Source: NSS report 533: Migration in India: July 2007-June 2008. pp 24

In 1999-2000, the migration rate of males in rural areas was lowest among ST, nearly 6 per cent and it was highest among the 'others', (8 percent). On the other hand, the migration rateamong females, in rural areas, was lowest among ST (36 percent) and it was highest among 'others' (44 percent). In urban areas, some changes in the pattern of migration rate were observed during 1999-2000 and 2007-08. It is seen that migration rate was lowest among SC in 1999-2000 (31 percent) but was lowest among OBC in 2007-08 (33 percent), while it was highest among 'others', in both the periods (35 percent in 1999-2000 and 38 percent in 2007-08). In 1999-2000 the migration rate among urban males was lowest for SC (23 percent), while in 2007-08 it was lowest for OBC (23 per cent). However for urban males in these two time periods, the migration rate was highest among ST and others (28 percent each in 1999-2000and 29 percent each in 2007-08).

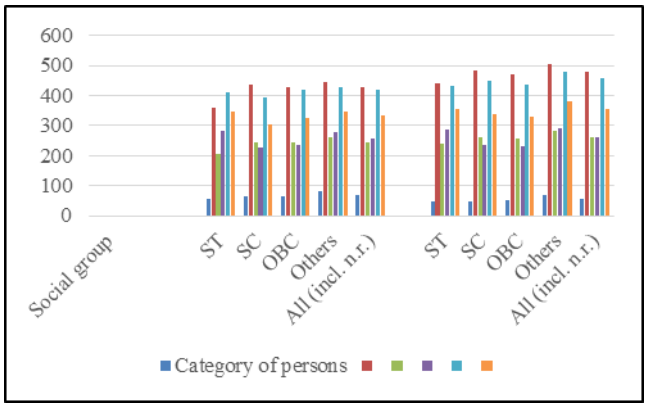


Fig. 2 Chart 2:Number of migrants per 1000 persons of each social group for each category of persons during 55th round (1999-00) and 64th round (2007-08)

For females in urban areas, the migration rate was lowest among SC in 1999-2000 (39 percent), while in 2007-08 it was lowest for ST (43 percent). The migration rate for urban females for 'others'was highest in both the periods (48 percent in 2007-08 and 43 percent in 1999-2000). Fig. 2 depicts the graphical representation of same phenomenon with the help of bar diagram.

Four Types of Migration Streams

Table 3 presents the distribution of internal migrants, at the all-India level, by four types of migration streams, namely, rural-to-rural, rural-to-urban, urban-to-rural and urban-to-urban for NSS 55thround and NSS 64thround. During NSS 64th and 55th rounds, rural-to-rural migration was the most dominant migration stream accounting for nearly 62 percent of the total migration, while urban-to-rural migration shared merely 6 percent of total migrants. However, the pattern displayed by male migrants are distinct from that of female migrants. For male migrants, rural-to-urban migration stream was the most dominant one which shared nearly 34 percent and 39 percent of total male internal migrants respectively, while for female rural-to-rural migration stream shared nearly 70 per cent of the total internal female migrants as observed in both surveys.

The variation in the shares of the four types of migration streams, for males and females combined, in NSS 64thcompared to those in NSS 55thround (1999-2000) is insignificant. However, some changes in the shares of the migrations streams for male migrants have been observed in 2007-08 compared to that in 1999-2000. It may be seen that the shares of rural-to-rural migration for males has decreased and the shares of rural-to-urban migration has increased in 2007-08 from those of 1999-2000. In NSS 64thround, the share of rural-to-rural migration for males has decreased by nearly 5 percentage points from 32 percent in 1999-2000 and the shares of rural-to-urban migration has increased by nearly 5 percentage points in 2007- 08 from 34 percent in 1999-2000.

TABLE 3
DISTRIBUTION (PER 1000) OF INTERNAL MIGRANTS OVER THE FOUR TYPES OF RURAL-URBAN MIGRATION STREAMS AS PER NSS 55TH ROUND AND NSS 64TH ROUND

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Category of migrants	Migration stream				
	Rural-rural	Rural-urban	Urban-rural	Urban-urban	All
	55th round (1999-2000)				
Male	323	344	107	226	1000
Female	703	144	52	101	1000
Person	618	188	64	129	1000
	64th round (2007-08)				
Male	272	390	89	248	1000
Female	700	148	49	103	1000
Person	617	195	57	131	1000

Source: NSS report 533: Migration in India: July 2007-June 2008. pp 30

Migration in Urban Areas from Rural Areas

Having observed the shares of the four types of migration streams, it would be of interest to study the pattern of migration to urban areas from rural areas. In the above table, the shares of migration from rural areas in the total urban migrants have been presented for 1999-2000 and 2007-08 for all-India. It is seen that as per the estimates obtained from NSS 64thround survey,nearly 60 percent of urban male migrants and 59 percent of urban female migrants had migrated from rural areas. The dominance of migrants from rural areas to the urban areas was also observed from the survey results of NSS 55thround and the magnitude of the share of migrants in urban areas from rural areas as estimated in NSS 64thround was almost of the same order though marginally higher than those estimated from NSS 55thround.

TABLE 4
NUMBER OF PERSONS MIGRATED FROM RURAL AREAS TO URBAN AREAS PER 1000 MIGRANTS IN URBAN AREAS AS PER NSS 55TH ROUND AND NSS 64TH ROUND

Category of migrants	**55th round (1999-2000)**	**64th round (2007-08)**
Male	592	603
Female	581	585
Person	586	592

Source: NSS report 533: Migration in India: July 2007-June 2008. pp30

Inter-district and inter-state migration for different migration streams:

For a better understanding of mobility behaviour of the population it is necessary to study various components of migration streams by intra-district, inter-district and inter-State movement of population. In Table 5 for different categories of migration streams, the proportion who migrated from the same district or from other districts, within same state or from other states have been presented for both NSS 55thand NSS 64thround survey for all-India.

TABLE 5
DISTRIBUTION (PER 1000) OF INTERNAL MIGRANTS BY LAST USUAL PLACE OF RESIDENCE FOR EACH COMPONENT OF (LIKE INTRA-DISTRICT, INTER-DISTRICT AND INTER-STATE) RURAL-URBAN MIGRATION STREAMS DURING 1999-2000 AND 2007-08

Migration stream	Last usual place of residence			
	Intra-district	Inter-district	Inter-state	All
	55th round (1999-2000)			
Rural-rural	753	201	46	1000
Rural-urban	438	365	196	1000
Urban-rural	465	335	200	1000
Urban-urban	366	435	199	1000
	64th round (2007-08)			
Rural-rural	724	232	44	1000
Rural-urban	412	336	252	1000
Urban-rural	488	338	175	1000
Urban-urban	279	492	229	1000

Source: NSS report 533: Migration in India: July 2007-June 2008. pp 31

Survey results of NSS 64th round show that at the all-India level, the rural-to-rural migration stream was dominated by intra-district migration (72 percent) and nearly 96 percent in the rural-to-rural migration was through intra-State migration. For other categories of migration streams too, the share of intra-State migrants was dominant though lower compared to rural-to-rural migration stream: 75 percent for rural-to-urban, 83 percent for urban-to-rural and 77 percent for urban-to-urban migration streams. The pattern observed in NSS 55thround is also broadly similar to that observed in NSS 64thround with some minor increase in rural-to-urban and urban to urban migration through inter-State migration in 2007- 08. The increase was 5 percentage points for rural-to-urban migration stream and 3 percentagepoints for urban-to-urban migration stream in NSS 64thround from the corresponding shares observed in 55thround. On the other hand, in case of inter-state migration, the share of rural-rural migration and urban-rural migration had declined by 2 percentage and the share of rural-urban and urban –urban migration increased by 5 percent and 3 percent respectively from 55th round to 64th round of NSS.

Reason for Migration for Different Categories of Migrants

There are various reasons because of which people migrate from one place to other. In this study few important reasons are considered. For each migrant, the reason for migration was ascertained and recorded in terms of five different reason codes. In Table 6, per 1000 distribution of migrants by reasons for migration has been presented for all-India level. It is seen from NSS 64th round that the reasons for migration for males and females showed distinct pattern. For females in both rural and urban areas, the reason for the bulk of the migrants was marriage: for 91 percent of rural female migrants and 61 percent of the urban female migrants the

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reason was marriage. For urban females, movement of parent/earning member of the family, was the next major reason for migration after marriage, accounting for nearly 29 per cent of total urban female migrants. The reason for migration for the male migrant, on the other hand, was dominated by employment related reasons, in both the rural and urban areas. Nearly 29 percent of rural male migrants and 56 percent of urban male migrants had migrated due to employment related reasons. The movement of parent/earning member of the family also significantly induced male migration in both the rural and urban areas: for, nearly 22 percent of rural male migrants and 25 percent of urban male migrants, movement of parent/earning member of the family was the reason for migration. Study as a reason for migration also accounted for nearly 11 percent of rural male migrants and 7 percent of urban male migrants.

TABLE VI
DISTRIBUTION (PER 1000) OF MIGRANTS BY REASON FOR MIGRATION DURING 1999-2000 AND 2007-08

Reason for migration	Migrated in rural areas		Migrated in urban areas	
	Male	Female	Male	Female
	55th round (1999-2000)			
Employment related reason	303	10	519	30
Studies	53	4	62	13
Marriage	94	888	16	585
Movement of parents/earning member of the family	260	63	270	310
Other reasons (incl. n.r.)	290	35	133	62
All	1000	1000	1000	1000
	64th round (2007-08)			
Employment related reason	286	7	557	27
Studies	107	5	68	22
Marriage	94	912	14	608
Movement of parents/earning member of the family	221	44	252	294
Other reasons (incl. n.r.)	292	32	109	49
All	1000	1000	1000	1000

It is observed from the last two NSS rounds (as shown in Table 6) that for females, the prominent reason for migration was marriage and the estimates obtained in these two periods hinted at increasing share of the reason, marriage in total female migrants: in 1999-00, it was estimated that nearly 89 percent of the rural female migrants had migrated for marriage, the share had increased to 91 percent in 64th round while for urban female migrants the shares during these two time periods were 59 percent and 61 percent respectively. Such substantial increase (nearly 30 percentage points) of the reason marriage in the share of female migrants is found to be in tandem with a corresponding reduction in the share of the reason movement of parents/earning memberduring these periods. It is seen that the share of the reason movement of parents/ earning member in total female migrant in rural areas has reduced from 6 per cent in 55thround to 4 percentage points in 2007-08 and for the urban females the share reduced from 31 percent during 55thround to 29 percent in NSS 64thround.The reduction of the share of employment related reasons in total female migration is also visible during this two NSS rounds.For urban females the share of employment related reasons for migration has remained almost same (about 3 percent) in both 55thand 64throunds.

TABLE 7
DISTRIBUTION (PER 1000) OF INTERNAL MIGRANTS BY REASONS FOR MIGRATION FOR EACH OF THE MIGRATION STREAMS AT ALL-INDIA LEVEL DURING 1999-2000 AND 2007-08

Reason for migration	64th round (2007-08)								55th round (1999-2000)							
	Male				Female				Male				Female			
	R-R	R-U	U-R	U-U	R-R	R-U	U-R	U-U	R-R	R-U	U-R	U-U	R-R	R-U	U-R	U-U
Employment related reason	291	609	288	482	5	26	20	27	314	570	300	448	9	28	30	28
Studies	105	78	125	53	5	25	12	19	69	80	20	44	4	16	6	10
Marriage	122	16	21	12	926	628	742	585	121	17	23	14	906	614	642	550
Movement ofparents/earning member	237	228	184	289	36	282	154	311	268	244	225	315	51	292	215	337
Other reasons (incl. n.r.)	244	69	382	164	29	40	73	57	228	90	432	179	31	50	106	75
All	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Source: Compiled from NSS 55th round and 64th round reports

In case of male migrants of rural and urban areas the reasons for migration obtained during 55thround and 64thround have shown distinct characteristics. It revealed the reduced importance of employment related reasons for rural male migration and increasing importance of employment related reasons for urban male migrants. The share of employment related reasons in total rural male migration had slightly reduced from 30 percent in NSS 55thround to 29 percent in NSS 64th round, while for urban male migrants the trend reversed, with the share of employment related reasons increased from 52 percent in NSS 55thround to 56 percent in NSS 64th round.

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Reason for Migration Separately for Each of The Migration Streams

For each of the migration streams, viz, rural-to-rural, rural-to-urban, urban-to-rural and urban-to-urban, the reasons for migration have been studied here. The Statement 4.14 gives the per 1000 distribution of internal migrants by reason for migration for each of the migration streams at the all-India level.

In Table 7the data on reasons for migrations in both NSS 64th round and NSS 55th round reveal almost similar pattern for both male and female in respect of different streams of migration. In case of male migrants, the two migration streams, viz., rural-to-urban and urban-to-urban were basically driven by employment related reasons(61 percent of the migrants from rural-to-urban and 48 per cent of the urban-to-urban migrants during 2007-08 whereas 57 percent of the migrants from rural-to-urban and 45 per cent of the urban-to-urban migrants in 1999-00 are for employment related reasons)and even between these two migration streams, rural-to-urban migrations were prominently for employment related reasons. Though, employment related reasons were also dominating factors for males in rural-to-rural and urban-to-rural migration, the shares of employment related reasons were of moderate order. It may be noted that for the male migrants in the four types of migration streams, the movement of parents/earning member was also one of the significant contributing factors for migration.

The pattern observed in the reason for migration, in the four types of migration streams for females were quite different from that in case of male migrants. Nearly 93 percent and 91 percent of the females in rural-to-rural migration had migrated for marriage respectively in 2007-08 and 1999-00. It is observed that, for females, marriage too remained the prime factor for migration for the other three migration streams in both 55th and 64th round survey of NSS. After marriage the second highest contributing factor of female migration was the movement of parents/earning member of the family as observed before in case of male migration in all the four streams of migration in both rounds.

II. Conclusions

The major finding of the above study indicates that percentage of migrants to the total population was higher in urban areas than that in rural areas. In both rural and urban areas, females showed a higher propensity to migrate than males. The rate of migration of rural male is much lower than that of urban male which vindicates the fact that males neither from rural areas nor from urban areas have the tendency to migrate to rural areas. That is why government should frame out proper policies to restrict people movement from rural to urban areas so that unplanned urbanization can be controlled.

Rural migration among different social groups in India displayed almost similar pattern for both male and female category of persons where as in urban areas some changes in the pattern of migration rate were observed in both the NSSOsurveys under study. In other words, considerable gender differential was found to exist in the migration rates across all the social groups in both the rural and urban areas with male migration rate far lower than female migration rate.Another notable finding is observed in case of reasons of migration. Marriage was the principal reason of migration among females in both rural and urban areas whereas employment criteria is a major cause of migration among males in rural as well as in urban areas.

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"Sanskrit: Some Insights as a Computer Programming Language"

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Aims to explore how the Sanskrit Language can be used as a Natural Processing Language.

***Abstract*: Now a days it is in the "Sanskrit World", heard the voice that "Sanskrit is the best language for computer programming". Being some familiar with computer programming, I wondered if there was any truth to that statement. The claim is based on this paper by Rick Briggs, published in AI Magazine [1]. The paper talks about using Sanskrit in natural language processing (NLP). The idea of using a natural language for computer programming is to make it easier for people to talk to computers in their native tongue and spare them the pain of learning a computer friendly language like assembly/C/Java. In this paper we exhibited all the environments related to Sanskrit Language, Computer Programming Language and Natural Language, Processing so that the Sanskrit Scholar can be categorize the promises of the language suitable for NLP as an AI.**

***Keywords:* Sanskrit, Computer, Natural Processing Language, Programming Language, AI- Artificial Intelligence.**

I. INTRODUCTION

There was a paper by Rick Briggs, a NASA researcher, published in the spring issue of Artificial Intelligence magazine in 1985 (Volume 6 Number 1), entitled 'Knowledge Representation in Sanskrit and Artificial Intelligence'. It can be found here on AAAI's website [1]. The Rick Briggs' paper makes a case that natural languages are not that difficult to use for computer programming. He cites Sanskrit as an example as its grammar can be easily translated to a form understandable by a computer. But nowhere does it say that Sanskrit is the best way to program a computer. Hence we say, if somebody manages to create a computer language based on Sanskrit, then the question arises that: How likely is it that it will get adopted by non-Sanskrit speaking people?

I spend a lot of time on the internet searching for interesting things to learn for my research topic: "e-Resources of Sanskrit". The search isn't specific and neither is the inflow of information. I happened upon a few articles recently that suggest Sanskrit, the ancient nigh dead Indian language, is good for computer programming and that NASA uses it to program artificial intelligence[2][3][4]. A peek at the headlines triggered my bullshit alarm – we should all have one – but, in those moments of curiosity, I perused their contents. They were so very devoid of rationality, I had to search for a fun little activity to take my mind off it. Betteridge's law [5],[6] of headlines did the trick. The **Betteridge's law state that "**If the headline to an article is a question, the answer is always no." Also on the internet, I found the best comments for Rick Briggs is that: 'Rick Briggs' at best is a pseudonym [5]. There are absolutely no other works in related fields attributed to this name.

It begins with Briggs describing the current state of events surrounding artificial intelligence. It had been quite an undertaking to design unambiguous representations of natural languages for the purpose of computer processing. Natural languages – the way humans communicate with each other – had not been easy to parse and transform into information that a machine could understand. Even if they could overcome that barrier, there was the issue of ambiguity – statements could mean different unrelated things, depending on the context. A human who spoke the language wouldn't find it hard to understand what was actually meant, but computers would. It led to the belief that there might not be a way to effectively exchange information with machines without the help of an artificial language [7].

Briggs, in his paper, challenged that belief by drawing attention to the fact that there has existed at least one natural language which could, in theory, be used as an artificial language. It had a logical structure that mapped on to certain knowledge representation schemes perfectly. That language, of course, was Sanskrit.

II. THE CONTENTS OF THE PAPER.

The paper provides a whole lot of compelling arguments that show it is indeed possible for a natural language to work as an artificial one. That's it. It does not at all claim that Sanskrit has to be that language. Sure, it uses Sanskrit as a case study, but that's all there is to it. A quick read of the 8 page piece should make that clear. Here's a gist of the points he tried to make. I've used my natural intelligence to summarize it. It's not chronological but exhaustive.

A. A perfect natural language must have these characteristics.

- A statement should be easy to break down into a semantic net or an array of semantic data

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[8],[9],[10].(He referred to the array as series of triplets.)

- It should be easy to compile a natural language statement from the data array. It should be human readable and understandable.
- The statements coming out should be about the same as the ones going in. It shouldn't sound weird, nor should it loss or gain information.
- Deviations if any should be minimum.

B. Sanskrit, as it turns out, does all of that. It has an extremely logical structure. Its grammar rules allow a kind of precision unmatched by other languages. It has a near unchanging syntax.
C. The computer readable data representation of a Sanskrit statement can be obtained by simply placing the individual words of the sentence in an array. This is aided by the fact that word order simply makes no difference in Sanskrit.
D. That very sentence can be reconstructed by putting together the contents of the array.
E. The language is extremely concise. It has perhaps the highest information to word count ratio [11]. There are no redundancies.

Besides above, we also find the following from the last paragraph of Briggs' paper.

It is interesting to speculate as to why the Indians found it worthwhile to pursue studies into unambiguous coding of natural language into semantic elements [12]. It is tempting to think of them as computer scientists without the hardware, but a possible explanation is that a search for clear, unambiguous understanding is inherent in the human being.

Here note that the conclusion of the paper was that humans are capable of using an extremely precise unambiguous language. That should save you some back and forth when we debunk baseless claims.

III. SOME TRUTHS ABOUT SANSKRIT:

Sanskrit is a brilliant language. I'm not kidding and neither is I being ironic. It really is the most precise language in existence, with Latin being a close second [13]. However, it isn't a perfect language and it isn't natural either.

i. Sanskrit's Efficiency:

Sanskrit makes use of declensions in nearly every part of speech [14]. This means the ends of words, every single one of them, change depending on the part of speech they're supposed to be. Even proper nouns aren't exempt. The ends of people's names change in a sentence depending on whether they're the subject or the object. This is a bit of a problem for people whose names don't end in a vowel as there is no provision for that in Sanskrit.

The rules of inflections are precise. Just by knowing the ends of a word, one could know its role in a sentence. This makes word order a non issue. A three word sentence could be written six different ways and a four word sentence in twenty four. None of the permutations would alter their meaning.

Because of the use of declensions, a lot of information is packed in fewer words. This makes transmission of information extremely efficient in speech. Sanskrit is not the only language that can do this though. Latin, an equally dead language, also allowed word order independent sentences in a similar way. Latin too had quite a complicated set of grammar rules. It, like Sanskrit, isn't spoken very much because humans naturally tend to deviate toward simplicity.

ii. Storage Capacity:

Despite the arguably best verbal efficiency, there are a few issues with the language in actual knowledge representation. Sanskrit has a glyph based script rather than the alphabet based script as with Latin and its derivatives.

Latin alphabets take one byte of space each. Sanskrit written in the current character set for the Devanagari script is however not an efficient way of storing information. Here's a list of why that is.

- Vowels or consonant glyphs with the inherent vowel takes up 2 bytes of space each.
- The combination of a consonant glyph and a different vowel takes 4 bytes.
- A consonant with a suppressed vowel is 4 bytes.
- A double consonant glyph is 6 bytes.
- A double consonant glyph combined with a vowel is 8 bytes.

Latin script, on the other hand, is consistent. You spend exactly the same number of bytes in conveying a message as the number of letters it contains. My name, 'Denver', takes up 6 characters, 6 keystrokes and 6 bytes in the Latin script. The crude and borderline terrible Devanagari transliteration, 'डेन्वर्', takes 3 glyphs (in some renditions, it might look like four – in that case, the two in the middle are a single glyph), 7 careful keystrokes and 14 bytes.

If the character set were redone to start with Devanagari characters rather than the Latin ones, they could reduce space consumption to about a half. Unfortunately, that would mean I'll be spending a byte more to write my name in the wrong script and still have it screw up the pronunciation. Sanskrit is phonemically precise in that the pronunciation of words don't deviate. It does not have a universal phonology. A native speaker of a Sanskrit derived language will find it hard to sound in other languages.

iii. Sanskrit's Naturalness:

The fact is that Sanskrit, unlike other languages, hasn't had a natural evolution. Nearly everything about Sanskrit, as is known today, was codified sometime around the year 500 BCE by one person, *Panini*, who was bent on making it as precise and concise as was humanly possible

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[15]. Sanskrit didn't simply happen to have the required characteristics of an artificial language by coincidence. It's there by design. It is indeed the work of a primitive computer scientist without the hardware. This is not to say *Panini* intended for his language to be used with machines. At best, his work caught the eye of a pattern seeking human in need of an answer to a difficult, perhaps unsolvable problem – it was bound to happen sooner or later.

The Sanskrit of today, the one reportedly spoken by a few tens of thousands, is about the same as that codified two and a half millennia ago[4]. The language doesn't evolve, it can't evolve. Unlike natural languages, speakers of Sanskrit cannot be classified as proficient or eloquent as its precision does not allow gradations. You either speak the language or you don't; there is no grey. Even artificial languages do not suffer that restriction.

Sanskrit was never widely spoken. During the past two and a half millennia, Sanskrit scholarship was an exclusive club. None other than the Brahmins were allowed to use it. That all literary works in Sanskrit was made accessible only to the Brahmins, spelt its doom [16]. The thing about languages is that, like living organisms, languages too evolve by natural selection.

Natural languages thrive by fitting the need of the era. The flexible of the lot flourish organically forcing the less prominent ones to wither away. Sanskrit's resistance to change was the reason of its demise. This is essentially why every attempt to revive the language will fail, no exceptions.

IV. The Insight Focus on the Claim:

The paper does not at all contain any claim, mention or indication that Sanskrit can be used as a programming language. In fact, the one and only instance of the word 'program' was in an example sentence meant to illustrate semantic nets. Every single use of the word 'code' or variations thereof have been used to describe sentence construction rules or grammatical syntax. **Notice** that in my systematic summarization of Briggs' piece, the word 'program' doesn't appear once.

The question Briggs tried to answer was whether it was possible for one to create a perfect language for knowledge representation. If a computer scientist were to codify a new language humans could use just as well as a machine, what would the end result look like? He then shows how Sanskrit manages to fulfil all of those requirements. To him, it was astonishing to find that someone who lived a long while ago could accomplish such a feat of brilliance; the entire piece is a recurring acknowledgement of that fact.

Even after all of that, he never once suggested that Sanskrit should be used for knowledge representation. He insisted however that if anyone attempted to create such a language, they would do well to follow a similar pattern of processes as *Panini* did with Sanskrit.

V. Sanskrit as a Computer Language/NLP:

There is a lot of difference between Sanskrit being suitable for NLP and it being the best or perfect language for computer programming. For Sanskrit to be truly a best language for computer programming, a majority of computer users should be fluent enough in it. Otherwise it is much easier for them to learn a computer friendly language than to learn Sanskrit and then use it for programming a computer. By that logic, we off course fail to see how it is the best language for programming a computer when the number of people who are fluent in C outnumber the number of people who are fluent in Sanskrit. Its natural things but that did not stop some Indians from expanding their chests with pride based on a false premise. They are so lacking in knowledge of history of India, that even when there are other real reasons to proud of Sanskrit such as its influence on modern linguistics or its similarity with Backus-Naur form [17], they ignore them and spout second hand nonsense to inflate,,their,egos.

Perhaps the people who originate these kinds of falsehoods expect everyone all over the world to recognize the technical merits of Sanskrit and throw away their native tongues and instead adopt Sanskrit. If that really is the case, their hypocrisy is mind boggling. These are same people who are likely to make a stink about "western" elements destroying traditional Indian elements. Yet they would like other cultures to throw away their cultural artefacts just because a researcher published a paper saying that Sanskrit is a good language to use in NLP.

It's computer friendly in the sense of Artificial Intelligence not writing a program. Sanskrit is a very predictable language. It is easy to formulate sentences and get meanings from words. It is easy to make words plural. This means that a computer can inherently formulate sentences very easily. Just compare this to English for instance. If we want a computer to formulate sentences we have to teach it all the grammar rules plus the exceptions. For instance, telling the computer that adding "s" to a word does not always mean plural. We have to put in the case of child and children etc. Add to that all the context based meanings and usage of words and it becomes very complicated to program that in. Sanskrit is very formulaic in this sense and the sentences which a computer will formulate given a few set of rules are very accurate.

By the way programming has nothing to do with script. Latin script is mainly used because the West happened to be where computers got popular first so it dominated as choice. All that happens when you load a program is that a bunch of capacitors are charged up. This charging up can be done by any means necessary. With respect to current computer language, if someone ask a question: Is c# better or Java or Python?. But truth is that, every computer language has its advantages. We can't really pick one for all purposes. In this thread, many are either computer illiterates or

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programmers commenting on natural language processing. NLP requires both an in-depth knowledge of the language and relevant computer literacy.

Sanskrit is a language that has not been explored for NLP like English or Spanish or even Hindi. Absence of evidence is seldom the evidence of absence. In my opinion, a natural language is more of a computer-buddy if it is simple like you say. The thing with Sanskrit, as I understand is that the all sentences can be very simple, thereby making it easy for the semantic parsers. However, research with proof needs to be presented for which research needs to be done for which some agency should come up with this motives to initiate this research, may required huge amount of grants.

It's not computer friendly or programmer friendly in the practical sense. That's just what people who don't understand this say. The structure of the language is such that it can be easily interpreted by a computer if someone had to make an interpreter for Sanskrit. Knowing Sanskrit won't make you a better programmer.

My opinion, this is one of them shitty myths. What this probably originates from is that, Sanskrit is highly compositional, i.e. there are a few basic concepts and roots which can be combined in many complex ways to come up with new words and ideas. And while there are many "exceptions" to rules and all, it is still very consistent. Think how every rule in English grammar has 100s of common exception, Sanskrit usually doesn't. This is probably because Sanskrit has pretty much always been a "scholarly" language. So, if you want to design some kind of natural language (NLP) system for computers which relies on hard coded rules and all then Sanskrit would probably be a better choice than English or Hindi. But the thing is, for the last three decades, AI researchers have found that the older rule-based paradigms-the Chomsky school of thought has diminishing returns with increasing complexity and moreover is not how human brains work either [18]. So there has been a huge move to statistical methods that rely on huge amount of texts being available. Until 2005 or so, most statistical research also focused on automatically learning "rules" from huge text corpuses, but in the last 10 to 15 years, with the advent of methods like deep learning, we are moving to purely statistical models.

In these modern methods, the size of available text corpus is the most important factor, so Sanskrit doesn't really have any particular advantages. It has very strict grammar rules, which means there are very few or practically no exceptions to the rules. Hence it is easier for artificial intelligence systems or language interpreting compilers to deal with such languages rather than English which has lot more exceptions hence the compiler need to be more complex to understand the language without errors. Actually any Indian language will fare better than English.

But the above restriction is no longer a concern as the computing power is now greatly improved and compiler complexity is not a big issue. Moreover there is no point in using a dead language for computing as you will still have to translate it to a modern language. English is the best choice as it is spoken by many. Infect any Indian language would be a better choice than Sanskrit as the number of speakers will be more.

Those who boast about Sanskrit being the best language for computing should instead implement an artificial intelligence system based on Sanskrit and demonstrate the advantage of Sanskrit vs English with proper benchmarking measurements.

Interpreting the language is only a small component of realizing AI systems. There are many more aspects that are far more complex like understanding a joke, insult, sarcasm etc. And no language will have an edge for these aspects. Hence you don't reduce the AI complexity much by switching to a particular language. Suppose one translator program that can understand Sanskrit and another one that understands English & both have to read the Sanskrit and English versions on the same novel and translate it to a common third language. Measurement of the time taken will settle the debate forever. Unless this is done, such prod claims have the same credibility as the ancient plastic surgeons and head transplants.

When people say computer friendly, they mean it is simpler to create AI generated sentences, without worrying about context or grammar mistake. So, an AI can generate full novel in Sanskrit and it will be free of any grammatical error. Compared to English, there will be less contextual errors as well. So, if a human can understand Sanskrit, computers will find it easier to generate responses using simple rules. Sadly, as for programming, Sanskrit or any natural language will have same problems. So, unless the whole use of computers is to generate a lot of text, any natural language is a disadvantage.

In simpler terms, a novel writing bot will work better in Sanskrit than any contextually complicated language. But that's all the advantage of using Sanskrit. At the same time, disadvantage includes asking users to learn an outdated language, along with reprogramming literally every piece of software we have.

We know that the Sanskrit is the most structured language which has well defined set of rules for grammar & It is also a language which is naturalized by default. These things make it a good language for computer programming. BUT Sanskrit is also one of the most ambiguous languages e.g. What we call tree in English has many words for it in Sanskrit e.g. vriksha, taru, padap, naga, kuja, phalada etc. which makes it not good for programming. So unless this ambiguity is removed, Sanskrit can not be used for computer programming.

If we want to make a computer which could be programmed using vernacular language then in order to

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compile that information you'd need to design a whole lot of rules for the computer to interpret everyday sentences and words. The problem with most modern languages is that there aren't many consistencies in the syntax of sentence creation. Therefore its almost impossible to create a perfect compiler to compute vernacular language. However, since Sanskrit and other older languages had a more strictly defined syntax, they are technically more computable. That's not exclusive to Sanskrit though.

We also know that the Computing has two aspects: Logical and Language.

- Logic Language: Logic gives power of motion which leads to the automation of the process just like invention of wheel.
- Language : Language gives the power of expression which provides space for representing the content.

We find contributions of Pāṇini in both the aspects by writing a logical processing machine for generation of Sanskrit words/syntax using a formal language and programming techniques by providing basis to analyse the language and to decode the content coded in it. Natural Languages are the languages that are spoken or written for human communication. Its strength is good for expression of feelings and emotions etc. and its weakness is lead to ambiguity at all levels starting from word, syntax and pragmatics. In the same way the formal Languages are used for representing facts in Science, whose strength is unambiguous syntax and weakness is insubstantial for human beings.

Computing requires unambiguous representation of content. Therefore, the natural choice is formal language. Since Natural Languages lack unambiguous representation, and do not fit into the logic, Artificial Languages are created using formal structure/syntax.

VI. Conclusion:

As I have mentioned that, I read the research paper published and I don't remember it mentioning at any single place that Sanskrit could be used as a general-purpose programming language. The paper says knowledge representation in Sanskrit is highly suitable for current on-going work in AI. I have not studied AI or NLP in details, but after reading the paper and couple of Wikipedia links, I also felt that Sanskrit is a good language for AI. In brief, NLP is about human-computer interactions using a common language. We all know that Sanskrit is a natural language. Now, what makes it special that NLP could be achieved with it? The answer is that, any word or sentence in Sanskrit is based on some rules which do not have any exceptions or probably far less exceptions as compared to modern day languages. And no words are added to the language as time progresses unlike other languages. The very first paragraph of the paper seems like it respects all modern languages but don't feel disheartened or frustrated by it. Go on and you will understand why Sanskrit is associated with NLP. Panini's grammar is what modern linguists call a generative grammar, and that is what they use to describe language grammars themselves; and, as it happens that is also the way computer scientists describe the syntax of programming languages. The ancient Indian grammarian Pāṇini described the structure of Sanskrit using rewriting rules, similar in spirit to the Backus Naur form[19]. With that he established formal language theory, which is used today in research on parsing programming languages. My point of view, it is possible to design a computer entirely based on Sanskrit, but the reasons that the people do not take initiative is due to:

1. No guarantee of success.
2. No one will take up such a project that does not have commercial value. Why would you waste your time in such a project instead of finishing you Phd and getting a job.
3. Huge amount of work involved in this project.

And following points should be kept in mind to initiate the project.

1. Design a Compiler for a programming language based on Sanskrit.
2. Once you have compiler in place you can write minimum Operating System.
3. Define Micro-operations for Computer Hardware System that is based on Sanskrit.

To use Sanskrit would be no different than using English, except in Devanagari script, which would require a whole new series of computers and programming languages to be used. Computers using Sanskrit and Devanagari commands would maybe be more efficient or less efficient. It's a gamble, and a costly and time consuming one at that.

So far, I have found no credible citation stating so. The only things I'm finding are blogs saying Sanskrit is best because Sanskrit sentences have the same meaning whichever order they're read in. I wonder if the people writing these blogs even know how programming languages work. Also, if scientists had to use a heavily inflected language, then they would shift to a completely new script. They could use Latin instead. Almost as inflected as Sanskrit, plus programmers don't have to learn a whole new script, or even discard all current computers and shift to a completely new alphabet system.

Now let's speak in terms of Sanskrit becoming the most suitable NLP language, it would be if only majority of people communicate in Sanskrit. With my experience of AI and Sanskrit, I would say it may be possible. Accordingly to following feasibility point of view:

Pros :

1. Sanskrit is unambiguous in terms of processing. Thanks to the strict grammar rules. So programming an NLP would be much more easier and efficient.

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Cons :

1. Sanskrit is not used in day to day basis and almost no one communicates in Sanskrit these days. So, the options of AI for learning is extremely low. Only if 25% of people in the world learn Sanskrit and communicate to AI, it would learn only a portion of whole world's activity through its rules.
2. We need processors to process Natural Language, to do that, we need people who communicates in Sanskrit and has a good hold over it.
3. Sanskrit NLP will be only a matter of research until and unless everyone communicates in Sanskrit.

So, you can see that, using a NLP Translator for Sanskrit, you can only make it useful if the whole world or at least 25% of its population, communicate in Sanskrit.

But in this era of internet, people already have developed a big portion of NLP based on English, so using Sanskrit as a base for NLP is still a question.

Till a Properly Created Sanskrit NLP is made, it will be difficult to assess whether it is the Best Language, Sanskrit is a Precursor Language and will probable not evolve in the same way that Data and AI evolve.

The article published by a Mr. Briggs has been typed again and again and certain sites have even propagated it saying that NASA uses Sanskrit as a Language for their computers. There is no proof for the same, other than the same article. It therefore should be awaited, that If and When someone develops a Sanskrit NLP in a usable state, One would have to see the benefits of the same. The paper doesn't conclude as wether the Sanskrit is not good or bad for AI. Instead it says, even AI can be solved if rethought in line with the structure of Sanskrit.

One of the conclusions I draw personally is that IF the knowledge (currently in latin, french, german, italian or other languages) were made available in a strict rules-based language (like Sanskrit) it may make it easier/optimal for an AI system to process, decipher & utilize the knowledge to take decisions.

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Comparative Analysis of Chitinase Activity by Four Different Assay from Soil Born *Actinomycetes*

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Abstract: **Eleven Actinomycetal isolate were selected that showed chitin degradation. Four different methods were tested for measuring chitinase activity by ten different Actinomycetal isolate which included p-DMAB method, Boric acid method, DNSA method and Schales method. Amongst these assay, p-DMAB method was selected as it was most sensitive and reproducible results were obtained. Chitinase activity was found maximum by SP24 isolate by all the four assays.**

Keywords**: Chitinase, plant growth promotion, *Streptomyces rubiginosus* SP24, p-DMAB, potassium tetraborate method, DNS assay and Schales method**

I. INTRODUCTION

Actinomycetes, Gram positive filamentous bacteria have a high G+C content. Most important function of this group is to decompose organic matter such as chitin, cellulose, lignocelluloses and starch with an aid for formation of enzymes corresponding to it. *Streptomyces sp*. is one of the main microbes which have high ability for formation of various lytic enzymes. As reported by Gupta et. al. (1995) amongst *Streptomyces sp*. screened *S. viridificans* was found to be good chitinase producer. Amongst those lytic enzymes, one such enzyme is chitinase, which has ability to degrade cellwall of phytopathogenic fungi, partial degradation of exoskeleton of invertebrates, nematodes and thus making it important in biological research (Felse and Panda 2000, Saadoun I, 2009, Honee & Visser, 1993, Ruiz-Herrera & Martinez-Espinoza, 1999). Chitinase enzyme breaks chitin into oligomers or monomer such as N-acetyl D-glucosamine. Chitinase enzyme is divided into three categories such as exochitinase, endochitinase and N-acetylglucosaminidase demonstrating its activity for formation of tetrameric, trimeric, dimeric monemeric units of N-acetyl glucosamine. Different methods having different substrate or reagents are used for estimating chitinase activity.

Hence, our research focus is first isolating *Actinomycetes* that were able to degrade chitin and simultaneously producing chitinase enzyme in sub-merged condition. Secondly, with different assay determining best suitable method for estimating chitinase activity.

II. METHODOLOGY

Isolation of Actinomycetes

Soil samples were collected in sterile polypropeline bags from the rhizosphere of *Gossypium* sp. (Cotton) grown in Dastan farm, Naroda, Gujarat. For isolation, Bennet's agar medium was used. First, little amount of the soil from different fields were taken in petriplates and on them calcium carbonate was sprinkled, these was kept for drying for a period of 4-5 days to allow *Actinomycetes* to sporulate. Dilutions (10^{-3} to 10^{-6}) of enriched soil samples were plated which were incubated at 30°C. Desired colonies culturally appeared as *Actinomycetes* were picked up and restreaked for obtaining pure colonies. *Actinomycetes* were isolated by the serial dilution and spread plate techniques (Jha S. et. al 2016).

Colloidal chitin preparation

Chitin flakes (10 gm) were suspended in concentrated HCl (60 mL) and incubated on rotary shaker for 1-2 hr at room temperature until chitin flakes were completely dissolved. The resulting solution was then poured into doubly deionized water (400 mL) with rapid stirring to form the precipitates of colloidal chitin, which were subsequently collected by centrifugation at 7000 xg for 10 min at 4°C. The precipitates were washed with sterile distilled water (10 mL each) several times to bring the pH value of the colloidal chitin suspension to 2.0-3.0. After neutralization with sodium hydroxide (1 M), the low-salt colloidal chitin was obtained on repeated centrifugation (7000 xg, 10 min) and washing with sterile water 2-3 times. The colloidal chitin was kept at 4°C as a pellet for further applications (Wu, Cheng, & Li, 2009).

Screening of Chitinase producing Actinomycetes:

Actinomycetal isolates obtained from Bennet's agar media were then screened for chitin hydrolysis by spoting on the centre of 1% CCA (Colloidal Chitin- 1%, $NaNO_3$-0.2 gm, K_2HPO_4-0.1 gm, $MgSO_4$-0.1 gm, $CaCO_3$-0.1 gm, $FeSO_4.7H_2O$-0.001 gm, KCL-0.05 gm) media at neutral pH and were incubated at room temperature. The zone of clearance due to chitin hydrolysis was recorded up to 8 days. The isolates those formed clear zones above 8 mm were selected. Actinomycetal isolate were selected on the basis of zone of degradation i.e. Selection ratio

Chitinase Assay by different assay:

1) p-DMAB assay

The reaction mixture contained 1 ml of 0.1% colloidal chitin in phosphate buffer (0.05 M, pH 7.0) and 1 ml culture filtrate

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was incubated at 37ºC for 1 hr. Suitable substrate and enzyme blanks were included. Chitinase activity was assayed by following the spectrophotometric method of Reissig et. al. (1955). The reaction was terminated by adding 0.1 ml of 0.08 M potassium tetraborate, (pH 9.2) to 0.5 ml of reaction mixture and then was boiled in a water bath for 3 min. Then 3 ml of diluted p-dimethylaminobenzaldehyde [10 gm of DMAB dissolved in 100 ml of glacial acetic acid containing 12.5% 10 N (v/v) hydrochloric acid] reagent was added and again incubated at 37ºC for 15 min. The released product in the reaction mixture was read at 585 nm in a visible spectrophotometer. Chitinase activity was determined using N-acetylglucosamine (Hi-media) as the standard. One unit of chitinase activity is defined as the amount of enzyme, which produces 1 µ mole of N-acetylglucosamine in 1 ml of reaction mixture under standard assay condition (Mathivanan et al., 1998).

2) Boric acid assay

Chitinase activity was assayed by the method of Yanai *et al.* (1992). The reaction mixture consisited of 250µl of 0.5% colloidal chitin, 250 µl of 0.2 M sodium acetate buffer (pH 4), and 500 µl of enzyme (crude enzyme) solution was incubated for 2hr at 37°C. After centrifugation at 3000 rpm for 15 mins, 500 µl supernatant was mixed with 100 µl of 0.8M boric acid, and the pH of this mixed solution was adjusted to 10.2 with KOH. The solution was heated for 3 min in boiling water. After the mixture was cooled, 3ml of *p*-dimethyl aminobenzaldehyde (DMAB) (1 g of DMAB dissolved in 100 ml of glacial acetic acid containing 1% 6N V/V hydrochloric acid) was added and the mixture was incubated for 20 min at 37°C. Absorbance at 585 nm was measured against water as a blank.

3) DNSA assay

The reaction mixture consisted of 2.5 ml buffer, 2.5 ml 1% colloidal chitin followed by 0.5 ml of crude enzyme. Tubes were incubated at 37°C for 1 hr. The reaction was stopped by adding 3.0 ml of 10% DNSA and heating in boiling water bath for 15min. The colored solution was centrifuged at 8000×g for 5 mins at 4°C. The absorption of supernatant was measured at 540nm spectrophotometrically. The reducing sugar was estimated from standard curve of glucose.

4) Modified Schales assay

In this assay, 96-well Microtitre plates were used for estimation of chitinase activity. The reaction mixture contained 1ml of 1% colloidal chitin in phosphate buffer (0.05, pH 7.0) and 1ml culture filtrate was incubated for 1 hr at 30°C. After incubation, centrifuge mixture at 4°C for 15 mins. About 100 µL of supernatant was transferred in a new plate. A volume of 100 µL of Schales' reagent (a solution of 0.5 M sodium carbonate and 0.5 g/L potassium ferricyanide in water) was added. The plate covered with aluminum foil and was incubated at 100°C for 15 minutes and allowed to cool. Read the absorbance at 420 nm spectrophotometrically. As a positive control, 50 mM of N-acetyl-D-glucosamine was used (Ferrari et. al. 2014).

III. STATISTICAL ANALYSIS

Chitinase activity obtained by different methods after 72 hours of incubation period were analyzed for knowing the significant difference within the assay. Experiment was designed in such a way that five replicates were obtained and mean results were analyzed by performing analysis of variance test (ANOVA) followed by tukey post-hoc test using software IBM SPSS 23.0 trial version (IBM Corp. Released 2015)

IV. RESULTS & DISCUSSION

Actinomycetes were screened on the basis of hydrolysis of colloidal chitin (substrate) against creamy background. Selection Ratio was measured on zone of hydrolysis and colony size. Maximum chitin hydrolysis was observed by isolate SP 24 about 2.13 and minimum hydrolysis was observed by SP 12 about 1.5 as described in Fig. 1.

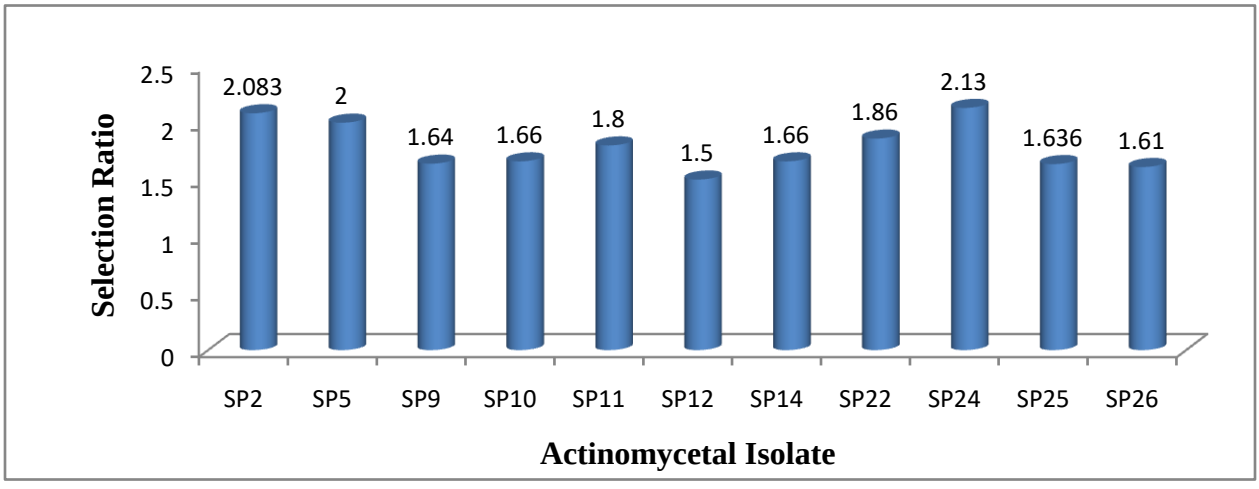


Fig. 1 Selection ratio of Actinomycetal isolate based on chitin degradation

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Eleven *Actinomycetal* isolates were found to give high selection ratio. So, a study was conducted with eleven *Actinomycetal* isolate with different methods to find chitinase production to assess best suitable method. Colloidal chitin as a substrate was most preferred because chitin as such is insoluble in water or buffer or acid/base and hence cannot be digested when incubated with enzyme. It is also cheaper in comparision with other substrates which are commercially available in market. So, for preparation of colloidal chitin, chitin was hydrolysed by two step acid catalyzed process: Depolymerization and De-N-acetylation. Four different reagents were used that produced color based on corresponding method used (Potassium tetraborate method, Schales method and Boric acid method) which measured exact amount of N- Acetyl glucosamine which were formed from colloidal chitin present in medium whereas, By DNS method, all reducing sugars were measured instead of N-acetyl glucosamine. SP24 gave maximum chitinase activity in all four methods. In potassium tetraborate method, SP24 gave maximum chitinase activity after 72 hours of incubation period about 2.79 U/ml (Fig. 2) and in Boric acid method SP24 also gave maximum chitinase activity about 2.06 U/ml (Fig. 3). Comparing selection and reagents of both method, Potassium tetraborate method was selected because it gives more chitinase activity than Boric acid method and it was very reliable method. The compounds which are used in Potassium tetraborate method are also less cheaper. In case of DNS method, maximum chitinase activity was obtained (4.98 U/ml) as shown in fig.4 because it measured all the reducing sugars present in the solution. Hence this method was not specific for measuring N-acetyl glucosamine that was measured by potassium tetraborate method. With Schales method, a modification were made in method of incubation time of substrate and enzyme but still chitinase activity obtained were less about 1.32 U/ml (Fig. 5) in comparision with p-DMAB method, boric acid method and DNS assay. All the four methods used in this research has an advantage of using insoluble colloidal chitin as a substrate in reaction medium which can be separated before addition of acidic/alkaline medium. In potassium tetraborate method, certain chromophoric substances of cyclic intermediate structure of N-acetyl glucosamine was produced on addition of p-Dimethylaminobenzaldehyde under acidic condition (10 N HCL). NAG,Dimers, trimers and tetramers released in medium were further hydrolysed at 100°C. Released product were further treated with DMAB and can be spectrometrically measured (Takahashi T, 2003). Statistical analysis results revealed that values with same letters within the column are not significantly different from each other. Results of chitinase assay for SP24 isolate by statistical software was found to be maximum after 72 hours of incubation period and were analyzed for tukeys test which revealed as most significant among other isolates.

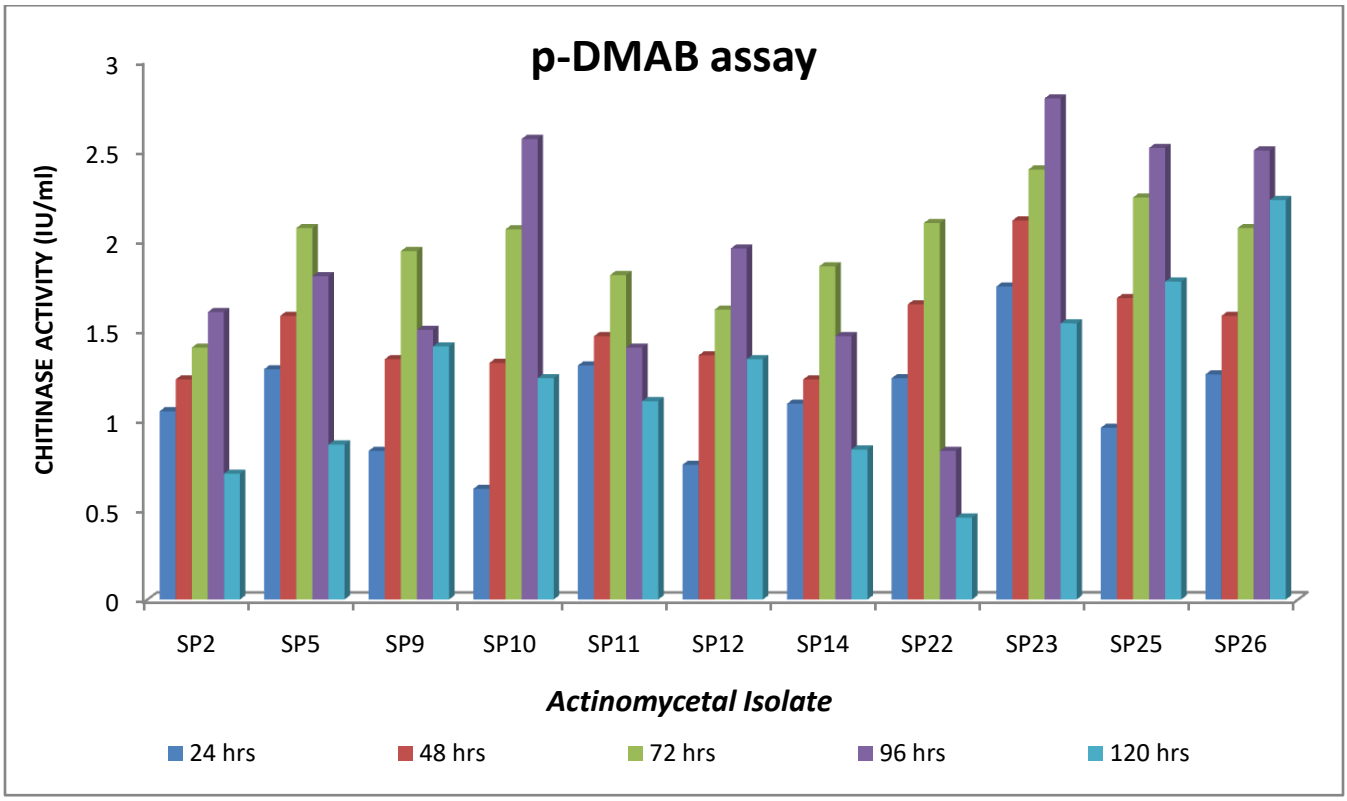


Fig. 2 Chitinase assay by p-DMAB method

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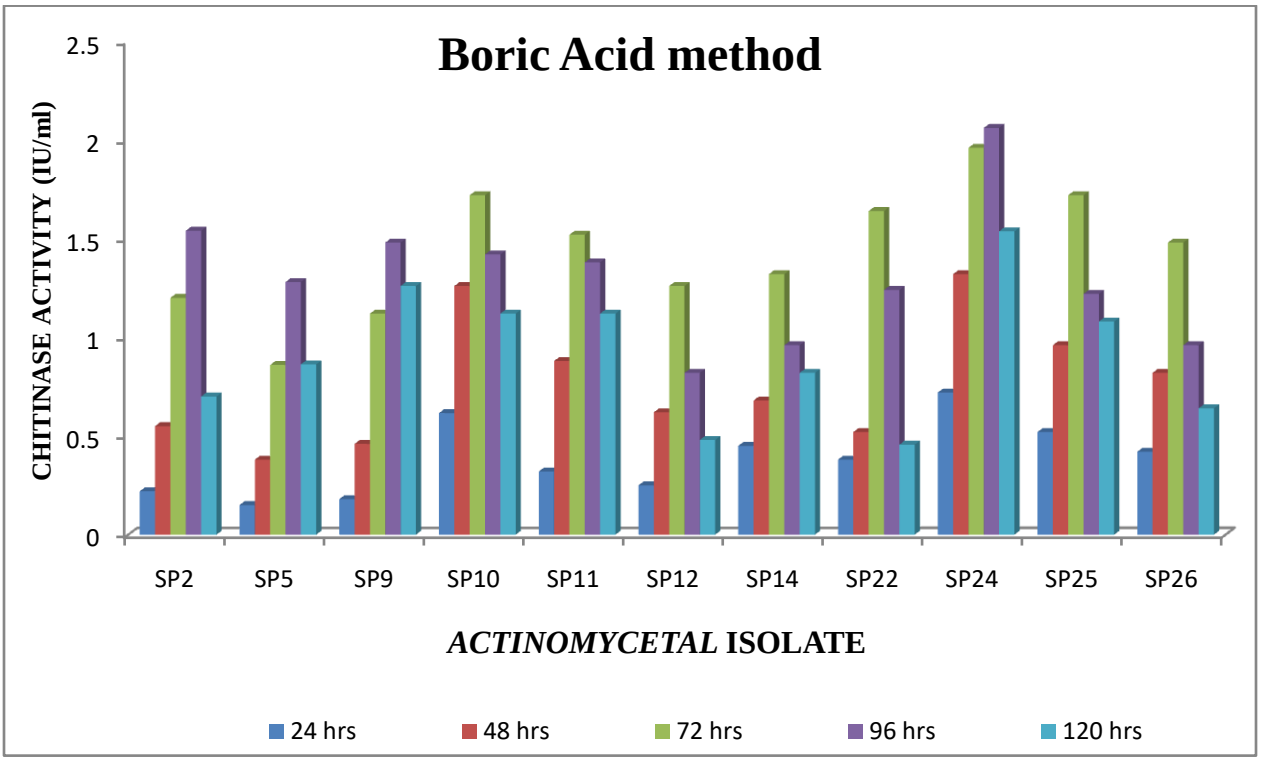


Fig. 3 Chitinase assay by Boric acid method

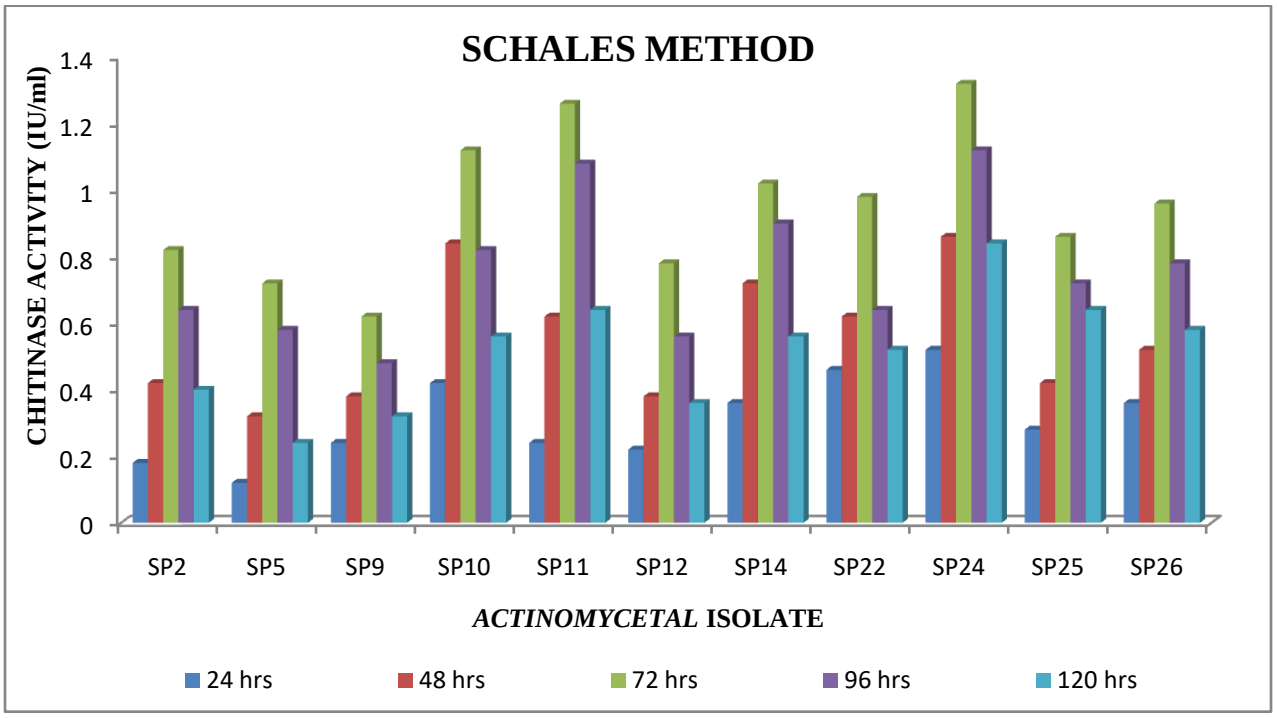


Fig. 4 Chitinase assay by Schales method

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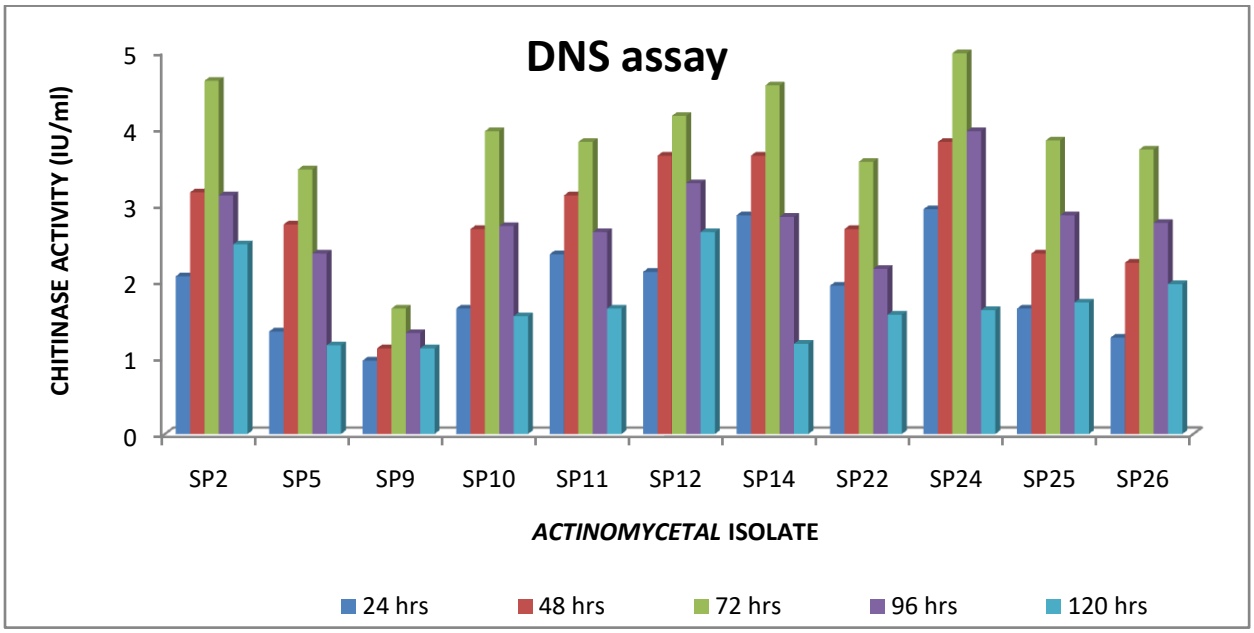


Fig. 5 Chitinase assay by DNS assay

Table 1 Chitinase activity by different assays after 72 hours of incubation period for selected isolates.

Method	P-DMAB	Boric	Modified Schales	DNSA
Isolates	72 hrs	72 hrs	72 hrs	72 hrs
SP2	1.402^{d}	1.2^{cd}	0.82^{cde}	4.62^{b}
SP5	2.068^{ab}	0.86^{e}	0.72^{de}	3.46^{g}
SP9	1.94^{bc}	1.12^{de}	0.62^{e}	1.64^{h}
SP10	2.061^{ab}	1.72^{ab}	1.12^{ab}	3.96^{d}
SP11	1.806^{bcd}	1.52^{bcd}	1.26^{ab}	3.82^{e}
SP12	1.614^{cd}	1.26^{cd}	0.78^{cde}	4.16^{c}
SP14	1.855^{bc}	1.32^{cd}	1.02^{bc}	4.56^{b}
SP22	2.096^{ab}	1.64^{b}	0.98^{bc}	3.56^{fg}
SP24	2.394^{a}	1.96^{a}	1.32^{a}	4.98^{a}
SP25	2.238^{ab}	1.72^{ab}	0.86^{cde}	3.84^{de}
SP26	2.068^{ab}	1.48^{bc}	0.96^{bcd}	3.72^{ef}

Values with the same letters (abcdefgh) within the column are not significantly different and values with different letters within the column are significantly different from each other according to tukey's test .

V. CONCLUSION

In the present investigation, isolate SP 24 was considered to be most potent *Actinomycetes* amongst all tested isolates for giving maximum chitinase activity. Different assays used in present research showed that p-DMAB method was most sensitive, rapid, low cost reagents needed as well as precise for giving maximum chitinase activity. It had added advantage of using colloidal chitin as a substrate which is easily prepared in comparision with other substrate such as glycol chitin and swollen chitin which are too expensive.

ACKNOWLEDGEMENT

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Implementation of Box-Behnken Experimental Design for the Robustness Study and Its Comprehensive Approach in Development and Validation of RP-HPLC Method for Simultaneous Estimation of Rifampicin and Levofloxacin

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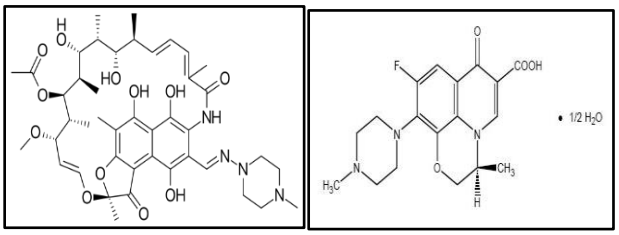
Abstract*: - Chemometrically assisted development and validation of the RP-HPLC method intended for the quantitative analysis of Rifampicin (RIF) and Levofloxacin (LFX). Box-Behnken experimental design was applied in Robustness study for obtaining desired chromatographic resolution with limited numbers of experiments. Three independent variables; volume of acetonitrile in mobile phase (X_1), pH of mobile phase (X_2) and flow rate (X_3), were used to design the mathematical models and study the in depth effect of this independent variables on retention time of both drugs and Asymmetric factor of LFX. The chromatographic separation was carried out on Kinetex C_{18}, 100 A Phenomenex column (250 mm × 4.6 mm, 5µm) with a mixture of 0.03M Potassium dihydrogen phosphate buffer (pH 3.0): Acetonitrile (55:45, % v/v) as mobile phase; at a flow rate of 0.8 ml/min, with UV detection at 230nm. A linear response was observed over the concentration range of 2-10 µg/ml for both drugs, with retention time of RIF (4.86±0.395 min) and LFX (2.92 ± 0.447 min) and LOD and LOQ value as 0.0214 and 0.0648 µg/ml for RIF and 0.0858 and 0.2600 µg/ml for LFX respectively. The method was rapid as separation of both drugs was achieved within the run time of 10min. The method was validated for linearity, sensitivity, system suitability, accuracy, precision and robustness as per the ICH guideline. The system revealed that there was no significant effect of all three factors on the responses. Finally, the developed experimental design was validated by statistical analysis using ANOVA. The obtained results revealed that the proposed method is simple, accurate, reproducible, and robust thus finding applicability for routine quality control testing.

Keywords: **Rifampicin, Levofloxacin, RP-HPLC, Box-Behnken experimental design, Validation Parameters**

I. INTRODUCTION

Tuberculosis is one of the leading killer disease among the young adults worldwide. It is pervasive and highly contagious chronic bacterial infection, which has led to 1.7 million deaths in 2016 [1]. Returning with a new face, the global tormentor of multi-drug resistant TB (MDR TB) is reaching epidemic proportions. The treatment of Tuberculosis remains very difficult and laboratory studies in order to characterize drugs working with mechanisms other than first line agents and having high bactericidal activity has become a necessity. In order to overcome various drawbacks of TB therapy viz. lengthy treatment time, various side effects of conventional drugs, and premature self-termination by patients [2], at least two or more bactericidal drugs need to be incorporated. Thus, a strategic combination therapy is a key to overcome emergence of drug resistance and to shorten the treatment duration.Rifampicin (RIF) (Fig. 1a), a first line anti-tubercular agent, is a complex semisynthetic macrocyclic Rifamycin class of antibiotic derived from *Streptomyces mediterranei* [3]. Rifampicin used for the treatment of tuberculosis and other infectious diseases.RIF acts via the inhibition of DNA dependent RNA polymerase, leading to a suppression of RNA synthesis and cell death [4-7]. Fluoroquinolones are the emerging class of antibacterial agents, included in tuberculosis treatment regimens since 1980s. Moreover, clinical trials have found that fluoroquinolones may also be useful in the treatment of drug-susceptible *Mycobacterium tuberculosis* in order to shorten the treatment. Levofloxacin (LFX) (Fig. 1b) is a third generation fluoroquinolone and an active L-isomer of ofloxacin (OFX). The DNA gyrase inhibiting potential of LFX along with penetration to infection loci aids in the bactericidal and sterilizing effect of combination therapy [8,9]. In one of the study, it has been found that inclusion of LFX to first line drug combination containing rifampicin showed synergism against both resistant as well as drug-susceptible isolates [10]. Thus, RIF and LFX are proposed to be formulated as combination therapy to widen the anti-tubercular effect in both resistant as well as susceptible isolates.

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(a) (b)

Fig. 1. Chemical structure of (a) RIF and (b) LFX

As a part of fabrication of microparticles based dry powder inhaler drug delivery system of RIF and LFX, development of suitable assay method for the simultaneous estimation of both the drugs is the prerequisite. From the thorough literature survey, various methods have been reported for the determination of RIF [11-18] and LFX [19-27] individually and in combination with other drugs. However, RP-HPLC method for the simultaneous determination of RIF and LFX in combination has not yet been reported till date. Hence, the aim of the present study was to develop accurate, precise and selective RP-HPLC assay procedure for the simultaneous estimation of RIF and LFX in synthetic mixture. The validation of proposed method is done according to the ICH guideline ICH Q2 (R1) [28].

Analytical Quality by design (AQbD) is a systematic approach to development that begins with a predefined objective and emphasises method understanding and control based on sound science and quality risk management. AQbD plays an important role in developing a robust method as an early risk assessment and helps to identify the critical analytical parameters and to focus on these factors in method development [29, 30]. Furthermore, experimental design is a good alternative than traditional approach for proper planning and conducting of improved study. In order to study the simultaneous variation of the factors on the considered responses, a multivariate approach using design of experiments is recommended in robustness testing [31]. Among the various experimental designs, Box-Behnken experimental design (BBD), a response surface design, is preferred for the prediction of nonlinear response and also due to its flexibility, in terms of experimental runs and information related to the factor's main and interaction effects [32]. Selection of critical parameters and responses is an important aspect for the development of HPLC method. The method has to be validated by statistical analysis using ANNOVA in compliance with regulatory requirements for demonstrating its suitability when used. Hence, in line with the notion and keeping the current FDA requirements in mind while pursuing the research considering AQbD based approach, the objective of our study was to develop a novel, simple, accurate, robust and specific HPLC methodsuitable for quality control of RIF and LFX using BBD design for robustness testing.

II. EXPERIMENTAL

A. Standards and Reagents

Analytically pure RIF and LFX were purchased from Swapnroop Drugs and Pharmaceuticals, Aurangabad, India. PLGA (75:25) used in preparation of synthetic mixture was received as gift sample from Evonik Degussa India Pvt. Ltd., Mumbai, India.All solvents and chemicals used were of HPLC grade, purchased from Merck Specialities Pvt. Ltd., Mumbai, India.

B. Instrumentation

A HPLC instrument (LC-2010C HT, Shimadzu, Japan) was used. The system also includes photodiode array (Shimadzu SPD- M20A) detector. Data were acquired and processed using LC solution software version 1.25. Analytical balance AUW 220D (Shimadzu, Japan) with minimum 1 mg sensitivity was used.

C. Chromatographic conditions

Chromatographic separation was performed at ambient temperature with a constant injection volume of 10 µl, using Kinetex $C_{18,}$ 100 A Phenomenex column (250 mm x 4.6 mm, 5 µm) with run time of 10 min. The mobile phase consisted a mixture of 0.03M Potassium dihydrogen phosphate buffer (pH 3.0): Acetonitrile (55:45, % v/v). The mobile phase was prepared daily followed by filtration through 0.45-µm nylon membrane filter and sonicated for 15 min. The flow rate of 0.8 ml/min for the mobile phase with an UV detection carried at 230 nm.

D. Preparation of Standard Stock Solutions

A standard stock solution of RIF and LFX (1000 µg/ml) was prepared individually by dissolving accurately weighed, 10 mg of drug in 10 ml volumetric flask, dissolved and made upto the mark with acetonitrile. Aliquots of the stock solutions were appropriately diluted with acetonitrile to obtain working standards of 100 µg/ml solutions of RIF and LFX.

E. Method validation

The HPLC method was validated in terms of linearity, sensitivity, precision, accuracy, robustness in accordance with ICH Q2 (R1) guideline and system suitability test as per USP [33].

i. *System suitability test***:** System suitability was determined by five replicate injections of the standard solution of RIF and LFX (2 µg/ml) before the sample analysis. Various parameters like resolution, theoretical plate (N), tailing factor (T) were evaluated in terms of %RSD.

ii. *Linearity:* The linearity of an analytical method is its ability, within a given range, to provide results that are directly, or through a mathematical transformation, proportional to the concentration of the analyte. Different volumes of standard solutions of drugs were injected to obtain a concentration range of 2-10 µg/ml of RIF and LFX, in five replicates. The linearity in terms of

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measured peak areas versus corresponding concentration of drugs wasestimated by ordinary linear regression analysis. The slope, intercept (with respective confidence intervals) and correlation coefficient (r^2) were calculated and evaluated. Furthermore, the homoscedasticity of the variances along the regression line of each drug was verified using the Bartlett's test[34].

iii. *Limit of detection (LOD) and limit of quantitation (LOQ):* The Limit of Detection (LOD) and Limit of Quantification (LOQ). LOD and LOQ of the developed method were calculated from the standard deviation of the response and slope of the calibration curve of drugs using the formula as per ICH guideline,

Limit of detection = $3.3 \times \sigma/S$
Limit of quantitation = $10 \times \sigma/S$

Where, "σ" is standard deviation of y intercepts of regression lines, "S" is Slope of calibration curve.

iv. *Precision:* The precision of the developed method was evaluated by performing Intra-day and Inter-day precision studies. Intra-day precision was carried out by performing three replicates of three different concentrations (2, 6 and 10 µg/ml of RIF and LFX) on same day and peak area measured was expressed in terms of percent relative standard deviation (% RSD). The inter-day precision study was performed on three different days using mentioned concentrations of both drugs in triplicate and % RSD was calculated.

v. *Accuracy:*The accuracy of the method was assessed employing the standard addition method, where sample containing synthetic mixture of RIF, LFX and PLGA were spiked at three different concentrations levels of 50%, 100%, and 150%. Briefly, recovery studies were carried out by spiking three different amounts of RIF and LFX standard (2 µg, 4 µg and 6 µg) to the synthetic mixture containing RIF (4 µg/ml) and LFX (4 µg/ml). Recovery studies were performed in triplicate by calculating the recovery and % RSD for both the drugs.

vi. *Robustness testing using Box-Behnken experimental design:*In the present study, robustness of HPLC analytical method for the simultaneous estimation of RIF and LFX was determined by Box-Behnken experimental design (BBD).Here, three independent factors were selected based on the criticality of factors observed during trial runs, chromatographic intuition and experience gained from optimization of chromatographic conditions. The effect of changes on parameters like, acetonitrile volume in mobile phase composition (X_1), pH of mobile phase (X_2) and flow rate (X_3) on the retention time of both drug, and asymmetric factor of LFX was examined.

The nominal value for all these three factors, volume of acetonitrile in mobile phase (X_1), pH of mobile phase (X_2) and flow rate (X_3) were 45ml, 3.0, and 0.8 ml/min respectively. In context to this, volume of acetonitrile in mobile phase was kept between 40-50 ml. Similarly, minimum and maximum pH of mobile phase was fixed in between 2.8-3.2, respectively. Likewise, minimum and maximum values for flow rate were selected as 0.7 and 0.9 ml/min. The data generated were analyzed using Design Expert (Version 10.0, Stat-Ease Inc., Minneapolis, MN, USA) statistical software. A total of 15 runs were obtained for the fixed variables by selecting one center repetition, carried out in order to know the experimental error variance.Each combination of mobile phase composition, pH and flow rate suggested by BBD were finally run on the system; the observed responses such as retention time of both drugs and asymmetry factor of levofloxacin were noted and represented in Table II. All experiments were performed in randomized order to minimize the effects of uncontrolled factors that may introduce a bias on the response.

F. Analysis of synthetic mixture

The synthetic mixture was prepared by choosing PLGA (75:25) as a polymer with an aim to formulate dry powder inhaler. The synthetic mixture comprised of RIF: LFX (1:1) and drugs: polymer (1:1), the ratio mimicking the formulation composition. Accurately weighed 40 mg of synthetic mixture equivalent to 10 mg of RIF and 10 mg LFX was transferred in to 10 ml volumetric flask and dissolved in 5 ml acetonitrile. Then the solution was sonicated for 5 min and made up the volume up to 10 ml with acetonitrile. The solution was filtered through Whatman filter paper no. 42 wetted with acetonitrile and further diluted to obtain 2 µg/ml of RIF and 2 µg/ml of LFX.

III. RESULTS AND DISCUSSION

A. Optimization of chromatographic conditions

The optimizations of chromatographic conditions were done with a view to develop HPLC method for the simultaneous determination of RIF and LFX in bulk and in pharmaceutical dosage form. For the selection of wavelength, 10 µg/ml standard solutions of RIF and LFX were scanned in the spectrum mode between 190 and 400 nm using acetonitrile as a blank. Both drugs absorbed appreciably at 230 nm, which was selected as the detection wavelength (Fig. 2).

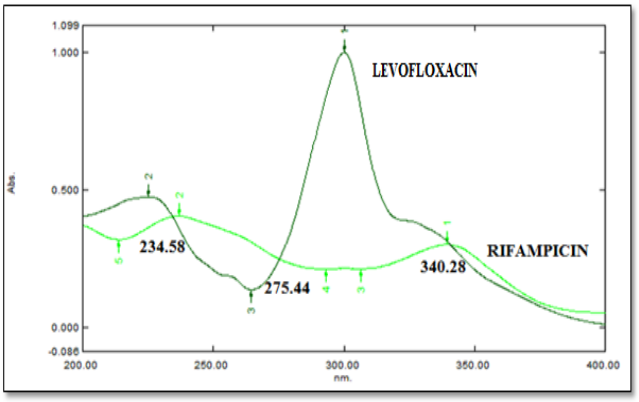


Fig. 2. Zero order overlay spectra of RIF and LFX

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Various mobile phases comprising different ratios of water, acetonitrile and potassium dihydrogen phosphate buffer were tried. Water and acetonitrile when used as mobile phase in different ratios lead to early elution of both drugs giving sharp peak of RIF but tailing was observed in LFX peak. Hence, various ratios of different strengths of potassium dihydrogen phosphate buffer and acetonitrile were tried that gave acceptable peak shape of RIF and LFX and resolution. Finally, mobile phase comprised of 0.03M potassium dihydrogen phosphate adjusted to pH 3.0 with ortho-phosphoric acid and acetonitrile in ratio of 55:45 % v/v gave acceptable retention time LFX (2.92 ± 0.447 min) and RIF (4.86 ± 0.395 min) at 230 nm and 0.8 ml/min flow rate.

B. Method validation

i. *System suitability parameters:* System suitability testing is used as method control strategy. System suitability tests are an integral part of method development and were performed to evaluate the behaviour of the chromatographic system. The % RSD was found less than 2%, for system suitability parameters: R_t (For RIF, 4.86 ± 0.395; for LFX 2.92 ± 0.447), peak area (For RIF, 52605.2 ± 0.011; for LFX, 101063.8 ± 0.005), and resolution (4.81 ± 0.255). Moreover, theoretical plates, 6941.98 ± 0.196 and 3752.76 ± 0.772 as well as tailing factor 1.26 ± 0.433 and 1.38 ± 0.824 for RIF and LFX respectively were obtained.

ii. *Linearity:* Linear relationship between peak area and concentration of RIF and LFX showed a good correlation coefficient (r^2 = 0.9998 and 0.9909 respectively) in the proposed concentration range 2-10 µg/ml for RIF and LFX. Homoscedasticity of variance was confirmed by Bartlett's test and the response of peak area for both drugs showed homogenous variance that was exemplified by the χ^2 value less than the tabulated value (Table I). Thus, from the obtained results, there was no further need of weighting and transformation approach. Fig. 3 shows overlay HPLC chromatogram for linearity of RIF and LFX at 230 nm.

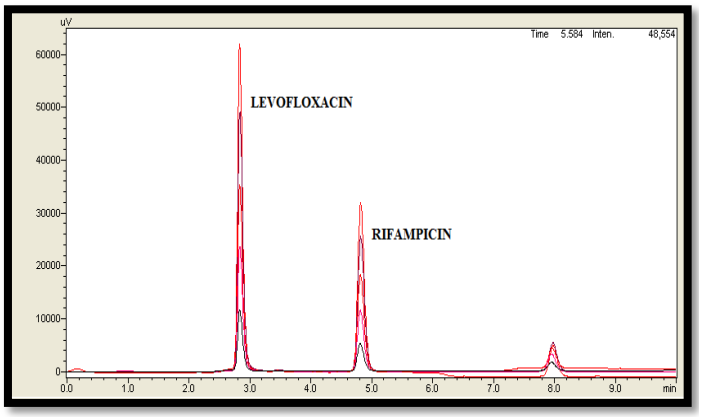


Fig. 3. Overlay HPLC chromatogram for linearity of RIF and LFX at 230nm.

iii. *LOD and LOQ:* LOD for RIF and LFX was found to be 0.0214 and 0.0858µg/ml while LOQ was found tobe0.0648 and 0.2600 µg/ml respectively indicating the sensitivity of the proposed method (Table I).

iv. *Precision:* The experiment was repeated three times in a day (Intra-day precision) and the average % RSD values of the results were calculated. Similarly, the experiment was repeated on three different days (Inter-day precision) and the average % RSD values for peak area of RIF and LFX was calculated. Results of intra-day and inter-day precision expressed in terms of % RSD less than 2 confirm precision of the method (Table I).

v. *Accuracy:* The mean percentage recovery at three levels, 50%, 100% and 150% after spiking with standard were in the range of 99.02- 100.48 % for RIF and 100.83-102.62 % for LFX which were within acceptable ranges of 100 ± 2 % (Table I). Good agreements between actual and determined values were found that confirm the accuracy of the method. The % RSD less than 2 for both drugs suggest suitability and applicability of the method for routine drug analysis.

Table I. Analytical Validation Parameters for RIF and LFX by HPLC Method

Parameters	RIF	LFX
Linearity [a]		
Linearity range (µg/ml)	2-10	2-10
Correlation coefficient (r^2)	0.9998	0.9909
Slope ± SD	31233.70±8.79	28890.75± 68.00
Confidence limit of slope[b]	31208.7-31258.7	28660.75-29120.75
Intercept ± SD	9856.76 ± 202.39	34499.82± 751.21
Confidence limit of intercept[b]	9676.76-10036.76	33839.82-35159.82
Bartlett's test [c](χ^2)	0.0005	0.0030
Sensitivity		
LOD (µg/ml)	0.0214	0.0858
LOQ (µg/ml)	0.0648	0.2600
Precision[d] (%RSD)		
Intra-day Precision	0.000 - 0.042	0.034 - 0.468
Inter-day Precision	0.032 - 0.229	0.678 - 1.904
Accuracy[e]		
50%	100.48 ± 0.22	102.62 ± 0.24
100%	99.02 ± 0.21	102.13 ± 1.14
150%	99.68 ± 0.15	100.83 ± 0.41

SD = standard deviation, % RSD = relative standard deviation, RIF = Rifampicin, LFX = Levofloxacin

[a] Average of five determinations

[b] Confidence interval at 95% confidence level and 5 degree of freedom (t=2.57)

[c] Calculated value less than tabulated value, χ^2critical value 9.488 at $\alpha = 0.05$.

[d] Average of three determinations for each concentration[e] Average of three determinations at each level.

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vi. *Robustness testing using Box-Behnken experimental design:*As defined by the ICH, the robustness of an analytical procedure refers to its capability to remain unaffected by small and deliberate variations in method. In the present study, three independent factors, i.e. acetonitrile volume in mobile phase composition (X_1), pH of mobile phase (X_2) and flow rate (X_3) were selected based on the criticality of factors that was observed during trial runs, chromatographic intuition, and experience gained from previous optimization studies. The experiments were carried out based on the experimental domain, and the qualitative responses studied were the retention factor of LFX (Y_1), retention factor of RIF (Y_2)and asymmetric factor of LFX (Y_3).The observed responses were noted and are represented in Table II.Among the various models, the classical second-degree model with a quadratic experimental domain was suggested by the design with the highest least squares regression value for all responses as compared to other models. The model was examined using lack of fit test, which indicated insignificant lack of fit value corresponding with higher p-Value as compared to the model F-Value. Graphical interpretation in form of response surfaces and perturbation plots showed the correlation of the effect of the factors on the retention factor of each drug. Perturbation plots reveal the change in response from its nominal value with all other factors held constant at a reference point, and steepest slope or curvature indicates sensitiveness to specific factors. Perturbation plots indicated that none of the factors had significant effect on responses (Fig. 4). The model was evaluated for the effect of individual factors on the responses in the form of contour plots and three dimensional response surfaces for the response Y_1, Y_2 and Y_3 as shown in (Fig. 5). The contour plots indicated that the effect of all the responses are independent of the factors X_1 (ACN volume), X_2 (pH) and X_3 (flow rate). Furthermore, the model was validated by the application of analysis of variance (ANOVA) to all the response variables to examine the significance of model, which showed that all the responses achieved insignificant differences in their values. The quadratic equations for all model responses Y_1, Y_2 and Y_3 are as follows:

Y_1 (R_t of LFX) = $-25.415000 + 0.2940\ X_1 + 13.1250\ X_2 + 4.47500\ X_3 + 0.06500\ X_1X_2 - 0.04000\ X_1X_3 + 0.25000\ X_2X_3 - 5.10000E\text{-}003X_1^2 - 2.68750\ X_2^2 - 2.25000X_3^2$

Y_2 (R_t of RIF) = $-56.47708 + 2.151750\ X_1 - 8.00000X_2 + 69.50417X_3 + 0.10500X_1X_2 - 0.20500X_1X_3 + 1.00000\ X_2X_3 - 0.026117X_1^2 + 0.48958X_2^2 - 42.29167X_3^2$

Y_3 (Asymmetry factor of LFX) = $-57.38958 + 0.53175X_1 + 25.1625X_2 + 23.35417X_3 + 0.027500X_1X_2 - 0.020000X_1X_3 + 0.62500X_2X_3 - 6.66667E - 003X_1^2 - 4.47917X_2^2 - 15.16667X_3^2$

Here positive sign indicates synergistic effect, while a negative sign indicates antagonistic effect in polynomial equation. From the Table III of ANOVA for response Y_1, Y_2 and Y_3 showed that the predicted values for all factors are under the satisfactory value with predicted model F-value representing the model is highly significant. Model p value > 0.05 indicates that factors had non-significant effect on response resulting in a robust method.

Table II. Experimental Design for Robustness Testing Using Factors and Obtained Responses

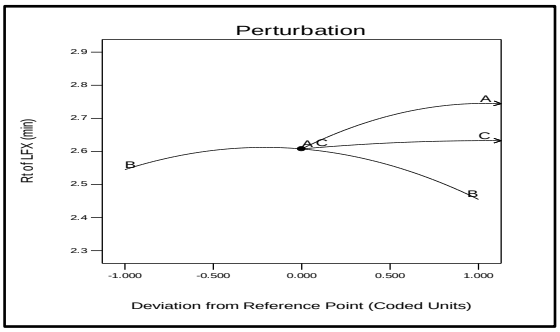
Number of runs	Volume of ACN (ml)	pH of mobile phase	Flow rate (ml/min)	R_t of LFX	R_t of RIF	Asymmetric factor of LFX
1	40.00	3.00	0.70	2.60	4.65	1.36
2	50.00	3.00	0.90	2.56	4.20	1.35
3	45.00	2.80	0.90	2.58	4.50	1.34
4	45.00	3.00	0.80	2.82	5.60	1.86
5	45.00	3.00	0.80	2.80	5.60	1.85
6	40.00	3.20	0.80	2.50	5.50	1.32
7	50.00	2.80	0.80	2.40	4.23	1.30
8	40.00	3.00	0.90	2.62	4.40	1.37
9	45.00	2.80	0.70	2.64	5.84	1.33
10	45.00	3.00	0.80	2.63	5.61	1.34
11	45.00	3.20	0.90	2.61	4.60	1.40
12	45.00	3.20	0.70	2.65	5.86	1.34
13	50.00	3.00	0.70	2.62	4.86	1.38

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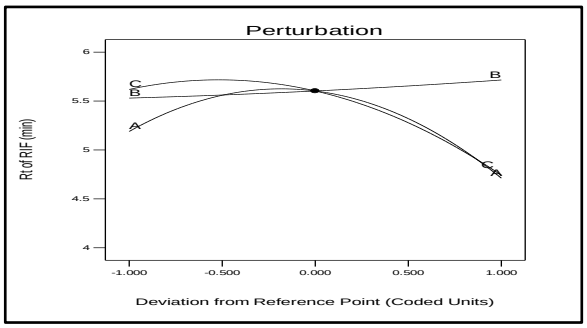
14	50.00	3.20	0.80	2.61	4.75	1.34
15	40.00	2.80	0.80	2.55	5.40	1.39

Table III. Statistical Parameters by ANOVA Analysis for the Responses

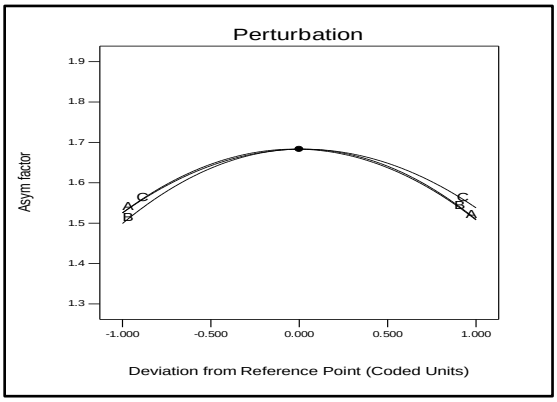
Parameters	SS	Df	MS	F-value	p-value	Model F-value	Model p-value	Prob>F
Response Y_1 (R_t of LFX)								
ACN volume (ml)	*8.000E-004*	1	*8.000E-004*	*0.17*	*0.7003*	2.83	0.1324	Not significant
pH	*5.000E-003*	1	*5.000E-003*	*1.04*	*0.3547*			
Flow rate (ml/min)	*2.450E-003*	1	*2.450E-003*	*0.51*	*0.5073*			
Response Y_2 (R_t of RIF)								
ACN volume (ml)	*0.46*	*1*	*0.46*	*2.67*	*0.1632*	2.78	0.1361	Not significant
pH	*0.068*	*1*	*0.068*	*0.40*	*0.5545*			
Flow rate (ml/min)	*1.54*	*1*	*1.54*	*9.02*	*0.0300*			
Response Y_3 (Asymmetric factor of LFX)								
ACN volume (ml)	*6.125E - 004*	*1*	*6.125E- 004*	*0.017*	*0.9012*	0.84	0.6164	Not significant
pH	*2.000E - 004*	*1*	*2.000E-004*	*5.564E – 003*	*0.9434*			
Flow rate (ml/min)	*3.125E - 004*	*1*	*3.125E- 004*	*8.693E-003*	*0.9293*			



(a)



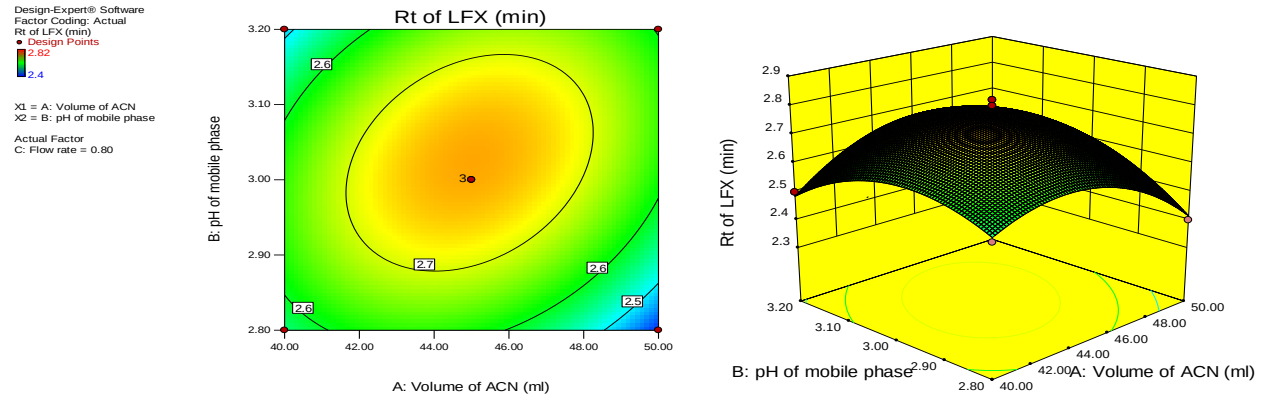
(b)



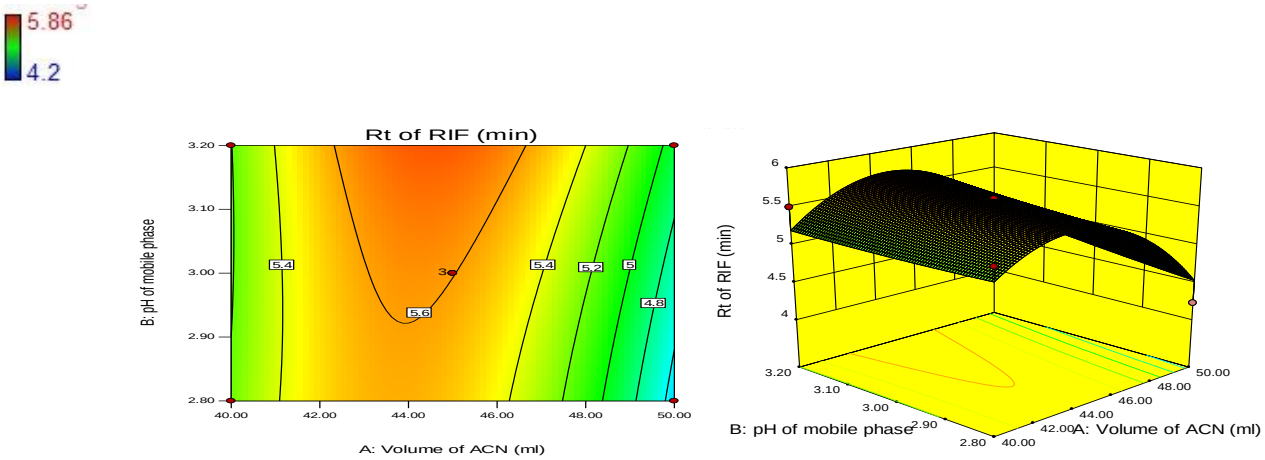
(c)

Fig. 4. Perturbation plot showing effect of factors on Responses

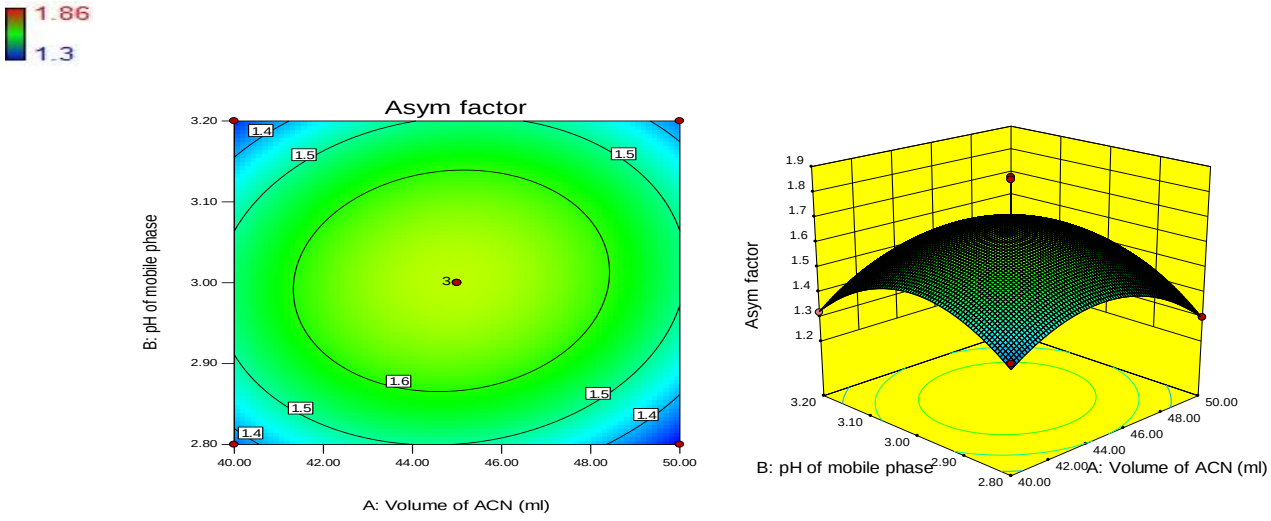
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(A)



(B)



(C)

Fig. 5.Contour plots and three dimensional response surfaces (A) Effect of factor X_1 (ACN volume) and X_2 (pH); fixed factor X_3 (flow rate0.8), on response Y_1 (R_t of LFX), (B) Effect of factor X_1 (ACN volume) and X_2 (pH); fixed factor or actual factor X_3 (flow rate 0.8), on response Y_2 (R_t of RIF) and (C) Effect of factor X_1 (ACN volume) and X_2 (pH); fixed factor or actual factor X_3 (flow rate 0.8), on response Y_2 (Asymmetry factor of LFX)

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IV. ANALYSIS OF SYNTHETIC MIXTURE

The concentration of RIF and LFX was analysed in synthetic mixture using proposed HPLC method in triplicate. The percent assay was found to be 99.84 ± 0.55 and 101.56 ± 0.101 % w/w and %RSD less than 2 reveals lack of interference from PLGA (75:25) and the proposed method can be successfully applied to analysis of formulation containing RIF and LFX.

V. CONCLUSION

A simple, sensitive, accurate, economical and precise HPLC analytical method has been developed for the simultaneous determination of RIF and LFX and validated as per ICH guidelines. A Box-Behken design use dissuitable for exploring quadratic response surfaces and constructing econdorder polynomial models by evaluating the selected factors simultaneously including interactions between factors. ACN volume in mobile phase, pH of the mobile phase and flow rate were simultaneously optimized by applying useful tools of response surface design and Derringer's desirability function. The results revealed that the all selected factors have not significant effect on retention time of RIF and LFX, as well as Asymmetric factor of LFX.The good % recovery in synthetic mixtures suggests that the excipients present have no interference in the determination. The validation study supported the selection of the best conditions by confirming that the method was specific, linear, and robust. The proposed HPLC method would be of use in routine quality control and combined dosage form analysis.

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Slope Stability of T-shape Analysis

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***Abstract*-A two-dimensional (2D) finite difference method was adopted to find the factor of safety (FOS) against failure of embankments over T-shape deep mixing column over soft soil. the factors affecting the factor of safety (FOS) against failure of embankments over T-shape deep mixing column over soft soil includes the spacing, size, and friction angle, cohesion of soft soil, height of embankment, and existence of ground water. Based on numerical models, various reductions for deep mixing columns can be proposed for the preparation of factor of safety (FOS). The reduction factor for factor of safety (FOS) of 0.90 is used to convert calculated factor of safety (FOS) by this study. Further, the existence of the water table will reduce the factor of safety then establish it without groundwater table which would reduce the shear strength of the foundation work. The chosen factor of safety (FOS) is highly dependent on the engineer's judgement and past experience.**

***Key Words*- Soft soil, Numerical analysis, Embankment, Soil bearing capacity, T-Shape column**

I. INTRODUCTION

Problems of slope instability of soft soil can be overcome by the geotechnical engineers. A number of ground improvement techniques have been successfully adopted to prevent deep- seated slope failure, such as sand compaction piles, stone columns, geo-textiles, and deep mixed columns.

The new factors of safety and their results and a suitable information according to software models. technique to overcome the instability of soft soil is T-shape deep mixing columns which are broadly described below as the project format. hence in this method we had given the detail information regarding the various

T-shape deep mixing column method is perhaps the newest numerical method used for solving sets of different software models. The slope instability of embankments may develop locally, near the facing, within the embankment, or through foundation soil may get fail, It is also called as global slope failure due to weak foundation existing under the embankment.

Many researchers have done studies on the applicability of TDMC for soft soil improvement. The studies focused on laboratory model test, numerical analyses, field tests, and analytical solution.

This paper presents the detail study on the behaviour of TDMC in the 2-D Plaxis software. The results and discussion of factor of safety and with water embankment first time performed in is discussed. The results of the tests indicated that the T-shape column can be reinforced partially to improve the load carrying capacity adequately.

II. INSTALLMENT METHOD

T Shape deep mixing column Deep cement/lime mixing column is a foundation technique where a binder material cement is injected into the ground for soft soil stabilization. T Shape deep mixing columns is constructed in the soft soil and on which embankments /building foundation laid as results this would prevent foundation of the embankment/ building foundation form the deformation and will give stability.

a) Material model and parameters

The embankment fill, the foundation soils, and the columns were modelled as linearly elastic-perfectly plastic materials with Mohr-coulomb failure criteria. The elastic properties have an insignificant effect on the factor of safety calculation and, therefore, these properties are required by 2-D Plaxis.

The equivalent parameters for the improved area were estimated based on the area average of these parameters of these parameters from T-shape deep mixing column and the soft soil as follow:

$$C_{eq} = C_c * a_s + C_s(1 - a_s)$$

Where a_s is the area replacement ratio by T shape deep mixing column over the overall soft soil area; $C_{eq,}$ C_c and C_s are the equivalent cohesion and the cohesion of the column and the soft soil. Under an embankment, however, the stress concentration ratio of 1 is reasonable and safe.

As soft soil is mostly normal or under-consolidated, it is more critical or and embankment over the soft soil under an undrained condition than under a drained condition. Therefore, undrained cohesion was assumed for the soft soil in the study.

The installation of T-shaped deep mixing column may change the properties of the soft soil; however, numerical study have shown that such properties changes are minimum, as specially 2D-PLAXIS is used to install T-shape deep mixing columns. Therefore, the changes of the properties of soft soil is include the in this study.

b) Model size

The sizes of the model and mesh were determined on the basis of several trials, during which the mesh was progressively refined to 0.25 m and its horizontal boundary was extended such that zones did not influence the development of the failure surface. The size of the mesh is presented in fig. for the individual column and equivalent area. Results from these trials showed that the side boundary on the right should be extended to 14 to 24 m beyond the toe the embankment.

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c) Boundary conditions

It was assumed that the sand was underlain by 2m and a rigid hard soil and the contribution of the firm layer was considered to be negligible for the instability of the embankment. Thus, the bottom boundary was set at this depth. Nodes on the two vertical boundaries were fixed against horizontal movement but allowed to move freely in the vertical direction.

d) Computation of factor of safety

In the numerical study, 2D-PLAXIS software adopted to solved for the factor of safety(FOS) value of slope stability

For each trial analysis by 2D-PLAXIS, the same factor of safety value is applied to the strength parameters of soil and column in the individual T-shape columns method and numerical method. By adjusting height of the embankment boundary condition factor of safety analysed and also by adjusting cohesion and friction angle of embankment for the numerical analysis method.

III. ANALYSIS OF RESULTS

The number of factors influencing the factor of safety against failure of embankment over T-shape deep mixing columns to improving soft soil, including the spacing, size, and friction angle of embankment T-shape deep mixing columns, the cohesion of soft soil, and the height of embankment fill. The influence of each factor on the factor of safety is presented below. The results from numerical method are calculated.

a) FRICTION ANGLE OF EMBANKMENT

The T-Shape deep mixing column was modelled as a cohesion less material, which has only friction angle. The influence of the friction angle of the embankment fill material on factor of safety of the embankment over TDMC improved soft soil shown in fig. the result show that better quality embankment material yielded a higher factor of safety for the embankment system. Furthermore, consideration of the ground water table with respect to embankment the friction angle of embankment is increase with increase in factor of safety of TDMC.

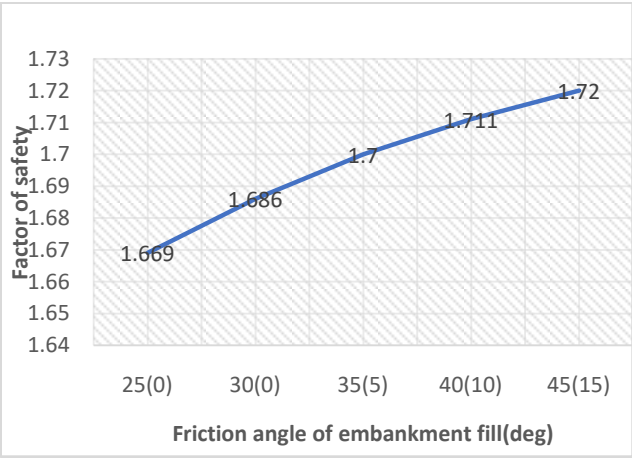


Fig.1 friction angle of embankment fill(deg)

b) SIZE OF TDMC

In which the TDMC column has two parts:

Flange of TDMC

Web of TDMC

Flange of TDMC:

The width of the Flange TDMC is about 1.08,1.2,1.32,1.44 and more. The width is twice of the width of the web of TDMC (D_2 = 2D). the influence of the width of flange of TDMC on the factor of safety is shown in fig. it is shown that an increase of the width of the Flange of TDMC increased the factor of safety values of embankment system. The results from the equivalent area model had the similar trend as those from the T- shape individual column model. When the width of the flange is increase the factor of safety is increasing. and that is shown in fig.

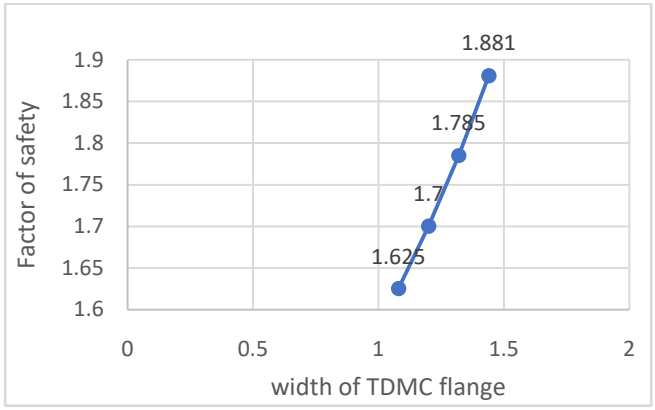


Fig. 2 width of TDMC flange

The Depth of flange range is 1 to 5 and more. Various depth of flange is adopted. As above the sizes of the flange of the TDMC graph are shown. As well as the depth of the flange of TDMC are shown in fig.it is show that an increase the depth of flange of TDMC to increasing the factor of safety and that can the stability of a soft soil increase.

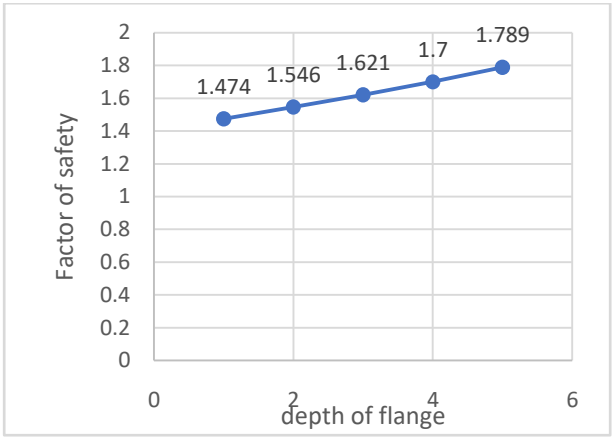


Fig.3 depth of flange

c) Spacing of TDMC

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The various spacing of TDMC between two columns about 1.8m, 2m, 2.2m, 2.4m. that's various space using the making of the TDMC column analysis. And factor of safety v/s spacing graph is shown in fig. that is show that an increase the centre-to-centre spacing of column of TDMC is the reduced the value of factor of safety. The result from the equivalent model had the similar trend as those from the individual T-shape column.

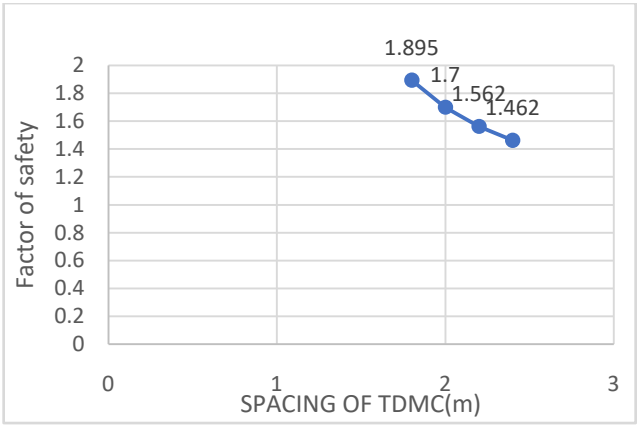


Fig.4 spacing of tdmc

d) cohesion of soft soil:

The influence of the drained cohesion of the of the soft soil on the factor of safety shown in figure. An increase of the drained cohesion of the soft soil increased the factor of safety values of the embankment over TDMC the equivalent area model yielded higher factor of safety than the individual T - shape column. the difference became the larger when the drained cohesion of the soil increased it is shown that the benefit of the drained cohesion of the soft clay became less significant when the cohesion was higher than 30 Kpa. because the slip surfaced developed was shallow were in the improved foundation contribution of the foundation becomes less important.

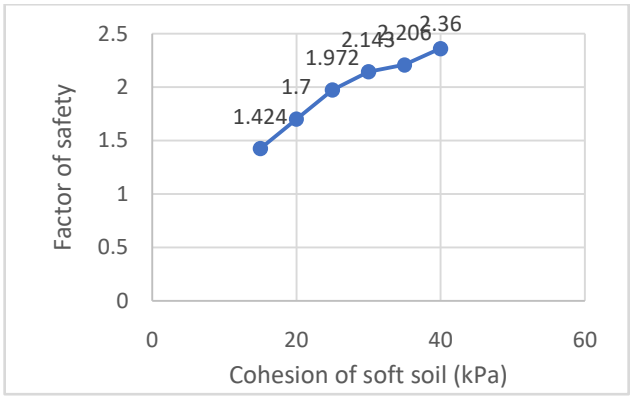


Fig. 5 cohesion of soft soil

e) HEIGHT OF EMBANKMENT FILL

The influence of the height of the embankment on the factor of safety is shown in fig. It is correct that the factor of safety decreased with an increase of the height of the embankment. The factor of safety computed by the equivalent model were higher than those by the individual T-shape column. The equivalent model and individual T-shaped column difference became larger when the height of embankment increased.

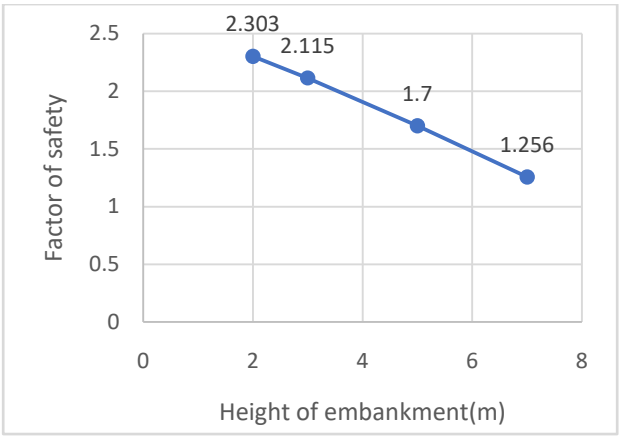


Fig. 6 height of embankment

f) Cohesion of TDMC equivalent:

The influence of the cohesion of the TDMC on the factor of safety is shown in figure. it is show that the factor of safety increased with an increase of the cohesion of the TDMC equivalent. The various cohesion of the TDMC equivalent range 65Kpa to 160Kpa. Generally, the factor of safety is computed by equivalent area model were higher than the individual T-shape column. And their difference became larger when the cohesion of the TDMC equivalent increased.

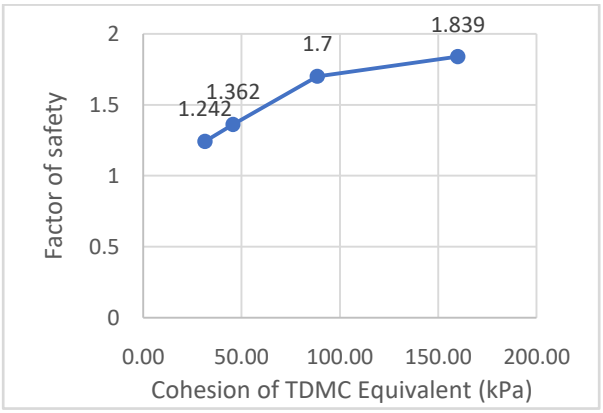


Fig. 7 cohesion of tdmc equivalent

IV. CONCLUSIONS

In study of the TDMC, Tow-dimensional finite difference analyses were conducted to find the factor of safety (FOS) against deep-seated failure of embankments/any structures over T-shape deep mixing column based on the individual T shape column model and the equivalent area model. Based on the numerical analyses, the following conclusion can be drawn.

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1. The strength, spacing, and size of TDMC, the cohesion and depth of soft soil, and the friction angle and the height of the embankment fill all the factor of safety values against deep seated failure of the embankment.
2. A Reduction factor (ß) is take 0.9 to the factor of safety value of calculated based on Equivalent area method
3. A factor of safety calculated using the equivalent area model were higher those calculated using the individual T-shape column model.

All above given conclusion are only applicable 2D stability analysis of embankments over TDMC-improved soft soil due to deep seated failure, in with TDMC consider as walls in the individual T-shape column method.

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Bearing Capacity of a Footing Soil Reinforcement with Rubber Tyre Waste

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***Abstract*- Discarded tyres are becoming globally problematic because recycling them may cause environment related problems. Thus, making use of them needs to be considered, and solutions must be sustainable. In addition, the solution should cover social, environmental, and economic sustainability. Nowadays, the waste tyres are increasingly being considered as construction material. This is because their basic properties are desirable for engineers. In this study, an experimental testing program was undertaken using a large-scale triaxial apparatus with the goal of evaluating the optimum dosage and aspect ratio of tire shreds within granular fills. The effects on shear strength of varying confining pressure and sand matrix relative density were also evaluated. The tire shred content and tire shred aspect ratio were found to influence the stress–strain and volumetric strain behaviour of the mixture.**

***Keywords*- sandy soil, waste rubber, shear test**

I. INTRODUCTION

Solid waste management is one of the major environmental concerns worldwide. For the last 30 years many studies have been conducted in order to assess the feasibility of using industrial by-products and waste materials in civil engineering applications. It is estimated that thousands of millions tyre waste are generated annually and it is either deposited in ground in uncontrolled manner or been burnt in atmosphere which causes air soil pollution. The recycling and re-use of scrap tires has been of growing interest in civil engineering applications during the last two decades. Granulated rubber or tire chips composed of recycled scrap tires exhibit low unit weight of solids, along with low bulk density, high drainage capacity, and high elastic deformability. In this study, an experimental testing program was undertaken using a large-scale triaxial apparatus with the goal of evaluating the optimum dosage and aspect ratio of tire shreds within granular fills. The effects on shear strength of varying confining pressure and sand matrix relative density were also evaluated. The tire shred content and tire shred aspect ratio were found to influence the stress–strain and volumetric strain behaviour of the mixture.

Many researchers have done studies on the application of sand and rubber mixture. (Sompote Youwai and Dennes T. Bergado (2013) [3]; E.A.Subaida, S. Chandrakaran and N. Sankar (2009) [12]; E. Kalkan (2013) [7]; M.S.Chauhan, S.Mittal, and B. Mohanty (2008)) [16].though different studies and test were performed but these paper include soil rubber tyre mixture but not illustrated the use cemented rubber mixture in order to enhance the load bearing capacity of soil. Shear strength properties of tyre buffing / fibre cement sand is required to study not-being found in the literature. In recent years, the application of different fibers to improve strength and other properties of various soils has been investigated. The results of these studies have generally indicated an increase in CBR values [4-8], tensile strength [9-11] and unconfined compressive strength [12-14] of different types of soils when reinforced by various fibers.

Naval et al. [17] studied the impact of using tire fibers in sandy soils. In their study, different percentages of fibers, i.e. 0%, 0.5%, 0.75%, and 1% with various lengths of 25mm, 35mm, and 45mm were examined. The results of their research indicated that adding fibers would increase the strength and the internal friction angle of the soil and it would also decrease its deformation. These changes were more significant at 0.75% fiber content.

Das and Singh [18] investigated the behaviour of cohesive soils mixed with fly ashes and tire fibers. Tire fibers were used in the percentages of 0%, 5%, and 10% of the soil weight and lengths longer than 25mm. The fly ashes were used in the percentages of 0%, 20%, 35% and 50% of the soil weight. The results of their study indicated that adding fibers would increase the adhesion and would decrease the internal friction angle of clayey silt-fly ash-rubber fiber mixes.

Kalkan [17] investigated the application of tire fibers- silica fume mixtures for modification of clayey soils. The fibers were applied in lengths of 5mm to 10mm and in percentages of 1%, 2%, 3%, and 4% of the mixture weight. The results of his research indicated that when only fibers were added to the clayey soil, the maximum dry density and optimum moisture content were reduced. It was also found that at 2% fiber content, the unconfined compressive strength of the examined soil increased from 92.8KPa to 177.1KPa, the adhesion increased from 76kPa to 214kPa and the internal friction angle increased from 16 to 32 degrees.

Panu Promputthangkoon [20] The soil was a laterite having low strength classified as SC according to Unified Soil Classification system. It had a specific gravity of 2.64. The mean particle size of the soil was 1.6 mm; the coefficient of uniformity Cu = 5.4, and the coefficient of curvature Cg = 0.5.

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Panu Promputthangkoon [20] a low strength soil was chosen as a base geometrical to be mixed with recycled tyre chips and stabilised by cement for the purpose of using them as construction material. The soil to tyre chips ratios by weight were 100:0, 98:2, 93:7, 85:15, and 75:25. Each mixture was mixed with the cement ranging from 0, 1, 5, 10, and 15%. The specific gravity values for the soil and tyre chips are 2.64 and 1.11, respectively. The CBR values for both soaked and unsoaked are gradually increased with the increase of cement content.

Panu Promputthangkoon [20] the CBR required for a road base is 80. It was observed that the CBR for pure soil (100S) is just 19; but, it was substantially increased to over 600 when 15 % of cement added. However, for the unsoaked specimen it required only 2.9 % of cement to attain the CBR of 80. Hence, it was interesting to compare this analogy to all of the other mixtures

ekrem kalkan [19] has use the clayey soil silica flume , scrap tire rubber fibre , and complete has experiment . the tyre is shaved off into 150mm length and smaller strips using a sharp ratating disc . they had length ranging from 5 to 10mm , thickness ranging from 0.25 to 0.50mm and width ranging from 0.25 to 1.25mm. the grain size distribution was determined by using fiber width . this mixturebis increase the UCS and its value is obtain by addition of 20 % silica and 2 % fiber mixture

sompote youwai and dennes T. bergado [21] has use shredded rubber tyera , they perfome the triaxial testing and consitutive model test . the result is increasing the proportion of sand in mix , the strength and unit weight increase and deformation due to isotropic compression decreased the deformation was significantly reduced when the sand in the mixture was more than 30 % the proposed hypolasticity model can model the strength and deformation characteristics of shrded rubber tire - sand mixture.

II. DESIGN METHODOLOGY

For the preparation of sub base of foundation cemented rubber soil mixture is prepared. The waste rubber buffings were used in mixture. Sandy soil is used which passes through sieve size of 3.5 mm.

The grade of cement used for mixture was M53 grade. The sub base of foundation was prepared for different composition of rubber and cement and for different width of sub base.

The strength for each width and composition of mixture were found and result were obtained.

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A Critical Study on the Role of Unified Power Flow Control in Voltage Power Transfer

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***Abstract*- The unified power flow controller (UNIFIED POWER FLOW CONTROL) is being used as a compensating and power control device in the power systems due to its easy build, high robustness and efficiency. Simulation results reveal that as far as voltage sag and swell are concerned both the two-level and five level inverter based UNIFIED POWER FLOW CONTROL exhibit the similar performance.As the five level inverter based UNIFIED POWER FLOW CONTROL generates nearly sinusoidal load voltage, its THD is observed to be 3.15%. It is 15.65% in the case of its two level counterparts. It may be noted that for power of good quality the THD must be less than or equal to 5% as per standards. Hence, with respect to power quality, the five level UNIFIED POWER FLOW CONTROL scheme has an edge over two level UNIFIED POWER FLOW CONTROL scheme.**

I. INTRODUCTION

Fewer natural resources and ever increasing demand has set the stage for unprecedented changes and new regulations. In this restructured and deregulated power system environment, added problem is restriction building new transmission lines and generating plants. Therefore the thrust has shifted to maximize available transmission facilities. Unregulated active and reactive power flows may result in loss of power system stability, high transmission losses, voltage collapse etc. Power flow generally in the low impedance path, there by overloading that line and restricting UPFC with minimum losses and low storage capacity at unity or higher voltage transfer ratio. This research work proposes a unique converter structure using Z Source Impedance coupled to Bridge Configured Matrix Converter based unified power flow controller not dealt with so far

The UPFC is capable of integrating all conventional transmission control concepts i.e. series compensation, phase shifting, and voltage regulation into a generalized power flow controller. As a dynamic real and reactive power flow controller with operations under power system oscillations and transmission line faults it is competent of enhance the transfer capability of the transmission line beyond imagination.

Extensive researches continue to contribute on different structures and converter configurations of UPFC. The conventional VSC based unified power flow controller, has the internal loss of extensive direct current network capacitor striking further destruction and the model proponent placed unified power flow controller has the disadvantage of less current(volt.) variation proportion. The controllable parameters of unified power flow controller and the system state variables are certainly adjusted to obtain a UPFC. Voltage collapse normally occurs in heavily loaded and faulted lines.

Detailed investigations on steady state voltage stability analysis like PV curve, Stability Indices, VQ curve and Modal analysis are made on different IEEE test bus systems to identify critical nodes and voltage control areas before the placement of UPFC. A comparison of results obtained with and without PIM- UPFC in voltage stability analysis is discussed. Thus optimal reactive power compensation becomes a necessity with minimum transmission losses, best location for the reactive compensation device in addition to its rating, enhanced voltage at all nodes level and improved voltage stability margin. Therefore this problem can be designated as highly nonlinear, multimodal, and discontinuous i.e. a combinatorial optimization problem. Evolutionary based Genetic Algorithm is adopted to provide an optimal power flow solution.

II. LITERATURE REVIEW

In all electric power transmission system, whether overhead lines or underground cables, there will be a drop of voltage along the system when current flows in it. This drop will vary with the current and power factor.

The variations in voltage are permissible, but with favorable zones, for example the rise or drop in voltage should not exceed a prescribed tolerance of ± 10% of the nominal voltage.

Yanfang Wei et al., (2011)[15]uses the MATLAB Voltage StabilityToolbox to study power flow, singularity based analysis, eigenvalue analysis, static and dynamic bifurcation analysis and time domain simulation.

(Sharad*et. al.* 2010)[5](Yan Zhang and Jovica V. Milanovic 2010) presents an approach to optimally select and allocate flexible ac transmission (FACTS) devices in a distribution network in order to minimize the number of voltage sags at network buses. Three types of FACTS devices are implemented in this study, namely, static var compensator, static compensator, and dynamic voltage restorer.

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Naidu and Fernandes (2009[14])decribed the closed loop control of a four leg VSC based DVR. The three phase input variables are resolved into positive, negative and zero sequence components using a weighted, recursive, least square estimator. A laboratory model of the restorer has been constructed and its performance has been tested by simulation using MATLAB and experiments.

Sasitharan and Mahesh K. Mishra (2009)[4] proposed a filter structure for improving the performance of switching band controller based DVR. The control method of the VSI inherits merits, Such as fast dynamic response, robustness, zero magnitude/phase errors and ease of implementation. The proposed filter structure and the adaptive band controller for the DVR are presented by carrying out PSCAD simulation studies.

The design strategy for optimizing the total rating of an IDVR is presented **(Karshenas and Moradlou 2008)[13].** An IDVR, which is two DVRs installed in two feeders with a common DC bus, has the ability of active power exchange between two DVRs, and thus the energy storage device is not an issue. Therefore, the design criteria for the selection of the rating of an individual DVR is not applicable to the IDVR obtained.

Bingsen Wang *et. al.* (2006)[1] described the detailed design of a closer loop regulator to maintain the load voltage within acceptable levels in a DVR using a transformer coupled H bridge converters. A laboratory scale experimental prototype was developed tha verifies the power circuit operation and controller performance. The experimental results indicate an excellence with the digital simulations.

MahindaVilathgamuwa*et. al.* (2006)[2] proposed a new topology based on the Z source inverter for the DVR, in order to enhance the voltage restoration property of the device. It was observed that the DVR compensates the disturbance caused by a sag effectively, while utilizing the stored energy fully by the use of the buck – boost capability of the proposed Z source inverter.

Poh Chiang Loh*et. al.* (2004)[6] described a detailed analysis on Z source inverter modulation, showing how various conventional PWM strategies for controlling a conventional VSI can be modified to switch a voltage type Z source inverter either continuously or discontinuously. The theoretical and modulation concepts presented have been verified both in simulation and experimentally.

III. UNIFIED POWER FLOW CONTROL SYSTEM

The control algorithm are classified as open and closed loop system.

The control algorithm of **open loop system** is based on the active power filter reference current calculation method. In the UNIFIED POWER FLOW CONTROL system without shunt compensation, the line current consists of active and reactive components (neglecting the dc and harmonic components) as in Equation (3.1).

$$\overrightarrow{\iota(t)} = \overrightarrow{\iota_p(t)} + \overrightarrow{\iota_q(t)} = I_p \sin(\omega t) + I_p \cos(\omega t)$$

Where,

$i_p(t)$- in phase line active current of the transmission line

$i_q(t)$- reactive current of the transmission line

To regulate the voltage at bus connected to the shunt converter of the UNIFIED POWER FLOW CONTROL, the only component that this bus should supply is the active current component. Using Equation (3.1), it can be noted that if the shunt converter of the UNIFIED POWER FLOW CONTROL supplies the reactive component, then the sending bus needs only to supply the active component. This can easily accomplished by subtracting the active current component from the measured line current.

$$\iota_q(t) = \iota(t) - I_p \sin(\omega t)$$

In Equation (3.2), I_p is the magnitude of the in-phase current (to be estimated) and sin(ωt) is a sinusoid in phase with the line voltage. The circuit shown in Figure 3.1 can accomplish this operation.

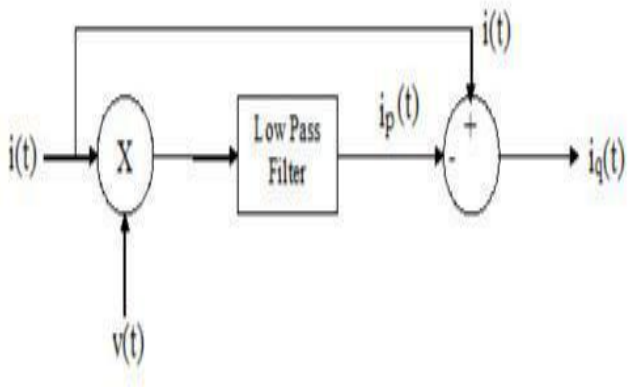


Figure 3.1Open-loop system for calculating the UNIFIED POWER FLOW CONTROL shunt injected current)

$$i(t).\sin(\omega t) = \frac{p}{2}[1 - \cos(2\omega t)] + \frac{q}{2}\sin(2\omega t)$$

After the multiplication, the only dc term in Eqn. (3.3) is proportional to I_p. Thus, a low-pass filter whose cut off frequency is below ω permits to obtain I_p which is an estimation of the magnitude of $i_p(t)$. Then, this dc value is multiplied by the same in-phase sinusoid, obtaining an estimation of the instantaneous active current $i_p(t)$. Finally, this value of $i_p(t)$ is subtracted from the measured line current obtaining the reactive current $i_q(t)$ injected to the power system.

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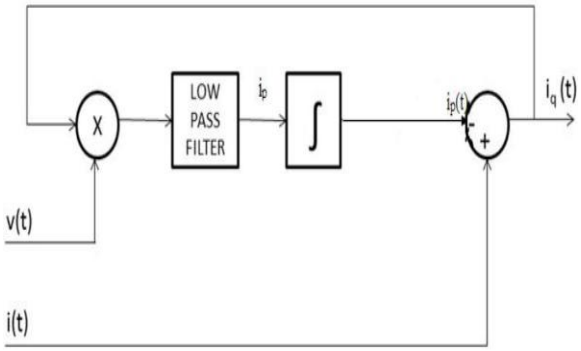
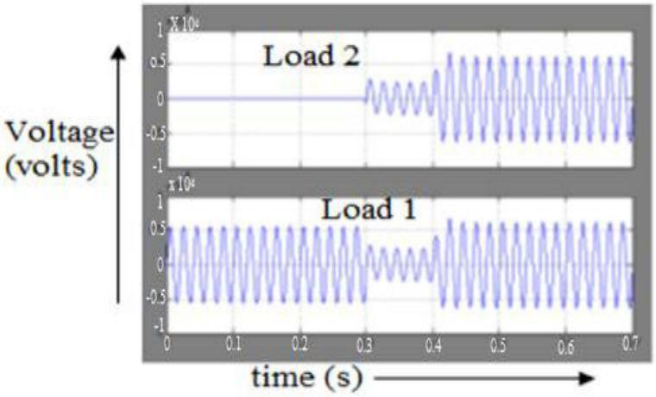


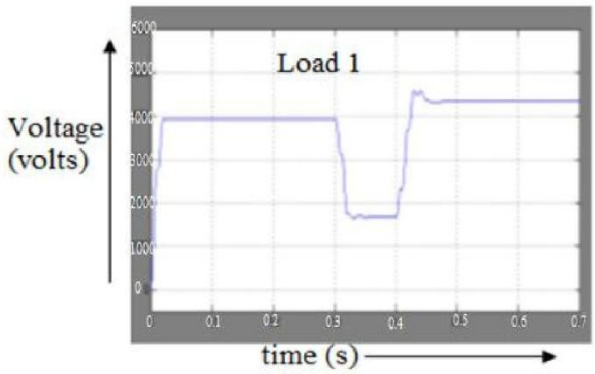
Figure 3.2 Closed-loop modified systems for UNIFIED POWER FLOW CONTROL shunt injected current

The Figure 3.2 shows the closed loop control algorithm for the UNIFIED POWER FLOW CONTROL system. The reactive component of the current $i_q(t)$ is multiplied with instantaneous voltage v(t) and the resultant is passed through the low pass filter to get i_p. The output of low pass filter is integrated with an integral constant, so as to get $i_p(t)$. The difference of the real component $i_p(t)$ and instantaneous current i(t) gives the resultant reactive component $i_q(t)$ required for the UNIFIED POWER FLOW CONTROL system, to inject the shunt current.

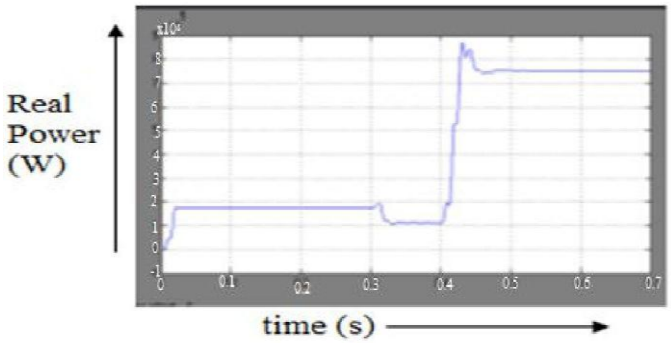
IV. RESULTS



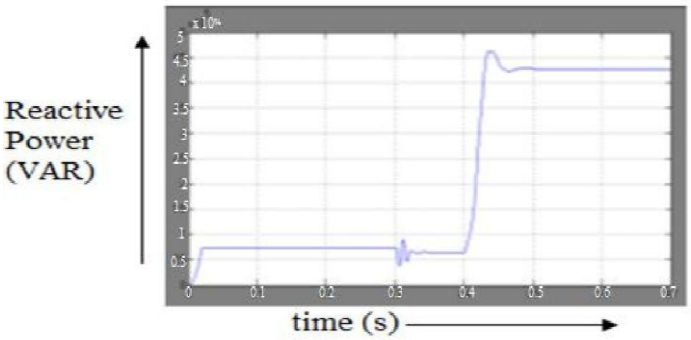
(a) Voltage across Load -2 and Load 1



(b) RMS voltage of Load -1



(c) Real Power



(d) Reactive Power

Figure 3.9 Simulated Results of Compensated System

V. CONCLUSION AND FUTURE SCOPE

Performance comparison has been made between uncompensated and compensated two bus system on the aspects of voltage sag, swell, load voltage, real power, reactive power and THD. It may be noted that the compensated system refers to the power system controlled by UNIFIED POWER FLOW CONTROL. The UNIFIED POWER FLOW CONTROL built with open-loop two level rectifier inverter has been used in this case.From simulated results, the sag is found to be 40% of the system voltage the additional load of (25+j50) ohm theconnected with the uncompensated system. In the case of compensated system, the sag is only 18.5% and its duration is just 0.1sec. Compensated system exhibits improved real power flow and reduction in reactive power supplied by the source unlike uncompensated system.in firing angle of the UNIFIED POWER FLOW CONTROL decreases the load voltage. Performance analysis of UNIFIED POWER FLOW CONTROL based power systems can be made using modern controllers viz., fuzzy tuned controllers, Adaptive Neuro fuzzy controllers and controllers driven by soft computing

The voltage swell is observed as 1.25 times the supply Voltage in the uncompensated system whereas it is just 10% higher than the supply voltage with the compensated system and it lasts only for 0.1sec.

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Energy Audit: A Case Study

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Abstract: **Today, the uses of energy are increased very sharply. Electricity audit is an survey and study to reduce the electrical ower consumption of the various electrical and electronic appliances. An energy audit help to determine the energy-wastes area in the institution and can be easily short out that problem, even more it's provide more benefits point of saving of energy. By energy audit survey or study of data gives a result about how much money and energy we can save each year by apply the recommendations. In this paper, study about electricity consumption in our college campus. This paper just goes to achieve more efficiency in college campus. Determine how and where energy is used and to identify methods for energy savings. Energy can be saved by use of more efficient machinery, high quality of equipment's and by better technique.**

Keywords: **Energy audit, energy consumption, energy appliances, savings techniques.**

I. INTRODUCTION

In this world, we are use AC supply as our input, generation of electricity possible by renewable sources or non-renewable sources. Renewable energy sources are scare in the world. By Non-renewable sources generation of electricity is very costly so, we need to studies about energy conservation, how to save energy. In order to reduce consumption of energy for a building or plant and makes it's more efficient, it's only possible by continuous process of energy audit. Energy audit minimize cost of energy and provide a proper planning, controlling of electricity supply [1]. As per the energy Conservation Act. 2001 "Energy Audit" is define as the verification, monitoring and analysis of use of energy including submission of technical report containing, recommendation for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption [2]. We have more of techniques for saving energy [3]. Systematic approach, to analysis building energy consumption and to pin point source of wastage, is known as energy audit. A process for auditing is shown in fig 1.

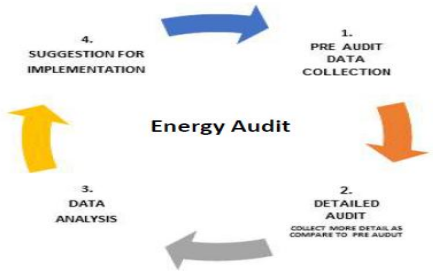


Fig:1 Process of Energy Audit

II. PRELIMINARY ENERGY AUDIT

The preliminary energy audit also called a simple audit or walk through energy audit, is the very simplest and fastest type of audit. This type of audit takes limited time and its focus on energy supply and demands. It consists with collection of energy data, Meetings with facility department, collection of electricity bills and other operating data and identify energy wastage area or inefficiency. This type of audit can't be covered major problem. This level of data detail, not sufficient for searching a final decision, for implementation need brief detail of data [5,6].

The preliminary energy audit as step to step explained below: -

A. Find out energy consumption in the organization.
B. Estimate scope for saving.
C. Identify no cost/ low cost improvements and savings.
D. Set a reference point.
E. Identify areas for more study or detailed measurement [6].

III. GENERAL ENERGY AUDIT

This type of audit is also called mini audit, site energy audit or complete site energy audit. General energy audit is next step of preliminary audit, it expanded form of pre audit by collecting more detailed information about equipment operation, electricity bill 12 to 36 months' period for best decision. This type of audit will be able to thinking all the point of energy conservation by measure operating parameters and identify that area where energy is not required. Sufficient detail is provided to justify project implementation [5].

IV. DETAILED ENERGY AUDIT

This audit is also called investment grader audit or comprehensive audit. It expands on the general energy audit. This audit will be completed in a period of three to five weeks. Detailed energy audit estimation of energy input for different processes, collection of past data and accurate study on energy consumption. It should be saved 8 to 10 percent of energy. Thus, the scope of this audit is to reduce total energy costs, consumption of energy. Detail energy audit gives the most accurate estimate of energy savings and cost. In this audit, one of most important factor is the energy balance.

Detailed energy auditing can be classified in three phases as

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[5,6]:-

Phase I – Pre-Audit

Phase II – Audit Phase

Phase III – Post-Audit

V. ENERGY CONSERVATION

Energy conservation is the act of use of energy in more efficient and effective way [7]. According to law of conservation of energy, energy can neither be created nor be created nor destroyed. Less use of energy can be define as energy conservation. It is a result of change in behaviour. For example: Turn off light when not required, make use of daylight in the morning hours etc. [8].

Need of Energy Conservation [3,9]: -

- To reduce energy/fuel shortage.
- To reduce peak demand shortage.
- To save fuel, natural resources and money.
- To reduce environmental pollution.
- Only 1 % of natural resources available in India, while population is 16% of the world.
- Provides Energy security.

VI. METHODOLOGY FOR COLLEGE CAMPUS

A. Collection of Data of all COLLEGE CAMPUS, KABLANA Building: In this step we collect the room wise details of electrical connected load, pervious two year's electricity bill and other power consumption information.
B. Calculation of Total Load: In this step we calculate the total load of all GANGA CAMPUS, KABLANA the building from the collected data of all kind of devices and equipment.
C. Generator Data Collection: In this step we collect the information about generator like monthly diesel consumption, monthly running time of generator and monthly amount paid for diesel.
D. Identification of Week Points of Installation: In this step we identify the week point in the wiring and lighting system of each floor of the building.
E. Total Unit Consumed per Day/ per Month/ per Year: In this step of methodology we calculate the total unit of electricity consumed in a day, month and year.
F. Total Amount Paid to Grid: In this step we calculate the total amount paid to the grid on day, monthly and yearly basis according to the unit consumption.
G. Analysis of DG Data: In this step we analyse the whole data of generator and calculate the total amount paid for diesel and total amount of diesel consumed.
H. CO2 Emission due to Burning of Diesel: In this step we have estimated the total emission of CO2 gas due to DG set working.
I. Total Cost Losses in Electricity: In this step of methodology we calculate the total amount of losses in the electricity.
J. Suggestions for Reducing Power Consumption Cost andCO2 Emission: Solar power plant is proposed to reduce the consumption of diesel in DG set and to reduce the emission of CO2.
K. Calculation of Payback Period: In this step we calculate the payback period on the basis of cost and saving.
L. Implementation of Plant: After complete audit process plant are proposed to implement.

VII. ENERGY CONSUMPTION OF COLLEGE CAMPUS

Surveying the Energy Consumption: Energy audit has conducted in this college to estimate consumption of energy per year. For energy audit, it is necessary to analysis previous bill amount and all data records. The annual consumption of electricity in year 2015 is 2,10,963 and in year 2016 is 2,67,038. A pump operating system annual amount paid to grid is 92,846 in year 2015 and total monthly consumption of energy represent by plotted a graph. This graph offers possibilities of energy conservation. This collection of data of electricity and diesel generator was taken from the institute record. Total connected load of all college campus is 226090watt and 226.090 kw [10].

Year	Annual unit consumption of electricity	Annual Amount (Rs.)	Annual operating pump amount(Rs.)	DG Consumption in litre	Annual amount of DG(Rs.)	Yearly co2 emission	(Electricity+DG+Pump) Grand Total
2015	2,10,963	22,79,814	92,846	23,315	12,82,325	61,318.45kg	36,54,985
2016	2,67,038	29,20,572	82,763	14,090	7,75,009	37,056.7kg	37,78,338

Table:1: Annual energy consumption of college campus.

Table 1 Shows the total energy consumption during the year 2015 and 2016. The consumption of electricity is increasing each year.

The graphs for electricity bill and energy consumption by the institution during two years are plotted.

Analysis of collected electricity bills: -

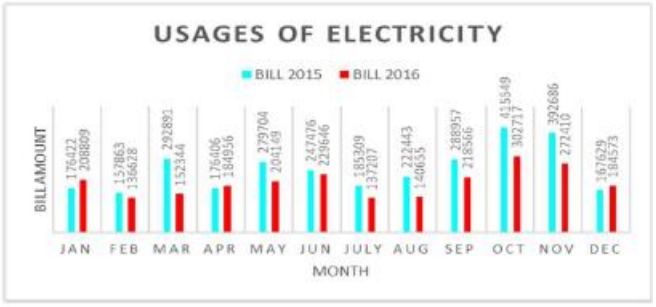


Fig 2 Shows the pattern of the energy consumption.

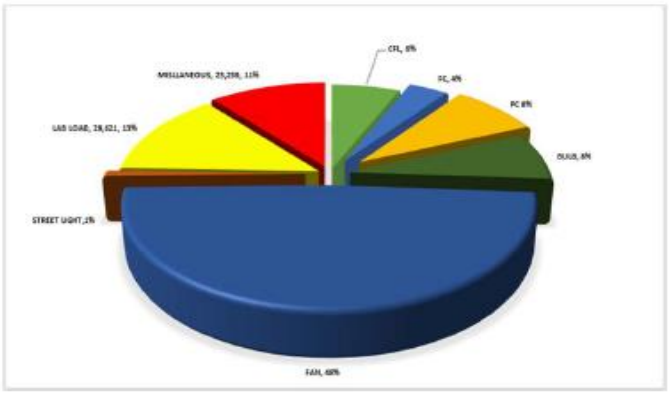
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The amount of electricity increases per year as show in fig2.In year 2015 the amount paid to grid for electricity is 22,79,814 and for pump operating system amount paid in 2015 is 92,846. Total amount spent on electricity in 2015 is 23,72,660. There is a sudden increase in the energy consumption during the months of October, November of both years.

Connected Load of College Campus: -

LOAD	QUANITY	PER WATT	ENERGY CONSUMPTION (IN WATT)
CFL	618	22	13,596
FC	198	40	7,920
PC	255	70	17850
BULB	159	100	15,900
FAN	1585	65	1,03,025
STREET LIGHT	25	75	1,875
LAB LOAD			28,621
MISCELLANEOUS			23,239
		TOTAL	2,12,026

Pie Chart of Connected Load: -



VIII. ENERGY SAVING CALCULATION

A. Replace CFL with LED: - In college campus, there are 618 CFL. On the average a CFL Consume 22 watt while a LED Consume only 12 watt. This saving of 10 watt per CFL is very large.

Cost analysis:

Total No. of CFL in College Campus =618 Power saved per CFL =10 watt

Total Power saving =618*10 w =6180 w =6.180 kw Average Use of CFL per year =5*295 =1475 h

Total Energy saved per year =1475*6.180 =9115.5 kwh Saving in Rs. Per year =9115.5*7.75 =70645.12 Rs

B. Replace FC with LED Tube: -

Total No. of FC in College Campus =198 Power saved per FC =20 w

Total Power saving =198*20 w =3960W =3.960 kw Average Use of FC per year =7*295 =2065 h Total Energy saved per year =2065*3.960 =8177.400 kwh Saving in Rs. Per year =8177.4*7.75 =63374.85 Rs

C. Replace PC with Green PC 7th Generation: -

Total No. of PC in College Campus =255 Power saved per PC =45 w

Total Power saving =255*45 w =11,475 w =11.475 kw Average Use of PC per year =9*295 =2655 h Total Energy saved per year =2655*11.475 =30466.125 kwh Saving in Rs. Per year =119475*7.75 =236112.47 Rs

D. Replace Bulb with LED: - Total No. of BULB in College Campus =159 Power saved per Bulb =88 w

Total Power saving =159*88 w =13992 w =13.992 kw Average Use of BULB per year =3*295 =885 h Total Energy saved per year =885*13.992=12382.92 kwh Saving in Rs. Per year = 12382.92*7.75=95967.63 Rs

E. Replace Fan with low power consuming Fan: -

Total No. of Fan in College Campus =1585 Power saved per Fan =15 w

Total Power saving =1585*15 =23775 w =23.775 kw Average Use of Fan per year =10*295 =2950 h Total Energy saved per year =2950*23.775 =70136.25 kwh Saving in Rs. Per year = 70136.25*7.75 =543555.94 Rs

F. Replace Street light with LED TUBE: -

Total No. of Street Light in College Campus =25 Power saved per Street Light =45 w Total Power saving =25*45 =1125 w =1.125 kw Average Use of Street Light per year =10*295 =2950 h

Total Energy saved per year =2950*1.125=3318.75 kwh Saving in Rs. Per year =3318.75*7.75=25720.31 Rs

IX. CONCLUSION

This paper represent idea to reducing energy losses in college campus by replacing high power consuming devices to low power consuming devices such as CFL can be replace by LED. In this way the energy consumption can be reduces. It is possible to reduce the energy consumption by 20%.

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Failure Analysis of Turbocharger

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Abstract: **Turbocharger consists of centrifugal compressor driven by an exhaust gas turbine and employed in engines to boost the charge air pressure to improve its performance in terms of output power and overall efficiency. Authors have considered three turbochargers for failure analysis. All the turbochargers have failed before designed conditions, which is premature failure. In the first turbocharger, ruptures were noticed at the compressor end on the tip of all compressor blades except for one which had undergone bending. In the second turbocharger set, fractured turbine edges and splitting up of the shaft at stress raiser was observed. On these two radial turbochargers, visual examination and metallographic examination (SEM) have been conducted. In the third turbocharger, bluish colour on the shaft and carbon deposition on the bearing house and heat shield were observed. The results of the failure have been discussed in detail in this paper.**

I. INTRODUCTION

The reasons of failure of turbine includes high temperature and pressure operating conditions, fuel and air contamination, high mechanical stresses, high thermal stresses, fatigue and creep/stress rupture [1-8]. The Compressor surge and entry of foreign particles are mainly responsible for compressor failure [9, 10]. The reasons for shaft failure are oil starvation, oil delay, hot spot, carbon build up, non-homogenous material composition, improper clearance in fully floating bearing, impact loading, ductile or brittle failure etc. [11-13]. Most commonly used methods of failure analysis are visual examination, non-destructive testing (NDT), chemical analysis, metallographic examination [14, 15]. In this paper, authors have considered Visual examination technique and metallographic techniques for failure analysis of the three turbocharger components.

For the failure analysis, the authors have investigated the failed components of turbochargers using the visual examination. To further proceed with the investigation for the satisfactory and detailed results, metallographic examination is carried out by scanning electron microscope (SEM).

II. FAILURE ANALYSIS

Author have selected three turbochargers for failure analysis. Samples from first turbocharger includes two compressor blade, one with rupture at outward end of the blade and another with bending at tip of blade. Samples from second turbocharger includes turbine blade with ruptured edges and split shaft from the stress raiser. Samples from the third turbocharger includes shaft with bluish colored strips and bearing house and heat shield with Carbon deposits. Visual examination was carried out on all the samples. To reach to the root of the cause of the failure, Optical microscopy was carried out on this samples, but results obtained were unsatisfactory. So the author decided to continue with the investigation using Scanning electron microscopy and this results of Visual examination and Scanning electron microscopy are discussed in next session. The scanning electron microscope of Model- S3400 has 3nm resolution, work distance of 5mm to 35mm and highest acceleration voltage of 30 KV.

2.1. Visual examination

2.1.1. Turbocharger 1: Rupture is noticed on the compressor blades (Refer: Fig.1) with the exception of one compressor blade which has undergone bending as shown in Fig.2. All the compressor blades are eroded at tip profile side which indicates surface erosion due to collision of blade with outer casing. Bending of inducer tip, near compressor inlet, is observed in one of compressor blade passage (Refer: Fig. 2). There is no damage observed on the turbine andshaft.



Fig.1 Ruptured Compressor Blade



Fig.2 Bent Compressor Blade

2.1.2. Turbocharger 2: In this sample; material removal is observed at the edge of all turbine blades as represented in Fig. 3. For enlarge view, one of the fractured turbine blade is shown in Fig. 4. Main shaft of turbocharger is also split up into two at stress raiser (Refer: Fig. 5).

There is no damage on the compressor end. The visual examination suggests that first of all shaft is failed due to which turbine became decentralize and all the blades tip are rubbed with outer casing of turbine which is moving at very high speed. This leads to material removal from the tip of turbine blades. Main shaft of turbocharger is broken from the

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groove of turbine shaft assembly. No observable bending has occurred on the failed main shaft as shown in Fig. 5.



Fig.3 Turbine End of the Turbocharger



Fig.4 Fractured Turbine Blade



Fig.5 Shaft from the compressor end

2.1.3. Turbocharger 3: Bluish coloured strip on the shaft of the turbocharger is noticed as shown in Fig. 6. This suggests premature failure because of the lack of lubrication (Oil starvation) may be due to pump failure. The oil starvation leads to excessive temperature inside the turbine assembly. The black carbon deposits observed on the turbine side heat shield (Refer: Fig.7) and central bearing house (Refer: Fig.8). This also indicates failure due to high temperature regions developed inside the turbocharger may be due to lack of lubrication inside the turbine assembly. As one of the function of central bearing housing is to support and lubricate the turbocharger bearing. In case of lack of lubrication it is not able to handle the heat and stress of the turbine, due to which the casing material burnt and formed carbon are deposited on different parts.

Thus, premature failure of shaft has taken place due to improper functioning of pump which prevented the lubricant from reaching the bearing house. Due to this there was no medium for escape of heat produces due to the very high rotational speed of the turbo shaft. Bluish region of the shaft is region where excessive heat buildup took place, leading to rapid wear. Carbon buildup on the bearing house and turbine side heat shield is the indication of use of poor quality oil/ lack of servicing. This has occurred due to combined effect of pump failure and use of poor grade oil/ not changing the oil on time which lead to blueing of the turboshaft and carbon buildup on bearing house and heat shield. Thus, the visual inspection of the failed component gives clear idea about the type of failure and its mechanism.



Fig.6 Bluish Colored Stripes on the shaft



Fig.7 Carbon deposition on turbine side heat shield



Fig.8 Carbon deposition on central bearing house

2.2. Observation using Scanning Electron Microscope

The reasons of failure are not cleared by visual examination in case of sample 1 and 2 of turbochargers. Therefore, SEM is used to generate magnified view of failed component, and SEM micrographs are analyzed to find out the reason for failures. The different micrographs are taken at different magnifications ranging from 18X to 1000X.

For Turbocharger 1, two samples are prepared as per the requirement for the observation by SEM. The first sample is of one of the rupture compressor blade whereas; second is of bent compressor blade.

Sample 1.1: Ruptured compressor blade

Fatigue striations (parallel lines) are observed on the center surface of the blades as shown in Fig. 9. Furthermore, porosity is notice on the specimen averaging at 100-150 μm, indicating a manufacturing defect which leads to decrease in strength. The porosity is of totally enclosed type (it does not extend and stays circular, while not joining other pores). This may have occurred during the casting process. On further magnification (Refer: Fig.10) we notice a dimpled surface which is indicative of ductile failure. Fig.11 indicates fatigue striations as well as a few pores on the surface. Also, we can notice that the surface on the back has a cup and cone structure indicating ductile failure. Another micrograph (Refer: Fig.12) of the right end of the top section of the compressor, shows irregularities at the bottom left area of the micrograph.

On further magnification of the bottom left portion of Fig. 12, we notice cup and cone features on the surface, as can be seen in Fig. 13.

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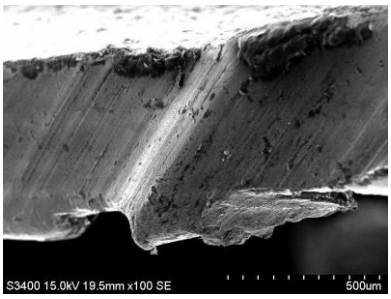


Fig.9 Fatigue striations are seen in this side of the specimen

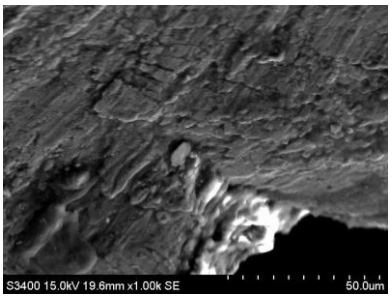


Fig.10 Dimpled surface at the mid-section (magnified view of Fig. 9)

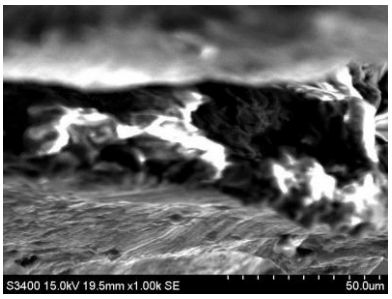


Fig.11 Porosity and dimples are seen

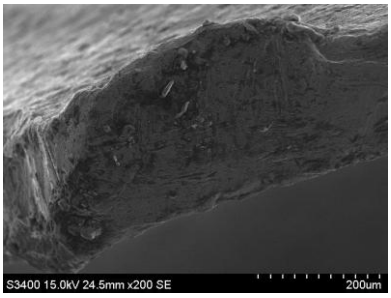


Fig.12 Overview of right end of compressor

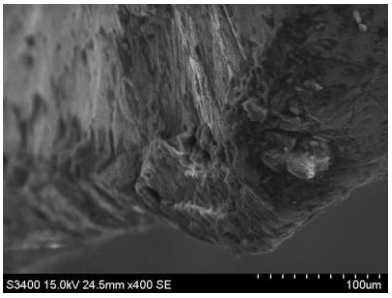


Fig.13 Cup and cone features noticed on the surface at right end.

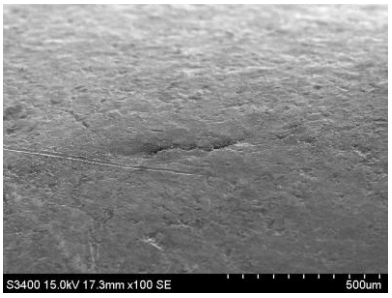


Fig.14 Crack noticed on bent area of compressor blade

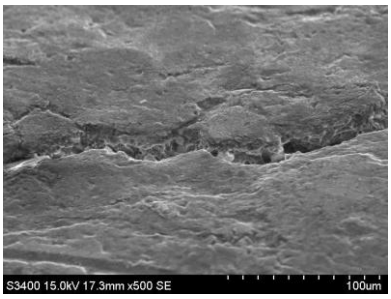


Fig.15 Further magnification of crack area

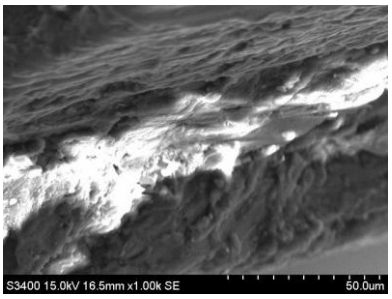


Fig.16 Cup and cone features can be seen

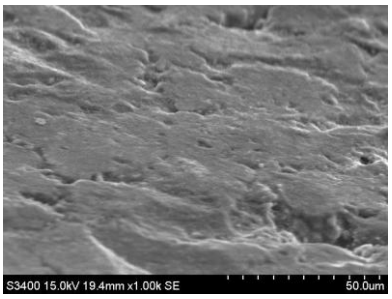


Fig.17 Micro cracks noticed on surface of the compressor blade along with porosity

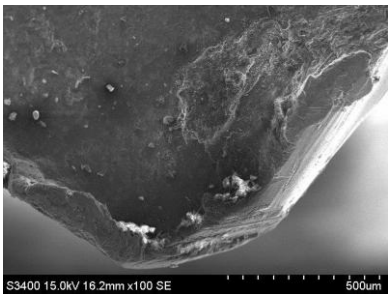


Fig.18 Tip of the compressor blade

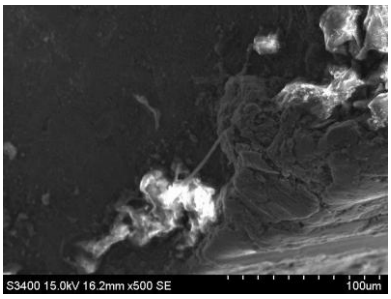


Fig.19 Impact on end of the compressor blade

From the fatigue striations we can say that fatigue has played a part in the failure of the compressor blade. Also the presence of dimples and cup and cone features indicates that ductile failure has taken place due to manufacturing defects during casting of the compressor blades.

Sample 1.2: Bent Compressor Blade

A crack is observed on the bent area of the blade as seen in fig. 14. Irregularities are noticed on further magnification of the crack (Refer: Fig.15). The irregularity is investigated at higher magnification and cup and cone features on the surface is seen (Refer Fig.16). On the surface of the compressor blade the presence of micro cracks and porosity on the surface can be observed (Refer: Fig.17). At the tip of

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the compressor blade impact has taken place (Refer: Fig.18, Fig.19). Thus, in the second sample, at the tip of the compressor blade, authors noticed that impact has taken place. The possible reason for the bending of compressor blade is the combined result of compressor surge due to which there has been temperature rise of the compressor blade and the entry of the foreign particle, large enough to cause the bending is due to rupture of the air filter.

The cup and cone fracture, of samples of turbocharger 1, suggests that first of all shear slip- take place, due to which crack propagated with rapid speed and failure occurs.

2.2.1. In case of the Turbocharger 2, two samples one for turbine blade and another for failed shaft surface are prepared for the observation by SEM.

Sample 2.1: Fractured edges of turbine blades

In the turbine blade, removal of the material has taken place from the edges of the blades due to the physical contact with the turbine housing. The tip of the turbine blade has chipped.

At the left side of top end of the turbine, material removal due to wear with other material can be noticed (refer Fig 20). The right end of the turbine where chipping has taken place is investigated (refer Fig.21), where cup and cone features are noticed in the SEM micrograph, which shows that ductile failure has taken place. An overview of the top section (including the edge) of the blade is seen in fig.22, where a rough, irregular surface is observed. The top end away from the edge is viewed at higher magnification where irregular areas are observed, possibly have a cup and cone surface (refer Fig.23). The same can be seen in Fig.24 which is towards the edge. After zooming in on the red circle at higher magnification (Fig.25) the presence of cup and cone surface is confirmed. This may be due to excessive stress generation within the turbine wheel assembly.

Thus, this sample analysis indicate failure of turbocharger due to the ductile and fatigue failure of turbine blades.

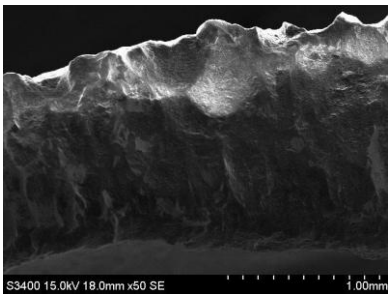


Fig.20 SEM micrograph of the left side of the top end

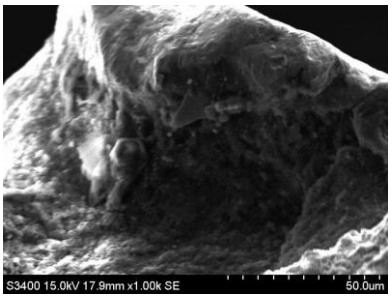


Fig.21 Right end of SEM micrograph showing cup and cone surface

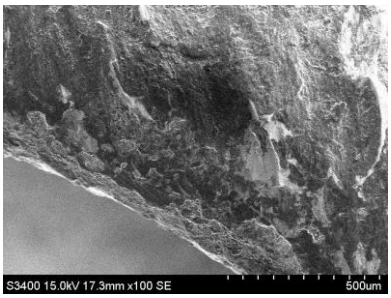


Fig.22 Top section of the blade, including edge

Sample 2.2: Failed shaft

Fig.26 shows the complete overview of the failed shaft surface and Fig. 27 represents enlarge view of surface at the edge of the shaft. At the edges initiation marks are noticed on the edges of the shaft. After the initiation marks, concentric circles are seen, after which one can observe multiple cracks ending at the center.

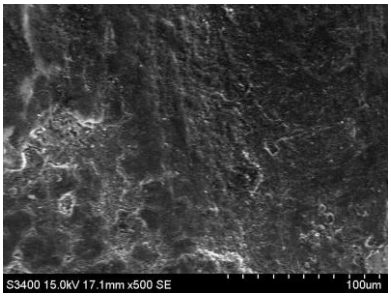


Fig.23 Centre area of the top end, away from the edge irregularities are seen

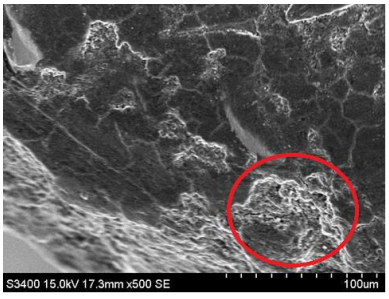


Fig.24 Top section of the blade towards the edge

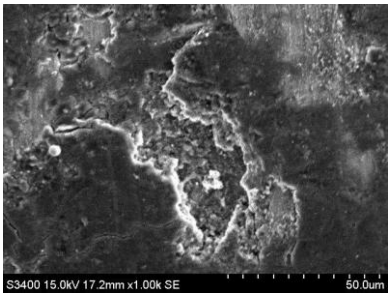


Fig.25 Presence of cup and cone features on the surface

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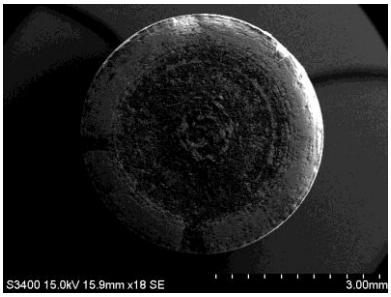


Fig.26 Overview of shaft through SEM

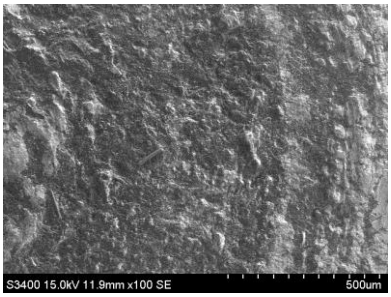


Fig.27 Surface at the edge of the shaft

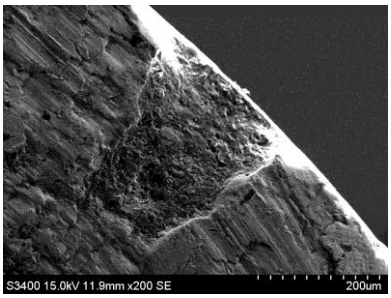


Fig.28 Cup and cone Features noticed at the triangular portion at the edge

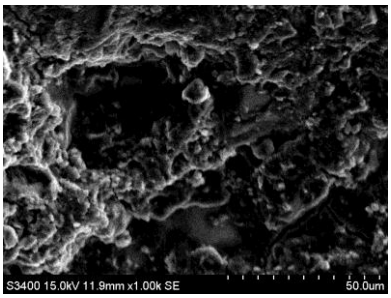


Fig.29 Cup and Cone feature (Magnified view of Fig.28)

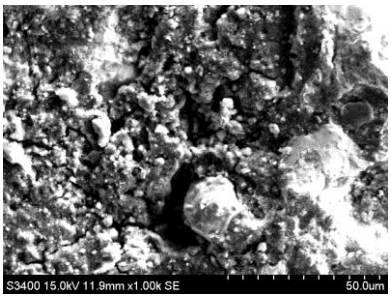


Fig.30 SEM micrographs showing multiple cracks towards the center of the shaft

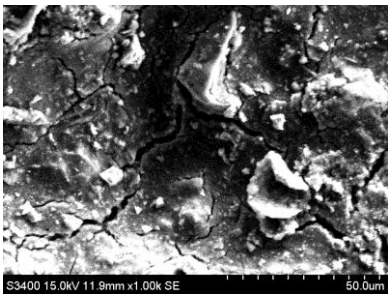


Fig.31 SEM micrographs showing multiple cracks (Magnified view of Fig.30)

Authors noticed the cup and cone features on the surface as shown in Fig.28 and 29. This is indicative of ductile failure. Multiple cracks are noticed on the surface which arepropogating in random directions as represented in Fig.30 and 31. SEM micrograph of a single crack can be observed in figure 32.

In the shaft, the initiation of the failure which is the splitting of the shaft at the stress raiser has occurred at the outer edge of the shaft which corresponds to ductile failure. The concentric circles which follows the initiation points are called as progression lines. After the progression lines the brittle failure occurs after certain distance which can be noticed by multiple cracks. Finally instantaneous center is obtained at the center. This has occurred due to combined effect of bending and torsion at the stress raiser region which may be due to either improper clearance provided for the fully floating bearing of or improper assembly of the components.

Thus, the shaft is failed due to the combination of ductile and brittle failure which leads to the turbine blade failure also.

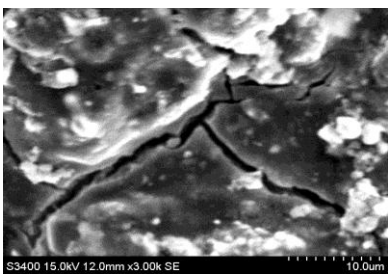


Fig.32 SEM micrograph of a single crack

III. CONCLUSION

Three different failed turbochargers are taken for the failure analysis of the components of turbocharger. The analysis is carried out by visual examination and SEM micrographs. Reasons of failure are identified for all the three turbocharger.

ACKOWNLEDGEMENT

Authors acknowledge guidance of Dr. J. V. Menghani (Assistant Professor, S.V.N.I.T), for carried out micrographs from SEM. Also, thanks other project mates for their support.

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Addressing the Singapore-Johor Causeway Cross-borderhigh Toll Charges

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***Abstract*— This paper attempts to address concerns arising from the increase in the toll charge on vehicles plying between Malaysia-Singapore via the Causeway with effect from 1 August 2014 and in retaliation, the policy of reciprocity of symmetrical toll charges from Singapore effective from 1 October 2014. An impact assessment of the toll imposition on three major stakeholders are made together with the analysis whether the private-public partnership (PPP) approach adopted on construction of the new Eastern Dispersal Link (EDL) expressway linking to Singapore has lightened or increased the burden of the general public. The impact assessment sheds some light on the issues pertaining to the socio-economic factors, cost of financing of this project, and the extent of financial support from the government and the taxpayers in order to ensure that the infrastructure is provided in an economical way. Possible solutions to the issues surrounding the EDL by focussing on the pricing of toll that would be of best interests to the affected groups. Analysis of various alternatives with adjustments to the toll rates and concession periods were made, and examined on their viability as solutions from differing standpoints and strategies to mitigate the impact, and the likely win-win solutions for the parties involved were put forward. The proposals are intended for the government as considerations for a more manageable and moderate toll levels so that the issue could be resolved without further delay, thus averting the potential of knock-on effects to the Malaysian economy.**

***Keywords*— cross-border; toll pricing; imposition; abolishment; knock-on effects; impact on business,**

I. INTRODUCTION

The Eastern Dispersal Link (EDL) expressway in the Southern region of Malaysia was opened in 1 April 2012. Despite being opened to the public for two years, toll collection has yet to start. During that period, there have been on-going discussions between the government and the concessionaire on the possible acquisition of EDL, but since this did not materialise, there has been no clear resolution that eventually yield a win-win situation for the public, government, and the concession holder. Finally, the Malaysian Government has allowed concessionaire of EDL, as stipulated in the concession agreement, to collect toll charges effective from 1 August 2014.

The EDL is a 8.1 km link between the Customs, Immigration and Quarantine (CIQ) Complex to the existing North-South Expressway (NSE). Costing about MYR1.27 billon to build, the EDL functions as a bypass towards the CIQ complex, addressing the heavy traffic flows along the federal route towards CIQ during peak hours. In 2013, the EDL expressway was reported to have served and provided convenience on a daily basis to almost 170,000 vehicles travelling within the business districts of Johor Bahru, thus realizing the main objective of EDL as a traffic dispersal scheme

In the past, only inbound vehicles entering the Johore's CIQ complex from Singapore are subject to toll charges, ranging from MYR2.90 to MYR6.10, depending on the different class of vehicles. Motorcycles are exempted from toll payment. From 1 August 2014 onwards, motorists are required to pay toll for both inbound and outbound at the CIQ complex at the Malaysian border checkpoint at Johor Bahru. The charges imposed on various types of vehicles are as illustrated in Table 1. Resulting from this imposition, a round trip will now cost MYR16.50 for private cars, as compared to MYR2.90 previously, causing a whopping 469% increase of MYR13.60.The exorbitant increase in toll charges has caused a lot of public outcry due to the impact on individual consumers and commercial enterprises that are commuting between Malaysia and Singapore by land.

Table 1: Total Toll Charges at Johor Bahru Customs

Type of Vehicle	Previous Charges (MYR)	New Charges (MYR) Effective 1 Aug 2014[(a)]			Increase (MYR) %
	Inbound	Inbound	Outbound[(b)]	Round Trip	
Class 1 Private Car	2.90	9.70	6.80	16.50	13.60-469%
Class 2 Small Lorry	4.50	14.70	10.20	24.90	20.40 - 453%
Class 3 Heavy Truck	6.10	19.70	13.60	33.30	27.20-446%
Class 4 Taxi	1.40	4.80	3.40	8.20	6.80 - 486%
Class 5 Bus	2.30	7.80	5.50	13.30	11.00 - 478%

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(a) As per Federal Government Gazette P.U.(A) 224, the rates of toll authorized are for use in either direction of any part of the road known as the Eastern Dispersal Link Expressway (EDL) effective from 1 August 2014.
(b) Previously, there were no outbound toll charges. Before 1 Aug 2014, toll charges were imposed for only one way from Singapore to Johor.

The toll booths are located inside the CIQ Complex at Johor Bahru Causeway.[1] The imposition of toll charges is affecting those who are plying between Johor and Singapore, using the Causeway that link Johor Bahru and Woodlands in Singapore. Based on unofficial statistics and traffic record, there are about 220,000 vehicles using the EDL daily, but only 60,000 users are expected to pay the toll, as these are users travelling to Singapore.[2] However, over half (58%) of the 60,000 users are on motorcycles and are exempted from the EDL toll charges. Although the majority of the EDL users do not have to pay the toll, it would be rather unreasonable and unfair to tax the users who are daily commuters of the Johor Causeway to Singapore. The controversy arises from the fact that all users of the CIQ complex have to pay toll charges to contribute towards the EDL's costs, irrespective of whether they are actually using the EDL or not. And the users of EDL are not required to pay the toll charges if they are not exiting to Singapore. It appears that the huge hike in toll charges to and fro Singapore is used to subsided domestic commuters of EDL.

Meanwhile, Singapore has a long-standing policy of matching its toll charges with that of Malaysia. The rationale is simply to discourage high tolls being imposed, while preventing only one side benefitting from the toll revenue from the crossing. Despite this insistence, the Singapore authority has also came up openly that if Malaysia reduces or sets no toll imposition, Singapore would also follow suit but if the Malaysian authority increases the toll charges, they will impose the same increase.

The Singapore Land Transport Authority (LTA) has announced in their press release on 12 September 2014 that the new toll rates to take effect from 1 October 2014. The previous symmetrical toll for Class 1 vehicles (passenger cars) is SGD1.20, payable upon leaving Singapore. In orderto match the toll imposed at the Malaysian border, the rates was raised to SGD3.80, while a toll charge of SGD2.70 will be applicable for cars entering Singapore. The toll charges effective from 1 October 2014 are depicted in **Error! Reference source not found.** below. Comparing Table 1 and Table, it is apparent that the Singapore will revise the tolls charges to the MYR equivalent whenever the Malaysian Government makes any revision.

[1] *The rationale for erecting the two booths at CIQ and not on the EDL is to allow the majority to use EDL for free as this was one of the conditions set by the Johor government. If toll booth is placed along the EDL, road users would avoid by using the other surrounding non-toll roads around the city, hence defeating the purpose of dispersing the traffic congestion.*
[2] *BERNAMA, Aug 11 2014 (http://kpdnkk.bernama.com.pulse.petronas.com.my/); The Star, 30 July 2014.*

Table 2: Toll Charges at Singapore Woodlands Checkpoint

	Previous Toll Charges		Toll Rate effective 1 Oct 2014				% Inc.
	SGD	MYR equi.	Outbound SGD	Inbound SGD	Total SGD	MYR equi.	
Motorcycle	-	-	-	-	-	-	-
Private Car	1.20	3.05	3.80	2.70	6.50	16.45	442%
Small Lorry	1.90	4.80	5.80	4.00	9.80	24.80	416%
Heavy Truck	2.60	6.60	7.70	5.30	13.00	32.90	400%
Taxi	0.60	1.50	1.90	1.40	3.30	8.35	450%
Bus	1.00	2.55	3.10	2.20	5.30	13.40	430%

Source: Land Transport Authority (www.lta.gov.sg), accessed on 14 Sep 2014
Note:Conversion rate of MYR2.53=SGD1, including rounding-up to the nearest multiple of five sen. The exchange rate has significantly increased subsequently.

1.1. Immediate Impact

Without any other more economical routes, the impact of the toll hike is inevitably affected individuals as well as the commercial and the trade sectors. With no clear signals of cooperation between the two countries to address the issue, amid Malaysian high toll rates imposed since 1 August 2014, the impact of the tit-for-tat matching toll rates from Singapore from 1 October onwards would have a hefty impact especially on the daily commuters to work.

As illustratedin **Error! Reference source not found.**, the overall total round-trip across the Johor Causeway by private cars (Class 1 vehicles) will eventually cost almost 5.5 times more to approximately MYR32.95 from MYR5.95 prior to 1 August 2014, and from the present MYR19.55.

Table 3: Total Round-trip Cost across the Johor Causeway for Class 1 vehicles before and after toll hike in Malaysia and Singapore

Private Cars	Prior Cost before both toll hikes			Cost from 1 Oct 2014 onwards			Increase(%)
	Malaysi-	S'pore (SG	Both Tolls (MY	Malaysia (MY	S'pore (SGD)	Both Tolls (MYR)	
Johor-Singa-pore	-	-	-	6.80	2.70	13.65	-
Singa-pore-Round-trip	2.90	1.20	5.95	9.70	3.80	19.30	224 %
	2.90	1.20	5.95	16.50	6.50	32.95	454 %

Note:Singapore toll charges are converted into MYR with rounding-up to the nearest multiple of 5 sen.Exchange rate for MYR and SGD of 2.53 is assumed.

Although small lorries and heavy trucks account for less than five percent of the daily traffic across the Causeway, the imposition such excessive toll charges would have an immediate effect on the transportation and logistics costs,

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triggering a rise in business costs. Table 4 shows that Class 2 vehicles like small trucks would incur additional MYR40.35 per round-trip across the Causeway. Logistic providers or entrepreneurs are expected to transfer these increases to their customers, and eventually passed onto the end consumers, hence causing a general increase in consumer prices. The ultimate impact would be on the consumers again, i.e. with higher cost of living and having less to spend.

Table 4: Total Round-trip Cost across the Johor Causeway for Class 2 vehicles before and after toll hike in Malaysia and Singapore

Class 2[(a)]	Prior Cost before both toll hikes			Cost from 1 Oct 2014 onwards			Inc. (%)
	Malaysia (MY	S'pore (SG	Both Tolls (MYR)	Malaysia (MYR)	S'pore (SG	Both Tolls (MYR)	
Johor-Singapore	-	-	-	10.20	4.00	20.30	-
Singapore-Johor	4.50	1.90	9.35	14.70	5.80	29.40	214 %
Round-trip	4.50	1.90	9.35	24.90	9.80	49.70	431 %

Note:
(a) Class 2 vehicles are defined as vehicles with2 axles and 5 or 6 wheels, excluding buses.
(b) Singapore toll charges are converted into MYR with rounding-up to the nearest multiple of 5 sen.Exchange rate for MYR and SGD of 2.53 is assumed.

II. IMPACT ASSESSMENT OF EDL EXPRESSWAY

A. The role played by the EDL expressway

The public have been using the EDL expressway on toll-free basis for the past two years since the EDL was opened. During the first month after its opening, 3.8 million vehicles have used the highway, averaging to 126,000 vehicles daily, and subsequently about 132,000 vehicles daily in May 2012.[3] On an average, the EDL expressway has served about 150,000 vehicles per day since its opening on 1 April 2012.[4] In 2013, the EDL expressway was reported to have served and provided convenience on a daily basis to almost 170,000 vehicles travelling within the business districts of Johor Bahru, thus realizing the main function of EDL as a traffic dispersal scheme.[5]

The views on the socio-economic roles of EDL expressway can range from strong advocators who have experience the significance benefits of using the EDL, or from commuters who believe that the EDL is not a sustainable solution with the costs or toll charges incurred. Other less recognisable benefits of the new expressway is the value of a widened geographical size of transport network and new destinations that allow unrestricted access to commuters, and access to freight deliveries.

Overall, the EDL expressway provides the following benefits to the users and commuters: (i) connectivity to several districts in Johor and avoid relying only on the previous main road (JalanTebrau) leading to Johor-Singapore Causeway; (ii) to help disperse traffic heading into the Johor Bahru city area. The travelling time between CIQ and NSE could be reduced from 20 minutes to an average 5-6 minutes, when travelling at 90 km/h as compared to 35 minutes via JalanTebrau; (iii) an impetus for economic development along the eastern corridor of Johor Bahru.[6]When the idea of the expressway project was conceptualized, it was already decided that the highway will be built using an 'open toll' concept. Open toll concept is generally more suitable for urban or semi-urban areas where traffic flows are high, and the toll collected is unrelated to the distance travelled. The map of the EDL expressway is illustrated in Appendix A.

The toll booths are located in the CIQ Complex, known as Sultan Iskandar Building (BSI). The main reason for locating the toll collection centre at the CIQ Complex is to benefit the majority of the Johor population using the EDL. As long as users of EDL do not pass through the CIQ Complex, they are not subject to any toll charges. According to the latest estimates, this will enable will allow approximately 160,000 to 180,000 EDL road users per day, travelling within Johor Bahrucity to enjoy to use the expressway for free at the expense of those travelling across to Singapore. Toll is levied only on about 40,000-50,000 EDL users (excluding motorcyclists) who travel across Singapore via the Causeway daily. This translates to about 25% of the EDL road users. This implies that majority of the EDL users were accorded the benefits of EDL without any charges, while the concessionaire benefits from the traffic volumes between Malaysia and Singapore.

The traffic behavioural study was conducted by a traffic consultant, engaged by the project concessionaire. According to the study, the Causeway serves about 69 million persons trips annually. The traffic on the Causeway has also proven to be resilient, and grew at a compounded annual rate of 4.6%.[7] The nature of the inelastic traffic volume at the Causeway is also attributable to the lack of alternative route since the Second Link (from TanjungKupang, Johor to Tuas Checkpoint, Singapore) is no less expensive and relatively longer distance as compared to Johor Bahru Causeway to Singapore. This provides a strong justification for the toll collection centre at the CIQ complex considering that the daily traffic flows are from essential working trips for those

[3] *As reported in CIMB report, "Day break Malaysia", 1 June 2012*
[4] *MRCB Annual Report 2012, pg. 49.*
[5] *As reported in MRCB Annual Report 2013, pg. 82.*
[6] *Source: Traffic Consultant Report enclosed with the InfoMYRation Memorandum furnished on P&C basis to prospective investors; and www.edlconnects.com.my. The evaluation was undertaken by PerundingTrafikKlasikSdn Bhd.*
[7] *Traffic volume compounded at 4.6% per annum during the period 1991-2005; estimate of 9% per annum during 2003-2005 period.*

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who reside in Johor but working in Singapore. The traffic consultant reckoned that the traffic volume at the Causeway should not be significantly impacted after the toll is imposed, unless the toll charges exceed MYR10.00 per vehicle per way.

B. Impact of the toll imposition

The toll charges imposed which are multi-folds increase from the previous rates are considered exorbitant. Such astronomical increases have caught many parties off guard, as there were no clear indications that the toll charges would be imposed so soon and at such a high quantum. The Malaysian Highway Authority (MHA) only made the announcement of toll collection on 25 July 2014. Such significant increase would immediately impact those commuters travelling daily to and fro to work or schooling in Singapore.

Approximate 300,000 people, including the residents along the 5km radius of the EDL have access to the EDL expressway.[8] On a typical day, there is about 60,000 vehicles crossing over.[9] The types of vehicles crossing over the Causeway on a daily basis are motorcycles (58%), cars (36%), light trucks (1%), heavy trucks (2%), taxis (0.5%) and buses (2.5%). According to the latest Johor Customs Department, from January to June 2014, approximately 4.76 million vehicles used the Causeway, while 33.5 million had used the GelangPatah Second Link.[10] This means that about 26,000 vehicles use the Causeway vis-à-vis 184,000 vehicles using the Second Link.

The imposition of toll charges is impacting those who are plying between Johor and Singapore, using the Causeway that link Johor Bahru and Woodlands in Singapore. Based on unofficial statistics and traffic record, there are about 220,000 vehicles using the EDL daily, but only 60,000 users are expected to pay the toll, as these are users travelling to Singapore.[11] The controversy of the EDL expressway arises from the apparent fact that all users of the CIQ complex have to pay toll charges to contribute towards the EDL's costs, irrespective of whether they are actually using the EDL or not.

From the Ministry of Transport Singapore, an average 13,000 foreign-registered cars entered Singapore on a daily basis. Singapore. However, over half (58%) of the 60,000 users are on motorcycles and are exempted from the EDL toll charges. Accordingly, the toll at CIQ complex would be taking away approximately MYR11-MYR12 million a month from the disposable income of majority Johor citizens travelling on private cars, taxis and buses and goods carrying vehicles such as lorries and trucks, which would have undesirable impact on the local business and economy.

From this analysis, although the majority of the EDL users do not have to pay the toll (based on the rule of thumb based on Pareto-rule, 80% are non-paying), it would be rather unreasonable and unfair to tax the user who are daily commuters of the Johor Causeway, but less likely to travel on the entire 8.1 km expressway.

II.B.1 Impact of Causeway commuters

The increase in toll charges instantly affects the everyday commuters from the level of school-going children and their parents, workers, logistic providers, business operators, public transporters such as public buses and taxis, as well as weekend shoppers from Singapore. The following section describes the impact of the toll imposition on these main groups of users:

(i) School-going commuters - the increase in toll charges instantly affects the everyday commuters at the level of schooling and for work. There are many primary school kids and secondary school students from Johor commuting across the Causeway to attend schools in Singapore via school vans and bus operators. Based on SERC estimates, this would increase its daily expenses by between MYR8.20 for buses, or MYR13.60 for vans, or between MYR500-MYR700 per month, depending on the number of trips made daily. In order not to face any squeezed margins, the school bus operators will eventually pass the increase of toll charges to the students by making adjustment to the bus fare.

(ii) Workers commuting to Singapore - For workers driving to work, the hikes in toll charges mean that they have to fork out additional expenses of at least MYR350 per month.[12] Though these workers are earning in a stronger Singapore currency, the higher payments on toll charges suggest that they now have less take-home-pay. Since the toll booths are located at the CIQ complex, and in the absence of non-tolled route to the Causeway, these group of users have no alternative option, but to abide with the toll imposition.[13]

(iii) Weekend Shoppers or Visitors-Similarly, for those Singaporeans as well as Malaysian who are permanent residents in Singapore, the higher toll charges translate to fewer propensities to purchase. The impact on this group of commuters, who normally make leisure or shopping trips, particularly during the weekends, would be inconclusive, depending on the demand elasticity of such trips. They would either reduce the frequencies by combining their trips, or for some who could not reduce their frequencies, their tendency to spend during each trip may have to be cut down. According to the Johor Bahru

[8] *This was cited in the rational for EDL, adapted from Eastern Link Dispersal (www.edlconnects.com.my), accessed on 6 August 2014.*

[9] *Source: Iskandar Malaysia (http://www.iskandaMYRalaysia.com.my/flagship-a-johor-bahru-city), accessed on 6 August 2014.*

[10] *New Straits Times, "New toll charges at Causeway", 27 July 2014.*

[11] *BERNAMA , Aug 11 2014 (http://kpdnkk.bernama.com.pulse.petronas.com.my/); The Star, 30 July 2014.*

[12] *According to Singapore Ministry of Transport, there are 13,000 foreign-registered cars entering Singapore on a daily basis in 2013.*

[13] *The rationale for erecting the two booths at CIQ and not on the EDL is to allow the majority to use EDL for free as this was one of the conditions set by the Johor government. If toll booth is placed along the EDL, road users would avoid by using the other surrounding non-toll roads around the city, hence defeating the purpose of dispersing the traffic congestion.*

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Small Business Association, there has been a drop in business since the imposition of the new toll charges. Some members have reported that the business turnover have dropped by 30 to 50% during the first two weekends since the toll was imposed.[14]

(iv) Logistic Providers and Business Operators - Although small and heavy trucks account for less than five percent of the daily traffic across the Causeway, the imposition such excessive increase (453% and 446% increases, respectively) would have an immediate effect on the transportation and logistics costs, triggering a rise in business costs. Logistic providers or entrepreneurs are expected to transfer these increases to their customers. This would have a huge inflationary implication, particularly in the Johor state, when these additional costs are eventually passed onto the end consumers. Ultimately, the adverse impact would be on the consumers again, i.e. with higher cost of living and depletion of disposable income.

(v) General Impact on Toll Payers-It is rather unfair to levy the prevailing high toll charges on all vehicles crossing the Malaysian-Singapore border via the Causeway, when there is no other better alternative access other than the Causeway. The traffic volumes at the Causeway is inevitable and demand usage of the Causeway is considered inelastic in nature attributable to the lack of alternative route. Not only that the tolls at the Second Link are no more cheap, but more notably, the distance is relatively longer between Johor Bahru and Singapore. There is not much incentive to switch to Second Link because of the additional distance, although higher traffic volume at Second Link can be expected especially from those commuting from Kuala Lumpur.

It is unwarrantable that toll charges are not even levied on users of the expressway when the EDL was constructed with a rather high cost of approximately MYR1.2 to 1.3 billion. The general public should not be burdened by such excessive toll charges in order to recover the excessive investment outlay of the EDL, which incurred a very substantial costs vis-à-vis other expressways in the country. The EDL expressway is considered to be the most expensive expressway in the country, with a cost of MYR148.15 million per km. As comparison, the Ampang-Kuala Lumpur Elevated Highway (AKLEH), which was the first elevated highway in Malaysia completed in 2001, only cost MYR108.11 million per km.

As illustrated inTable 5, the cost per elevated km for EDL was MYR33.67 million as compared to MYR13.68 million for AKLEH, and MYR12.26 million for Duta-Ulu Kelang Expressway (DUKE). Even with time value of money or inflation factored in, AKLEH would have only cost less than MYR30 million per elevated km. Generally, the completed and under-construction expressways in the country were built with less than MYR70 mil per km as shown in Table 5 below. With such rapid development of the toll road in Malaysia, there is certainly an urgent need for the government to establish comprehensive evaluation of the costs-benefits of these expressways from the users' point of view so that the public is not excessively burdened with the high toll rates.

II.B.2 Impact of toll concessionaire

The revenue for the highway concessionaire is generated through toll collection and ancillary income such as advertisement billboards, telecommunication antenna, rental of stalls, etc. and any compensation payable by the Government as stipulated the Concession Agreement (CA). Under the CA, the Government is obliged to pay compensation to the concessionaire in the event that the toll rates imposed are lower than that were set out in the CA.

Table 5: Comparison of Costs of Major Expressways in Malaysia

Expressways	Construction Cost (MYR mil)	Length (km)	Cost per km (MYR mil)	Concession period	Notes
Completed:					
EDL	1,200	8.1	148.15	until 2042	Elevated - 4.4km
AKLEH (E12)	800	7.9	108.11	until 2029	Elevated - 7.9km
DUKE (E33)	1170	18	65.00	until 2039	Elevated - 5.3km
NPE (E11)	1,360	19.6	69.39	until 2026	
LDP (E10)	1,327	40	33.18	until 2029	
SLE (E3)	1,149	45.7	31.33	45 years 5 months	-
Besraya (E9)	520	16.6	31.33	35 years 9 months	
SPRINT (E23)	1,300	26.5	49.06	36/36/33 years	Kerinchi, Damansara&Penchala Link
MEX (E20)	1,320	26.0	50.77	until 2037	
Work-in-progress/Planned projects:					
SUKE	4,180	31.8	131.45	not available	Awarded to Prolintas
DASH	4,300	20.1	213.93	not available	Awarded to Prolintas
EKVE	1551.1	39.5	39.27	50 years	Awarded to AZRB
KIDEX	2,420	14.9	162.42	48 years	Fully-elevated; Project by KidexSdnBhd, temporary shelved

Source: Malaysian Highway Authority Annual Reports, 2008-2012; Websites of concessionaires.
Note:

[14] *The Sun, 12 August 2014.*

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EDL	*Eastern Dispersal Link in the State of Johor, linking NKVE to Johore-Singapore Causeway*
AKLEH	*Ampang-Kuala Lumpur Elevated Highway*
DUKE	*Duta-Ulu Kelang Expressway*
NPE	*New Pantai Expressway*
LDP	*LebuhrayaDamansara-Puchong*
SLE	*Second Link Expressway linking TanjungKupamg, Johor to Tuas, Singapore*
Besraya	*SungeiBesi Expressway*
SPRINT	*SistemPenyuraianTrafik KL Barat (Western KL Traffic Dispersal System)*
MEX	*Maju Expressway (KL-Putrajaya Expressway)*
SUKE	*SungeiBesi-Ulu Kelang Expressway*
DASH	*Damansara-Shah Alam Highway*
EKVE	*Eastern Klang Valley Expressway*
KIDEX	*Kinrara-Damansara Expressway*

The toll concessionaire has not been allowed to collect toll since the expressway has been operational from April 2012. This long impending decision from the government has not been very favourable to MRCB's cash flows and profitability, despite of the compensation payment from the government. As illustrated in Table 6, the total interim payments received by MRCB up to 30 June 2015 amounted to MYR287.6 million, translated to approximately MYR11million per month.

Table 6: Interim Payment from Government

	2012[(a)]	2013	2014[(b)]	Total
Interim Payment (MYR'000)	68,277	100,287	119,388	287,592
Duration (months)	8	12	6	26
Monthly compensation	MYR 11,075,000			

Source: MRCB Annual Report 2012 & 2013; Interim Report for the Financial Period ended 30 June 2014.
Note: (a) From May 2012 onwards
(b)Up to 30 June 2014

The decision to allow toll collection from 1 August 2014 not only translates to toll proceeds in the form of cash, but also enables the company to predict with more certainty on its revenue, and manage its operating and maintenance (O&M) expenditures. It is very likely that MRCB's proceeds are expected to be more than the government compensation of about MYR11 million per month. The commencement of toll collection would help to cover all its O&M expenditures, finance cost, and obligations to its shareholders.

II.B.3 Impact on government

The government made the announcement of acquiring the EDL expressway on 10 September 2012. The government made this announcement so that the expressway can be continued to be toll-free, as pledged by the government earlier to the public. Pending the conclusion of the take-over, the government agreed to make interim payments commencing 1 May 2012 to reimburse MRCB the operating and maintenance expenses inclusive of finance cost related to the expressway. The Government has up to 30 June 2014 forked out a total of MYR287.6 million to compensate the concessionaire, MRCB Lingkaran Selatan SdnBhd for the shortfall in toll revenue due to the delays in commencement of the toll collection. This payment is of utmost important to MRCB as it has bearing on the ability of MRCB to repay the bondholders of EDL. Pending the take-over by the Government, MRCB has placed the EDL as Service Concession Asset (SCA) for sale valued at MYR1,321 million.[15]

After two years, the government has finally decided to allow toll imposition. It is not viable for the government to acquire the EDL from MRCB based on the following reasoning:

(i) The price that the government offers cannot match that MRCB expects. The construction cost of EDL is estimated at MYR1.254 billion, while the acquisition cost for the government was no lesser than MYR1.7 billion.[16] Based on SERC's further analysis on the future stream of toll revenue, the value would approximately at MYR1.86 billion.

(ii) Even if both the government and MRCB are agreeable to the SCA value, the government is required to fork out at least a lump sum fixed amount of nearly MYR1.4 billion, being the value of EDL is placed at SCA valued and the premium for early redemption of the bonds or loans.

It would be rather baseless if the Government utilizes taxpayers money to acquire such short 8.1 km highway, that only benefit a small numbers of users, probably less than 2% of the Malaysian population.

(iii) If the acquisition of EDL is successful, the government must be prepared to incur at least MYR12 million monthly in O&M costs, although this can be offset by the toll revenue. However, the public would certainly expect that no toll charges would be imposed as pledged by the Government. Even if the government decides to impose toll, the charges would likely be affordable to the users vis-à-vis current toll rates. Under such scenario, it will definitely take more lengthy years before the government can recoup the MYR1.4 billion acquisition outlay.

(iv) Despite the government's inability to sustain the MYR11 million monthly payments to MRCB, the public is still hoping that the government can review the present toll rates imposed by the concessionaire. After weighing the viability of the acquisition and arriving at the decision of allowing tolling, the current toll levels can only be reviewed and lowered to a more acceptable level to the public only if the government obliges to compensate the concessionaire with another interim payment package. Going by this solution, this would imply that it would certainly cost the government to mitigate the public

[15] *Source: MRCB Annual Report 2013. The borrowing costs of MYR277,552,058 has been capitalized in the construction cost in relation to the SCA as at 31 Dec 2013.*
[16] *This was revealed by the Minister of Prime Minister Department, Datuk Abdul Wahid Omar (NST, 5 Aug 2014; Harian Metro, 6 Aug 2014).*

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unhappiness, but more importantly, this compensation would be disruptive to the government's subsidy rationalization plan.

C. *Impact of Symmetrical Toll Charges Imposed from Singapore*

The Malaysian Government should also be heedful that Singapore would follow suit to increase its toll rates. Singapore has a long-standing policy of matching its toll charges with that of Malaysia. The matching principle of the toll charges can be tracked way back to the Malaysia-Singapore Second Link project which was opened to traffic in January 1998. The rationale of this symmetrical toll charges is simply to discourage high tolls being imposed by the Malaysian authority, while preventing only one side benefitting from the toll revenue from the crossing. Despite this insistence, the Singapore authority has also came up openly that if Malaysia reduces or sets zero tolls, Singapore would also follow suit.

TheLand Transport Authority (LTA) Singaporefirst announced on 1 August 2014 that it would match the new toll charges based on its usual practice of pegging its rates toMalaysia.[17] Subsequently, on 12 September 2014, the Singapore LTA released the new toll rates that would take effect from 1 Oct 2014 onwards. The current symmetrical toll for Class 1 vehicles (passenger cars) is SGD1.20, payable upon leaving Singapore. To match the toll currently imposed in Johor, the current toll will be raised to SGD3.80, while a toll charge of SGD2.70 will be applicable for cars entering Singapore.

The current toll for cars of SGD1.20 (MYR3.05) would be raised to around SGD6.50 (equivalent to MYR16.45) with effect from 1 October 2014. Thus, the overall total round-trip across the Johor Causeway by private cars will eventually cost almost 5.5 times more to approximately MYR33 from MYR5.95 prior to 1 August 2014 and from the present MYR19.55. Without any other more economical routes, the impact of the toll hike is inevitably seen in the commercial and the trade sectors in terms of business cost, and consequently spill over to the general consumers in the form of price increases.

III. LESSONS LEARNED FROM SINGAPORE-MALAYSIA CROSS BORDER TRAVELLING

The Causeway has been one of the busiest crossings in this region. The two countries shared historical issues and political differences that have manifested into economic competition issues and somewhat strained-bilateralrelationship particularly during 1986-1991, and 1997-2003. Historically, there have been ethno-political related events even before the separation of Singapore from Malaysia in 1965. Despite the political separation and being intertwined with a host of historical events, the two countries seemed to continue with the economic interdependence, but not without lingering circumspect from both sides as commercial rivalry particularly stemming from the strategic sea-location still exists although the two economies are complementary.

Regardless of the complex bilateral relationship or political tensions, there were a couple of policy changes over time that have reinforced and intensified the economic interactions across the two countries.[18] These changes have indeed gradually shaped the developments in the southern tip of Malaysia, which saw daily labour flow from Johor to Singapore, growth in skilled-labour migration, and the rise of Johor as a time-out and shopping destination for the Singaporeans. It is clear that the economic inter-dependence of the two countries is reflected in the extent of human and vehicle flows. On a typical weekday, it was disclosed that more than 114,000 vehicles use the Causeway, with motorcyclists topping the list with 71,772, followed by nearly 33,500 cars; and nearly 75 per cent of these are Singapore-registered cars.[19]

The optimism of economic relationship was however dented between 1997 to 2003 with a series of provocations and exchanges between the two leaders; and intensified economic rivalry worsened by the Asian financial crisis. In the past, both countries attempted to improve the relations by addressing the many issues, including significant ones such as the water agreement, land reclamation, territorial and national sovereignty and the KTM issue, and repatriation of Singapore pension funds for Malaysian employees, sovereignty dispute over PedraBranca (PulauBatuPutih), airspace issue, and the replacement bridge for the Causeway.

The matching principal of the toll charges can be tracked back to the Second Link project which was opened to traffic in January 1998. The Second Link project was mooted in the late 1980s, arising from the delay at causeway that may hinder cross-border investment growth. As a promise to ease bottlenecks at cross-border, the proposed toll charges for Second Link were twice the charge at the causeway then. The Singapore authorities stated at that time that any toll imposed would need to be shared by both sides, or else both countries would need to impose a toll.

When the project was completed, the proposed toll announced by Malaysia was eight times the causeway rate for cars and 25 times for good vehicles, ensuing an outcry in both countries. The Singapore government reiterated that it would standby it earlier decision to levy a symmetrical toll with intention to ensure fair distribution of total revenues from the

[17] *From the media statement by Singapore Land Transport Authority (LTA) dated 1 Aug 2014, accessed from www.lta.gov.sg.*

[18] *Some of these changes are related to trade liberalization, foreign investment policies, soaring prices and wages in Singapore and the differences in tax rates. In May 1986, Malaysia lifted the entry peMYRit that had been levied on Singapore vehicles since 1978. The higher value-added tax create incentive for consumer to cross the border to shop.*

[19] *This was revealed by Dr. Tai Tuck Leong of PerundingTrafikKlasikSdnBhd in an interview with The New Straits Times in 2006, as quoted in Barter (2006).*

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toll collection. Nevertheless, Singapore urged Malaysia to lower its proposal as it is in its interests to encourage goods traffic across the border. On the other hand, Malaysia while having its economic development agenda, realized that Johor's economy obviously leverages on Singapore, but has be cautious of Singapore's transhipment role over its own ports, including PelabuhanTanjungPelepas (PTP).

Barter (2006) revealed that the lack of little-discussion of tolls have been important in its own way, and guise as 'bargaining chips' in formal bilateral relationships. Although being locked in multiple unresolved issues, both Singapore and Malaysia are well aware the mutual important relations which are marked by high level of economic inter-dependence, people linkages, and the geographical proximity of the causeway. The key takeaway point from the past lessons is that despite having serious bilateral disputes and the historical political differences, the two countries have managed to co-exist successfully. The lacklustre cooperation efforts to address single issue of toll or transport link are somewhat associated to the test of more complex multidimensional agendas.

IV. THE ANALYSIS OF TOLL PRICING

In view of the concerns arising from the increase in the toll charges, this king paper attempts to find possible solutions to the issues surrounding the EDL tolled highway project focusing on the pricing of the EDL expressway. This section examines the options available to mitigate the impact by making toll adjustments, working out the lowest possible rates for the public while essentially ensuring the toll structure's ability to recoup the capital investment.

Moving forward, this part of the analysis also highlights the potential shortfall of cash flows when the alternative option is adopted, and the funding challenges on the part of the government should the toll rates is revised downwards. Against the background of tight fiscal constraints, there is likelihood of the government reluctance of successive compensation in the policy of tolled roads like the EDL expressway.

A. The basis of assessment

The purpose of this part of the analysis is to evaluate the various toll prices and the impact to the three major groups. i.e. users, concessionaire, and the government. The objective of this assessment is to establish the best possible fair and balanced toll rates to be applied to benefit the consumers and the private concessionaire while not burdening the government.

A financial analysis conducted on each of these options to determine the amount of the total development costs that can be covered by toll revenues. The assessment is based on financial models that aid in establishing whether or not the project is beneficial or affordable to the parties affected by this issue. The models are built based on costs and revenues associated with the project over the concession period in the form of anticipated cash flows based on the various toll charges proposed. The project indicators will help ascertain whether the proposed toll rates and the amount compensation that is required from the government is potentially workable and consequently.

The determination of toll pricing is critical to the concessionaire as the revenue from the toll highways is usually derived from the toll receipts. The underlying basis of the evaluation of the toll concessionis the projected annual net cash flow generated by the traffic flows over the entire concession period. Lengthening the concession period or adopting a higher toll rates may result in the surplus of the revenues to the concessionaire. On the contrary, lower toll rates, or a lower than anticipated traffic volumes may result in a less than projected stream of revenue for the concessionaire. Because the revenue generated from toll roads is long term and incur at differing time period, we adopt the weighted approach of discount rates as normally practiced in World Bank in project evaluation. For this analysis, we assume the weighted average cost of capital (WACC) of 10.3%, weighted against cost of borrowing, cost of equity as well as interest-free loans. The Net Present Value (NPV) of future cash flows is a common method used to calculate the cash flow value of a long term investment. The NPV of EDL expressway is the sum of the present values of the annual cash flows (toll revenues less expenditures) generated during a specified period of time.

The base case assumption is illustrated in Appendix 2. The traffic projection is based on the assumption that current 60,000 vehicles daily is expected to rise by 5.5% per year, but expected slowdown over time as the base increases. By year 2035, the traffic growth for Class 1 vehicles is capped at 3% per year.

One of the most obvious costs associated with the EDL is the capital costs of construction. Other costs involved are costs for toll operations, maintenance of the expressway, upgrading costs, interest payments, and other costs related to providing the facilities to the users.

B. The earlier toll revenue estimation

The expected toll revenue is a major consideration as the revenue is major source for sustaining its operating expenditure and loan payoffs. Toll revenues for the entire concession period are generated from the vehicle (private and commercial) traffic at the differing toll rates as agreed upon in the Concession Agreement (CA). Hence, the changes in toll revenue over the concession period up to 2042 are primarily attributable any changes in traffic volume, the change in the mix between private vehicles and commercial vehicles, and the toll rates.

The basic premise of determining the toll rate is to consider the financial situation of the toll concessionaire or operator,

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and the road users. Fundamentally, the toll rates impose should at least satisfy the following requisites:

(i) The stream of revenue generated from the toll concession should cover the operating and maintenance costs during the duration of tolling;
(ii) The revenue collected by the concessionaire is sufficient to recover the construction cost and to pay off the interests and loans within the required time period and provide adequate fair returns to the concessionaire in undertaking the project.
(iii) The toll rate should be within the affordability of general consumers and commercial users. When the toll rate is too low, the capital investment cannot be adequately recovered, thus may jeopardize the operations and maintenance of the expressway and other future development or extension related to the EDL project.

With the present toll charges as described in The toll rates imposed may reflect a revenue-maximizing pricing approach where the pricing for the expressway has been set at a level resulting in the highest toll revenue for the private concessionaire. In terms of returns on investment, the IRR is approximately 23% vis-à-vis the WACC of 10.3% and the assumed cost of equity of 22%, with a payback period of nearly 6 years.

Table 7 in the earlier section, the total toll collection for the entire concession period until 2008-2042 is estimated at MYR14.27 billion, generating a net cash flow of MYR12.50 billion. This stream of revenue produces total revenue of MYR1.86 billion in NPV terms over a 34-year period. The current toll pricing produces strong surplus of cash that can adequately cover the capital and operating costs throughout the life of the EDL project as shown in The toll rates imposed may reflect a revenue-maximizing pricing approach where the pricing for the expressway has been set at a level resulting in the highest toll revenue for the private concessionaire. In terms of returns on investment, the IRR is approximately 23% vis-à-vis the WACC of 10.3% and the assumed cost of equity of 22%, with a payback period of nearly 6 years.

Table 7 below. The toll rates imposed may reflect a revenue-maximizing pricing approach where the pricing for the expressway has been set at a level resulting in the highest toll revenue for the private concessionaire. In terms of returns on investment, the IRR is approximately 23% vis-à-vis the WACC of 10.3% and the assumed cost of equity of 22%, with a payback period of nearly 6 years.

Table 7: Summary of Financial Analysis

Summary of Financial Analysis (in MYR million)	2012 to 2015	2016 to 2025	2026 to 2035	2036 to 2042	Gross Cash Flows	Net Present Value (NPV)
Revenues	501.6	3,220.3	5,528.8	5,020.4	14,271.1	3,032.5
Expenditures	1,027.2	204.1	275.9	260.0	1,767.1	1,169.7
Cash Flow	(525.5)	3,016.2	5,253.0	4,760.4	12,504.0	1,862.9

The average monthly net cash flow before debts repayment in 2015 after taking into account financing cost is estimated at about MYR4.97 million. This has not taken into account the repayment of loan principal which will only commence in 2018 for the 18-year Senior Sukuk and 20-year Junior Sukuk.

While the present toll rates may satisfythe financial requirements for a return oninvestment (ROI) on the part of the private concessionaire, the present toll rates are deemed to be exorbitant from the perspective of the users, and therefore may not necessary meet the social and commercial needs of the users.

C. Analysis of alternative options

The imposition of the current toll charges have led to the public outcry due the adverse impact on individual consumers and commercial enterprises. For the purpose of this paper, SERC will analyse a number of alternative toll values to understand the impact of the variation on the concessionaire, hence providing a meaningful assessment of the toll rates on the revenue drivers. An assessment of the alternatives options allows a test of pricing options in order to determine the feasibility of a project. The impacts of value pricing were assessed on the basis on the ability to meet the goals of the private concessionairewhile providing better benefits to the users and the government. The revenue generation provides financial incentives to implementing the value pricing that can cover the capital and operating costs.

This evaluation is also intended to seek a viable solution to the current high toll rates that the consumers are facing while ensuring that the concessionaire company remains viable and able to operate efficiently. The seven case scenarios in terms of toll rates and concession period that are evaluated are:

Case 1	Impose current toll rates, but for single way only
Case 2	Increase 10% from previous CIQ rates, and impose for two ways
Case 3	Revert to previous CIQ rates, and impose minimal toll on EDL on single way
Case 4	Revert to previous CIQ rates and impose 2 ways, plus impose toll on EDL
Case 5	Revert to previous CIQ rates for both ways, plus impose minimal toll on EDL to 2050
Case 6	(a) Propose New Rates for CIQ, plus impose toll on EDL for 45 years
	(b) Propose New Rates for CIQ, plus impose toll on EDL for 50 years

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(c) Propose New Rates for CIQ, plus impose 1-way toll on EDL.

Case 7 Propose New Rates for CIQ, plus impose toll on EDL for both ways for 50 years

The above scenarios appraise the impact of maintaining the previous toll rates and lengthening the concession period on the financial situation of the concessionaire. The stream of revenues generated by toll collection from the different scenarios is estimated with the assumption that traffic volumes will not be affected by any changes in the toll rates. It should be noted that the gross revenues used for this analysis are considered to be very preliminary in the absence of actual operational cost data and traffic volumes. The scenarios also evaluate the bearing of imposing toll on EDL from the perspective of the consumer, government as well as to the toll operator.

D. Analysis and interpretation

The financial indicators based on varying toll revenues from the perspective of the concessionaire are summarized in Table 8. The estimated average monthly toll revenue in 2015 showed that all options are able to generate sufficient proceeds to cover the monthly operations and maintenance of the EDL expressway. However, most of the options fall short in meeting the obligation of financing cost estimated at approximate MYR7 million monthly.

Table 8: Summary of Financial Indicators

Scenario		Average Monthly Revenue[(a)] (MYR mil)	NPV (MYR mil)	Payback (years)
Current Toll Rates (1 August 2014)		13.036	1,862.9	5.81
Case Scenario:				
1	Present toll rates; collect 1-way	7.578	719.7	7.89
2	Increase 10% from original rates; collect 2-way ways	4.674	(142.2)	13.42
3	Original rates + Collect from all EDL users	4.682	(162.9)	13.65
4	Original rates 2 way + Collect from all EDL users	6.801	185.8	9.93
5	Original rates 2-way + all EDL users until 2050	6.801	296.5	9.93
6(a)	New Rates 2-way for 45 years	5.086	4.7	12.89
6(b)	New Rates 2-way + all EDL users for 50 years	7.650	461.8	9.32
7	New Rates 2-way + 2-way EDL user for 50 years	10.214	994.9	7.64

Note:
[(a)] Estimates for 2015.

On the basis of financial analysis of the various scenario options to address the current high toll rates, some of these alternatives fell short as viable solutions from the standpoints of either the concessionaire or the government, or both parties. However, we can attempt to make the following conclusions:

(i) It is highly unlikely that the toll rates be revised to the vicinity of the previous rates of MYR2.90 for Class 1 vehicles. Maintaining the previous rates or increasing by a moderate 10% would not be beneficial to the concessionaire as the expected revenue over the concession period up to 2042 would not be sufficient to satisfy the pre-requisites as discussed in section 4.2.

(ii) While the low toll rates may please the general public and merit in terms of cost containment, the approach to suppressing the toll rates or adjusting the previous rates by 10% would imply that there is high possibility for government to pay for any differences by way of monthly compensation to the concessionaire.

Even by additional collection at EDL as depicted in Case 3, the approach to maintain the original CIQ rates or increasing it by 10% is still not workable for the concessionaire, unless with compensation from the government.

(iii) The strategy of pricing the toll at current rates on single-way collection, i.e. MYR 9.70 for Singapore-Johor direction could be feasible. At a single-way collection, the EDL project would still generate positive cash flow to pay for operating and maintenance cost, while maintaining adequate margin for loan servicing.However, the financial analysis appeared to be unfavorable to the operator since the rate of return is lesser than the weighted cost of capital.

Nevertheless, for the daily commuters (Class 1 vehicle), this pricing strategy would still constitute a significant increase of 234%. For the business and commercial sectors, there is high chances that they are unable to absorb the over 220% cost increase (versus the rates before 1 August 2014), without having squeezed margins, or without having to pass the cost onto their customers.

(iv) The extension of toll collection period is will benefit the concessionaire in terms of generating a higher NPV, as demonstrated in Case 5 in comparison with Case 4.

(v) The analysis revealed that if the toll rates have to be revised downwards to lessen the burden on the public and commercial, or to avert government's compensation, then the toll pricing should be designed to include collection at EDL. The financial analysis on Cases 6 and 7 divulged the point that the inclusion of the EDL traffic volume that is currently not levied would make a huge difference in providing a win-win solution for the three parties involved.

(vi) As illustrated in Table 8 above, the assessment of Case 7 exhibits the potential of collection from EDL and extending the length of concession terms in achieving a

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more balanced approach of pricing that address the concern the interested parties. The concessionaire is expected to be minimally compensated, unless the government trade-off with a longer concession period[20].

V. RECOMMENDATIONS ON PAY-PER-USE TOLL STRUCTURE

While the public appreciate the objective of the EDL to disperse traffics and to reduce traffic congestion; and the collection of toll charges are being used for the maintenance of the EDL, due consideration should be given to the toll payers who currently use the lesser part of the EDL. On the other hand, the public can no longer expect to enjoy toll-free facilities indefinitely, because any prolonged toll-free would mean that the government has to borne the compensation to the concessionaire using tax payers' money.

From our assessment, we can conclude that there are two very crucial issues facing the implementation of toll on the EDL. Firstly, the increases from both countries would indefinitely Increase the cost of business, and consequently would have knock-on effects on the prices of goods, thus adding burden to the general public. Secondly, the manner the toll issue either being address or being eluded by certain parties lead to a conclusion that we would not expect any cordial cooperation to tackle this challenging issue with the intention to enhance the competitiveness and benefit of both parties, at least not for the immediate term.

This leads to the conclusion of our analysis that the immediate strategy is to address the issue on our part quickly. Indeed, we have more control over our policy, and if the toll rates have to be reviewed downwards to lessen the burden on the public and on commercial grounds, while averting government's compensation, then the toll pricing should be designed in such a way to include collection along EDL expressway. The government should re-consider its decision on the current rates on grounds of fairness, since the majority consumers who get into the CIQ complex and towards Singapore are the ones less likely to use the entire EDL expressway.

A. Proposed solutions to the current toll rates

The analysis in Section 4 shows that it is no longer practical and sufficient to maintain the previous rates of MYR2.90 (Class 1), unless the government is prepared to compensate the concessionaire of any shortfall as stated in the Concession Agreement signed in 2007. It can also be reasoned from the analysis that if the present applied toll rates have to be reduced in order to lessen the burden on consumers and to keep the business cost in check, the best option would be to include a minimal collection on EDL users.

Fundamentally, the proposed toll structure should meet the pre-requisites of generating the a stream of revenue that are sufficient to sustain the operating and maintenance costs, and payment of interests on loans while providing adequate and fair returns to the concessionaire. The toll structure should be within affordability parameters of general consumers and commercial users, while minimizing the government's burden or conceding funds as compensation by forgoing other potential projects that potentially have multiplier effects on the economy

The appraisal of a variety of options in Section 4 concludes that the inclusion of EDL traffic volume would have made huge differences in providing the required revenue to sustain the operations of the expressway. The best solution to address the present controversy is for the government to re-consider its decision on free-of-charge EDL expressway. Instead, the principles of fairness and pay-per-use at exit points should be highly advocated.

One very crucial determining factor in our proposed structure is the manner of reciprocal and symmetrical toll being charged by Singapore. It is prudent at this stage to assume that any immediate cordial cooperation to tackle this issue would see Singapore retracting their hike intention effective from 1 October 2014. The Singaporean authority is very clear and consistent with their matching policy, thus the ball is very much at the Malaysia's court to reduce the rates.

Based on the above reasoning, the following are 4 viable options to be considered by the government as conceivable Pay-Per-Use solutions to address the impending high tolls issue:

SERC Proposal:	Pay-per-Use based on previous CIQ toll rate + toll charges on EDL use
Comparison 1:	Reduced CIQ toll rate payable on both ways + toll charges on EDL use at double of current PLUS rate
Comparison 2:	Reduced CIQ toll rate payable on both ways + toll charges on EDL use at 1.5 times of current PLUS rate, with extension of concession period.
Comparison 3:	Lower than current CIQ toll rate + minimal toll charges on EDL, with extension of concession period

B. Summary on pay-per-use strategy

With the introduction of Pay-per-use toll collection as proposed above, all users are required to pay for using and gaining benefits of the EDL. It is worthwhile to consider having toll booths at the EDL interchanges, despite earlier explanation that it is not advisable to build two collection booths along the 8.1 km expressway in anticipation of traffic congestion. The possibility of traffic bottleneck, however, can be unravelled by the implementing the cashless toll collection, as already widely practised in most advance

[20] The summary worksheet analysis of the above alternatives with adjustments to the toll rates and concession periods are not shown here for brevity reasons and is available upon request in writing to the corresponding author.

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countries. Ideally, pay-per-use toll at Bakar Batu interchange would deal with use users who exit at this interchange to use surrounding roads to the city centre, or to proceed towards the direction of Pasir Gudang. EDL Users exiting at CIQ interchange (without entering the CIQ complex) can also be imposed a fair toll based on distance travelled. As compared to the present narrow way of charging, the scope of coverage would be extended wider with a much lower toll rate. After all, users who are unwilling to pay-per-use do have the alternative of non-toll roads, or prepare to embrace the traffic congestion or longer route in lieu of toll payment.

From our assessment, we can conclude that there are two very crucial issues facing the implementation of toll on the EDL. Firstly, the increases from both countries would indefinitely Increase the cost of business, and consequently would have knock-on effects on the prices of goods, thus adding burden to the general public. Secondly, the manner the toll issue either being address or being eluded by certain parties lead to a conclusion that we would not expect any cordial cooperation to tackle this challenging issue with the intention to enhance the competitiveness and benefit of both parties, at least not for the near term.

This leads to our recommendation for an immediate approach is to address the issue within our own jurisdiction quickly. Indeed, we have more control over our policy, and if the toll rates have to be reviewed downwards to lessen the burden on the public and on commercial grounds, while averting government's compensation, then the toll pricing should be designed in such a way to include collection along EDL expressway.SERC Proposal and the respective comparisons are intended for the government to consider the possible manageable and moderate toll rates so that the issue could be resolved without further delay.

C. Other recommendations

V.C.1 Establish toll variations to relieve the burden

Typically tolls vary with distance travelled and based on the type of vehicles. A distinct variation that have been long practiced and adopted is the toll rate according to number of axles and the inclination of the vehicle towards the damage on the expressways. There are other options which can be combined with this variation as measures to lessen the burden on consumers and users of the expressway. Some of these measures can be used to further disperse the traffic, thus creating a higher-value-of-time travelling particularly for vehicles like buses and trucks that merit the charging system.

(a) Variation according to time and day of the week - Variation by time of day is typically used where congestion causes considerable delays to commuters. For example, In France, 10% of the commuters have re-scheduled their journeys when the tolls were increased 50% in the peak periods. Likewise, if the EDL concessionaire considers introducing off-peak period toll rates, certain users can opt travelling during those times in order to save cost.

(b) Tolling by occupancy - Singapore is a good example of congestion pricing, where users are charged according to different times automatically as vehicles pass under the gantries. Such pricing have reduce the number of solo drivers, and shifting the trips to non-peak time, thus led to less travelling time. Based on this model, the authorities may wish to consideradopting similar approach on our highway system so that users can capitalize on the incentives for off-peak toll rates or waiver for high occupancy vehicles.

(c) Loyalty or Discount programs. With the introduction of electronic tolling system, such programme is now more feasible to be implemented. Furthermore electronic tolling can be convenient and benefit from lower collection cost which should be passed back to consumers. For example, MRCB can accord special privileges to frequent or daily users with special privileges such as huge discounts of up to 50% if they achieved a minimum of 50 transactions per month.

V.C.2 Encourage the use of public transportation

Instead of driving across to work daily, Malaysians working in Singapore can opt for a more economical option for travelling by road to Singapore by using public transportation such as bus or by rail, i.e. increasing public bus network and frequency. Although toll charges on busses have also increased, the choice of using public busses would help to ease the cost burden of driving across. A more regular train service in order to support commuters who wouldbe opting for cheaper alternative to crossover to Singapore[21] could allow commuters to switch to public transportation instead of driving.

V.C.3 New revenue vs AEC 2015 implementation

If the government decides to review and subsequently revise the toll rates downwards, it can make up for the loss in toll revenue by re-considering the imposition of vehicle entry fee for foreign-registered car entering Malaysia. Singapore has been practicing this for many years, and has since 1 August 2014 revised the vehicle entry permit (VEP)[22] fee from SGD25 to SGD30 per day for private cars. For goods vehicles, the GVP fee is now at SGD40 per month from SGD10. The fees on motorcycles remain unchanged at SGD4 per day. Although the GVP may seem to have increased by 300%, one should not overlook the fact that the GVP fee has remained at SGD10 per month per vehicle since it was first

[21] *There are current five KTM train services daily from Johor Bahru (JB) Sentral-Woodlands CIQ and vice-versa, but these may be far from adequate in meeting the peak hours crossings. The trains departing from JB Sentral are 0500/0620/1140/1405/2105 hrs, while departing from Woodlands CIQ are 0820/1605/1830/2000/2330 hrs.*

[22] *VEP are only imposed during weekdays (Mondays to Fridays) during 2am-5pm; and during Singapore school holidays (2am – 12 pm). No VEP fee is payable for other times during weekdays, Saturdays, Sundays and Singapore public holidays.*

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introduced way back in 1965. The VEP was last raised in 1994 to SGD30 from SGD20, but was revised downwards to SGD25 in 2004. [23] On the counterpart, the Malaysian Government have decided to impose VEP for all foreign vehicles coming into Malaysia from all border checkpoints, commencing with the Johor-Singapore Causeway in October 2015. A vehicle entry permit fee of MYR20 per vehicle was proposed and deemed reasonable so as not to discourage the inflow of vehicles from Singapore, particularly the buyers and consumers who have been supporting the retail, food and recreation businesses in the southern region. [24] Johor's economy is also reliant on the crossovers by Singaporeans to enjoy the lower prices. Nevertheless, the implementation is likely to be postponed owing to sensitivity as many sees this implementation will lead to further tit-for-tat with Singapore.

V.C.4 Engagements and public consultation

(a) The authorities should have more engagements with the commercial enterprises and solicit views from the consumers before revising the toll charges. The actions of increases by both Singapore and Malaysia parties at a same time are already perceived as a no coincidence, but misconstrued as tit-for-tat. Whether it is pure coincidence or retaliation, the private sectors of the two countries should also be working together to deliberate and address these issues, which if not resolved, would have spillover effects that potentially cause pressure to the trade and commercial, and distress to the general public.

(b) Learning from our past experiences, the greatest impediment to tolling is the public acceptance of the toll rates. Expressways usually must be of a sufficient economic size or length to offer the ample benefits that merit the toll payment. The government must therefore ensure that the toll project must not be too costly to be financed solely with affordable toll rates.

In most of our expressways projects, the Government agrees to compensate the concessionaire for infringement of the concession agreement commonly associated with the agreed toll rates. But, the obligation and the ability of the government to provide compensation are very critical issues that should no longer be allowed topersevere. Public resistance towards tolling can be minimalized only if there is more transparency on the project and efforts to instill the concept of road pricing to the public. Therefore, any government policy in deciding on toll rates should be based on comprehensiveevaluation of financial benefits from the perspective of both toll operator and the users or public.

(c) Effective Outreach Efforts

Public outreach has proven effective in garnering support for value pricing projects and creating an understanding of the tolling concept. To effectively gain public support, it is important that the public perceive the need for value pricing. Although the Government have given its assurance of no-tolling, whether driven by political reasons or social considerations, it is important that the authorities to view the situation as critical enough to recommend the tolling solution. This involves bringing all the stakeholders together to help create buy-in from the users; and clear communication to the users on the needs to warrant tolling, the value of the toll in addressing the problem, and finally the benefits of sharing the cost efficiently.

(d) Given the profound implications of privatization of roads, the government should be accountable for allowing the toll projects. The authorities must ensure that no deal should be approved unless the general users and business operators have the opportunity of public consultation. The authorities should no longer undermine the importance of transparency and public interest. Instead, the government should take more effective role in overseeing the agreements with concessionaires that may have adverse implications and knock-on effects on the national economy.

Finally, although the government have taken two years to make its assessment on this matter, it is fair that the governments re-look and re-consider the appeals and come out with an appropriate and feasible solution for the benefits of all parties, i.e. consumers, commercial, concessionaire and government.

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POSTSCRIPTS

After so much of contraversial issues, in the Malaysia 2018 National Budget Speech on October 2017, the Government of Malaysia decided to abolish toll collections at Eastern Dispersal Link (EDL), Johor, effective 1 January 2018.

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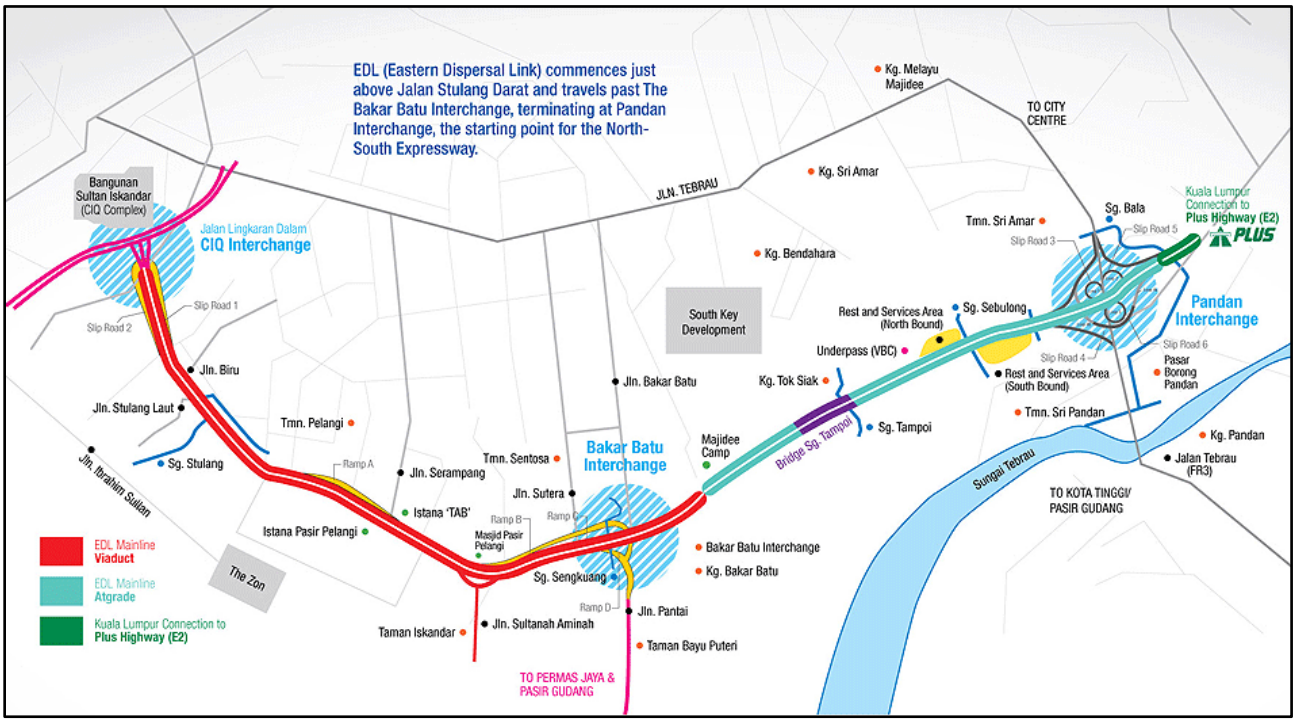
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Appendix A. Map of Eastern Dispersal Link (EDL) in the Southern region of Malaysia linking the North-South Expressway to the Johor-Singapore Causeway via the CIQ Interchange



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Cerium Oxide Nanoparticles and Alzheimer's Disease

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***Abstract*— Alzheimer's disease is a chronic neurodegenerative disease and the most common form of dementia in elderly. About 35 million people worldwide are diagnosed with the disease. To date, there is no cure for the disease. The current available treatments are mainly to treat symptoms associated with the disease. Alzheimer's disease is a costly disease. The financial burden of the disease is overwhelming for patients and their caregivers. Therefore, finding a treatment to cure, or at least halt the disease progression is necessary. Progressive memory impairment and cognitive decline are the major symptoms of the disease. Alzheimer's disease is associated with the presence of senile plaques in the brain areas responsible for learning and memory. Senile plaques are extracellular deposits of insoluble amyloid-beta (Aβ) peptide. Aβ is toxic and has been shown to cause death in many cell types including SH-SY5Y cells. SH-SY5Y cells are human neuroblastoma cells. Aβ-treated SH-SY5Y cells are a popular Alzheimer's disease model for in vitro studies. Cerium oxide nanoparticles have been demonstrated to have potential anti-oxidant and anti-apoptotic properties. We hypothesized that cerium oxide nanoparticles can alleviate Aβ-induced death in SH-SY5Y cells. Cell viability was quantified using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay. We found that the cell viability was reduced to ~75% when treated with Aβ25-35 (50 µM) for 2 days. Cerium oxide nanoparticles (25-100 µg/ml) were able to alleviate Aβ-induced cell death in a dose-dependent fashion. SH-SY5Y cell viability was restored back to ~90% when the cells were treated with 100 µg/ml of cerium oxide nanoparticles. Overall, our results suggest that cerium oxide nanoparticles could be potentially used for the treatment of Alzheimer's disease.**

***Keywords*— Alzheimer disease, amyloid beta-peptides, cell death, cerium oxide, dementia**

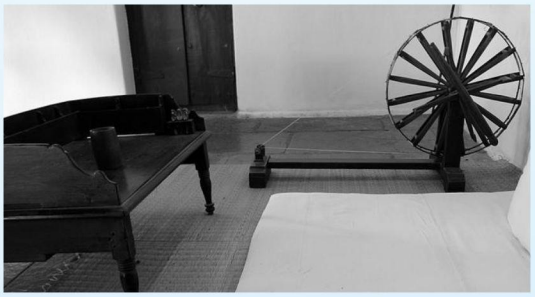
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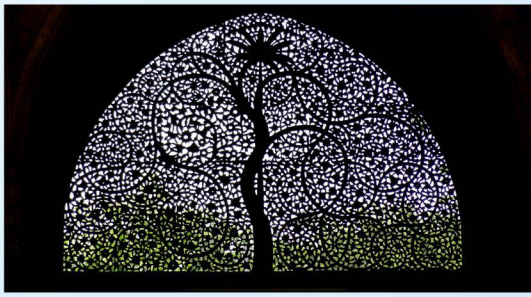
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