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Dear Readers,

The qualitative and timely publication of Vol. VII / Issue-II (Jul–Dec 2017) of our esteemed International Journal of Engineering, Sciences and Management (ISSN: 2231-3273) has brought great joy and happiness to the entire fraternity of the journal and honorable members of the Editorial and Advisory Board. The board members rich experience and varied expertize is providing immense succour in propelling the journal to attain an envious position in areas of research and development and accentuate its visibility. The distinctive feature is indexing of the journal by Jour Informatics, Index Copernicus, Google Scholar and DOAJ. It is a matter of great pride and honor that the journal has been viewed by researchers from one hundred and thirty nine countries across the globe. The aim of journal is to percolate knowledge in various research fields and elevate high end research. The objective is being pursued vigorously by providing the necessary eco-system for research and development.

Large number of research papers were received from all over the globe for publication and we thank each one of the authors personally for soliciting the journal. We also extend our heartfelt thanks to the reviewers and members of the editorial board who so carefully perused the papers and carried out justified evaluation. Based on their evaluation, we could accept twelve research papers for this issue across the disciplines. We are certain that these papers will provide qualitative information and thoughtful ideas to our accomplished readers. We thank all the readers profusely who conveyed their appreciation on the quality and content of the journal and expressed their best wishes for future issues. We convey our deep gratitude to the Editorial Board, Advisory Board and all office bearers who have made possible the publication of this journal in the planned time frame.

We invite all the authors and their professional colleagues to submit their research papers for consideration for publication in our forthcoming issue i.e. Vol. VIII | Issue I | Jan–Jun 2018 as per the "Scope and Guidelines to Authors" given at the end of this issue. Any comments and observations for the improvement of the journal are most welcome.

We wish all readers meaningful and quality time while going through the journal.

Wg Cdr (Prof) TPN Singh
Executive Editor
International journal of Engineering, Sciences and Management (IJESM)
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Dec 2017

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EFFECTS OF BIODIESEL ON ENGINE PERFORMANCE AND TAILPIPE CHARACTERISTICS

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ABSTRACT

This paper presents the findings of the effects of biodiesels B5, B20, and B99 on engine performance and tailpipe characteristics in comparison to Diesel #2. A single cylinder diesel engine with a dynamometer and a portable gas analyzer are used for experiments. Thermal efficiency, emissions of CO_2, NOx, CO, HC are measured at a wide range of engine speeds from 1000 rpm to 2500 rpm and at three loads of 4.32 Nm, 6.48 Nm, and 8.64 Nm. The results show that the biofuels tested affect the engine efficiency and tailpipe characteristics differently at different loads.

Keywords: Biodiesel, Efficiency, Tailpipe Characteristics.

1. INTRODUCTION

In an effort to abide by growing governmental demands steps are being taken to create alternate fuels in order to reduce the use of limited fossil fuels. By the year 2022 the Unites States Department of Energy's Renewable Fuel Standard (RFS) dictates that 36 billion gallons of renewable fuel be blended into transportation fuels [1]. Such fuels, particularly ones deemed renewable, need to be high in energy density and emit fewer greenhouse gases than would a typical petroleum based fossil fuel. Such a fuel must be compatible with internal combustions engines found in transportation vehicles as transportation is such a major consumer of fossil fuel. One such alternative to conventional fossil fuels is biodiesel. Biodiesel is a renewable energy source that is also biodegradable [1], making it an attractive alternative to fossil fuels, even to petroleum based diesel. Biodiesel is often made from vegetable oils, such as corn or animal fats that undergo a transesterification process and produce alkyl esters [2]. Since these biodiesels are derived from plant matter the carbon emissions they release can be absorbed by crops also used to produce biofuel, thus creating a possibly carbon neutral life cycle. It is also considered an Advanced Biofuel and a Biomass-Based Diesel, meaning that is a renewable fuel source made from feedstocks and reduces Green House Gas emission in its lifecycle by at least 50% [1].

Biodiesels, namely ethanol derived from corn or sugarcane, have been studied [3]. However other blends of biodiesel have yet to be examined namely biodiesels that use biofuel derived from non-edible oils. Such biodiesels must be compatible with preexisting diesel engines, or at the very least require minimal alterations. It is for this reason some fuels are over looked as they require changes to an engine in order for proper combustion to occur. Such fuels must have high cetane numbers to limit ignition delay and low viscosities to avoid build up in the engine. Biodiesels have generally comparable cetane values along similar energy densities and heat of vaporization, when compared to petroleum based diesel [4]. With the idea that a renewable fuel would be used for transportation in mind, it is important to study the emissions and performance of the test fuels through a basic diesel internal combustion engine.

Monitoring the emissions of varied blends of biodiesel is imperative. The combustion of a biodiesel blend will emit carbon dioxide CO_2, unburned hydrocarbons (HC), carbon monoxide CO, NO_x emissions, and particulate matter (PM). The overall usefulness of a biodiesel most not only burn cleaner than petroleum based fuels, but also carry enough energy to be a suitable transportation fuel, and thus deliver similar energy outputs.

2. EXPERIMENTAL METHOD

The fuels tested included, Diesel #2, B5, B20, and B99. Diesel #2, B5, and B20 were obtained from Propel and B99 was obtained from Downs Energy Fuel and Lubricants. Diesel #2, B5, and B20 has a fuel density of 740 $\frac{kg}{m^3}$ as well as a calorific value of 43.8 $\frac{MJ}{kg}$ B99 has a density of $\frac{kg}{m^3}$ 740 however its calorific value is $\frac{kg}{m^3}$ 37.4. In this regard, the amount of biofuel found in the fuel has little effect on its density and calorific value.

In order to test the various fuels, a Modified 4 Stroke Diesel Engine TD212 from TecQuipment was used. The engine has a max power and torque output of 3.75 kW and 10.8 Nm respectively, at 3000 rpm. The compression ratio is 22:1 with a 232cc capacity. The engine is attached to a dynamometer and has a volumetric fuel gauge. An engine cycle analysis software and Enerac portable gas analyzer are installed. The exhaust system has a thermocouple installed to measure exhaust gas temperatures. A Kistler pressure sensor is installed, to measure the cylinder head pressure of the engine.

Table 1: Engine specifications

Engine type	**Equipment (TD212)**
Fuel Injection System	Direct
Max Power (Kw)	3.75
Compression Ratio	22:1
Number of Cylinders	1
Number of Cycles	4
Intake system	Naturally Aspirated
Cooling system	Air cooled
Engine Capacity (CC)	232

An encoded is attached from the dynamometer to the Data Acquisition (DAQ) system. This DAQ system is equipped with a computer GUI and a data analysis software. The software directly measures the engine parameters: engine speed in rpm, engine torque in Nm, engine power in W, ambient air temperature in ˚C, exhaust gas temperature in ˚C, differential pressure in the engine's intake system in Pa. The parameters calculated include heat of combustion, air mass flow rate, fuel mass flow rate, and thermal efficiency. Theses parameters help to examine the performance of the Biodiesels tested.

To measure the actual emissions of each of the fuels, the Enerac portable emission analyzer system was connected to the tailpipe. The system recorded , O_2 CO_2 , CO, NO_x , and HC concentrations that are created during combustion. The Enerac can measure oxide from 0- NO_x 25%, from 0-5000 ppm, and uses a non-dispersive infrared gas sensor to measure CO from 0-15%, CO_2 , from 0-20%, and HC from 0-30000 ppm.

The fuels were tested at four different speeds, evenly incremented in 500 rpm intervals from 1000-2500 rpm. Each fuel was tested at 3 different target loads 4.32, 6.48, and 8.64Nm. Each load case was tested with the given rpm range and interval.

First the engine was brought to the sampling rpm with the specified target load via the dynamometer. At each incremental step, the engine performance parameters were recorded for 2 minutes under steady state conditions. Here steady state is determined by monitoring the exhaust gas temperatures. Steady State is reached when the exhaust gas temperatures converge to a single temperature or to changes of less than 1% per minute. Emissions were collected after steady state was reached and were collected for 10 minutes. At the end of the data collection periods, the data was averaged over 2 minutes for performance data and 10 minutes for emissions data.

3. RESULTS AND DISCUSSION

3.1 Thermal Efficiency Looking at the thermal efficiency data in Figures 1-3, it is seen that B20 has an efficiency between 60% and 80% for all three loads over the entire tested rpm spectrum. B5 tends to decline in efficiency as rpm increases from all load cases. B99 has comparable efficiencies to both B5 and B20, however for 4.32 Nm and 6.48 Nm loads, there is a near 20% drop in efficiency around 1500 rpm. The regular petroleum based Diesel #2 holds similar trends for all load cases and similar characteristics over the rpm range. In general, the efficiency of Diesel #2 is below that of B20 and B99.

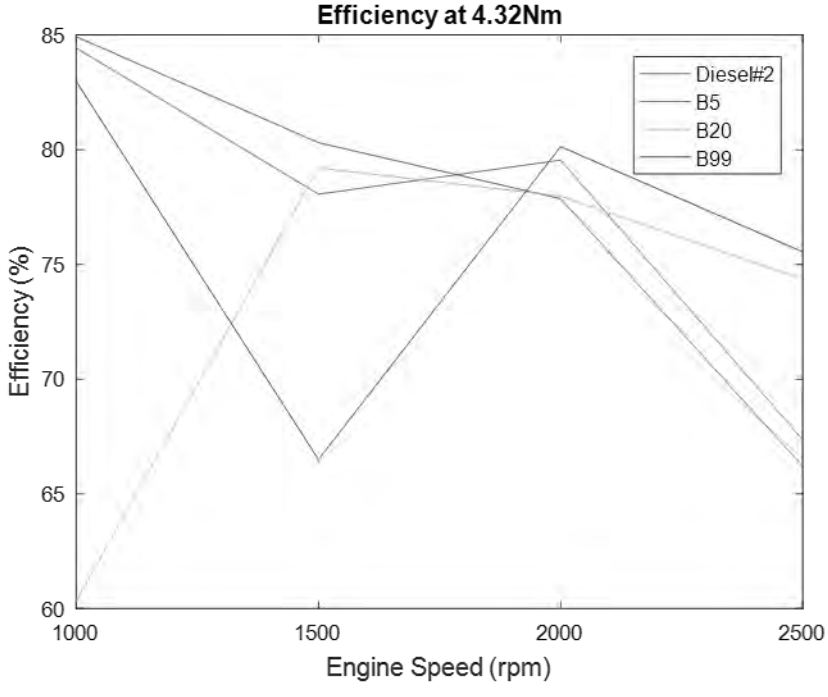

Figure 1: Efficiency of various fuels with 4.32Nm load

B5 and Diesel #2 behave most similarly in terms of thermal efficiency at all conditions studied. This is likely due to the fact that B5 has the least amount of Biofuel and is most similar to the petroleum based diesel #2.

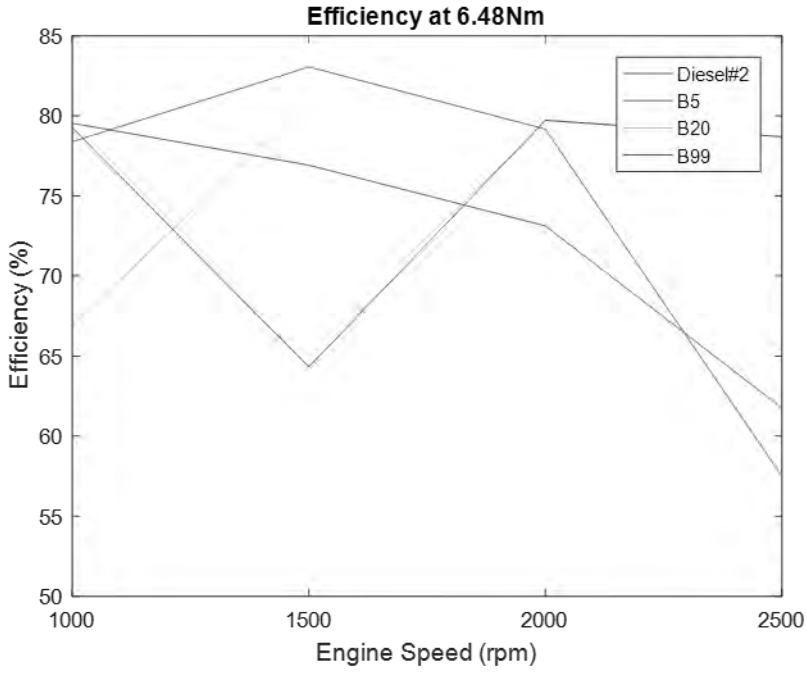

Figure 2: Efficiency of various fuels with 6.48Nm load

B99 has the greatest efficiency when engine speed is above 2000 rpm at all three loads. B5's efficiency drops quickly as the rpm increases. Its close counterpart Diesel #2 has similar characteristics.

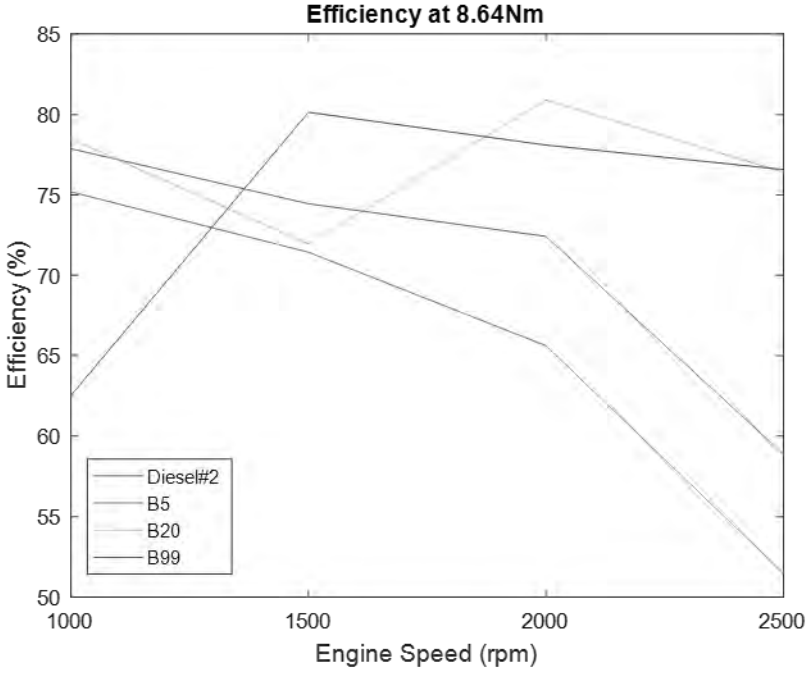

Figure 3: Efficiency of various fuels with 8.64Nm load

In all accounts, biofuel increases the efficiency of diesel. The efficiency of Diesel #2 is below all other test fuels. This indicates that biodiesels can and do have higher efficiency ratings than regular petroleum based diesels, particularly Diesel #2. To this end however in can be seen that B99 has high efficiency at above 2500rpm.

3.2 Emissions Looking at Figure 4 of the emissions in terms of percentage of Carbon Dioxide at 4.32NM it can be seen that both B99 and B20 have higher percent values of Carbon Dioxide emissions than Diesel #2 and B5. Once again the similarity between B5 and Diesel #2 can be contributed to the fact that B5 is most similar to Diesel #2. When the max load of this study is applied, the Carbon Dioxide emissions prove similar for B20 and B99 as well as B5 and Diesel #2. This trend that can also be seen in Figures 5 and 6, indicates that higher levels of biofuel in diesel create greater carbon dioxide emissions, they do however hold a higher efficiency as discussed prior.

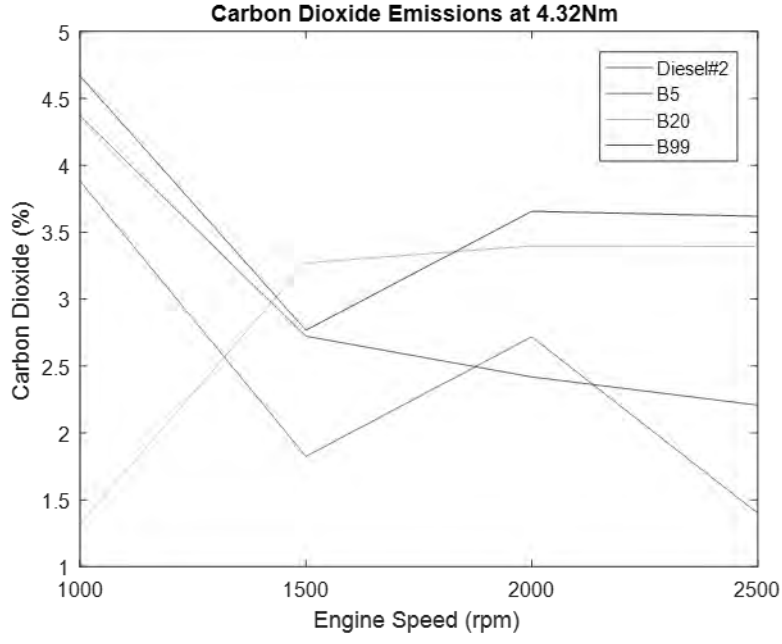

Figure 4: Emissions of Carbon Dioxide at 4.32Nm Load

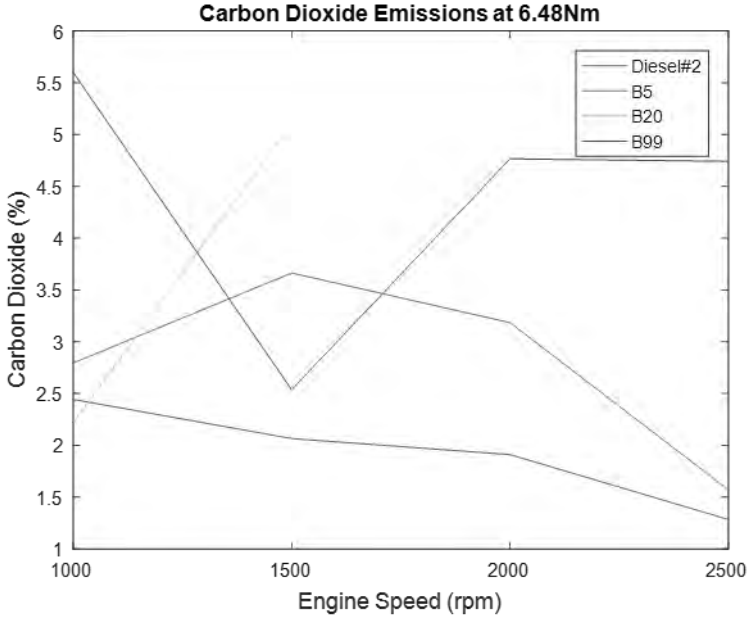

Figure 5: Emissions of Carbon Dioxide at 6.48Nm

The trend for 6.48Nm load is similar to that of 4.32Nm. B99 continued to have higher CO_2 emissions. The petroleum based product had the least amount of CO_2 emissions overall for the highest load case as can be seen in Figure 5. Comparing Figures 4, 5, and 6, Diesel #2 and B5 have lower levels of CO_2 emissions.

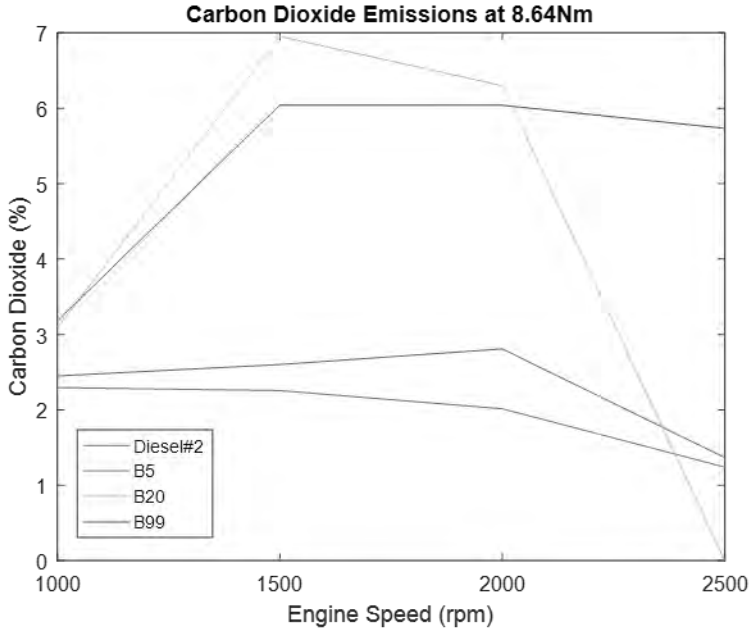

Figure 6: Emissions of Carbon Dioxide at 8.64Nm load

Another emission that is a product of combustions is NO_x gases. In general, the higher the load is, the higher the NO_x emission is due to the increased combustion temperature [5]. Looking at Figure 7, B99 is notably lower in its NO_x emissions, especially under 2000 rpm, with a positive slope as rpm increases. B20 has high emissions of NO_x, but then proceeds to drop quickly around 1500 rpm. Among all the load cases, the general trend is that while B5, Diesel #2, and B20 have negative slopes with increasing rpm ranges, B99 increases.

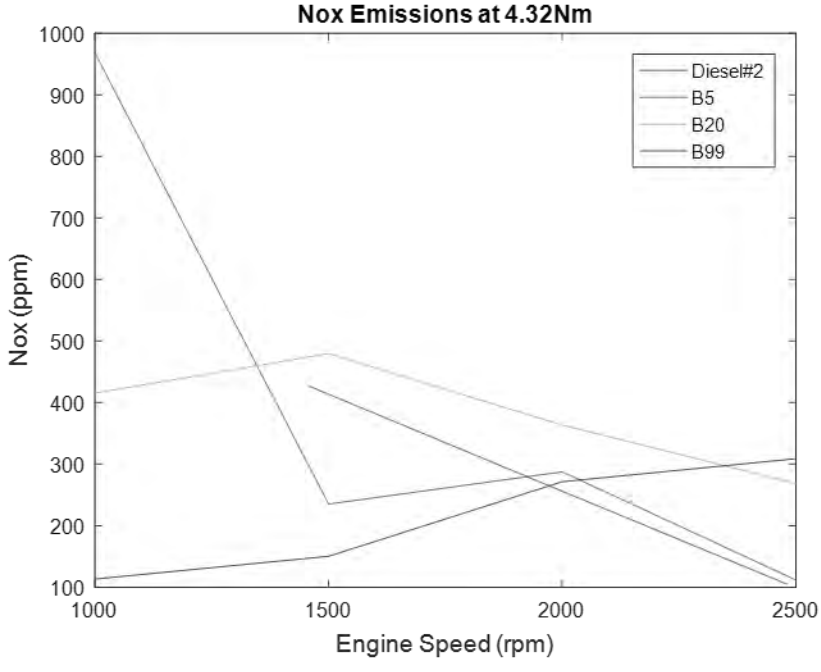

Figure 7: NO_x Emissions at 4.32Nm

In Figure 8, in which the load increases to 6.48 Nm, B5 and Diesel #2 continue to have the similar negative slope. Once again B5 and Diesel #2 have similar behavior. At 2500 rpm both are producing less NO_x.

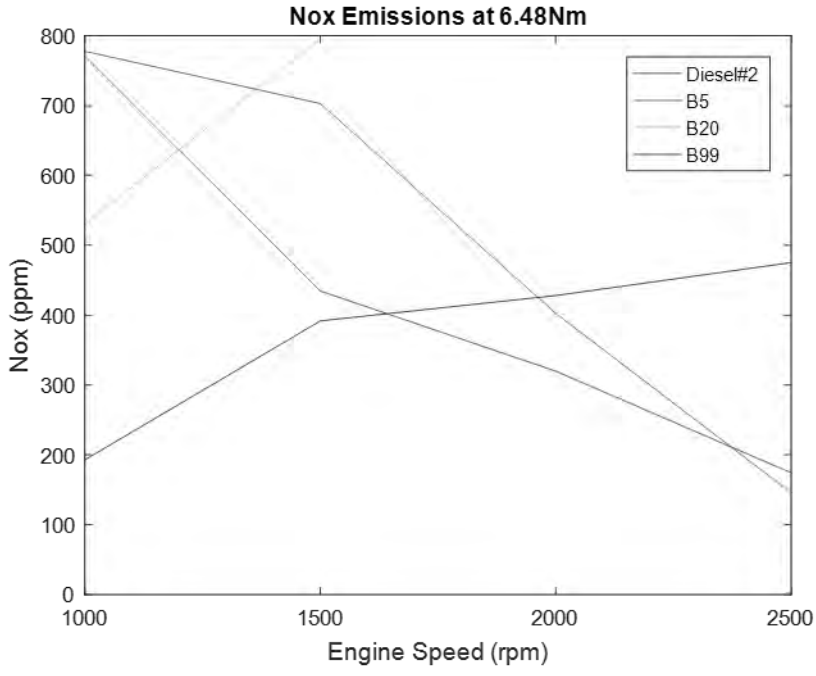

Figure 8: Emission of NO_x gases at 6.48Nm

In Figure 9 in which the load increases to 8.64 Nm, once again B5 and Diesel #2 have a lower emission rating. B99 ends at 2500 rpm with just under 700 ppm. Overall B5 and Diesel #2 have lower emission trends as opposed to B99 and B20 which appear to increase emission concentration with increases in rpm

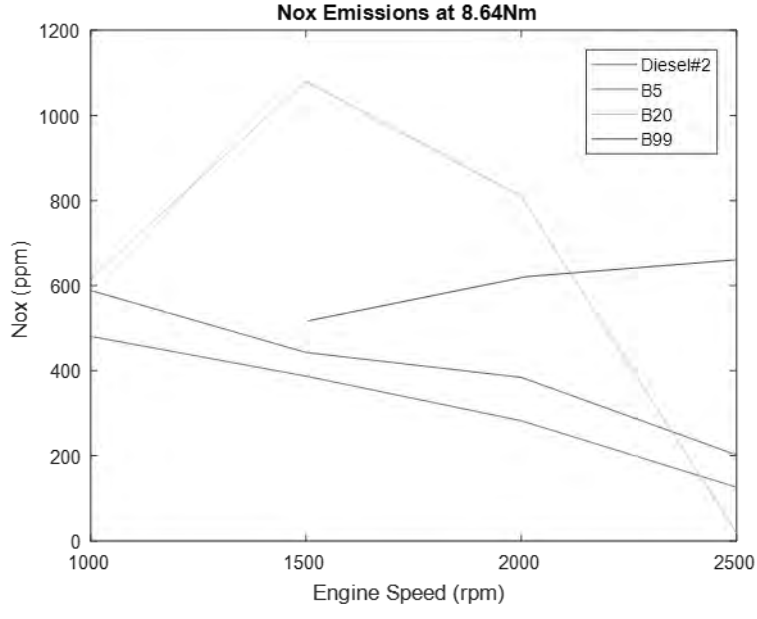

Figure 9: Emission of NO_x gases at 8.64Nm.

Figure 10 presents the CO emissions from all fuels studied at load of 4.32 Nm. The carbon monoxide emissions are lower than that of NO_x. B5 and Diesel #2 have similar trends again. B99 continued to have higher amounts of emissions but it decreases as engine speed increases.

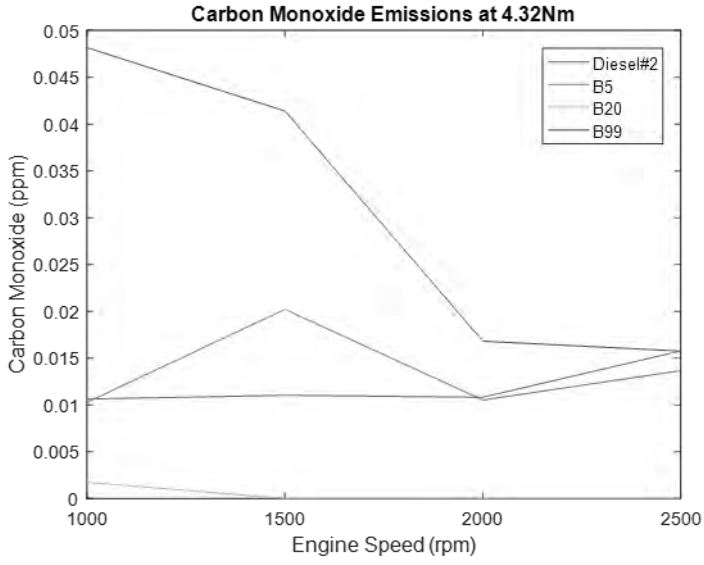

Figure 10: CO emissions as 4.32Nm

Figure 11 shows the emission of Hydrocarbons at load of 4.32 Nm. B99 has the highest emission of HC below 2000 rpm but the lowest above 2500 rpm due to a rapidly decreasing trend over engine speed. B5 and Diesel #2 are still similar but not as close as in other figures. B5 has a greater emission than Diesel #2 below 2500 rpm but lower when engine speed is above 2500 rpm. Emission of HC from Biodiesels decreases as engine speed increases. B99 has the highest reduction rate than other biodiesels. However, emission of HC from Diesel #2 actually increases as engine speed increases.

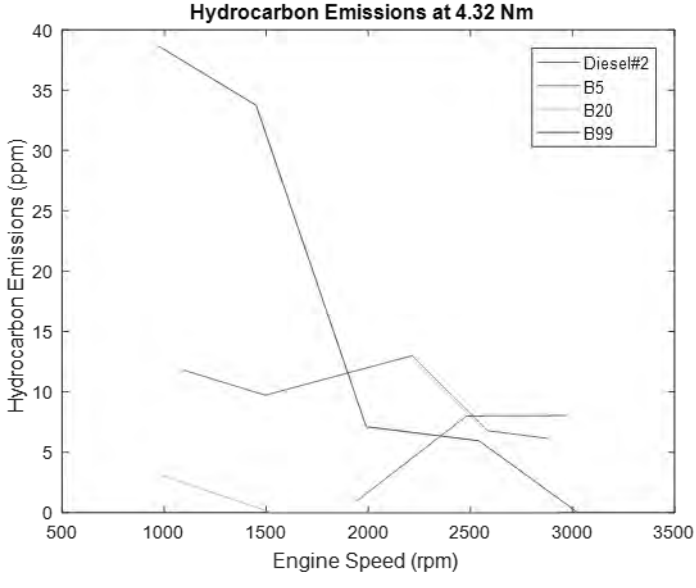

Figure 11: Hydrocarbon Emissions at 4.32Nm

4. CONCLUSION

Experimental studies were conducted to evaluate the emissions and performance of biodiesels B5, B20, and B99 in comparison to traditional petroleum based diesel #2. Each fuel was tested at three different loads, 4.32 Nm, 6.48 Nm, and 8.64 Nm, and at 4 different target engine speeds, 1000 rpm, 1500 rpm, 2000 rpm, and 2500 rpm.

The results indicate that varied levels of biofuel do in fact affect not only the efficiency of the engine it is burning in, but the emissions as well. Generally, the amount of biodiesel in the fuel blends positively affects the thermal efficiency of the engine, especially when the engine speed is above 1500 rpm at all loads studied. B99 has the highest thermal efficiency when the engine speed is above 2000 rpm.

The emissions of the test fuels varied greatly but generally the content of biodiesel tents to increase of emission of CO_2, CO, and HC. The effects of biodiesel on the emission of NOx varies greatly for the biodiesels studied here at different engine loads and engine speeds.

In summary, for the fuels studied here, biodiesels tend to increase the thermal efficiency of an engine but also increase the emissions of CO_2, CO and HC.

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LUCENEX: A SEARCH ENGINE FOR XML DATA ON TOP OF APACHE LUCENE

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ABSTRACT

In this research paper, we have developed a prototype system termed LuceneX that serves as a search engine for XML data across a directory containing XML documents. Our search engine was built on top of Apache Lucene, which is a high-performance, simple text based search engine library written entirely in Java. We utilized Windows Forms in .NET framework to design and implement the graphical user interface of LuceneX. In order to embed Java code into .NET application, we leveraged IKVM.NET to convert our Java code into .NET DLL files.

Keywords: XML, Search Engine, Apache Lucene

1. INTRODUCTION

As we know, XML has become the standard form for representing and exchanging data on the web, there is an increasing interest in indexing, querying, and ranking text-centric XML documents. XML query languages, such as XPath [13] and XQuery [14], were very powerful in expressing exact queries over XML data, but they did not meet the needs of the IR community since they were lacking of full-text capabilities.

In order to support full-text search functionalities over XML documents, we built a XML search engine called LuceneX, that supports a variety of XML full-text search queries over XML data. Our search engine was built on top of Apache Lucene[5], which is a high-performance, simple text based search engine library.

The rest of the paper is organized as follows: Section 2 introduces Apache Lucene and IKVM.NET, which are the back-ends of our search engine, LuceneX. Section 3 presents our search engine LuceneX in more details, including architecture, GUI design, and type of queries supported. Section 4 discusses related work. Finally, section 5 concludes the paper and presents the future work.

2. APACHE LUCENE AND IKVM.NET

2.1 Apache Lucene Our XML search engine was built on top of Apache Lucene[5], which is a high-performance, scalable, full-featured text search engine library written entirely in Java. Apache Lucene is a technology suitable for applications that requires full-text search, and it is supported by the Apache Software Foundation and is released under the Apache Software License. Lucene offers some powerful full-text search features such as high-performance indexing, ranked searching, different query types(phrase queries, wildcard queries, proximity queries, range queries), fielded searching, and so on.

2.2 IKVM.NET IKVM.NET is an implementation of Java for Mono[16] and the Microsoft .NET Framework[17]. It includes the following components[15]:

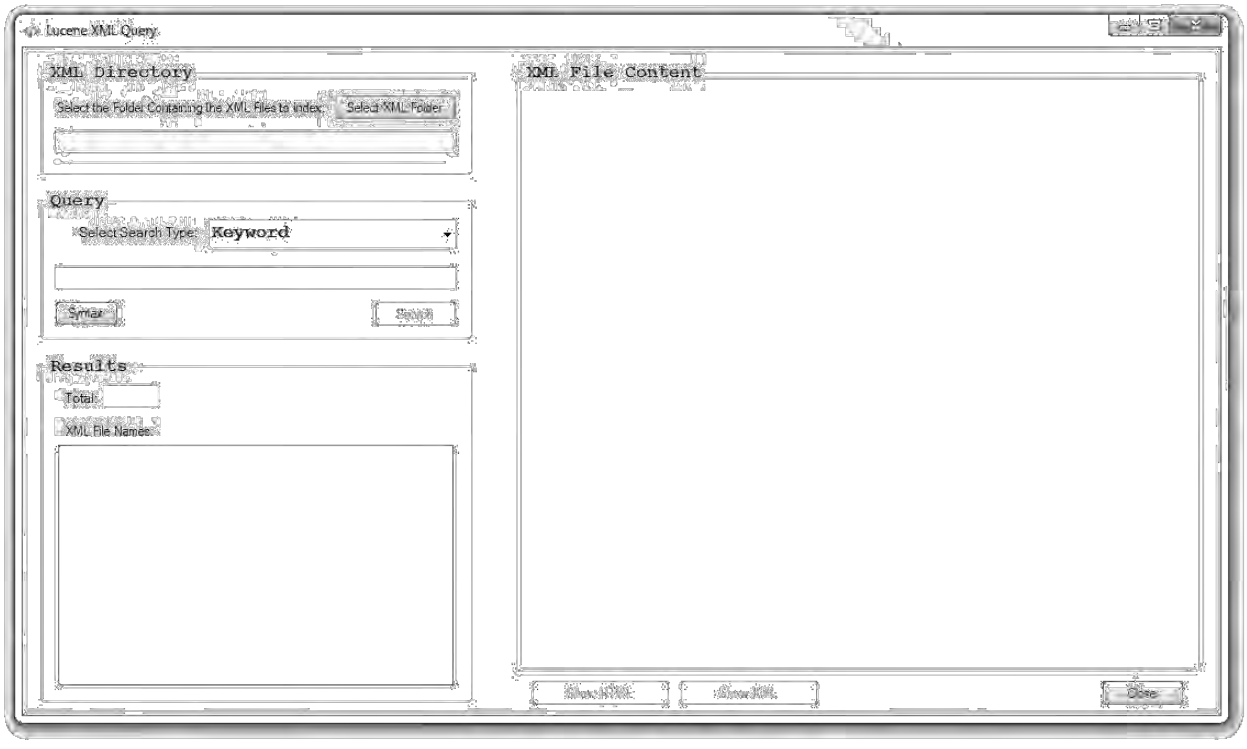
- A Java Virtual Machine implemented in .NET
- A .NET implementation of the Java class libraries
- Tools that enable Java and .NET interoperability

In order to embed Java code into our .NET Windows Forms applications, we leveraged IKVM.NET to convert our Java code into .NET DLL files. IKVM.NET includes ikvmc, a Java bytecode to .NET IL translator. We run the following command to convert the Java library to .NET dll files: ikvmc -target:library mylib.jar to create mylib.dll.

3. LUCENEX

In order to support full-text search of XML document collections, we have developed a prototype system termed LuceneX that serves as a search engine for XML data across a directory containing XML documents. Our search engine was built on top of Apache Lucene, which is a high-performance, simple text based search engine library written entirely in Java. We utilized Windows Forms in .NET framework to design and implement the graphical user interface of LuceneX. In order to embed Java code into .NET application, we leveraged IKVM.NET to convert our Java code into .NET DLL files.

Our system allows the user to specify a directory of XML documents to create an in-memory index. Then the user may pose a query, with a built-in syntax assist feature, against the index that was created. The query result is a list of XML document hits, each of which can be viewed as a raw document as well as a stylized HTML document. Any well-formed XML document can be styled dynamically, regardless of structure, thanks to a combination of SAX and XSLT technologies built on top of Lucene. The snap shot of LuceneX is shown in the following figure.



Currently, the types of queries supported by LuceneX include simple keyword, keyword intersection, document title, range of document titles, document date range, and proximity of keywords to each other. In addition to this base functionality, it has been expanded to make XML specific searching possible using LINQ to XML. Here tag (element) names can be searched on, as well by a tag's value equaling or not equaling something.

4. RELATED WORK

Since XML is the data format for a wide variety of web data repositories, extensive work has been motivated on designing powerful query languages, developing efficient indexing and query evaluation algorithms, and proposing effective ranking schemes over XML data[1, 2, 4, 18,6, 8]. The related work can be classified into three categories. Approaches in the first category are focused on extending existing complex XML query languages, such as XQuery, with IR search predicates and incorporating simple IR scoring methods into the query evaluation. Khalifa et al[1] proposes bulk algebra called TIX, which integrates simple IR scoring schemes into a traditional pipelined query evaluator for an XML database. More specifically, new operators and efficient access methods are proposed to generate and manipulate scores of XML fragments during query evaluation. TeXQuery[2] supports a powerful set of fully composable full-text search primitives, which can be seamlessly integrated into the XQuery language. It mostly focuses on the TeXQuery language design and the underlying formal model, but also provides a costing model[9]. Strategies in the second category are dedicated to extending traditional IR models for scoring simple XPath-like queries with full-text extension. In [3], the authors present a framework that relaxes a full-text XPath query by dropping some predicates from its closure and scoring the approximate answers using predicate penalties. They further propose novel scoring methods by extending TF*IDF ranking to account for both structure and content while considering query relaxations[4]. Sigurbjornsson et al,[10] propose a framework that decomposes the query into several path-term pairs, evaluates these pairs separately and produces a final ranking that takes into account the scores of different sources of evidence. In the third category, efforts are made to address the problem of efficiently producing ranked results for keyword search queries over XML documents. XRank[7] extends Google-like keyword search to XML. The authors propose an algorithm for scoring XML elements that takes into account both hyperlink and containment edges. New inverted list index structures based on Dewey IDs and associated query processing algorithms are also presented. XSEarch[6] is a semantic search engine that extends simple keyword search by incorporating keyword context information into the query, i.e., each query term is a keyword-label pair instead of a single keyword. XSEarch extends the TF*IDF ranking scheme to rank the results. Another work, XKSearch[11], introduces the concept of smallest lowest common ancestors (SLCAs) and proposes two efficient algorithms,

Indexed Lookup Eager and Scan Eager, for keyword search in XML documents according to the SLCA semantics. Note that all the above proposals consider querying and ranking original XML documents, and returning XML fragments as query answers.

5. CONCLUSION

In this paper, we have developed a full-text search engine on top of Apache Lucene. Our search engine can support a wide range of XML full-text search queries over a collection of XML documents. As our future work, we plan to test our system over a large collection of XML documents in real world. We also plan to develop a ranking scheme which can rank the returned XML documents based on TF*IDF model in IR community.

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UWB SLOT ANTENNA FOR BODY AREA NETWORK (BAN)

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ABSTRACT

An UWB slot antenna has been designed and developed for BAN purpose. It is a compact, low profile and light weight antenna which can be used for on-body communication link. Slot antenna consists of a slot in ground plane and a stub attached with 50Ω feed. The proposed antenna covers 4-10 GHz frequency range antenna with a moderate gain of 4 dB. The antenna has been designed and fabricated on a low cost FR-4 substrate to reduce the cost and physical dimensions of the antenna.

Keywords: Ultra Wide Band (UWB), Slot Antenna, Body Area Network (BAN) and On-Body Communication.

1. INTRODUCTION

Ultra-Wideband (UWB) is defined as a frequency band covering 3.1 GHz to 10.6 GHz. It is a wide bandwidth technology for short range ultra-high speed communications. UWB transmissions represent a bandwidth of at least 500 MHz, as well as bandwidth of at least 20% of the centre frequency. It also offers a bit rate greater than 100 Mbps within a 10-meter radius for wireless communications. The advantages of UWB include low-power transmission, robustness for multi-path fading and low power dissipation.

Printed planar monopole antennas are widely used for UWB communications because they offer wide frequency impedance bandwidth and omnidirectional radiation patterns. Moreover simple structure, easy fabrication on printed circuit boards (PCBs), easy integration with other components and low cost are some additional features of these antennas.

The other proven topology for UWB antennas is slot antennas. In UWB slot antenna design, a large slot is cut in the ground plane to achieve a high level of electromagnetic coupling with the tuning stub. The wide-slot antenna offers wide impedance bandwidth but its operating bandwidth is limited by the degradation of the radiation patterns at higher frequencies [1]. The coupling is thus dependent on the type and shape of stub and slot. The coupling actually controls the impedance matching. In order to optimize the coupling between the microstrip line and the tapered slot, different stub shapes have been studied and reported in literature. Some of the commonly used stub shapes are shown in Fig. 1. For elliptical and circular shape tuning stubs, the impedance matching is very poor due to poor electromagnetic coupling between the feed-line and tapered slot. The rectangular shape tuning stub shows a good coupling with tapered shape slot proving a wider impedance matching for UWB application.

Fig. 1 Different stub geometry

2. DESIGN PARAMETERS

The proposed UWB antenna has dimensions of 16mm × 16mm × 1.64mm and it is designed on FR-4 substrate having = 4.4 and ε_r loss tangent 0.02. It consists of a tapered slot in the ground plane of dimensions 13mm × 7mm with an arc of 1mm radius. On the other side of the substrate, 50Ω feed line is designed and terminated with a rectangular stub of dimensions 7.5mm × 3mm. The offset between the stub and ground plane plays an important role and its optimized value is 1.65mm [2]. The simulated structure and surface current on antenna are shown in Fig. 2 and Fig. 3 respectively.

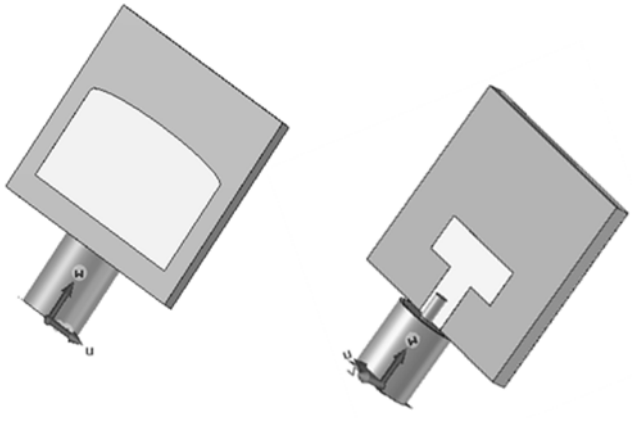

Fig. 2 Antenna Geometry

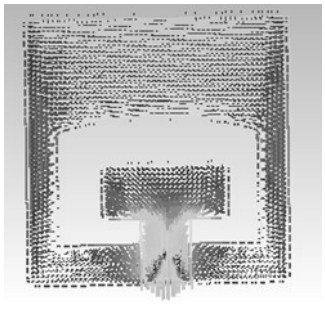

Fig. 3 Surface Current

3. PARAMETRIC STUDY

The spacing and arc radius of proposed antenna are taken as parameters to study their impact on antenna performance. The antenna has been simulated and optimized with these parameters to achieve desired bandwidth and radiation characteristics. The optimized return loss of proposed antenna is presented in Fig.4. The results suggest that 10 dB return loss has been achieved for over 3.6-11.6 GHz frequency range[3][4].

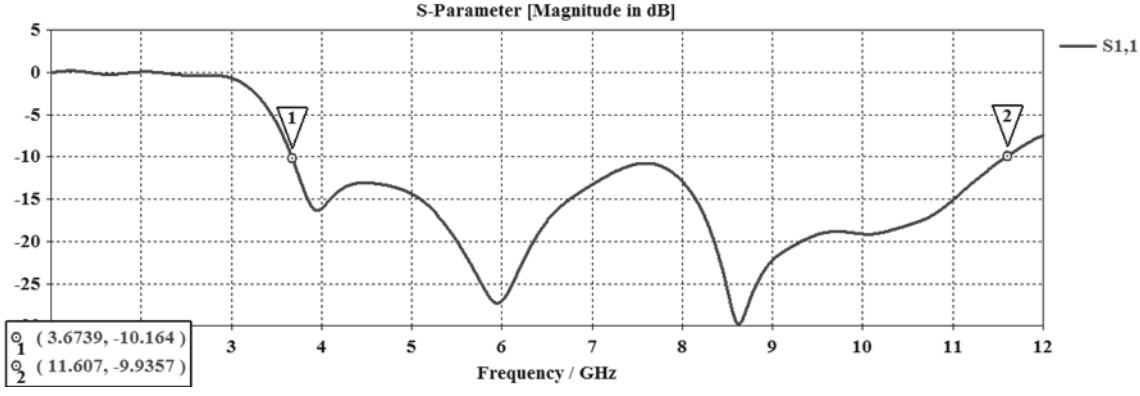

Fig. 4 Simulated S_{11} in dB

The simulated radiation pattern of the simulated antenna has been presented in Fig. 5. It is clear from the simulated result that the antenna radiates in broadside direction and the radiation pattern doesn't have nulls in the upper and lower hemisphere which is required for wireless applications.

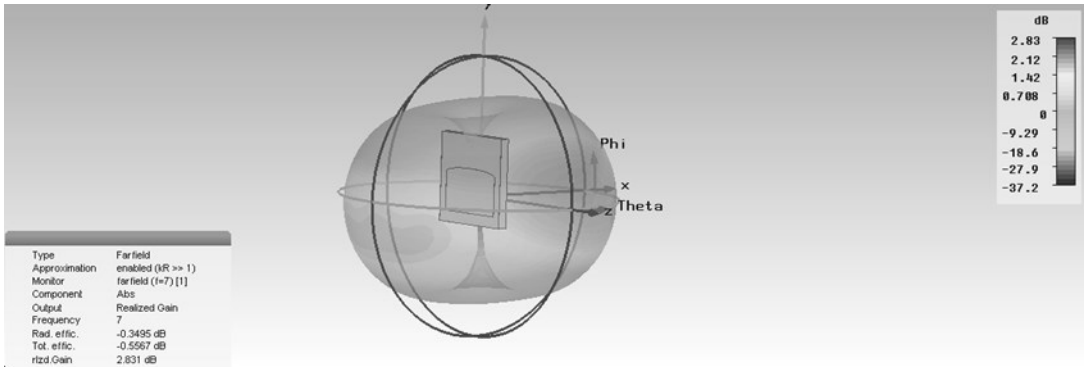

Fig. 5 Simulated radiation pattern

The simulated gain of the antenna over the 3-11 GHz frequency range is presented in Fig. 6.The plot suggests that the antenna offers moderate gain ranging 3-5 dB over 4-11GHz.

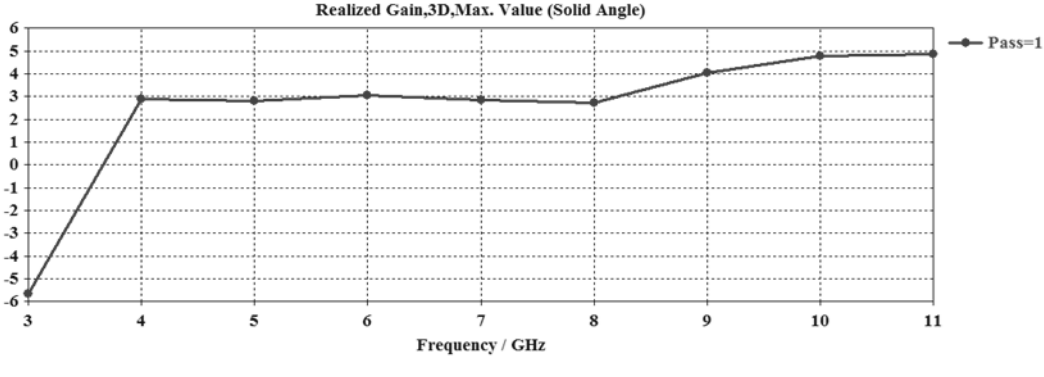

Fig. 6 Simulated Gain (dB)

The final values of the antenna parameters are given in Table1 for reference.

Table -1: Design Parameters

Parameter Name	Optimized value
Substrate Length	16mm
Substrate Length	16mm
Slot Length	13mm
Slot Width	7mm
Gap between stub and Slot	1.65mm
Stub Length	7.5mm
Stub Width	3mm

4. CONCLUSION

From the simulated results it can be concluded that introduction of the tapered slot instead of the rectangular slot changes the electric field distribution and as a result, the impedance matching is much improved resulting in overall enhancement of operating bandwidth. It is also observed that performance can also be improved by employing tapered slot structure with a rectangular tuning stub. This combination produces wider bandwidth than with a circular, elliptical, and square-shaped slot.

The wireless sensor nodes in BAN are designed to be as small as possible hence the requirements for the antenna system are very crucial in terms of physical dimensions. Most of the BAN antennas are electrically small and the aim of a designer is to find out the best possible compromise between antenna dimensions and radiation characteristics.

The antenna presented in this paper is very small and can be integrated with modern MMIC based Transmit-Receive modules for BAN. Also the antenna fulfills other requirements of wearable antennas like light weight, low cost and low profile.

As an extension of this work, the same antenna can be kept with human body model to study SAR. It can be optimized to achieve more bandwidth and improved performance under the presence of human body.

5. ACKNOWLEDGEMENTS

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5. CST Microwave Studio, User's Manual 2011

MONGRELIZED ALGORITHMS FOR REAL POWER LOSS MINIMIZATION

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ABSTRACT

In this paper Chaotic Local Search Artificial Bee Colony algorithm (CLABC) algorithm & Augmented Particle Swarm optimization (APSO) algorithm are used to solve optimal reactive power problem. Artificial Bee Colony algorithm is a global optimization algorithm which is motivated by the foraging behaviour of honey bee swarms. Basic Artificial Bee Colony algorithm (ABC) has the advantages of strong robustness, fast convergence and high flexibility, fewer setting parameters, but it has the disadvantages premature convergence in the later search period and the accuracy of the optimal value which cannot meet the requirements sometimes. The premature convergence issue in Artificial Bee Colony algorithm has been improved by increasing the number of scout and rational using of the global optimal value and by chaotic local Search. The Chaotic local Search ABC (CLABC) algorithm used to solve the reactive power dispatch problem. Particle swarm optimization (PSO) has received increasing interest from the optimization community due to its simplicity in implementation and its inexpensive computational overhead. However, PSO has premature convergence, especially in complex multimodal functions. Extremal Optimization is a recently developed local-search heuristic method and has been successfully applied to a wide variety of hard optimization problems. To overcome the limitation of PSO, this paper proposes a novel hybrid algorithm, called Augmented Particle Swarm optimization algorithm (APSO), through introducing extremal optimization into PSO. The hybrid approach elegantly combines the exploration ability of PSO with the exploitation ability of Extreme optimization. Both the projected algorithms CLABC & APSO has been tested in standard IEEE 57,118 bus test systems and simulation results show clearly the enhanced performance of the both projected algorithms in tumbling the real power loss. But CLABC has slight edge over the APSO in reducing the real power loss.

Keywords: Chaotic Local Search Artificial Bee Colony algorithm, Augmented Particle Swarm optimization optimization, optimal reactive power, Transmission loss.

1. INTRODUCTION

Different algorithms are utilized to solve the Reactive Power Dispatch problem. Different types of numerical techniques like the gradient method [1-2], Newton method [3] and linear programming [4-7] have been already used to solve the optimal reactive power dispatch problem. The voltage stability problem play's an important role in power system planning and operation [8].Evolutionary algorithms such as genetic algorithm, Hybrid differential evolution algorithm, Biogeography Based algorithm, a fuzzy based approach, an improved evolutionary programming [9-15] have been already utilized to solve the reactive power flow problem In [16-18] different methodologies like interior point, upgraded approach are successfully handled the optimal power problem. In [19-20], a programming based approach and probabilistic algorithm is used to solve the optimal reactive power dispatch problem. ABC (Artificial Bee Colony) algorithm is based on the intelligent behavior of

honeybee swarms finding nectar and sharing the information of food sources with each other [21-27]. ABC algorithm has the advantages of strong robustness, fast convergence and high flexibility, fewer control parameters. The premature convergence issue of the Artificial Bee Colony algorithm has been improved by increasing the number of scout and rational using of the global optimal value and chaotic local Search. The Chaotic local Search ABC (CLABC) algorithm used to solve the reactive power dispatch problem and it has been tested in standard test systems. Particle Swarm Optimization (PSO) algorithm is a recent addition to the list of global search methods. This derivative-free method is particularly suited to continuous variable problems and has received increasing attention in the optimization community. PSO is inspired by the paradigm of birds flocking. PSO consists of a swarm of particles and each particle flies through the multi-dimensional search space with a velocity, which is constantly updated by the particle's previous best performance and by the previous best performance of the particle's neighbours. PSO can be easily implemented and is computationally inexpensive in terms of both memory requirements and CPU speed [28]. Recently, a general-purpose local-search heuristic algorithm named Extremal Optimization (EO) has been proposed by Boettcher and Percus [29, 30]. To avoid premature convergence of PSO, an idea of combining PSO with EO is addressed in this paper called as Augmented Particle Swarm optimization (APSO) algorithm and it has been tested in standard test systems. Both the projected algorithms CLABC & APSO has been tested in standard IEEE 57,118 bus test systems and simulation results show clearly the enhanced performance of the both projected algorithms in tumbling the real power loss. But CLABC has slight edge over the APSO in reducing the real power loss.

2. OBJECTIVE FUNCTION

Active power loss

Main aim of the reactive power dispatch problem is to reduce the active power loss in the transmission network, which can be described as:

$$F = PL = \sum_{k \in Nbr} g_k \left(V_i^2 + V_j^2 - 2V_i V_j cos\theta_{ij}\right) \quad (1)$$

Where g_k: is the conductance of branch between nodes i and j, Nbr: is the total number of transmission lines in power systems.

Voltage profile improvement

For minimization of the voltage deviation in PQ buses, the objective function turns into:

$$F = PL + \omega_v \times VD \quad (2)$$

Where ω_v: is a weighting factor of voltage deviation.

VD is the voltage deviation given by:

$$VD = \sum_{i=1}^{Npq} |V_i - 1| \quad (3)$$

Equality Constraint

The equality constraint of the Reactive power problem is represented by the power balance equation, and can be written as, where the total power generation must cover the total power demand and total power loss:

$$P_G = P_D + P_L \quad (4)$$

Where, P_G -Total Power Generation, P_D -Total Power Demand, P_L – Total Power Loss.

Inequality Constraints

Inequality constraints define the limitations in power system components and power system security. Upper and lower bounds on the active power of slack bus, and reactive power of generators are written as follows:

$$P_{gslack}^{min} \leq P_{gslack} \leq P_{gslack}^{max} \quad (5)$$

$$Q_{gi}^{min} \leq Q_{gi} \leq Q_{gi}^{max}, i \in N_g \quad (6)$$

Upper and lower bounds on the bus voltage magnitudes are described as follows:

$$V_i^{min} \leq V_i \leq V_i^{max}, i \in N \quad (7)$$

Upper and lower bounds on the transformers tap ratios are given as follows:

$$V_i^{min} \leq V_i \leq V_i^{max}, i \in N \quad (8)$$

Upper and lower bounds on the compensators reactive powers are written as follows:

$$Q_c^{min} \le Q_c \le Q_C^{max}, i \in N_C \quad (9)$$

Where N is the total number of buses, N_T is the total number of Transformers; N_c is the total number of shunt reactive compensators.

3. ARTIFICIAL BEE COLONY ALGORITHM

Artificial Bee Colony (ABC) contains three groups: employed bee, onlooker bee and scout. The bee going to the food source which is visited by it previously is employed bee. The bee waiting on the dance area for making decision to choose a food source is onlooker bee. The bee carrying out random search is scout bee. The onlooker bee with scout also called unemployed bee. In the ABC algorithm, the collective intelligence searching model of artificial bee colony consists of three essential components: employed, unemployed foraging bees, and food sources. The employed and unemployed bees search for the rich food sources, which close to the bee's hive. The employed bees store the food source information and share the information with onlooker bees. The number of employed bees is equal to the number of food sources and also equal to the amount of onlooker bees. Employed bees whose solutions cannot be improved through a predetermined number of trials, specified by the user of the ABC algorithm and called "limit", become scouts and their solutions are abandoned.

3.1. The Procedure of ABC

The classical ABC includes four main phases.

Initialization Phase: The food sources, whose population size is SN, are randomly generated by scout bees. The number of Artificial Bee is NP. Each food source x_m is a vector to the optimization problem, x_m has D variables and D is the dimension of searching space of the objective function to be optimized. The initiation food sources are randomly produced via the expression (10).

$$x_m = l_i + \text{rand}(0.1) * (u_i - l_i) \quad (10)$$

where ui and li are the upper and lower bound of the solution space of objective function, rand(0,1) is a random number within the range [0,1].

Employed Bee Phase: A employed bee flies to a food source and finds a new food source within the neighborhood of the food source. The higher quantity food source will be selected. The food source information stored by employed bee will be shared with onlooker bees. A neighbor food source v_{mi} is determined and calculated by the following equation (11).

$$v_{mi} = x_{mi} + \Phi_{mi}(x_{mi} - x_{ki}) \quad (11)$$

where x_k is a randomly selected food source, i is a randomly chosen parameter index, Φ_{mi} is a random number within the range [-1,1]. The range of this parameter can make an appropriate adjustment on specific issues. The fitness of food source is essential in order to find the global optimal. The fitness is calculated by the following formula (12). After that a greedy selection is applied between x_m and v_m.

$$fit_m(x_m) = \begin{Bmatrix} \frac{1}{1+f_m(x_m)}, f_m(x_m) > 0 \\ 1 + |f_m(x_m)|, f_m(x_m) < 0 \end{Bmatrix} \quad (12)$$

where $f_m(x_m)$ is the objective function value of x_m.

Onlooker Bee Phase: Onlooker bees observe the waggle dance in the dance area and calculate the profitability of food sources, then randomly select a higher food source. After that onlooker bees carry out randomly search in the neighborhood of food source. The quantity of a food source is evaluated by its profitability and the profitability of all food sources. P_m is determined by the formula

$$P_m = \frac{fit_m(x_m)}{\sum_{m=1}^{SN} fit_m(x_m)} \quad (13)$$

where $fit_m(x_m)$ is the fitness of x_m.

Onlooker bees search the neighborhood of food source according to the expression (14)

$$v_{mi} = x_{mi} + \Phi_{mi}(x_{mi} - x_{ki}) \quad (14)$$

Scout Phase: If the profitability of food source cannot be improved and the times of unchanged greater than the predetermined number of trials, which called "limit" and specified by the user of the ABC algorithm, the solutions will be abandoned by scout bees. Then, the scouts start to randomly search the new solutions. If solution xi has been abandoned, the new solution x_m will be discovered by the scout. The x_m is defined by expression (15)

$$x_m = l_i + \text{rand}(0.1) * (u_i - l_i) \quad (15)$$

Where x_m is the new generated food source, rand (0,1) is a random number within the range [0,1], u_i and l_i are the upper and lower bound of the solution space of objective function.

4. CHAOTIC LOCAL SEARCH ABC

In the basic Artificial Bee Colony algorithm, the best solution founded by onlooker bee which adopted the local search strategy is unable to reach the ideal level of accuracy. In order to improve the accuracy of optimal solution and obtain the fine convergence ability, we use the chaotic search method to solve this problem. In the Chaotic local Search ABC algorithm, onlooker bees apply chaotic sequence to enhance the local searching behavior and avoid being trapped into local optimum. In onlooker bee phase, chaotic sequence is mapped into the food source. Onlooker bees make a decision between the old food source and the new food source according to a greedy selection strategy. In this paper, the well-known logistic map which exhibits the sensitive dependence on initial conditions is employed to generate the chaotic sequence. The chaos system used in this paper is defined by

$$x_{i+1} = \mu * x_i * (1 - x_i) \quad (16)$$

$$x = x_{mi} + R * (2 * x_i - 1) \quad (17)$$

Where x is the new food source and x_i is the chaotic variable, R is the radius of new food source being generated. The food source x_{mi} is in the central of searching region. After the food source has been generated, onlooker bee will exploit the new food source and select the higher profitable one using a greedy selection.

Chaotic search method includes the following steps:

Step1. Setting the iterations (cycle parameter) of chaotic search and produce a vector $x_0 = [x_{0,1} x_{0,2} x_{0,3}]$, which is the initial value of chaotic search.

Step2. The chaotic sequence is generated according to expression (16) and a new food source, which combining the chaotic sequence with the original food source, is obtained following the equation (17).

Step3. Calculating the profitability of the new food source and using the greedy selection select the higher profitability food source.

Step4. If the number of chaotic search iterations greater than maximum, the artificial bee algorithm will enter the scout bee phase, or else enter the next chaotic search iteration.

4.1. Global Search Strategy In the basic Artificial Bee Colony algorithm only one scout, but we added another one into the modified Artificial Bee Colony algorithm in order to improve the global convergence ability. When a scout bee find the food source unchanged times greater than the limit parameter, it will produce a new food source and replace the original one .Scout bee discover the new food source using the best optimal value strategy which accelerate the global convergence rate. Assume that the solution x_i has been abandoned and the scout bee will generate the new solution x_m using the following equation

$$x_m = x_{best} \quad (18)$$

$$x_m(i) = x_{best}(i) + \Phi_{mi} * (x_{best}(i) - x_{neighbor} \quad (i) \quad (19)$$

Where x_m is new food source produced by scout bee using the global optimal value x_{best} and is Φ_{mi} a random number within the range [-1,1].

4.2 The Procedure of CLABC

The procedure of CLABC is as following:

Initial Phase

According to equation (10) discovering the initial food sources Itertime = 1;

While (Itertime <= MaxCycle)

Employed Bee Phase

Step1. According to expression (11) searching the neighbourhood food source;

Step2. Calculate the function value;

Step3. According to formula (12) evaluate fitness of the food sources.

Onlooker Bee Phase

Step1. According to expression (13) calculate the profitability;

Step2. Onlooker bee in the guide of equation (14) and (15) exploiting the local optimal solution;

Step3. Calculating the function value of new food source;

Step4. Evaluating new food source fitness according to equation (15).

Scout Bee Phase

if (trial>limit)

Step1. The first scout randomly discovering the new food source;

Step2 The second scout bee updating the food source, which hit the limit parameter, according to formula (18) and (19).

Search the global optimal value

Global Min

End while

5. PARTICLE SWARM OPTIMIZATION

PSO is a population based optimization tool, where the system is initialized with a population of random particles and the algorithm searches for optima by updating generations. Suppose that the search space is *D*-dimensional. The position of the *i*-th particle can be represented by a *D*-dimensional vector $X_i = (x_{i1}, x_{i2}, .., x_{iD})$ and the velocity of this particle is $V_i = (v_{i1}, v_{i2}, .., v_{iD})$ .The best previously visited position of the *i*-th particle is represented $P_i = (p_{i1}, p_{i2}, .., p_{iD})$ by and the global best position of the swarm found so far is denoted by . $P_g = (p_{g1}, p_{g2}, .., p_{gD})$. The fitness of each particle can be evaluated through putting its position into a designated objective function. The particle's velocity and its new position are updated as follows:

$$v_{id}^{t+1} = \omega^t v_{id}^t + c_1 r_1^t (p_{id}^t - x_{id}^t) + c_2 r_2^t (p_{gd}^t - x_{id}^t) \quad (20)$$

$$x_{id}^{t+1} = x_{id}^t + v_{id}^{t+1} \quad (21)$$

Where $d \in \{1,2,..,D\}, i \in \{1,2,..,N\}$ *N* is the population size, the superscript *t* denotes the iteration number, ω is the inertia weight, r_1 and r_2 are two random values in the range [0,1], c_1 and c_2 are the cognitive and social scaling parameters which are positive constants.

6. EXTREMAL OPTIMIZATION (EO)

EO is inspired by recent progress in understanding far-from-equilibrium phenomena in terms of self-organized criticality, a concept introduced to describe emergent complexity in physical systems. EO successively updates extremely undesirable variables of a single sub-optimal solution, assigning them new, and random values. Moreover, any change in the fitness value of a variable engenders a change in the fitness values of its neighbouring variable.

Procedure of EO algorithm.

1. Randomly generate algorithm. $X = (x_1, x_2, ., x_D)$ Set the optimal solution $X_{best} = X$ and the minimum cost function . $C(X_{best}) = C(X)$
2. For the current solution X ,
   a. Evaluate the fitness λ_i for each variable , x_i $i \in \{1,2,..D\}$,
   b. Rank all the fitness and find the variable, x_j with lowest fitness i.e. for $\lambda_j \leq \lambda_i$ all i.
   c. Choose one solution X' in the neighbourhood X, such that j-th variable must change its state.
   d. Accept X= X' unconditionally
   e. If $C(X) <$ $C(X_{best})$ then set $X_{best} = X$ and $C(X_{best}) = C(X)$.
3. Repeat set 2 as long as desired
4. Return X_{best} and $C(X_{best})$

Note that in the EO algorithm, each variable in the current solution X is considered "species". In this study, we adopt the term "component" to represent "species" which is usually used in biology. For example, if $X = (x_1, x_2, x_3)$, then x_1, x_2 and x_3 are called "components" of X. From the EO algorithm, it can be seen that unlike genetic algorithms which work with a population of candidate solutions, EO evolves a single sub-optimal solution X and makes local modification to the worst component of X. A fitness value ¸i is required for each variable xi in the problem, in each iteration variables are ranked according to the value of their fitness. This differs from holistic approaches such as evolutionary algorithms that assign equal-fitness to all components of a solution based on their collective evaluation against an objective function.

7. AUGMENTED PSO ALGORITHM

Note that PSO has great global-search ability, while EO has strong local-search capability. In this work, we propose an Augmented PSO algorithm (APSO) which combines the merits of PSO and EO. This hybrid approach makes full use of the exploration ability of PSO and the exploitation ability of EO. Consequently, through introducing EO to PSO, the proposed approach may overcome the limitation of PSO and have capability of escaping from local optima. In the main procedure of Augmented PSO algorithm, the fitness of each particle is evaluated through putting its position into the objective function. However, in the EO procedure, in order to find out the worst component, each component of a solution should be assigned a fitness value. We defined the fitness of λ_{ik} each component of a solution for an unconstrained minimization problem as follows. For the i-th particle, the fitness of the k-th component is defined as the mutation cost, i.e. $OBJ(X_{ik})$ - $OBJ(P_g)$, where X_{ik} is the new position of the i-th particle obtained by performing mutation only on the k-th component and leaving all other components fixed, $OBJ(X_{ik})$ is the objective value of X_{ik}, and $OBJ(P_g)$ is the objective value of the best position in the swarm found so far.

EO algorithm for the RPO problem

1. Set the index of the current particle i =1.

2. for the position $X_i = (x_{i1}, x_{i2}, .., x_{iD})$ of the i-th particle

   a. perform mutation on each component of X_i
   One by one, while keeping other components fixed. Then D new positions $x_{ik}(k = 1, .., D)$ can be obtained;

   b. evaluate the fitness $\lambda_{ik} =$ OBJ(X_{ik}) - OBJ(P_g) of each component X_{ik} , k $\in \{1, .., D\}$

   c. compare all the components according to their fitness values and find out the worst adapted component x_{iw} ,and then x_{iw} is the new position corresponding to x_{iw} ,w. $\in \{1, .., D\}$

   d. if OBJ(x_{iw})< OBJ(x_i) then set X_i=X_{iw} , and OBJ(x_i) = OBJ(x_{iw})continue the next step. Otherwise, X_i keeps unchanged and go to Step 3;

   e. update p_i and p_g

3. If i equals to the population size N , return the results; otherwise, set i = i +1 and go to Step 2.

APSO Algorithm for solving reactive power dispatch problem.

1. Initialize a swarm of particles with random positions and velocities N on D dimensions.

   Set iteration = 0.

2. Evaluate the fitness value of each particle, and update. $P_i = (i = 1, .., N)$and P_g

3. Update the velocity and position of each particle using Eq.11 and Eq.12, respectively.

4. Evaluate the fitness value of each particle, and update. $P_i = (i = 1, .., N)$and P_g

5. If (iteration mod INV) =0, the EO procedure is introduced. Otherwise, continue the next step.

6. If the terminal condition is satisfied, go to next step; otherwise, set iteration = iteration +1, and go to Step 3.

7. Output the optimal solution and the optimal objective function value.

8. SIMULATION RESULTS

Proposed Chaotic Local Search Artificial Bee Colony algorithm (CLABC) algorithm & Augmented Particle Swarm optimization (APSO) algorithm has been tested in standard IEEE-57 bus power system. The reactive power compensation buses are 18, 25 and 53. Bus 2, 3, 6, 8, 9 and 12 are PV buses and bus 1 is selected as slack-bus. The system variable limits are given in Table 1.

The preliminary conditions for the IEEE-57 bus power system are given as follows:

P_{load} = 12.213 p.u. Q_{load} = 3.024 p.u.

The total initial generations and power losses are obtained as follows:

$\sum Q_G$ =12.4642 p.u. $\sum Q_G$ = 3.3011 p.u.

P_{loss} = 0.25729 p.u. Q_{loss} = -1.2028 p.u.

Table 2 & 3 shows the various system control variables i.e. generator bus voltages, shunt capacitances and transformer tap settings obtained after optimization which are within the acceptable limits. In Table 4, shows the comparison of optimum results obtained from proposed methods with other optimization techniques. These results indicate the robustness of proposed approaches for providing better optimal solution in case of IEEE-57 bus system. But CLABC has slight edge over the APSO in reducing the real power loss.

Table 1. Variable limits

Reactive Power Generation Limits							
Bus no	1	2	3	6	8	9	12
Qgmin	-1.4	-.015	-.02	-0.04	-1.3	-0.03	-0.4
Qgmax	1	0.3	0.4	0.21	1	0.04	1.50

Voltage And Tap Setting Limits

vgmin	Vgmax	vpqmin	Vpqmax	tkmin	tkmax
0.9	1.0	0.91	1.05	0.9	1.0

Shunt Capacitor Limits			
Bus no	18	25	53
Qcmin	0	0	0
Qcmax	10	5.2	6.1

Table 2. Control variables obtained after optimization

Control Variables	CLABC
V1	1.1
V2	1.041
V3	1.049
V6	1.037
V8	1.030
V9	1.011
V12	1.020
Qc18	0.0670
Qc25	0.200
Qc53	0.0465
T4-18	1.010
T21-20	1.059
T24-25	0.872
T24-26	0.880
T7-29	1.061
T34-32	0.881
T11-41	1.024
T15-45	1.040
T14-46	0.910
T10-51	1.020
T13-49	1.060
T11-43	0.910
T40-56	0.900
T39-57	0.950
T9-55	0.950

Table 3. Control variables obtained after optimization

Control Variables	APSO
V1	1.1
V2	1.037
V3	1.032
V6	1.049
V8	1.041
V9	1.010
V12	1.020
Qc18	0.0651
Qc25	0.200
Qc53	0.0470
T4-18	1.010
T21-20	1.072
T24-25	0.891
T24-26	0.897
T7-29	1.077
T34-32	0.891
T11-41	1.031
T15-45	1.040
T14-46	0.910
T10-51	1.021
T13-49	1.060
T11-43	0.910
T40-56	0.900
T39-57	0.950
T9-55	0.950

Table 4. Comparison results

S.No.	Optimization Algorithm	Finest Solution	Poorest Solution	Normal Solution
1	NLP [31]	0.25902	0.30854	0.27858
2	CGA [31]	0.25244	0.27507	0.26293
3	AGA [31]	0.24564	0.26671	0.25127
4	PSO-w [31]	0.24270	0.26152	0.24725
5	PSO-cf [31]	0.24280	0.26032	0.24698
6	CLPSO [31]	0.24515	0.24780	0.24673
7	SPSO-07 [31]	0.24430	0.25457	0.24752
8	L-DE [31]	0.27812	0.41909	0.33177
9	L-SACP-DE [31]	0.27915	0.36978	0.31032
10	L-SaDE [31]	0.24267	0.24391	0.24311
11	SOA [31]	0.24265	0.24280	0.24270
12	LM [32]	0.2484	0.2922	0.2641
13	MBEP1 [32]	0.2474	0.2848	0.2643
14	MBEP2 [32]	0.2482	0.283	0.2592
15	BES100 [32]	0.2438	0.263	0.2541
16	BES200 [32]	0.3417	0.2486	0.2443
17	Proposed CLABC	0.22098	0.23129	0.22114
18	Proposed APSO	0.22110	0.23134	0.22127

Then Chaotic Local Search Artificial Bee Colony algorithm (CLABC) algorithm & Augmented Particle Swarm optimization (APSO) algorithm has been tested in standard IEEE 118-bus test system [33] .The system has 54 generator buses, 64 load buses, 186 branches and 9 of them are with the tap setting transformers. The limits of voltage on generator buses are 0.95 -1.1 per-unit., and on load buses are 0.95 -1.05 per-unit. The limit of transformer rate is 0.9 -1.1, with the changes step of 0.025. The limitations of reactive power source are listed in Table 5, with the change in step of 0.01.

Table 5. Limitation of reactive power sources

BUS	5	34	37	44	45	46	48
QCMAX	0	14	0	10	10	10	15
QCMIN	-40	0	-25	0	0	0	0
BUS	74	79	82	83	105	107	110
QCMAX	12	20	20	10	20	6	6
QCMIN	0	0	0	0	0	0	0

The statistical comparison results of 50 trial runs have been list in Table 6 and the results clearly show the better performance of proposed Chaotic Local Search Artificial Bee Colony algorithm (CLABC) algorithm & Augmented Particle Swarm optimization (APSO) algorithm. But CLABC has slight edge over the APSO in reducing the real power loss.

Table 6. Comparison results

Active power loss (MW)	**BBO [34]**	**ILSBBO/ strategy1 [34]**	**ILSBBO/ strategy1 [34]**	**Proposed CLABC**	**Proposed APSO**
Min	128.77	126.98	124.78	117.91	118.81
Max	132.64	137.34	132.39	121.90	122.07
Average	130.21	130.37	129.22	119.06	120.98

9. CONCLUSION

In this paper Chaotic Local Search Artificial Bee Colony algorithm (CLABC) algorithm & Augmented Particle Swarm optimization (APSO) algorithm have been successfully solved the Reactive power optimization problem. The performance of the proposed algorithms demonstrated through its evaluation in IEEE 57,118 test bus systems & from the simulation study it has been found that both the proposed algorithms efficiently reduces the real power loss when compared to other standard reported algorithms. But CLABC has slight edge over the APSO in reducing the real power loss.

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A MODEL FOR FACE RECOGNITION SYSTEM USING VOILA-JONES ALGORITHM

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ABSTRACT

The paper work entitled "A Model for Face Recognition system using Viola-Jones Algorithm" mainly concentrated on detection and identification of human faces and describing a working, near real-time face recognition system which tracks the subject's head and then recognizes the person by comparing characteristics of the face to those of known individuals. In this paper, the main objective of face detection is to find whether there are any faces in the video/ image or not. If the face is present, then it returns the location of the image and extent of the each face. Pre-processing is done to remove the noise and reliance on the precise registration. There are various factors that makes the face detection is a challenging task. Pose presence or absence of structural components, Facial expression, Occlusion, Image orientation. The facial feature detection is the process to detect the presence and location of features, like nose, eyebrow, eyes, lips, nostrils, mouth, ears, etc. this is done with the assumptions that there is only a single face in an image. The feature space is defined by Eigen-Faces, which are the eigenvectors of the set of the faces. In the Face recognition process the input image is compared with the database. The input image is also called as probe and the database is called as gallery. Then it gives a match report and then the classification is done to identify the sub-population to which new observations belong. This project is carried by using MATLAB software.

1. INTRODUCTION

Face recognition has become a very active area of research in recent years mainly due to increasing security demands and its potential commercial and law enforcement applications. The last decade has shown dramatic progress in this area, with emphasis on such applications as human-computer interaction (HCI), biometric analysis, content-based coding of images and videos, and surveillance. Although a trivial task for the human brain, face recognition has proved to be extremely difficult to imitate artificially, since although commonalities do exist between faces, they vary considerably in terms of age, skin, color and gender [2].

Early face recognition algorithms used simple geometric models, but recently the recognition process has now matured into a science of sophisticated mathematical representations and matching processes. Major advancements and initiatives have

propelled face recognition technology into the spotlight [4]. Face recognition technology can be used in wide range of applications. Computers that detect and recognize faces could be applied to a wide variety of practical applications including criminal identification etc. Face detection and recognition is used in many places nowadays, verifying websites hosting images and social networking sites. Face recognition and detection can be achieved using technologies related to computer science. Features extracted from a face are processed and compared with similarly processed faces present in the database. If a face is recognized it is known or the system may show a similar face existing in database else it is unknown [3]. In surveillance system if an unknown face appears more than one time then it is stored in database for further recognition. These steps are very useful in criminal identification. The strong need for user-friendly systems that can secure our assets and protect our privacy without losing our identity in a sea of numbers is obvious. At present, one needs a PIN to get cash from an ATM, a password for a computer, a dozen others to access the internet, and so on.

Face detection has been a fascinating problem for image processing researchers during the last decade because of many important applications such as video face recognition at airports and security check-points, digital image archiving, etc. In this project, we attempt to detect faces in a digital image using various techniques such as skin color segmentation, morphological processing, template matching, Fisher linear discriminate (FLD), Eigenface decomposition, and support vector machines (SVM) [5].

2. DETAILS OF PAPER

Face recognition is a visual pattern recognition problem. There, a face as a three-dimensional object subject to varying illumination, pose, expression and so on is to be identified based on its two-dimensional image (three-dimensional images e.g., obtained from laser may also be used).

The block diagram of a typical face recognition system can be shown with the help of Figure. The face detection and face extraction are carried out simultaneously. The complete process of face recognition can be shown in the Fig.1.1

Fig.2.1: Block Diagram of a Face Recognition System.

The first step in face recognition system is to detect the face in an image. The main objective of face detection is to find whether there are any faces in the image or not. If the face is present, then it returns the location of the image and extent of the each face. Pre-processing is done to remove the noise and reliance on the precise registration. There are various factors that makes the face detection is a challenging task. Pose presence or absence of structural components, Facial expression, Occlusion, Image orientation. The facial feature detection is the process to detect the presence and location of features, like nose, eyebrow, eyes, lips, nostrils, mouth, ears, etc. this is done with the assumptions that there is only a single face in an image. In the Face recognition process the input image is compared with the database. The input image is also called as probe and the database is called as gallery. Then it gives a match report and then the classification is done to identify the sub-population to which new observations belong.

There are basically three approaches for face recognition

- Feature base approach In feature based approach the local features like nose, eyes are segmented and it can be used as input data in face detection to easier the task of face recognition
- Holistic approach in holistic approach the whole face taken as the input in the face detection system to perform face recognition.
- Hybrid approach Hybrid approach is combination of feature based and holistic approach. In this approach both local and whole face is used as the input to face detection system.

2.1 EIGENFACE TECHNIQUE FOR FACE RECOGNITION The Eigenface method is one of the generally used algorithms for face recognition. This method is successfully used to perform dimensionality reduction. Principal Component Analysis is used by face recognition and detection. Mathematically, Eigenfaces are the principal components divide the face into feature vectors. The feature vector information can be obtained from covariance matrix. These Eigenvectors are used to quantify the variation between multiple faces. The faces are characterized by the linear combination of highest Eigenvalues. Each face can be considered as a linear combination of the eigenfaces. The face can be

approximated by using the eigenvectors having the largest eigenvalues. The best M eigenfaces define an M dimensional space, which is called as the "face space. They defined that a face images could be approximately reconstructed using a small collection of weights for each face and a standard face picture. The weights describing each face are obtained by projecting the face image onto the Eigen picture.

Eigenface is a practical approach for face recognition. Because of the simplicity of its algorithm, implementation of an Eigenface recognition system becomes easy. It is efficient in processing time and storage. PCA reduces the dimension size of an image in a short period of time. There is a high correlation between the training data and the recognition data. The accuracy of Eigenface depends on many things. As it takes the pixel value as comparison for the projection, the accuracy would decrease with varying light intensity. Pre-processing of image is required to achieve satisfactory result. An advantage of this algorithm is that the eigenfaces were invented exactly for those purpose what makes the system very efficient.

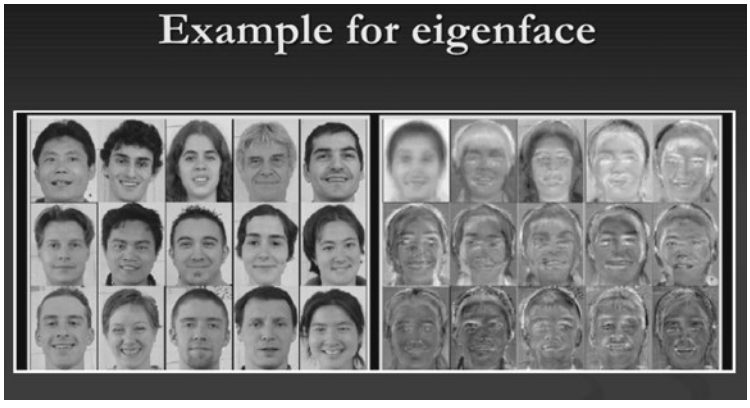

Fig 2.2: Example for Eigenface

A drawback is that it is sensitive for lightening conditions and the position of the head. Disadvantages-Finding the eigenvectors and eigenvalues are time consuming on PPC. The size and location of each face image must remain similar PCA (Eigenface) approach maps features to principle sub spaces that contain most energy.

2.2 PROPOSED ALGORITHM The Viola–Jones object detection framework is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of detection. The problem to be solved is detection of faces in an image. A human can do this easily, but a computer needs precise instructions and constraints. To make the task more manageable, Viola–Jones requires full view frontal upright faces. Thus in order to be detected, the entire face must point towards the camera and should not be tilted to either side. While it seems these constraints could diminish the algorithm's utility somewhat, because the detection step is most often followed by a recognition step, in practice these limits on pose are quite acceptable.

ViolaJones face detection algorithm has three critical steps, including feature extraction, boosting and multi-scale detection. Feature is very significant to any object detection algorithm. Basically, there are a lot of features, such as eyes, nose, the topology of eye and nose, can be used for face detection. In Viola Jones face detection, a very simple and straightforward feature has been used. Each feature can be obtained by subtracting white areas from the black areas. Here, the area means the summation of all the pixels' gray value within the rectangle. Aiming at calculating these features, a special representation named as integral image has been used. Integral image of a location is the sum of the pixel values above and to the left of, inclusively. The definition of boosting in viola jones face detection algorithm is the combination of several weak classifiers. This boosting idea makes the process of learning to be simple and efficient. Another important step in viola jones face detection algorithm is multi-scale detection. It is obvious that we have no idea with the size of face in an image before doing face detection. Therefore, multi-scale detection should be adopted to guarantee that faces with any size can be detected.

2.3 HISTOGRAMS OF ORIENTED GRADIENTS Histograms of Oriented Gradients descriptors, or HOG descriptors, are feature descriptors used in computer vision and image processing for the purpose of object detection. The ttechniques counts occurrences of gradient orientation in localized portions of an image. The implementation of these descriptors can be achieved

by dividing the image into small connected regions, called cells, and for each cell compiling a histogram of gradient directions or edge orientations for the pixels within the cell.

The first step of calculation is the computation of the gradient values.

The most common method is to apply the 1D centered point discrete derivative mask in both the horizontal and vertical directions. Specifically, this method requires filtering the Gray scale image with the following filter kernels:

The magnitude of the gradient is: $|G| = \sqrt{I_X{}^2 + I_Y{}^2}$

The orientation of the gradient is given by: $\theta = \arctan\left(\frac{I_Y}{I_X}\right)$

$D_X = [1\,0\,1]$, $D_Y = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$

Fig 2.3 : Initial Image.

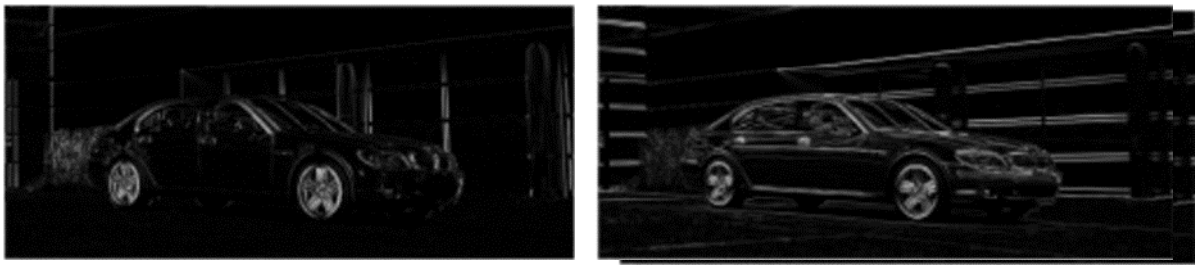

Fig 2.4: Left:X-derivative of the initial image; Right:Y-derivative of the initial image

The second step of calculation involves creating the cell histograms. Each pixel within the cell casts a weighted tone for an orientation based histogram channel based on the values found in the gradient computation.

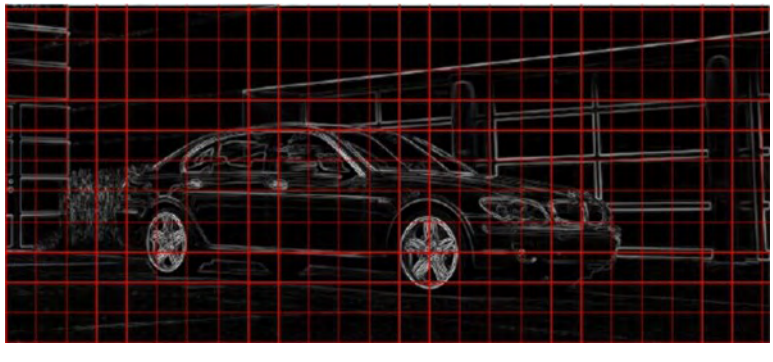

Fig 2.5: Cell division example

The cells themselves are rectangular and the histogram channels are evenly spread over 0 to 180degrees or 0 to360degrees, depending on whether the gradient is “unsigned”or“signed”. As for the vote weight, pixel contribution can be the gradient magnitude itself, or the square root or square of the gradient magnitude. That we have no idea with the size of face in an

image before doing face detection. Therefore, multi-scale detection should be adopted to guarantee that faces with any size can be detected.

There are different methods for block normalization. Let 'v' be the non-normalized vector containing all histograms in a given block, ||vk|| be its k-norm for k=1,2 and 'e' be some small constant (whose value will not influence the results). Then the normalization factor can be one of the following: The angle transformed into degrees is $\alpha = \theta$ *180/ π , that will give values in the range (-180, 180] degrees.

$$L2-norm: f = \frac{v}{\sqrt{\|v\|_2^2 + e^2}}$$

$$L1-norm: f = \frac{v}{\|v\|_1 + e}$$

$$L1-sqrt: f = \sqrt{\frac{v}{\|v\|_1 + e}}$$

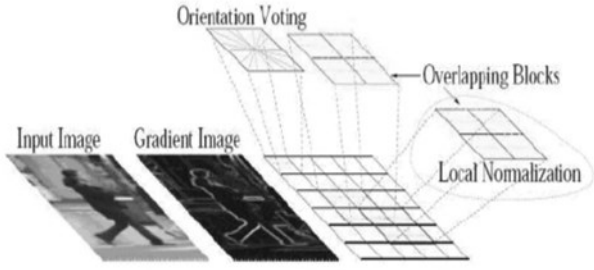

Fig 2.6: Block normalization scheme.

Being given an image, we will extract the gradient magnitude and orientation as follows:

$$\sqrt{|G|} = \sqrt{I_X^2 + I_Y^2}, where:$$

$$I_X = I * D_X, I_Y = I * D_Y$$

$$D_X = \begin{bmatrix} -1 & 0 & 1 \end{bmatrix}, D_Y = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$$

*is the convolutional operator

For the orientation, we will use the function atan2 that returns a value in the interval ($-\pi$, π].

So, the orientation of the gradient, for a pixel is θ = arctan2 (IY, IX) radians.

The angle transformed into degrees is $\alpha = \theta$ *180/, π that will give values in the range (-180, 180] degrees. For the signed gradient we will need to translate the range of the gradient from (-180, 180] to [0, 360) degrees. This is done using the formula:

$$\alpha_{signal} = \begin{cases} \alpha, if\ \alpha \geq 0 \\ \alpha + 360, if\ \alpha < 0 \end{cases}$$

Practical Work:You will use as input, grayscale images with 8b/px: car1.bmpAdd a new function to Diblook that computes the magnitude of the gradient and the orientation using the given formulas. Display the gradient magnitude, normalized in the range [0, 255].

Notice that you might need to change the palette of the image for performing this operation (for drawing colored pixels). For the image car1.bmp the result should look like:

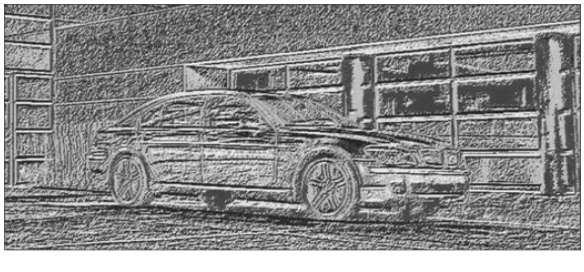

Fig. 2.7: Resulting image of car1.

Fig 2.8: Final output image of car1.

Implement a function that computes the HOG features for a given image divided in a specified number of rectangular cells. Each cell will be filled in with the corresponding color of the bin that has the maximum accumulated value. Use the signed gradient when computing the HOG features.

2.4 BLOCK DIAGRAM The project is basically divided into two sub projects

2.4.1 Creation of Database DATABASE is an important and integral part of this project without the database the whole project is a useless entity. A database is an organized collection of data It is the collection of schemes, tables, queries, reports, views, and other objects. The data are typically organized to model aspects of reality in a way that supports processes requiring information.

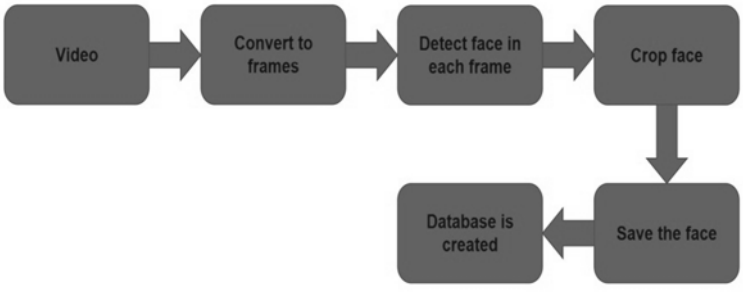

Fig.2.9: Block diagram of Database Creation.

The typical conventional way of creating a Database for Face recognition is having a person stand in front of a camera and clicks his face in different angle and different expressions This process is hectic and not user friendly. So we have designed a better way to create a database, wherein we can create one using a video of that person. The video can be anything from dancing, singing or playing. A video of 15 sec is more than sufficient to create a Database of a person

The following shows the steps for creating a DATABASE, The first step is to capture a video. We are using a 720p camera to capture a video. The video can be a live streaming or a recorded one. The camera properties like resolution can affect the accuracy and processing time. A high definition camera can get you more accuracy but can increase the processing time since high definition camera have more pixels, so large no of data takes more time to process. The next step is to convert the captured video into set of frames .We are using Matlab code to convert the video into frames. We know that videos are nothing but set of frame played in sequence. So a frame is taken for detecting the face. The next step is to detect faces in each frame. We are using a HAAR cascade feature extracting algorithm to detect face in each frame and Voila-Jones algorithm to optimize the processing time and accuracy. After detecting each face in a frame, the face needs to be cropped. The faces are cropped using matlab code. Each cropped face is of size 112x96. This is done so that all the unwanted things like the background in the frame is reduced, so that only the face is processed, Thus reducing processing time by not processing unwanted data.The cropped faces need to be saved in order to create a DataBase .The cropped faces are saved into a folder in a secured format so that no unauthorized access can be granted and only the person who is authorized can use. Finally the database of an individual person is created using a his/her video.This database can be used in identification of a person

2.4.2 Identification of a Person

Fig.2.10: Block diagram of Person Identification.

The following shows the steps in identification of a person

We have a camera to get live stream video .The camera properties like resolution can affect the accuracy and processing time. A high definition camera can get you more accuracy but can increase the processing time since high definition camera have more pixels, so large no of data takes more time to process. The video is converted to set of images to detect the faces. We are using Matlab code to convert the video into set of images. We know that videos are nothing but set of frames played in sequence. So a frame is taken for detecting the face. The next step is to detect faces in each frame .we are using a HAAR cascade feature extracting algorithm to detect face in each frame and Voila-Jones algorithm to optimize the processing time and accuracy. The next step is identifying the detected face. This is done by comparing the detected face with the Database. We are using HOG feature extraction in order to compare the face and identify the detected face . The result is displayed i.e. the details of the identified person is displayed.

2.5 RESULT ANALYSIS

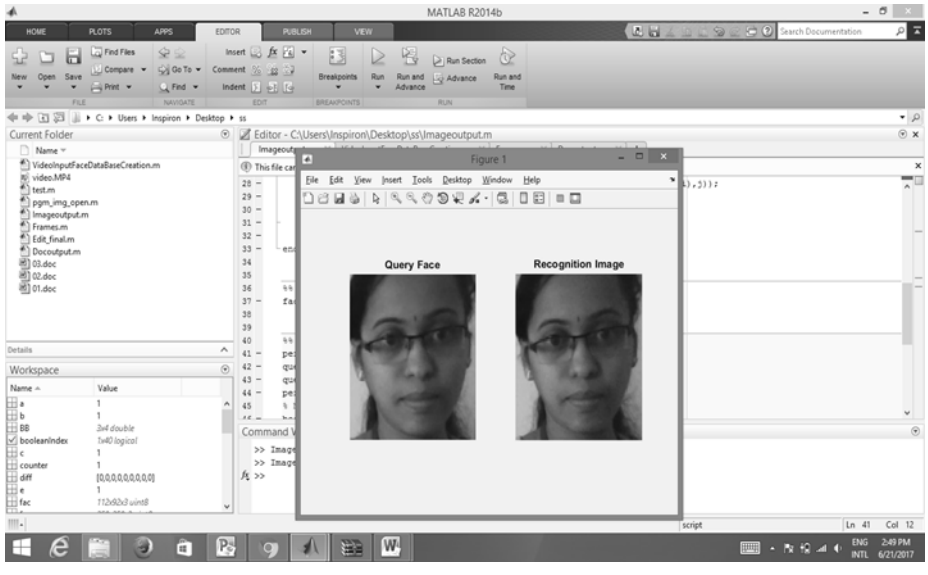

Fig: 2.11: Example of Data Query Image

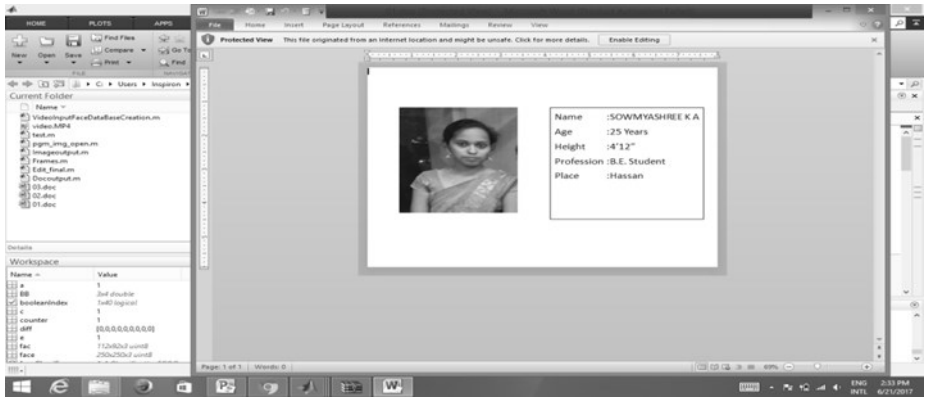

Fig: 2.12: Examples of Documents for Query Images

3. CONCLUSION

The purpose of face identification system is to identify criminals. In past years this process is carried out by humans. This process gives the exact image of the criminal but it is very difficult to identify the criminal details and also it requires much amount of human burden. The main aim of our project is to overcome the drawbacks of human based system by using the machine based face identification process. In this process we store the details of criminal into the database along with his photo or image. Then we make the image into different clips containing hair, forehead, eyes, nose, lips and chin and store these clips into the database. When any crime occurs we compare the details given by the eyewitness with the clips already stored in the database and we will identify the criminal. This project can be extended to adjust the gaps between the clips after construction of the image to be a perfect photograph using Image processing Techniques. We were able to create a new method to create a Database which is more user friendly than the conventional method. This can be used in future more sophisticated creation of Database. Limitations of face recognition are Image quality affects how well facial-recognition algorithms work, When a face-detection algorithm finds a face in an image or in a still from a video capture, the relative size of that face compared with the enrolled image size affects how well the face will be recognized. Even though high-definition video is quite low in resolution when compared with digital camera images, it still occupies significant amounts of disk space.

In future, we would be able to see face recognition technology becoming the more advance security technology outdating all other existing technologies

4. ACKNOWLEDGEMENTS

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DESIGN, ESTIMATION AND COSTING OF SEWAGE TREATMENT PLANT: A CASE STUDY

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ABSTRACT

Water scarcity has rightly occupied a prime concern due to migration of population from rural to urban areas. The all important resource for sustenance of life is depleting at all levels, ie., above and below ground surface and needs to be properly managed to make it more sustainable and available for future generations. The use of water, which has been segregated based on its type of utilisation, has to be recycled and used for certain purposes. Over 70% of population across the globe is unable to get access to drinking water. These aspects initiate the significance of design the economical treatment plants.

Vidya Vikas Institute of Engineering and Technology (VVIET), is located at Alanahalli midway, ($12^0 18' 13.3'' N$ $76^0 42' 36.9'' E$) between Mysore and Malavalli, having wide educational units starting from School to Master Degree which educates around 4000 students every year. The campus is about 65 acres where half of the campus is filled with green patches and lawn. There will be scarcity for water in campus during the early summer season itself due to less ground water availability. Keeping this in mind, reuse of water is suggested by adopting Sewage Treatment Plant for the Girl's hostel which provides water for gardening and other recreational purposes.

A study on domestic wastewater characterization has been performed followed by the design of sewage treatment plant. The present study involves the analysis of pH value, Total Dissolved Solids, Hardness, COD, BOD, DO, Nitrates, Sulphates, Turbidity.

The study was conducted for the primary, secondary and tertiary treatment and management of sewage generated in VVIET Girl's hostel, a sewage treatment plant was designed. The total sewage generated in one day was estimated to be 25 KLD, The various components of primary sewage treatment plant viz., screening chamber, Equalization and grit cum skimming tank, settling tank, modified activated sludge tank, flash mixer and clari-flocculator, rough composite filter, disinfection unit, sludge digester and sludge drying bed were designed considering the various standards and permissible limits of treated sewage water.

It was recommended that the treated water will be supplied for flushing of WC, curing and gardening purpose and the remaining sludge after treatment will be used as manure. The use of treated water will overcome the scarcity of ground water within the campus and additionally the treated sludge will be very useful for increasing the fertility of soil.

Key Words: Vidya Vikas Institute of Engineering and Technology (VVIET), Sewage Treatment Plant (STP),

BOD, TDS, RCC Design, Estimation and Costing.

1. INTRODUCTION

We are silently but surely heading towards "water shock" which will dwarf any oil crisis, because in the last two decades for the first time in the human history more water is being taken out across the globe than what Nature is putting in. Wastewater is used water, comprising of substances such as human waste, food scraps, oils, soaps, chemicals, domestic wastes. Businesses and industries also contribute their share of used water/wastewater in addition to storm runoff burdened with harmful substances via run off from roads, parking lots and rooftops and this can harm our fresh water systems. Even though, nature has an amazing ability to cope with certain amounts of contaminants, there is a necessity to treat the billion gallons of wastewater and sewage generated daily by homes, industries, and business establishments before releasing it back to the environment (Ravi Kumar P et.al, 2010).

Degradation of water quality is the unfavourable alteration in chemical, physical and biological characteristics of water that prevents domestic, commercial, industry, agricultural, and other beneficial uses of water. Sewage treatment plant is facility designed to receive the waste from domestic, industrial and commercial sources and to remove materials that damage water quality and compromise public health. Sewage is mainly composed of human fecal material, domestic wastes including wash-water and industrial wastes (S Ramya et.al, 2015).

Currently, the interest in wastewater reuse in various parts of the world has promoted the development of wastewater and secondary effluent treatment technologies. The main purpose of wastewater treatment is to prevent pollution of the receiving watercourse, and to protect human health and the environment. The reuse of reclaimed wastewater is an international practice. Due to the more and more pronounced water deficit, the reuse of wastewater in the Middle East countries is part of the strategy for the conservation and development of water resources. Therefore, the investigation of the characteristics of the reclaimed wastewater is necessary for evaluating its suitability for reuse (Al-Zboon, Kamel et.al, 2008). Wastewater or sewage treatment is one such alternative, wherein many processes are designed and operated in order to mimic the natural treatment processes to reduce pollutant load to a level that nature can handle. In this regard, a detailed characterization of the incoming wastewater based on the characterization a sewage treatment units were designed for efficient treatment of sewage generated from the girl's hostel and to prepare a detailed quantity estimate and costing for the same was carried out.

Unit Operations of Sewage Treatment Plant The treatment plant should be located as near to the point of disposal as possible. Care should be taken while locating the site that it should be on the downstream side and sufficiently away from water intake works (Pramod Sambhaji Patil et.al, 2016).

Primary treatment systems are usually physical processes. Primary treatment alone will not produce an effluent with an acceptable residual organic material concentration. Almost invariably biological methods are used in the treatment systems to effect secondary treatment for removal of organic material. In biological treatment systems, the organic material is metabolized by bacteria. Depending upon the requirement for the final effluent quality, tertiary treatment methods and/or pathogen removal may also be included. Today majority of wastewater treatment plants use aerobic metabolism for the removal of organic matter. The popularly used aerobic processes are the activated sludge process, oxidation ditch, trickling

filter, and aerated lagoons. Stabilization ponds use both the aerobic and anaerobic mechanisms (Kavita N Choksi et.al, 2015). The different treatment methods used in wastewater treatment plant are classified in three different categories as:

- Primary Treatment: Refers to physical unit operations.
- Secondary Treatment: Refers to chemical and biological unit processes.
- Tertiary Treatment: Refers to any one or combination of two or all three i.e., physical unit operations and chemical or biological unit processes, used after secondary treatment.

2. DESCRIPTION OF STUDY AREA

Fig 2.1: Aerial view of Vidya vikas Institute of Engineering and Technology.

Vidya vikas Institute of Engineering and Technology (VVIET) is located in alanahalli midway, ($12^0 18' 13.3'' N\ 76^0 42' 36.9'' E$) between Mysore and Malavalli, and is spread over a sprawling campus of 65 acres with academic and administrative buildings that are surrounded by a lush green ambience. VVIET is known for disciplined academic climate. Since its inception, Vidya Vikas Educational Trust has catapulted into one of the leading educational institutions ranging from primary schools to undergraduate and post graduate colleges covering the Arts, Commerce, Hospitality, Nursing, Social Work, Law, and all facets of Engineering in the districts of Mysuru. Fig 2.1 depicts the Aerial view of study area.

3. METHODS AND METHODOLOGY

3.1 Present Scenario: The UGD line of VVIET girl's hostel which accommodates nearly 220 students in 50 rooms together connected to common manhole through a series of chambers. Fig 3.1 shows the proposed site for STP which is located adjacent to VVIET Girl's hostel block with an area of 60m x 60m. Block leveling for proposed STP was done using total station. The site of area 50m x 50m is divided into blocks at an interval of 10m and the reduced level(RL) is recorded along the longitudinal and cross section of the site. Fig 3.2 depicts the Contours plotted for the proposed STP site.

Fig 3.1: Proposed site for STP, located adjacent to VVIET Girl's hostel with an area of 60m x 60m.

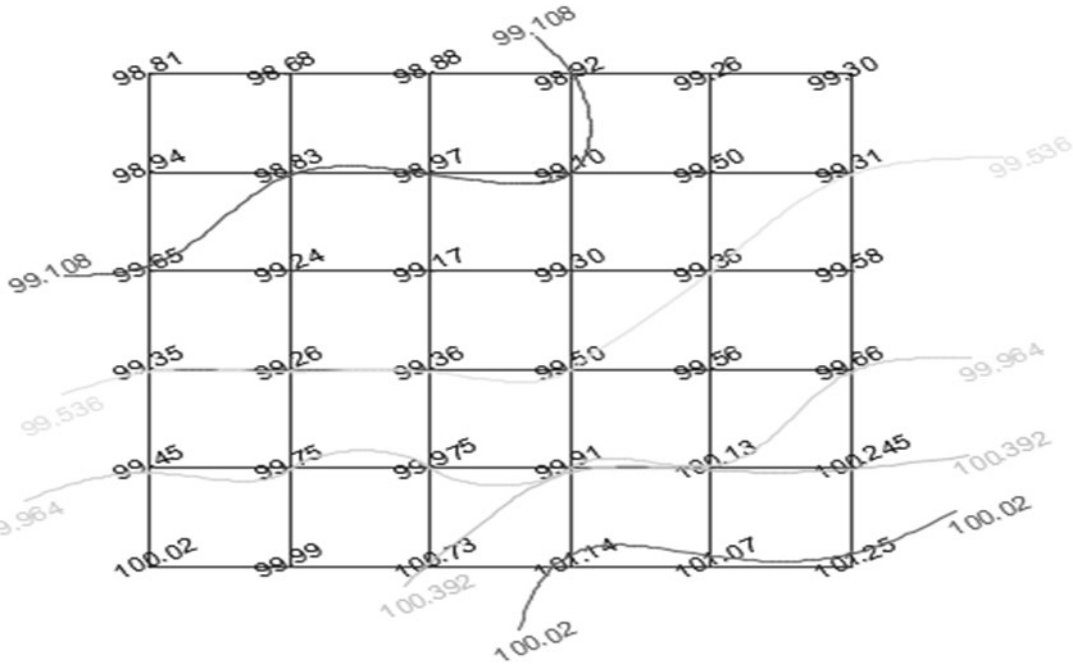

Fig 3.2: Contour of the proposed site

3.2 Land Survey Block leveling for proposed STP was done using total station. The site of area 50m x 50m is divided into blocks at an interval of 10m and the reduced level(RL) is recorded along the longitudinal and cross section of the site. Fig 3.2 depicts the Contours plotted for the proposed STP site.

3.3 Collection of sample The sewage sample was collected through a Grab sampling technique, from the manhole located at the corner of Hostel where the sewage from all the blocks flows into the manhole in a UGD. The sample is collected three times (Morning, Afternoon and Evening) at the peak hours, for four consecutive days and then it is analyzed in laboratory for various wastewater parameters. Fig 3.3 and 3.4 depicts the sample location and sample bottle after collecting the sample from manhole.

Fig 3.3: Sampling location (Manhole)

Fig 3.4: Sample collected in bottle

3.4 Laboratory Analysis Laboratory analysis was conducted for various wastewater parameters listed below as per the standard procedures.

a. pH

b. BOD (Biochemical Oxygen Demand)

c. COD (Chemical Oxygen Demand)

d. TDS (Total Dissolved Solids)

e. Nitrates

f. Sulphates

g. Turbidity

4. DESIGN AND DETAILS OF SEWAGE TREATMENT PLANT UNIT

4.1 Calculation of Quantity of sewage It is very difficult to ascertain the quantity of water required for a particular town. It involves the assumptions of many variable factors and foresight of the designer plays an important role in arriving at this quantity (K. Sesha Maheswaramma et.al, 2015). However the problem of estimating the quantity of water may be tackled by studying in detailed the following two factors, they are rate of demand and population.

No of students: 220 No's

Per capita demand: 135 LPCD

Percent Waste: 80%

Quantity of rain water: 1000 LPD

Influent BOD: 300mg/L

Operating cycle: 2 times per day

Total quantity of sewage: (220x135x0.8) + 1000=24760 ≈ **25000LPD OR 25KLD.**

4.2 Operational units Based the wastewater characteristics, treatment units were designed. Those operations used for the treatment of wastewater in which changes brought about by means of or through the application of physical forces are known as unit operations. Fig 4.1 shows the flow diagram of sewage treatment plant.

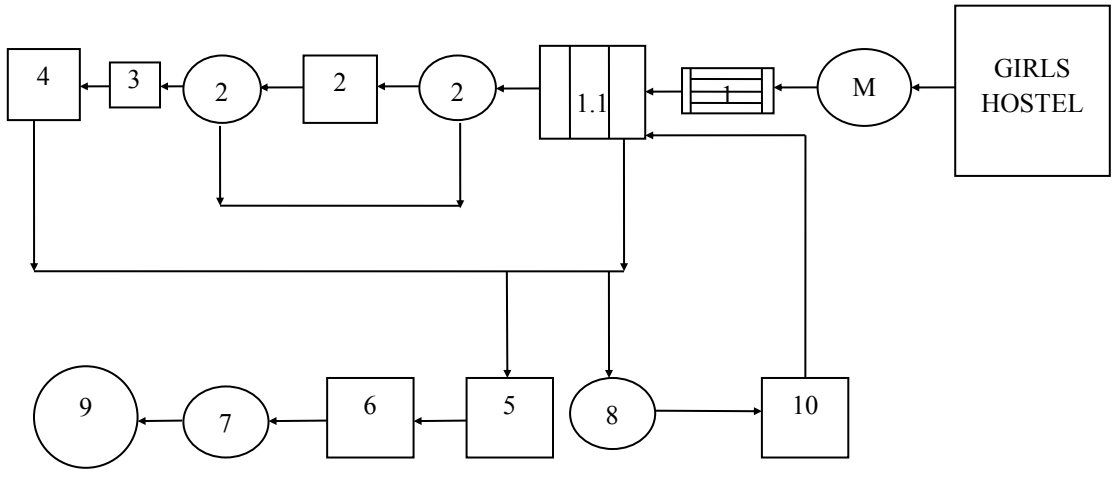

Fig 4.1: Flow Diagram of Sewage Treatment Plant

M.H. = Manhole

1. Bar Screen
1.1 Equalization and grit and skimming unit
2. Modified activated sludge process
3. Settling chamber
4. Flash mixer and clarriflocculator
5. Rough composite filter
6. Disinfection unit
7. Polishing carbon filter
8. Sludge digester
9. Treated water tank
10. Sludge drying bed

4.2.1 Bar screens The first unit operation encountered in wastewater treatment plant is screening. A screen is a device with openings, generally of uniform size, that is used to retain the coarse solids found in wastewater. The screening element may consist of parallel bars, rods or wings, grating, wire mesh, or perforated plate and the openings may be of any shape but generally are circular or rectangular slots. Screens have openings (spaces between the bars) of 15mm at an angle of angle of 45□ in the direction of flow. Bar screen should be either of epoxy-coated mild steel or stainless steel. Care is to be taken to see that there are no gaps left between the screen frame and the floor and the sides of the chamber. Provide **60 cm wide and 80 cm deep** drain section with bar screens of **2mmx4mm at 15 mm** C-C at angle 45^0 in the direction of flow. Bar screen should be either of epoxy coated mild steel or stainless steel. Care is to be taken to see that there are no gaps left between the screen frame and the floor and the sides of the chambers the nuisance of odour coming from the putrefying matter.

4.2.2 Equalization tank with grit cum skimming unit A grit chamber is generally not an essential unit in a typical residential complex. It is however mandatory unit in commercial and industrial units with a canteen on campus.

A skimming tank is a chamber so arranged that floating matter rises and remains on the surface of the wastewater until removed, while the liquid flows out continuously through deep outlets or under partitions, curtain walls or deep scum boards. This may be accomplished in a separate tank or combined with primary sedimentation, depending on the process and nature of the wastewater.

The equalization tank is the first collection tank in an STP. Its main function is to act as buffer: To collect the incoming raw sewage that comes at widely fluctuating rates, and pass it on to the rest of the STP at a steady (average) flow rate.

During the peak hour sewage comes at the high rates. The equalization tank stores the sewage and lets it out during the non-peak time when there is no/little incoming sewage. The operating cycles of the equalization tank is 2times per day.

$$V = \frac{total\ sewage\ per\ day}{number\ of\ treatment\ cycles} = \frac{2.5}{2} = 12.5\ m^3$$

Assuming the depth of basin as 2.5 m

$$L \times B = \frac{V}{H} = \frac{12.5}{2.5} = 5\ m^2$$

Taking L = 3 m, L = length
$L \times B = 5\ m^2$ B = breadth

$$B = \frac{5}{3} = 1.67 m$$

Provide a equalization basin of (3 x 1.67 x 2.5) m.

0.5m = free board
0.8m = sludge depth

4.2.3 Modified ASP The aeration tank (together with the settling tank/clarifier that follows) is at the heart of the treatment system. The bulk of the treatment system is provided here, employing microbes/bacteria for the process. The main function of the aeration tank is to maintain a high population level of microbes. This mixture is called MLSS (mixed liquor suspended solids). The mixed liquor is passed on to the clarifier tank, where the microbes are made to settle at the bottom. The settled microbes are recycled back to the aeration tank. Thus they are retained for a long period within the system.

Volume of ASP = $V = \frac{Q_0.\theta_c.Y.(S_0 - S_c)}{X.(1 + K_d\theta_c)}$

$$V = \frac{25 \times 25 \times .5 \times (300 - 30)}{2000 \times (1 + 0.05 \times 25)} = 18.75\ m^3 \approx 20\ m^3$$

Q_0 = Inflow of sewage = 25 m^3
θ_c = solids retention time = 25d
Y = bio kinetic constant =0.5/d
S_0=inflow BOD =300 mg/l
S_e= Outflow BOD = 30 mg/l
X = MLSS=2000 mg/l
K_d = Decay rate = (0.05/d)
Let SWD = 3.0 m

$L \times B = \frac{20}{3} = 6.66\text{m}^2$

Let us assuming $L = 4$ m

$B = \frac{6.67}{4} = 1.67 \approx \text{B} = 2\text{m}$

Provide (4 × 2 × 3) m for activated sludge unit.
0.3m = free board

4.2.4. Settling chamber Settling chamber is used for grit removal, particulate-matter removal in the primary settling basin, biological-floc removal in the activated-sludge settling basin, and chemical-floc removal when the chemical coagulation process is used. It is also used for solids concentration in sludge thickeners. In most cases, the primary purpose is to produce a clarified effluent, but it is also necessary to produce sludge with a solids concentration that can be easily handled and treated. In the design of sedimentation basin, considerations must be given to production of both a clarifier effluent and a concentrated sludge.

Oxidized organics from ASP are settled in settling chamber.

Surface area of ST = $A_s = \frac{Q}{\text{out flowrate}} = \frac{25/2}{3} = 4.16\ \text{m}^2$

$Q = \frac{25}{2} = = 12.5\ \text{m}^3/\text{cycle}$

Assume Outflow Rate =3 m/d

Assuming square settling chamber of size 3×3m, providing a SWD of 3m with 0.3m free board

and 0.5 m sludge depth

In flow and out flow arrangements

Inflow of biologically stabilized sewage is made by a rectangular chamber of c/s dimensions of 0.3m x 0.4m

Out flow is affected by a overflow channel of c/s dimensions of 0.5 ×0 .6m

4.2.5. Flash mixer with Clariflocculator Flash mixer with Clariflocculator Clariflocculator is a combination of flocculation and clarification in a single tank to achieve economy in construction. It has two concentric tanks where inner tank serves as a flocculation basin and the outer tank serves as a clarifier.

A flash mixing unit of (0.7× 0.6 ×0.5) m provided at the inlet of clariflocculator for rapid mixing of coagulant with effluent.

A clariflocculator of size 5m×4m is provided with 2 numbers of baffle walls for settling of flocs and side depth is 2 m, 1m sludge depth. An additional 1m depth for sludge is provided. Outlet arrangement consists of a overflow channel of dimension (0.7×0.6×0.5) m.

4.2.6. Filters Filtration is one of the principal unit operation used in the treatment of potable water. It is a well-established operation for achieving supplemental removals of suspended solids (including particulate BOD) from wastewater effluent of biological and chemical treatment processes. The role of filtration in the removal of effluent suspended solids becomes even more firmly established.

4.2.7. Activated carbon filter It is light weight equipment which is aesthetic in appearance and easy to install, doesn't require concrete foundation. This filter uses the adsorption action of activated carbon. Activated carbon is typically manufactured from coconut shell or charcoal, the "activation" process creating a highly porous material with a very large surface area. Organic pollutant molecules are physically adsorbed and held fast within the catacomb-like porous structure of the activated carbon. Granular activated carbon is typically used for this purpose.

4.2.7.1. Composite filter A rough composite filter is provided for the removal of any residual colloids from clariflocculator. It is made up of locally available economic materials such as charcoal, brickbats, and pebbles. It is provided with size of (2×2×2) m with free board 0.5m.

Filter media:

- 1st layer = 40mm brickbats of 0.5m deep
- 2nd layer = charcoal of 1m depth
- 3rd layer = pebbles of 0.5m depth

4.2.8. Disinfection chamber The various methods used for the disinfection are ozone, ultraviolet (UV) and chlorine. The most common method of disinfecting wastewater is by the addition of chlorine. In most STPs, the common form of Chlorine used is Sodium Hypochlorite (Hypo) available commercially at 10-12 % strength, being safe, easy to handle and having a reasonable shelf life. For disinfection of pathogens in treated effluents bleaching powder is added in chamber of (3×3×3) m with a free board of 0.3m.

4.2.9. Polishing carbon filter

- It helps to remove turbidity suspended particles chlorine, organic matter, odour and colour present in the effluent.
- In carbon filters adsorption process is involved.

4.2.10. Sludge digester Biological treatment of wastewater per force produces excess biological solids due to the growth and multiplication of bacteria and other microorganisms in the system. The excess biomass thus produced needs to be bled out of the system, and disposed off efficiently. This is a five-step process: sludge removal, storage, conditioning, dewatering and disposal. Sludge is removed from the system from the sludge recirculation pipeline (through a branch). The sludge is in the form of thick slurry. It is taken into a sludge-holding tank, and kept under aeration (to prevent the living organisms from putrefying) until dewatering operations can be carried out. Before dewatering, polymer or other chemicals may be added for conditioning the sludge, to facilitate the process. Sludge is then dewatered in a filter press/ Sludge bag/ centrifuge. The sludge digester is provided with size of 2m ϕ, height of 3m and free board of .97m.

4.2.11. Sludge drying bed: In order to dry the sludge obtained from various unit operations we are providing sludge drying bed in brick masonry(in 1:4 CM) of size (3.0 x 2.0 x 2.0) m.

4.3 RCC Design The designed structural and reinforcement details are listed in the table 4.1 and 4.2 respectively.

4.3.1 R.C.C design of Equalization tank

Step 1: Tank dimensions:

Length= 3m,

Width= 1.67m,

Height=2.5+0.5(free board) +0.8(sludge depth) =3.8m

Specific weight/density of waste water =10.2KN/m^3

Using M-30 grade concrete and HYSD bars (Fe-415)

Step 2: Permissible stress for M-30concrete and Fe – 415 steel

σ_{cbc} = permissible stress of concrete in bending = 10 N/mm^2

σ_{ct}= permissible stress of concrete in direct compression = 1.5 N/mm^2

σ_{st}= permissible stress of steel in tension = 150 N/mm^2

Step 3: Design constants:

m = modular ratio $m = \frac{280}{3\sigma_{cbc}} = \frac{280}{3 \times 10} = 9.33$

$k = \frac{m\sigma_{cbc}}{m\sigma_{cbc} + \sigma_{st}} = \frac{9.33 \times 10}{9.33X10 + 150} = 0.3834$

j = 1-k/3 = = 0.8721

$Q = 0.5 \times j \times k \times \sigma_{cbc} = 0.5 \times 0.8721 \times 0.3834 \times 10 = 1.67$ kN/mm^2

Step 4: $L = 3$m, $h = a = 3.8$m, $b = 1.67$m

B/a= $\frac{1.67}{3.8}$ =0.44≈0.5

M_x = -0.035 @ $y = 0$

M_y = -0.029 @ $y = b/2$

Horizontal moment = $M_y \omega a^3$= 0.029 x 10.2 x 3.8^3=16.23 kN-m

Vertical moment = $M_x \omega a^3$= 0.035 x 10.2 x 3.8^3 = 19.58kN-m

Thickness of wall is selected based on following three criteria

1. Thickness of wall should not be less than 150 mm
2. Thickness = 30H + 50 = 30 x 3.8 + 50 = 164 mm
3. $d = \sqrt{\frac{M}{Qb}} = \frac{19.58 \times 10^6}{1.67 \times 1000}$ =108.27 mm

Here we are adapting maximum of above value i.e. 164mm

Assume cover =40mm

Therefore, overall depth =165 + 40 (cover) = 205mm ≈ 210 mm

Effective depth, d_{eff}= 210 – 40 = 170 mm

Step 5: To find out the pull,

$T = \frac{Whb}{2} = \frac{10.2 * 3.8 * 1.67}{2}$ = 32.36 kN

Step 6: Check for stability:

$\frac{\sigma_{cbt}|}{\sigma_{cbt}} + \frac{\sigma_{ct}|}{\sigma_{ct}} < 1$; σ_{cbt}=2 N\mm^2, σ_{ct}=1.5N\mm^2 for M30 concrete

Tension is combined with horizontal moment

Therefore here moment, M = 0.029 x 10.2 x 3.8^3 = 16.23 kN-m

$Z = \frac{bd^2}{6} = \frac{1000 * 210^2}{6}$ = 7.35X10^6 mm^3

$\sigma_{cbt} = \frac{M}{Z} = \frac{16.23 \times 10^6}{7.35 \times 10^6}$ = 2.208

$\sigma_{ct}| = \frac{T}{bd} = \frac{50.875 \times 10^3}{1000X210}$ = 0.242

$\frac{2.208}{2} + \frac{0.242}{1.5}$ = 1.265 > 1

Hence unsafe

Therefore, we need to increase thickness

i.e. 270 mm thickness of wall and select 12mm dia bars

d_{eff} = 270-40-12/2 =224 mm

$\frac{1.33}{2} + \frac{0.188}{1.5}$ =0.74 > 1

Hence safe, therefore we are adopting 270mm thickness of wall

Step 7: Design of base slab,

$A_{st\ min}$ =0.3% of gross area = 0.003 x 1000 x 150 = 450mm^2

Assuming thickness of base slab =150 mm

Providing =225 mm^2 as main steel and distribution steel

Select 10 mm dia bars

Spacing = $\frac{1000 \text{ x } \pi \text{ x } 10^2}{225 \text{ x } 4}$ = 350 mm

Provide 10 mm dia bars @ 300 mm c/c as both main and distribution steel as both top and bottom reinforcement.

The further units are designed using IS 3370-1967 and IS 456 – 2000 and the procedure adopted for the design process is same as the above.

Design constants and parameters adopted for the design of treatment units:

The Specific weight/density of waste water =10.2kN/m^3

Using M-30 grade concrete and HYSD bars (Fe-415)

Permissible stress for M-30concrete and Fe – 415 steel

σ_{cbc} = permissible stress of concrete in bending = 10 N/mm^2

σ_{ct}= permissible stress of concrete in direct compression = 1.5 N/mm^2

σ_{st}= permissible stress of steel in tension = 150 N/mm^2

Design constants:

m = modular ratio $m = \frac{280}{3\sigma_{cbc}} = \frac{280}{3 \times 10}$ = 9.33

$k = \frac{m\sigma_{cbc}}{m\sigma_{cbc} + \sigma_{st}} = \frac{9.33 \times 10}{9.33X10 + 150}$ =0.3834

J = 1-k/3 = = .8721

$Q = 0.5 \times j \times k \times \sigma_{cbc} = 0.5 \times .8721 \times .3834 \times 10 = 1.67$ kN/mm^2

Table 4.1 : Structural Dimensions of the Sewage treatment units

Sl. No	Treatment unit	Dimensions (m)						
		length	width	depth			Thickness (mm)	
				free board	depth	sludge depth	slab	wall
1	Equalization and Grit cum Skimming Tank	3	1.67	0.8	2.5	0.8	150	270
2	Modified ASP	4	2	0.3	2		150	230
3	Settling Chamber	3	3	0.3	3	0.5	150	270
4	Flash Mixer Clariflocculator	5	4	1	2.5	1	150	270
5	Rough Composite Filter	2	2	0.5	2		150	200
6	Disinfection Unit	3	3	0.3	3		150	200
7	Polishing Carbon Filter	2φ		0.54	3		150	
8	Sludge digester	2φ		0.97	3		150	170
9	Treated water tank	6	6		3		150	300
10	Sludge drying bed	3	2		2		150	230

Note:

1. The slab thickness for the entire unit is 150mm.
2. The slab Reinforcements for entire unit is 10mm diameter at 300mm centre to centre
3. Sludge digester wall reinforcement horizontal wall is 400mm centre to centre and vertical walls is 12mm diameter at 200mm centre to centre
4. All dimensions are in mm

4.3Abstract of Estimated Cost The total abstract of estimated cost for the sewage treatment plant is given below in the following table 4.2.

Note:

- Rates considered are based on Schedule of Rates (PW, P & IWTD, SOUTH ZONE, BANGLORE) 2016-2017 and Schedule of Rates (Karnataka Water Supply & Drainage Board), 2016-0217
- For items not mentioned in Schedule of rates, Prevailing Market Rates were considered.
- Rate for Reinforcement Steel is as per present Market Rate.

Table 4.2: Total Cost abstract for Sewage Treatment Plant.

Cost abstract for Sewage Treatment Units		
Sl. No.	**Units**	**Cost in Rs.**
1	Bar Screens	15000
2	Equalization & grit cum skimming unit	288253.87
3	Modified ASP Unit	108567.23
4	Settling Chamber	169381.87
5	Flash Mixer with clariflocculator	293279.3
6	Rough Composite Filter	69014.49
7	Disinfection Unit	163242.77
8	Polishing carbon Filter	171225.72
9	Sludge Digester Unit	170552.3
10	Treated Water tank	513888.23
11	Sludge drying bed	66421.39
Total in Rs.		**2028827.17**

5. RESULTS AND DISCUSSION

The physico-chemical characteristics of raw wastewater from VVIET girl's hostel, which gives the data of 3 sessions (Morning, Afternoon and Evening) collected at the peak hours, for four consecutive days and the average results of 3 sessions and 4 days samples is as shown in table 5.1. The obtained results are considered for the design of STP, key pollutants in the wastewater from VVIET girl's hostel are organic compounds, solids, BOD, COD, nitrates and sulphates. Finally table 5.5 gives the final dimensions of various Treatment units for construction work.

Table 5.1: Physico-chemical characteristics of raw wastewater from VVIET girl's hostel

Day Number	Characteristics	pH	BOD	COD	TDS	Nitrates	Sulphates	Turbidity
	Unit		mg/L	mg/L	mg/L	mg/L	mg/L	NTU
Day 1	Morning	5.3	290	539	300	1.2	83.5	79.3
	Afternoon	7	300	120	1100	4.8	142.5	20.2
	Evening	7.4	300	104	1120	5.6	125.5	48.5
Day 2	Morning	5.4	292	536	298	1.4	82	76.8
	Afternoon	6.9	310	110	1015	4.3	138.6	19.6
	Evening	7	304	102	1100	5.2	124.3	42.9
Day 3	Morning	5.3	291	533	290	1.3	80.6	77.2
	Afternoon	7.3	315	106	1092	4.4	140.1	20.3
	Evening	6.9	305	99.8	1115	5	125.6	40.8
Day 4	Morning	5.4	290	540	292	1.4	82.8	76.5
	Afternoon	7	308	102	1108	4.2	138.9	22.7
	Evening	7.2	300	100	1109	5.2	123.5	38.6
	Average	**7**	**300.42**	**249**	**828**	**3.7**	**115.7**	**47.0**

Table 5.2: Final Dimensions of various Treatment units for construction work.

SLNo	Treatment units	Dimensions (in m)
1	Bar screens (in line with outfall drain)	(0.60 wide×0.80 deep) cm
2	Equalization & grit cum skimming unit	3.0×1.670×(2.50+0.80)
3	Modified ASP unit	4.0x2.0x(2+0.3)
4	Settling chamber	3.0x3.0×(3+0.3+0.5)
5	Flash mixer and clariflocculator	5.0×4.0×(2.50+1)
6	Rough composite filter	2.0×2.0×(2.0+0.5)
7	Disinfection unit	3.0×3.0×(3.0+0.3)
8	Polishing carbon filter	2.0φ×(3.0+0.54)
9	Sludge digester unit	2.0φ×(3.0+0.97)
10	Treated water tank	6.0×6.0×3.0
11	Sludge drying bed	3.0×2.0×2.0

6. CONCLUSIONS

The present paper works as a template for the similar designs of Sewage Treatment Plants (STP) which can be ready reckoner. Further this will be a motivation for implementing such treatment plants in line with our Prime Minister's National slogan, ***Swach Bharath.*** In addition, the cost of the entire STP has been optimized to reduce it to a meager percentage of the total cost of the associate building. A detailed Design, Estimation and Costing of Sewage Treatment Plant for VVIET Girl's Hostel were done. Available site area is found to be 60m x 60m and utilized area for the construction of STP is 50m x 50m. Care was taken while selecting a site such that it is on the downstream side so that wastewater can flow through the gravity where pumping cost will be reduced. Total quantity of wastewater to be treated is 25 KLD. Based on the results obtained, adoption of two filters in the treatment process ensures the better treatment of sewage and hence treated sewage could be used for gardening, flushing in Water closet and even treated water can be utilised for drinking purpose as higher degree of treatment is given to the wastewater generated. The sludge obtained from the sludge drying beds can be used for the gardening purpose within the campus. Surplus sludge can be sold out for reasonable price as it can be used as manure in agricultural fields. The overall estimated cost of the project is Rs. **20, 28,827** (Twenty lakh twenty eight thousand eight twenty two seven rupees).

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ANALYSIS OF BOOST CONVERTER USING DIFFERENT PID TUNING TECHNIQUES COMPARED WITH CLOSE LOOP SYSTEM

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ABSTRACT

The use of DC –DC power converters is continuously growing both in power electronics products & system. DC-DC converters are used to convert one DC voltage to another DC voltage. It is inordinately used in industry as well as in research. The major drawback of the boost converter is the uncontrolled supply of voltage and current. So initially convectional PID controller is designed to regulate the output voltage and shows improved performance of the converter when compared to close loop system.

Keywords: PID Controller, Boost converter, Tuning Techniques, MATLAB Simulation.

1. INTRODUCTION

Power converter has played very important role for handling high power. DC-DC converters are some of the simplest power electronic converter circuits. They are widely used in the power supply equipment for most electronic instruments and also in specialized high power applications such as battery charging, plating and welding. The wide variety of circuit topologies ranges from the single transistor buck, boost and buck/boost converters to complex configurations comprising two or four devices and employing some techniques to control the switching losses. The usual requirement of a control system for the converter is to maintain the output voltage constant irrespective of variations in the DC source voltage V_{in} and the load current. However, load changes affect the output voltage transiently, possibly causing significant deviations from the steady state level. Furthermore, in a practical system circuit losses introduce an output voltage dependency on steady state load current which must be compensated for by the control system [1,2 ,3].

PID controller is being used in 90% of industries[6]. PID is extensively used for it is simple in structure and has standard performance for most of the industries. But it is quite challenging to find gains of PID to meet response time and overshoot (phase margin) specifications. Manual tuning is purely trial and error process, time consuming and non-systematic. It may not produce optimal design and can lead to dangerous conditions. So some standard design procedures had been introduced like Ziegler-Nichols method, Chien-Hrones-Reswick method and pure numerical optimization approach . For analysis of a control system first a mathematical model of the boost converter is derived by state space averaging techniques [7]. The transfer function Thus obtained is used to find the gains of controllers by different tuning methods mentioned above.

In this paper in section II basic theory of PID controller is given. In Section III gives basic idea of DC to DC boost converter.In section IV & V design of boost converter with control transfer function is presented [8]. In section VII different

tuning methods are discussed and their respective compensator transfer functions are given. Various tuning methods are compared in section XI with system characteristics. Finally the tuning method with best performance is chosen and is implemented to designed boost converter.

2. MODEL OF PID CONTROLLER

Proportional-Integral-Derivative (PID) controller has been used for several decades in industries for process control applications. PID involves three separate parameter, the proportional, the integral and derivatives. By tuning the three constants in PID controller algorithm, the controller can provide control action designed for specific process requirement.

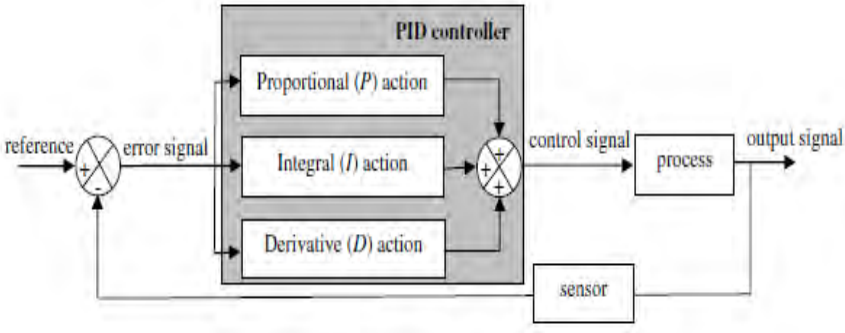

Fig.1 Block representation of PID Controller in a close loop system

This method is more popular among all control methods. The determination of proportional (K_P), derivative (K_d) and integral (K_i) constants are known as tuning of PID controller. A PID controller is shown in Figure 1 and is given by

$$G_c(s) = K_c\left(1 + \frac{1}{T_i s} + T_d s\right) \qquad \text{.....(1)}$$

Where Kc = proportional gain, T_i = integral time constant and T_d = derivative time constant. The introduction of integral action facilitates the achievement of equality between the measured value and the desired value, as a constant error produces an increasing controller output. The introduction of derivative action means that changes in the desired value may be anticipated, and thus an appropriate correction may be added prior to the actual change. Thus, in simplified terms, the PID controller allows contributions from present, past and future controller inputs.

3. DC – DC BOOST CONVERTER

In case of DC to Dc boost converter, average output voltage is always higher than the input voltage.

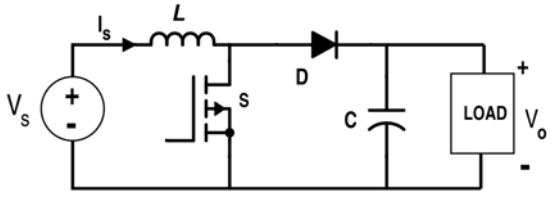

Fig.2 DC-DC Boost Converter

$$V = Vs = \frac{1}{1-D} \ldots\ldots\ldots \quad (2)$$

Inductor is used to resist the change in current supplied. The boost converter is operating as follow.

1. When switch S is close, Inductor stores the energy into it. Current is circulating in clockwise direction. Left side polarity of inductor is positive. When switch S is open, current is decrease. And inductor opposes the change of current into it. For that polarity will be reverse. i.e. Left side of inductor is negative in this situation.
2. Switch "S" is in ON state, current through inductor is increase. And diode is in off condition. Switch "S" is in OFF state, the current stored in inductor is now coming out through diode [4]. On the basic of Faraday's low we can conclude that,

$$V_{in}\,DT = (V_{in}-V_0)\,(1-D)T$$

V_{in} = Input DC voltage,

V_o = Output DC voltage,

D = Duty cycle,

T = Total time

In the switch ON, state inductor is been charged as source voltage of Vg and capacitor will discharge. The equation of duty cycle (D) is become [5].

$$D = \frac{Ton}{T}$$

As per voltage balance equation, we can see that

$$Vg\,(DTs) + (Vs - Vo)\,(1-D)\,Ts = 0$$

$$Vg(DTs) - Vg(DTs) - VgTs + Vo\,DTs - VoTs = 0$$

$$V0 = \frac{Vg}{1-D} \ldots\ldots.(3)$$

4. DESIGN CALCULATION OF BOOST CONVERTER

Boost converters are switched power converters. The converter uses a transistor switch, typically a MOSFET, to pulse width modulate the voltage into an inductor.

Duty Cycle (D): To determine the duty cycle D, for the minimum input voltage. The minimum input voltage is used because it leads to the maximum switching current.

$$D = 1-(Vin/Vo)$$

Vin = Input voltage

Vo = Desired output voltage

Load Resistance (R): $R = Vo/\,Io$

Vo = desired output voltage

Io = desired output current

Inductance (L): $L = Vin\,(Vo-Vin)/\Delta Il\,fs\,Vo$

$\Delta Il = 10\%\ of\ Io$

Vin = input voltage

Vo = desired output voltage

fs = switching frequency

ΔIl = inductor ripple current

Io = desired output current

Capacitance (C): $C = (Io\,D)\,/(fs\,\Delta Vo\,)$

$\Delta Vo = ESR(Io1 - D + \Delta Il2)$

Io = desired output current

D = duty cycle

fs = switching frequency

ΔVo = output ripple voltage

ΔIl = inductor ripple current

ESR = equivalent series resistance of the capacitor

Table 1. Design Specification

Sr. No.	Parameters	Values
1	Input Voltage (Vin)	60 V
2	Input Current (Iin)	5 A
3	Output Voltage (Vo)	300 V
4	Output Current (Io)	1 A
5	Duty Cycle (D)	0.8
6	Load Resistance (R)	300 Ω
7	Inductance (L)	240 mH
8	Equivalent Series Resistance (ESL)	0.5 Ω
9	Capacitance (C)	5000 µF
10	Equivalent Series Resistance (ESR)	16 mΩ

5. STATE SPACE MODELING

The modeling of DC-DC boost converter is carried out to determine the state space model. The output and the control transfer function of the system are obtained from the state space model using MATLAB. This method is known as state space averaging technique. The operation of the boost converter takes place in two modes.

Switch ON equivalent circuit

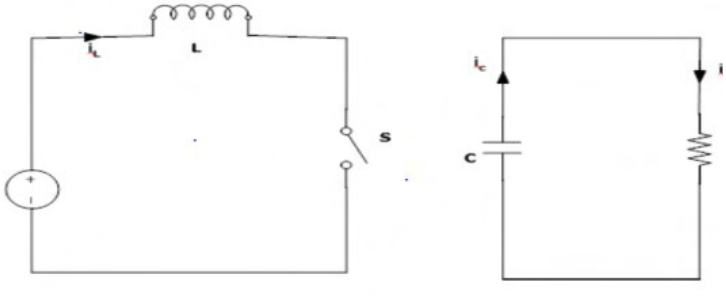

Fig 3: Boost converter- ON mode

During ON mode as shown in Fig 2, the state equation matrices are given by-

$$\begin{bmatrix} \frac{di_l}{dt} \\ \frac{dv_c}{dt} \end{bmatrix} = \begin{bmatrix} \frac{-R_l}{L} & 0 \\ 0 & \frac{-1}{C*(R+R_c)} \end{bmatrix} * \begin{bmatrix} i_l \\ v_c \end{bmatrix} + \begin{bmatrix} \frac{1}{L} \\ 0 \end{bmatrix} * V_{in}$$

$$V_o = \begin{bmatrix} 0 & \frac{R}{R+R_c} \end{bmatrix} * \begin{bmatrix} i_l \\ v_c \end{bmatrix}$$

Switch OFF equivalent circuit

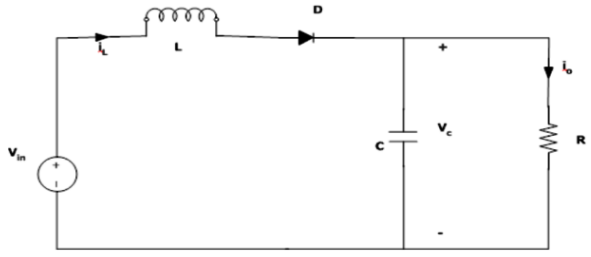

Fig 4: Boost converter- OFF mode

During OFF mode as shown in Fig .4, the state equation matrices are given by-

$$\begin{bmatrix} \frac{di_l}{dt} \\ \frac{dv_c}{dt} \end{bmatrix} = \begin{bmatrix} \frac{-R_l+(R\|R_c)}{L} & \frac{-R}{L(R+R_c)} \\ \frac{R}{C(R+R_c)} & \frac{-1}{(R+R_c)} \end{bmatrix} * \begin{bmatrix} i_l \\ v_c \end{bmatrix} + \begin{bmatrix} \frac{1}{L} \\ 0 \end{bmatrix} * V_{in}$$

$$V_o = \begin{bmatrix} (R\|R_c) & \frac{R}{(R+R_c)} \end{bmatrix} * \begin{bmatrix} i_l \\ v_c \end{bmatrix}$$

The state space parameters A, B, C and D matrices for the above equations are obtained for ON and OFF states. By averaging techniques the determined matrices are

$$A_{avg} = \begin{bmatrix} -2.06972 & -0.8332 \\ 39.996 & -0.666 \end{bmatrix}$$

$$B_{avg} = \begin{bmatrix} 4.166 \\ 0 \end{bmatrix}$$

$$C_{avg} = [0.0031980.999]$$

$$D_{avg} = [0]$$

Using MATLAB, the output transfer function obtained is $\frac{V_o}{V_{in}} = \frac{0.0133s+166.5}{s^2+2.753s+34.72}$

6. CONTROLLER PARAMETER

"Tuning" is the engineering work to adjust the parameters of the controller so that the control system exhibits desired property. Currently, more than half of the controllers used in industry are PID controllers. In the past, many of these controllers were analog; however, many of today's controllers use digital signals and computers. When a mathematical model of a system is available, the parameters of the controller can be explicitly determined.

However, when a mathematical model is unavailable, the parameters must be determined experimentally. Controller tuning is the process of determining the controller parameters which produce the desired output. Controller tuning allows for optimization of a process and minimizes the error between the variable of the process and its set point. Types of controller tuning methods include the trial and error method, and process reaction curve methods. The most common classical controller tuning methods are the Ziegler-Nichols and Cohen-Coon methods. These methods are often used when the mathematical model of the system is not available. The Ziegler-Nichols method can be used for both closed and open loop systems, while Cohen-Coon is typically used for open loop systems.

A closed-loop control system is a system which uses feedback control. In an open-loop system, the output is not compared to the input. Response of close loop system & its step response is shown in fig.5. i.e. Maximum Overshoot (Mp) = 72.7%, rise time (t_r) = 0.079 & Settling time (t_s) = 2.7 sec

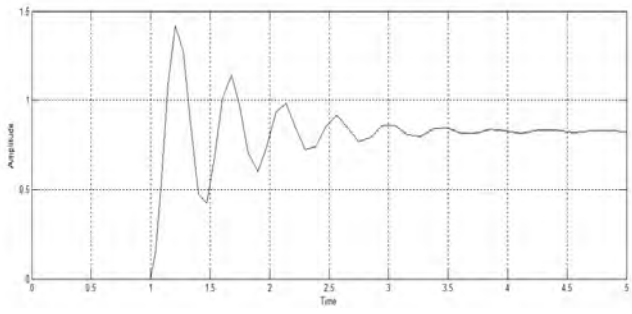

Fig.5 Close loop response of the system

7. ZIEGLER-NICHOLS (Z-N) METHOD

The Z-N tuning rule was discovered by Ziegler and Nichols in the year 1942[9].

This procedure is only valid for open loop stable plants and it is carried out through the following steps

i. Set the true plant under proportional control, with a very small gain.

ii. Increase the gain until the loop starts oscillating. Note that

linear oscillation is required and that it should be detected at the controller output.

iii. Record the controller critical gain $Kp = Kcr$ and the oscillation period of the controller output, Pcr.

iv. Adjust the controller parameters according to Table 2.

After applying above procedure, the step response for the $Kp = Kcr=200$.

Table 2: Ziegler –Nichols Tuning setting

PID Type	K_p	T_i	T_d
PID	$0.6K_{cr}$	$P_{cr}/2$	$P_{cr}/8$

Therefore, K_{cr} = 200 ,P_{cr}= 0.35 second .Obtain PID parameters from Table 2. K_P = 120 ,K_i = 0.291 & K_d = 0.0437 step response is shown in fig.6. Mp = 46%, tr = 0.00368 & ts = 0.0418 sec.

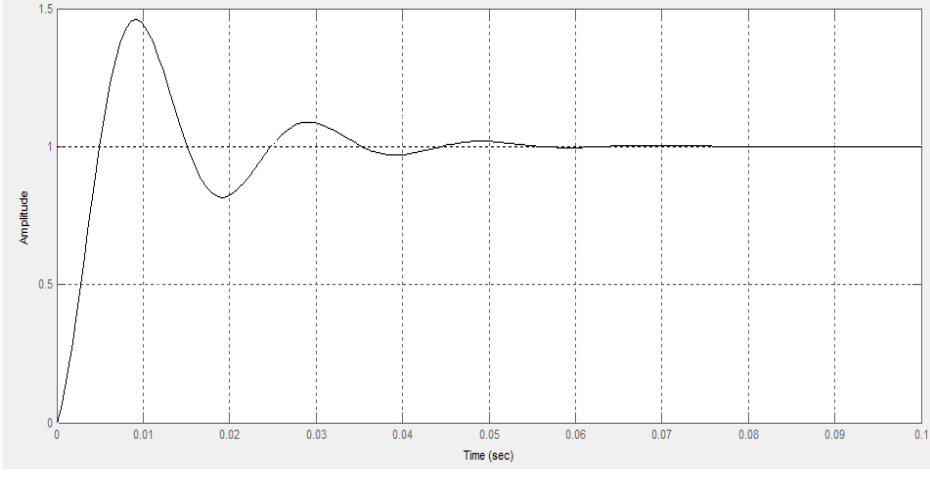

Fig.6. Time response of Ziegler-Nichols method

8. MODIFIED ZIEGLER-NICHOLS TUNING METHOD

For some control loops the measure of oscillation, provide by ¼ decay ratio and the corresponding large overshoots for set point changes are undesirable therefore more conservative methods are often preferable such as modified Z-N settings These modified settings that are shown in Table.3. Are some overshoot (10).

Table 3: Modified Ziegler –Nichols Tuning setting

Type of controller	Parameter		
	K_p	T_i	T_d
Some Overshoot	0.33 K_{cr}	$P_{cr}/2$	$P_{cr}/3$

As per Table 3, for some overshoot K_P = 66, $K_i = 1/T_i$ = 0.175 and K_d = 0.116, with the above values of K_P, K_i and K_d, step response is shown in Fig.7. Mp = 42.8%, t_r =0.00324 & t_s = 0.0363 sec.

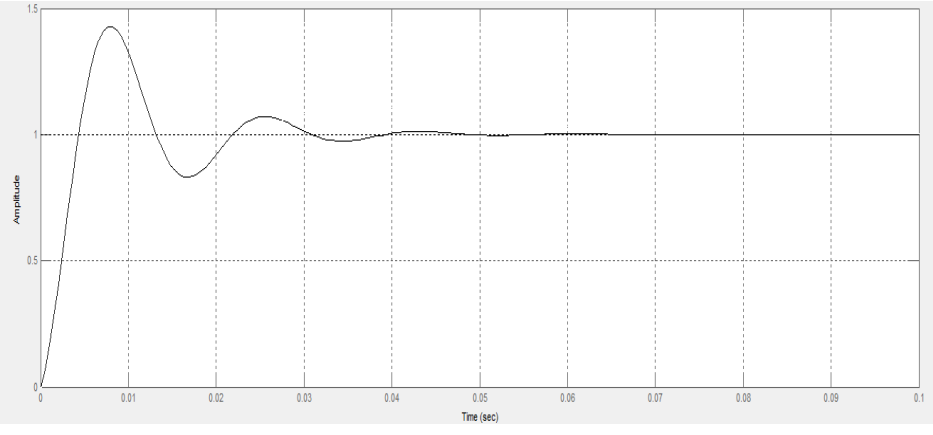

Fig.7. Response for Modified Ziegler –Nichols Tuning Method

9. TYREUS-LUYBEN METHOD

The Tyreus-Luyben procedure is quite similar to the Ziegler–Nichols method but the final controller settings are different [11]. This method is applicable for PI and PID Controller .This method are based on ultimate gain period and period given in table .4.

Table 4 : Tyreus – Luyben Parameter

Type of controller	Parameter		
	K_p	T_i	T_d
PID Controller	0.59 K_{cr}	P_{cr} /6	P_{cr} /1.5

As per Table 4, K_P = 62.5, $K_i = 1/T_i$ = 0.777 and K_d = 0.055, with the above values of K_P, K_i and K_d, step response is shown in Fig.8. Mp = 43.9%, t_r = 0.00368 & t_s = 0.0517 sec.

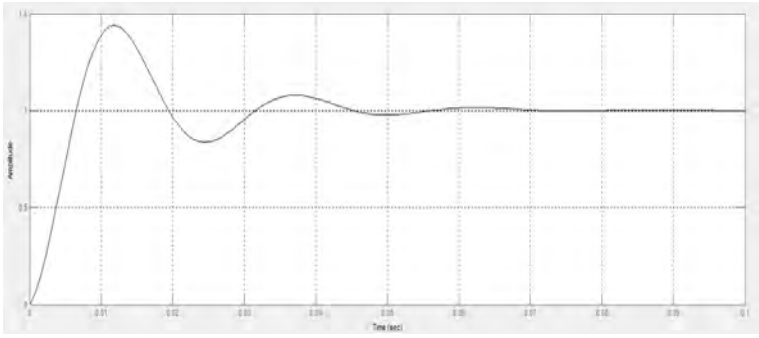

Fig.8. Response for Tyreus- Luyben Method

10. DAMPED OSCILLATION METHOD

In many cases, plants are not allowed to undergo through sustained oscillations, as is the case for tuning using continuous cycling method. Damped oscillation method is preferred for these cases. Damped oscillation method is invented by Harriott. The optimum settings for a P-I-D controller are shown in Table [12]

Table 5 : Harriott Tuning Parameters

Type of controller	**Parameter**		
	K_p	**T_i**	**T_d**
PID Controller	K_{cr} /3.2	P_{cr} /0.45	P_{cr} /6.3

As per Table 5, $K_P = 118$, $K_i = 1/T_i = 0.0583$ and $K_d = 0.233$, with the above values of K_P, K_i and K_d, step response is shown in fig.9. Mp = 37%, $t_r = 0.00162$ & $t_s = 0.0153$ sec.

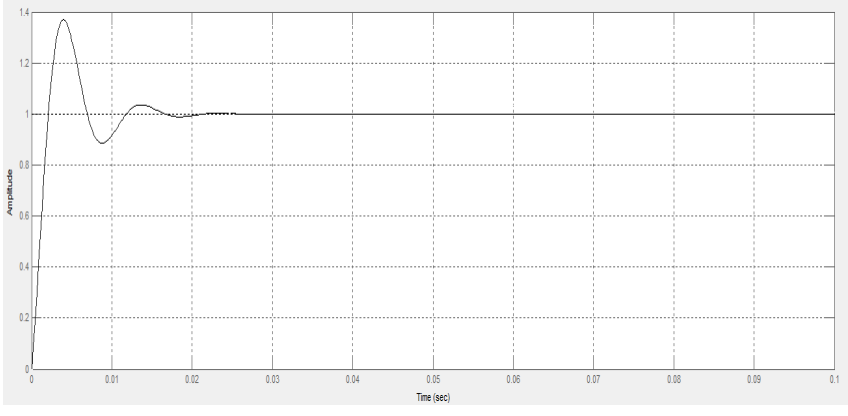

Fig.9.Response for Damped Oscillation Method

11. CONCLUSION

Different PID tuning methods are discussed in this paper. Step response of all methods and their system characteristics are compared with close loop system. Total four PID tuning techniques were implemented and their performances analyzed. The system exhibits a largest peak overshoot and settling time with Ziegler Nichols tuning technique. Damped oscillation method exhibits smallest maximum overshoot and settling time. Among the four PID tuning techniques, the damped oscillation tuned PID controller gives the best results for a second order system.

Table 6: Time response parameters

Algorithm	Rise Time (T_r)	Maximum Over-shoot ($M_{p)}$	Settling time (T_s)
Z-N Method	0.0036	46	0.0418
Modified Z-N Method	0.0032	42.8	0.0363
Tyreus – Luyben	0.0047	43.9	0.0517
Damped Oscillation Method	0.0016	37	0.0153

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DESIGN AND DEVELOPMENT OF CONSTANT PRESSURE DELIVERING PUMP

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ABSTRACT

Water pressure is one of the major problems today we are facing in domestic, agriculture and industrial sector since in all cases the initial requirement is to provide the water at high pressure. To maintain proper boosting pressure in commercial buildings and all other purposes, hydro pneumatic pump can be used. These pumps are highly energy efficient if we maintain a set pressure level whereas if we use constant speed booster systems it will tends to waste of energy. Hydro pneumatic system are generally installed in the basement of a building for the convenience of the user on the other end of a fixture side, at any given time. Boosters have a simple job; they "charge" the system with pressurized water such that as soon as tap is opened on an upper floor, the water is available immediately for the user. This reality has its inherent "inefficiencies" since many times throughout the day, the pump must either re-start to replenish any lost water in the system or continue to run as the water is disbursed to the fixture throughout the day. Sometimes these "occasional" loads can last throughout the day, this phenomenon realize that this run-time was costing more money. Hence the work of construction, designing and selecting of various accessories is being carried out in industry which is given in this paper.

Keywords: Control Panel; discharge; losses; manifold; pressure.

1. INTRODUCTION

A pump is a machine which is used to raise the pressure of the liquid and to move the liquid with pressure from one place to another. A pump can be further defined as a machine that uses several energy which gets transform to increase the pressure of a liquid. The transfer of liquids against gravity existed from time immemorial. A pump is one such device

which is used energy to raise, transport, or compress liquids. Pumps are widely used in industrial and residential applications. Pumping equipment is extremely diverse, varying in type, dimensions, size, and materials of construction used. There have been significant new developments are in the area of pumping equipment, early 1980s. Every year vast tonnage of liquid in the form of solid-liquid or semisolid mixtures, known as slurries. The application which involves the largest quantities is the dredging industry, continually maintaining navigation in harbors and rivers, altering coastlines and winning material to used to landfill and construction purposes. Dredging is one of the most common type and one of the ancient process involving slurry flows; the dredged materials contain a wide range of particles, tree debris, rocks, etc. Mining is one of the concept employed slurry flows in pipelines since the mid-nineteenth century, when the technique was used to reclaim gold from placers in California. Long-distance slurry pipelines have evolved in all continents since the mid-1950s. Some slurry mixtures consist of very fine solids at high concentration; other mixtures are based on coarse particles up to a size of 150 mm. Pumps are normally classified as: Reciprocating, Rotary, Centrifugal etc. in this project we utilize centrifugal pump.

Centrifugal pump works on the basic principle of forced vortex flow, which means that when a certain mass of liquid is rotated by an external flow, there will be rise in pressure head of the rotating liquid takes place by pump. The rise in pressure head at any point of the rotating/ moving liquid is proportional to the square of tangential velocity of the liquid at that point. Hence at the outlet side of the impeller where the radius is more, the rise in pressure head will be more and the liquid will be discharged at the outlet with high pressure. Due to high-pressure head, the liquid can be lifted to a high level. Figure shows flow of fluid in a centrifugal pump. When the pump is in operation there will be an increase in the fluid pressure from the pump inlet to its outlet. This pressure difference drives the fluid through the system or plant. The centrifugal pump increase in pressure by transferring mechanical energy of motor to the fluid through the rotating impeller. The fluid flows from the inlet to the impeller center and out along its blades. The centrifugal force increases the fluid velocity and consequently also the kinetic energy is transformed to pressure.

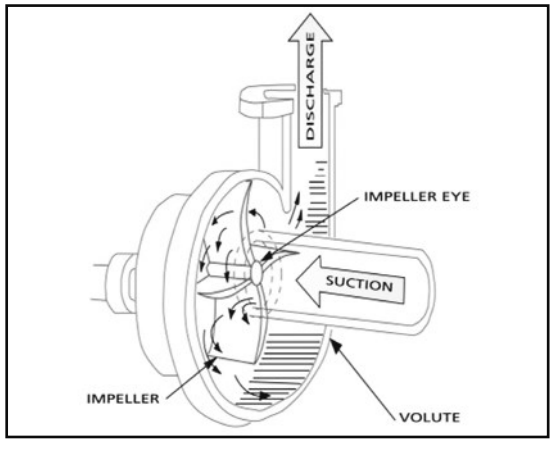

Fig1. Principle of centrifugal pump

2. MAIN COMPONENTS

A. *Pump:* The CR pump is a vertical inline multistage pump. This pump type is also able to pump corrosive fluids because the hydraulic parts are made of stainless steel or titanium.

B. *Pressure Transducer:* Pressure switches are used for maintaining the predetermined pressure differentials in the pressure tank. They are used as pilot circuits for starting the pump when the pressure in the tank reaches the low operating limit and again to stop the pump when the high operating limit is reached.

C. *Pressure Relief Valve:* Pressure relief valves are used to protect the system against damage because of either excessive water or air pressures. They are the safety valves of the system and, therefore, should be checked frequently to keep them in the best operating condition. They should be set to operate at a safe value above the maximum system pressure but always within the safe working limits of the tank or other parts which are to be protected and also selected with sufficient capacity to vent off all excess pressure.

D. *Pressure Gauge:* Pressure gauges are used for indicating the pressures existing in the system.

E. *Strainers:* Strainers are placed on the end of the water drain valves to protect the system against entrance of any possible contamination.

F. *Air Filters:* Air filters are placed on the intake lines to the air compressor, air inlet valves and vent connections when and as required. They are used to protect the system from atmospheric contaminations.

G. *Check Valves:* Thoughtful specification and selection of check valves for use in the piping lines of pneumatic pressure systems contributes to installation efficiency. Noisy, slamming valves should not be tolerated and definitely have no place in systems supplying hospitals, sanitariums, hotels and similar installations where noise is detrimental and a nuisance.

H. *Base Plate:* Base plate is the firm steel structure which is used to stand the complete assembly. It is provided to absorb shock, provide damping and provide the base.

I. *Suction Manifold:* Suction manifold is the essential need of any pump, in this project as the pump is of negative type hence specially design suction manifold is used in project.

J. *Delivery Manifold:* Delivery manifold are used to deliver pump water to the required section.

K. *Hydro pneumatic Tank:* Hydro pneumatic tank basic purpose is to maintain proper pressure and flow control. Two factors should be considered when specifying the construction of the pressure tank. They are the minimum safe working pressure which the tank must withstand in service and the possibility of corrosion which will affect the anticipated safe working life of the tank.

L. *Control Panel:* Control panel is being provided to the system in which various system are provided such as VFD, PLC and IO etc.

3. COMPUTER AIDED MODELLING

In modelling process CREO 2.0 have been used to developed different parts of the model which are necessary.

I. Inlet Skid:

Straight pipe: 5D-10D = 5x100 – 10x100

Flange= 100 mm, 8 holes dia 18, pcd 180mm.

Ball valve = 150mm

Long bend elbow 60º = 150mm

Length L = 720mm.

Eccentric reducer with flange= 100mm -150mm.

Straight pipe 2 = 200mm.

Straight pipe 3 =1500mm

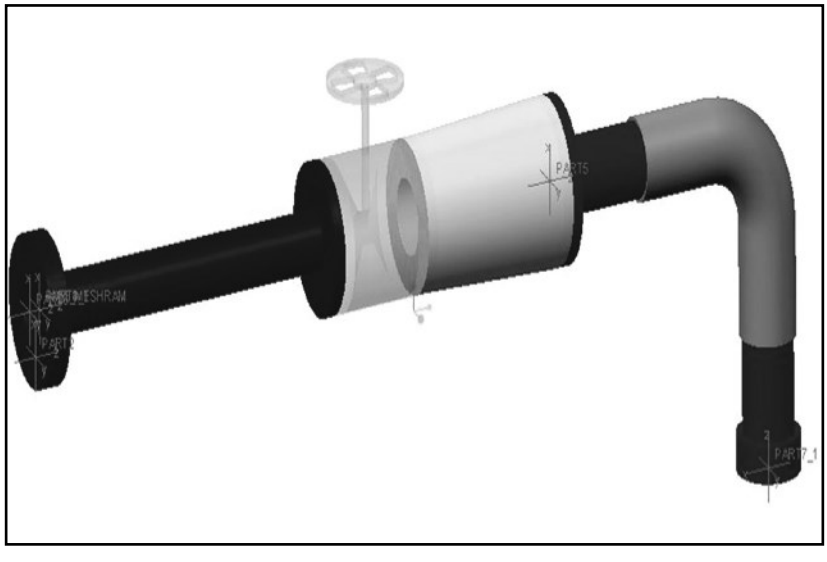

Fig. 2. Inlet Skid

II. Outlet Skid:

Outlet of the pump vary as per the requirement for this project we have taken the standard diameter 100mm

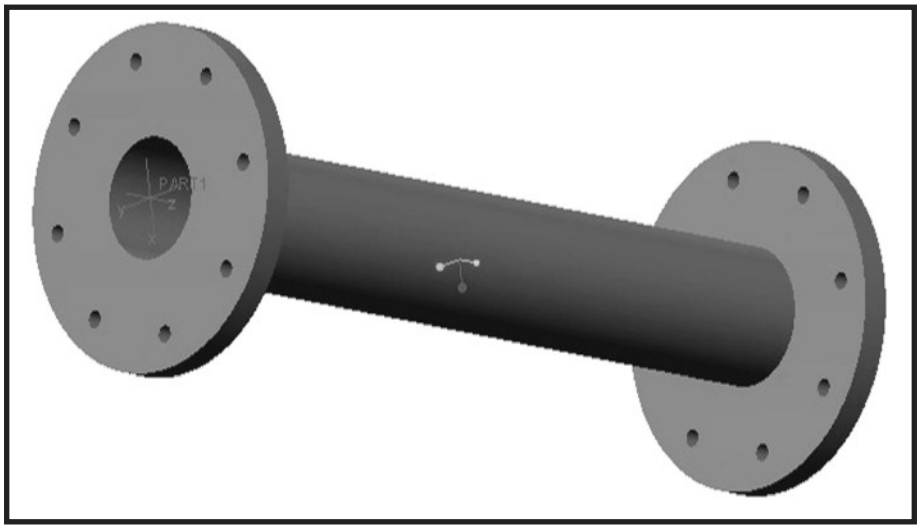

Fig. 3. Outlet Skid

4. DESIGN OF HYDRAUPNUEMATIC

I. Selection of Pump:

Head = 40 m, V=0.707m/s, Diameter= 0.1m

$Q = A \times V$ (1)

Applying Darcy formula we get,

$Hf = 4*0.01*1500*0.707^2 / 2*9.81*0.1 = 15.28$ m

NPSH = atmospheric pressure – elevation correction – vapor pressure –suction head

= 33.96 - 1.2 - 6.675 – 3 = 29.08 feet = 8.86m

NPSH required = 1.56 m, NPSH available = 8.86 m

On the above basis standard vertical centrifugal pump has been selected and its specification are as follows:

Table 1. Technical Specification

PRODUCT NAME	**CR 24-2-1**	**PRODUCT NAME**	**CR 24-2-1**
Technical		**Materials**	
Speed for pump data	2919 rpm	Pump housing	Cast iron
Rated flow	20.5 m^3/h	Pump housing	EN-JL1030
Rated head	46.6 m	Pump housing	ASTM A48-30B
Head max	58.8 m	Impeller	Stainless steel
Impellers	4	Impeller	DIN W.-Nr. 1.4301
Primary shaft seal	HQQE	Impeller	AISI 304
Approvals on nameplate	CE,TR	Material code	A
Curve tolerance	ISO9906:2012 3B	Code for rubber	E
Pump type	CR 20	Bush material	Graflon
Stages	4		
Pump version	A		
Model	A		

PRODUCT NAME	CR 24-2-1	PRODUCT NAME	CR 24-2-1
Installation		**Electrical data**	
Maximum ambient temperature	60 °C	Motor type	132SC
Max pressure at stated temp	16 bar / 120 °C	IE Efficiency class	IE3
Max pressure at stated temp	16 bar / -20 °C	Rated power - P2	5.5 kW
Flange standard	DIN	Power (P2) required by pump	5.5 kW
Connect code	F	Mains frequency	50 Hz
Pipe connection	DN 50	Rated voltage	3 x 220-240 D/380-415 Y
Pressure stage	PN 16	Rated current	36,0-34,5/20,8-19,8
Flange size for motor	FF265	Starting current	660-780 %
Liquid		Cos phi - power factor	0.88-0.84
Pumped liquid	Water	Rated speed	2920-2940 rpm
Liquid temperature range	-20 to 120 °C	Efficiency	IE3 91.2%
Liquid temp	20 °C	Motor efficiency at full load	91.2-91.2 %
Density	998.2 kg/m³	Motor efficiency at 3/4 load	91.80%
		Motor efficiency at 1/2 load	91.30%
		Number of poles	2
		Enclosure class (IEC 34-5	55 Dust/Jetting
		Insulation class (IEC 85)	F
		Motor protect	PTC
		Motor No	85U07417

II. *Design of Pipe:*

Inside diameter of pipe: $d = 1.13 \sqrt{(Q/v)} = 1.13\sqrt{(0.33/42.42)} = 0.099m = 100mm$ (2)

III. *Wall thickness of pipe:*

According to thin cylinder formula, wall thickness is: $T = pd/2\sigma t$ (3)

For design of pipe certain constant is added,

$T = pd/2\sigma t + c = 5x100/2x14 + 3 = 25mm$ (4)

Where c = 3 for MS, σ= 14 N/mm² for MS

Pressure drop in pipe: $\Delta p = [Q/cA]^2 \times d/2 = 0.0153$ bar (5)

IV. *Stresses in Pipe:*

According to LAMIS equation,

Tangential stress $(\sigma t) = [p(ri^2)/(ro^2 - ri^2)] \times [1+ (ro^2/x^2)] = [5(100^2)/ (125^2 - 100^2)] \times [1+ (125^2/100^2)] = 10.25$ MPa (6)

Where, p = internal fluid pressure, Ri = internal radius of pipe, Ro = outer radius of pipe.

Radial stress $(\sigma r) = [p (ri^2) / (ro^2 - ri^2)] \times [1- (ro^2/x^2)] = [5(100^2)/ (125^2 - 100^2)] \times [1- (125^2/100^2)] = -2.25$ Mpa (7)

V. *Design of Flanged Joint:*

D= 100mm, p=5bar, c=3, σt= 14

Thickness of pipe:$T = pd/2\sigma t + c = 5x100/2x14 +3 = 25mm$ (8)

Where c = 3 for MS, σ= 14 N/mm² for MS

Other dimensions of flange:

Nominal diameter of bolt: d= 0.75t + 10mm = 28mm (9)

Number of bolts: N = 0.0275d + 1.6 = 4 (10)

Thickness of flange: Tf = 1.5t + 3 = 40.5mm (11)

Width of flange: B= 2.3d = 64.4 = 66mm (12)

Outside diameter of flange: Do = d + 2t + 2B = 28 + 2x25 + 2x66 = 282mm (13)

Pitch circle diameter of bolt: Dp = D + 2t + 2d = 100 + 2x25 + 2x28 = 206mm (14)

Circumferential pitch of bolt: Pc = π x Dp / n = π x 206 / 4 = 161.71mm (15)

In order to make the joint leak proof, the radius of Pc should be in between 20√d1 to 30√d1 value.

D1 = diameter of bolt hole = d + 3 = 31mm

20√d1 = 113.35; 30√d1 = 167.03

Since circumferential pitch is in between 20√d1 to 30√d1, hence design is safe.

VI. Selection of Butterfly Valve:

As pipe diameter = 100mm, hence standard butterfly valve is selected, its technical specification are:

Valve body = cast iron ASTM A126 class GG25, Valve disc = stainless steel AISI 316, epoxy coating.

Valve seat = EPDM standard, Shaft bushing = PTFE lubricated plated steel.

Top flange = ISO 5211 standard, Pressure rating: 200 PSI/16 bar for ANSI125/150 flange

Temperature rating:

Working temp min +46ºf (+8ºc) Max +230ºf (+110ºc), Design temp min -4ºf (-20ºc) Max +248ºf (+120ºc)

VII. Assembly of Pump:

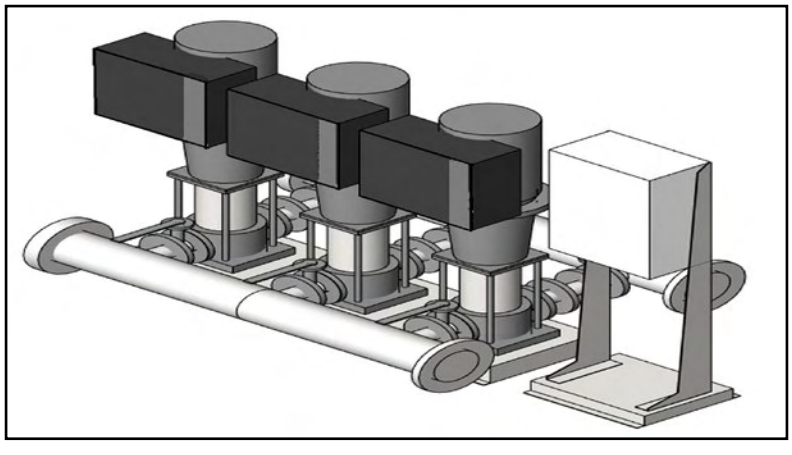

Fig. 4. Assembly of Pump

5. EXPERIMENTAL ANALYSIS

An experimentation is being carried out in Industry considering the various working aspects such as discharge obtained per unit time, pressure obtained per unit time and power consumed per unit discharge. Readings obtained after experimentations are:

Table 2. Experimental Data

Discharge Vs Time		Pressure Vs Time		Power Vs Discharge	
Discharge (m^3/hr.)	Time (hrs.)	Time (sec)	Pressure (bar)	Discharge (m^3/hr.)	Power (kw)
10	1	10	1.5	0	0
5	2	20	1.9	5	2
0	3	30	2.4	10	2.7
30	4	40	2.9	15	3.2
25	5	50	3.1	20	3.7
40	6	60	3	25	3.97
45	7	70	3.4	22	3.75
30	8	80	3.2	12	2.8

Graphs are very useful to correlate the behaviour of various aspects. Therefore graphs are plotted between discharge obtained per unit time, pressure obtained per unit time and power consumed per unit discharge.

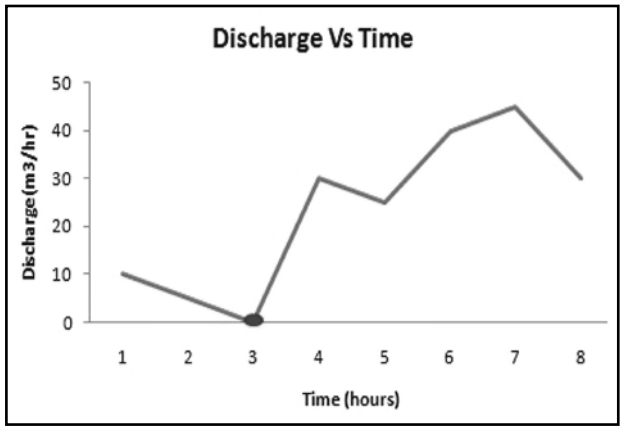

Fig. 5 . Time Vs Discharge

From Fig. 5, it has been seen that as the discharge or requirement is zero, in such case pump will directly shut off itself.

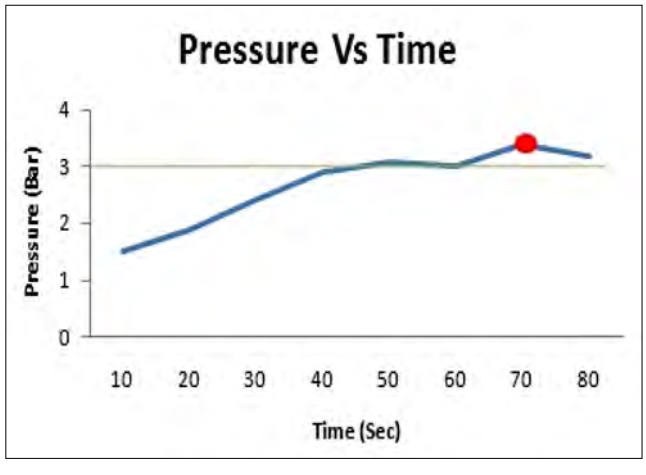

Fig. 6 . Pressure Vs Time

From Fig. 6, it has been seen that when we set the pressure of the pump at 3 bar and we started the pump initially it will start at lower pressure level and then gain the required pressure, suddenly at 70 sec when we close the valve, pressure suddenly increase in such case system will get shut off.

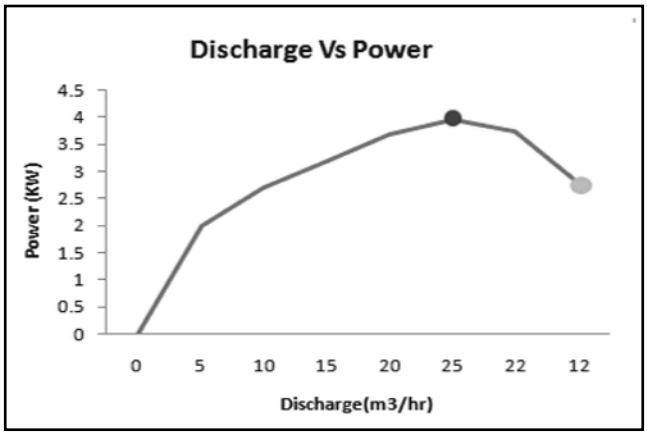

Fig. 7.Power Vs Discharge

Fig. 7 shows the power requirements as per the discharge condition at 25 m³/hr power require is 3.97kw, as discharge level goes down at 12 m³/hr power required is 2.8kw.

Table 3. Actual Performance

Head	Q (m³/hr.)	ETA (%)	Pump
40	5	40	1
40	10	58	1
40	15	68	1
40	20	72	1
40	25	67.5	1
40	29	67.5	1
40	30	67.5+64	1 + 2
40	35	67.5+70	1 + 2
40	40	67.5+74	1 + 2
40	45	67.5+70	1 + 2
40	50	67.5+67.5	1 + 2

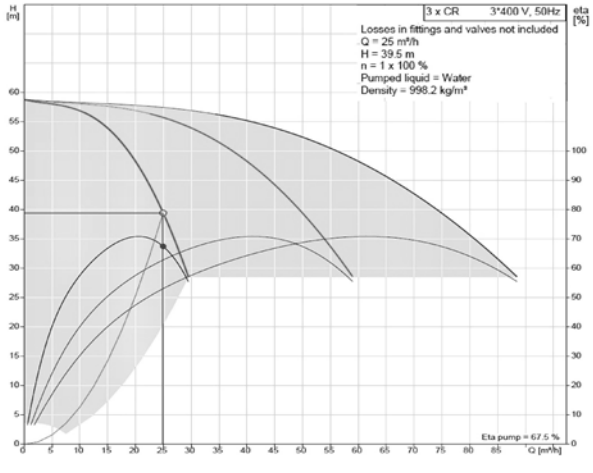

Fig. 8. Actual Performance Curve 1

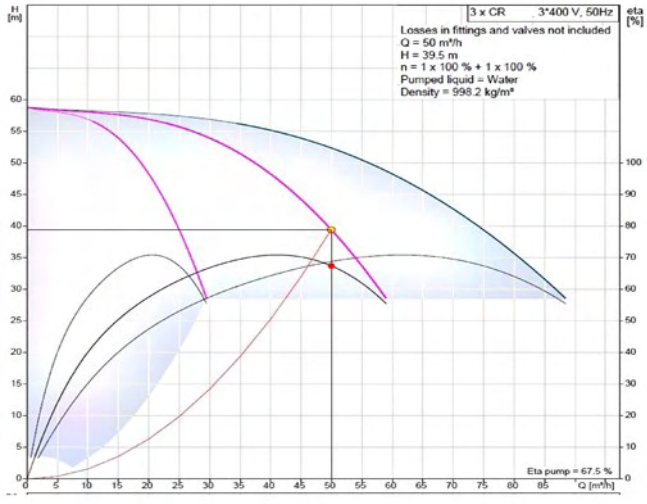

Fig. 9. Actual Performance Curve 2

From Fig. 8, it is observed that as pump is running at constant head 40m, if we maintain a discharge of 25 m³/hr. then pump 1 will start working from 0 m³/hr. to 25 m³/hr., at the same time we observe that ETA performance is increasing after achieving a constant height it start decreasing so as to maintain the efficient system as show in graph 1. As when the discharge level goes beyond the 25 m³/hr. than 2nd pump comes into operation to maintain the pressure and discharge in the system. VFD allows both pump to run but in an efficient manner as shown in Fig. 9.

6. COMPARISON OF HYDRO PNEUMATIC PUMP AND CONVENTIONAL PUMP

Comparison of Hydro Pneumatic pump with Conventional Pump has been carried out considering the various variables such as Power, Efficiency and Cost. The results are as shown in Fig. 10 and Fig. 11:

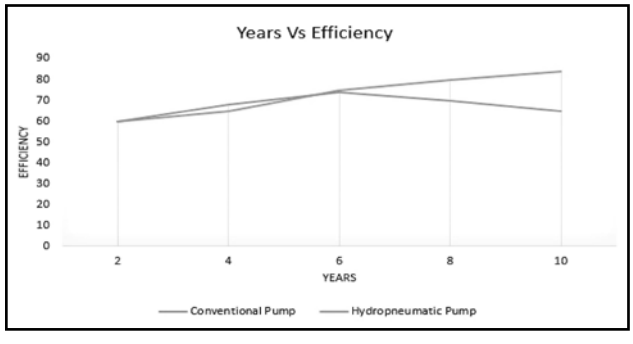

Fig 10: Efficiency Comparison

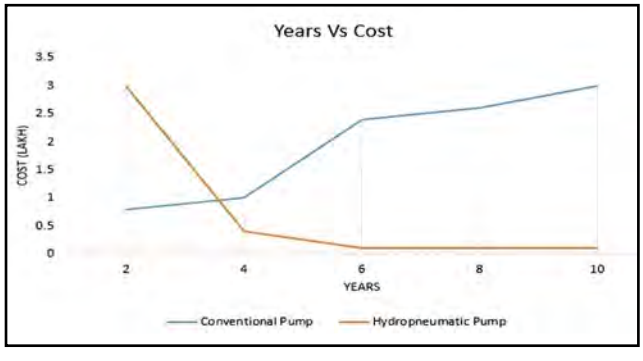

Fig 11: Cost Comparison

7. CONCLUSIONS

Conclusions obtained by above results are

- At no discharge or when requirement is zero, in such case pump will directly shut off itself. When the requirement is zero at discharge point pump get automatically switch off.
- When we set the pressure of the pump at 3 bar and we started the pump initially it will start at lower pressure level and then gain the required pressure, suddenly after some time when we close the valve, pressure suddenly increase in such case system will get shut off.
- Power requirement is directly proportional to requirement of discharge condition. Through with the help of VFD power is saved.
- Pump 1 runs upto predetermined discharge. As discharge level goes above the limit of pump 1 then automatically 2 pump starts running to maintain the constant pressure.
- Pump setup is installed in the premises of Textile Industry Nagpur, after successful implementation and trial problem of pressure and discharge has been eliminated.
- Hydro pneumatic pump is much more efficient as compared with conventional pump with respect to head, discharge, efficiency, power and cost etc.

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DESIGN AND DEVELOPMENT OF DROP WEIGHT GENERATOR FOR HARNESSING GREEN ENERGY

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ABSTRACT

Conserving energy has become the biggest issue in present scenario. Due to the development and modernization the electricity demand is increasing at high extent. To fulfil this demand globally which is without any harmful effect on environment is possible by using gravity power generation which is part of green energy. The reason behind generating power by using gravity is that it is available all over the earth. Comparing to the other sources like chemical, thermal and other sources gravity is weak, is scalable. This weakness is due to uniformity, or steady state of our interactions with gravity. The concept of Drop Weight Generator is simple. The basic concept of gravity power generation mechanism is, when a body moves down from higher altitude to lower one its potential energy is converted into kinetic energy. This motion is converted into circular motion and that circular motion is converted into electricity by using a single phase synchronous generator.

Keywords: Conservation of Energy, Green Energy, Drop weight, Gravity, potential energy, kinetic energy, single phase synchronous generator.

1. INTRODUCTION

Now a days due to the effects of pollution and global warming there is a need for generating power from renewable sources. Due to the availability of gravity all over the earth, abundant and consistent it is very suitable to generating power by using gravity. Energy demand is increasing day by day with rapid growth in industrialization as well as modernization.

But the energy resources are gradually decreasing at high extent. Within a few years the energy resources will be finished and hence there will be lack of fuel (coal, wood, water, etc.) for power generation. The other renewable sources such as solar, wind, biomass etc are available only for a particular duration of time during the day and night. Therefore the Drop weight generator is one of the method to generate power which fulfils energy demands and requirements of present time [1] [12][13].

It is possible to deflect gravitational action away from an object so that the object is partially deviated. That effect makes it possible to extract energy from the gravitational field, which makes the generation of Drop weight generator technologically feasible.

Fig 1: Project model

Gravitational force is force that attracts any object with mass (weight)[4]. The primary objective is to provide a gravity power generation mechanism which can continuously convert gravity potential energy into kinetic energy. This motion is converted into circular motion and is then converted into electricity using an Alternator .Fig 1 shows project model.

Drop weight generator has advantages over the hydro-electric plant, such as not needing of fuel and not polluting the environment. However, the Drop weight generator would be much smaller than hydro-electric plants. The location of that plant would not be restricted to suitable water elevations and Drop weight generator and their produced energy would be much expensive. If the gravitational power electric generation comes under operation and working then it can replace all existing nuclear and fossil fuel plants and it would essentially solve the problem of global warming to the extent it is caused by fossil fuel used.

2. BLOCK DIAGRAM OF DROP WEIGHT GENERATOR

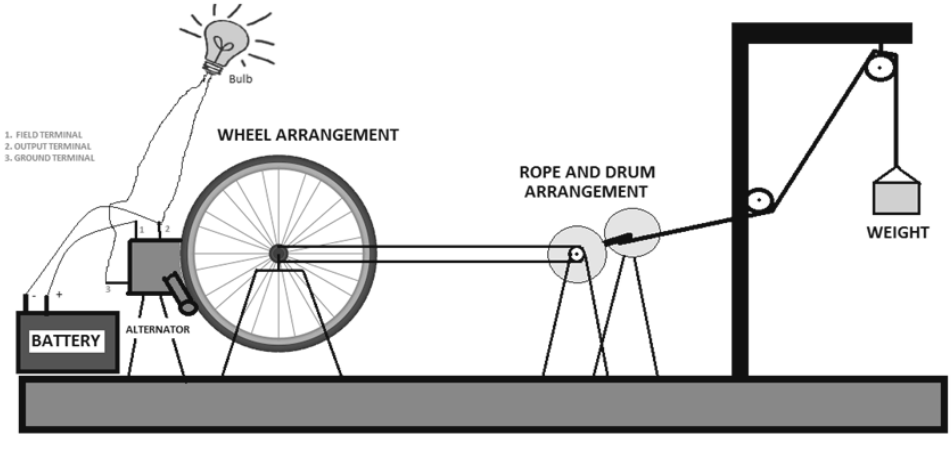

Fig 2:Block Diagram

Components of the block diagram are as shown in Fig 2:

- Alternator
- Wheel arrangement
- Rope and drum arrangement
- Weight (Driving force)
- Load

Alternator An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature. Occasionally, a linear alternator or a rotating armature with a stationary magnetic field is used. In principle, any AC electrical generator can be called an alternator, but usually the term refers to small rotating machines driven by automotive and other internal combustion engines. An alternator that uses a permanent magnet for its magnetic field is called a magneto. Alternators in power stations driven by steam turbines are called turbo-alternators. Large 50 or 60 Hz three phase alternators in power plants generate most of the world's electric power, which is distributed by electric power grids[6].

By Excitation There are two main ways to produce the magnetic field used in the alternators, by using permanent magnets which create their own persistent magnetic field or by using field coils. The alternators that use permanent magnets are specifically called magnetos. In other alternators, wound field coils form an electromagnet to produce the rotating magnetic field.

All devices that use permanent magnets and produce alternating current are called PMA or permanent magnet alternator. A "permanent magnet generator" (PMG) may produce either alternating current, or direct current if it has a commutator. If the permanent magnet device makes only AC current, it is correctly called a PMA.

3. REVOLVING FIELD DESIGN

The fig 3 shows a design of revolving field generator and the generator is to have the armature part on stator and the magnetic field part on rotor. A basic design of revolving field single-phase generator is shown on the right. There are two magnetic poles, north and south, attached to a rotor and two coils which are connected in series and equally spaced on stator. The windings of the two coils are in reverse direction to have the current to flow in the same direction because the two coils always interact with opposing polarities. Since poles and coils are equally spaced and the locations of the poles match to the locations of the coils, the magnetic lines of force are cut at the same amount at any degree of the rotor. As a result, the voltages induced to all windings have the same value at any given time. The voltages from both coils are "in phase" to each other. Therefore the total output voltage is two times the voltage induced in each winding. In the figure, at the position where pole number 1 and coil number 1 meet, the generator produces the highest output voltage on one direction. As the rotor turns 180 degrees, the output voltage is alternated to produce the highest voltage on the other direction. The frequency of the AC output in this case equals to the number of rotations of the rotor per second.

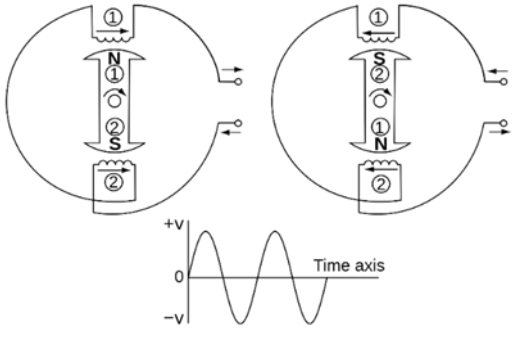

Fig 3:Revolving field design

This design can also allow us to increase the output frequency by adding more poles. In this example on the right, we have 4 coils connected in series on the stator and the field rotor has 4 poles. Both coils and poles are equally spaced. Each pole has opposite polarity to its neighbours which are angled at 90 degrees. Each coils also have opposite winding to its neighbours. This configuration allows the lines of force at 4 poles to be cut by 4 coils at the same amount at a given time. At each 90-degree rotation, the voltage output polarity is switched from one direction to the other. Therefore, there are 4 cycles of the AC output in one rotation. As the 4 coils are wired in series and their outputs are "in phase", the AC output of this single-phase generator will have 4 times the voltage of that generated by each individual coil.

A benefit of the revolving field design is that if the poles are permanent magnets, then there is no need to use any slip ring and brush to deliver electricity out of the generator as the coils are stationary and can be wired directly from the generator to the external loads [7][8]

4. PRINCIPLE OF OPERATION

A conductor moving relative to a magnetic field develops an electromotive force (EMF) in it (Faraday's Law). This emf reverses its polarity when it moves under magnetic poles of opposite polarity. Typically, a rotating magnet, called the rotor turns within a stationary set of conductors wound in coils on an iron core, called the stator. The field cuts across the conductors, generating an induced EMF (electromotive force), as the mechanical input causes the rotor to turn. [3]

The rotating magnetic field induces an AC voltage in the stator windings. Since the currents in the stator windings vary in step with the position of the rotor, an alternator is a synchronous generator.

The rotor's magnetic field may be produced by permanent magnets, or by a field coil electromagnet. Automotive alternators use a rotor winding which allows control of the alternator's generated voltage by varying the current in the rotor field winding. Permanent magnet machines avoid the loss due to magnetizing current in the rotor, but are restricted in size, due to the cost of the magnet material. Since the permanent magnet field is constant, the terminal voltage varies directly with the speed of the generator. Brushless AC generators are usually larger than those used in automotive applications.

An automatic voltage control device controls the field current to keep output voltage constant. If the output voltage from the stationary armature coils drops due to an increase in demand, more current is fed into the rotating field coils through the voltage regulator (VR). This increases the magnetic field around the field coils which induces a greater voltage in the armature coils. Thus, the output voltage is brought back up to its original value. [2]

Alternators used in central power stations also control the field current to regulate reactive power and to help stabilize the power system against the effects of momentary faults. Often there are three sets of stator windings, physically offset so that the rotating magnetic field produces a three phase current, displaced by one-third of a period with respect to each other [9].The Arrangement is shown in Fig 4 and Fig 5.

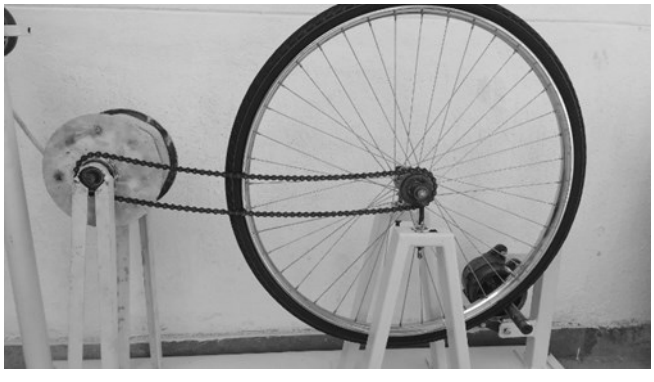

Fig 4: Wheel arrangement

Fig 5: Rope, drum and load arrangement

Load

The load can be a lamp or a battery that is to be charged or any other low voltage devices. The generated output can be used for charging laptops and mobile phones. In this case, we require rectifiers in order to convert the generated AC voltage to DC voltage. Car alternators usually have inbuilt rectifiers and hence this output can be used directly to charge mobile phones and laptops.

5. WORKING OF DROP WEIGHT GENERATOR

The driving force here is the Weight and gravitational force. The Weight drives the wheel and the alternator shaft. The diameter of the wheel is 26 inches whereas that of the alternator shaft is 1 inch. This makes the gear ratio to be 26:1. This implies one rotation of the wheel would make the alternator shaft rotate 26 times. The Fig 6 shows the gear ratio.

Fig 6: 26:1 gear ratio

The alternator being
used is a Car Alternator. This alternator has three terminals as shown in Fig 7 and namely

- Field supply terminal
- Output terminal (Armature)
- Ground terminal (Body).

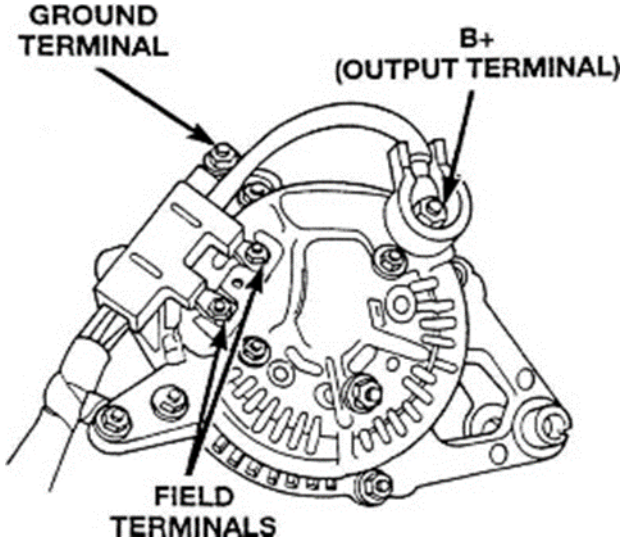

Fig 7: Alternator terminals

Field Excitation
Automotive alternators require a voltage regulator which operates by modulating the small field current to produce a constant voltage at the battery terminals. Early designs (c.1960s-1970s) used a discrete device mounted elsewhere in the vehicle. Intermediate designs (c.1970s-1990s) incorporated the voltage regulator into the alternator housing. Modern designs do away with the voltage regulator altogether; voltage regulation is now a function of the electronic control unit (ECU). The field current is much smaller than the output current of the alternator; for example, a 70 A alternator may need only 7 A of field current. The field current is supplied to the rotor windings by slip rings. The low current and relatively smooth slip rings ensure greater reliability and longer life than that obtained by a DC generator with its commutator and higher current being passed through its brushes. [2]

Fig 8: Field of an alternator

The field windings are supplied with power from the battery via the ignition switch and regulator. A parallel circuit supplies the "charge" warning indicator and is earthed via the regulator.(which is why the indicator is on when the ignition is on but the engine is not running). Once the engine is running and the alternator is generating power, a diode feeds the field current from the alternator main output equalizing the voltage across the warning indicator which goes off. The wire supplying the field current is often referred to as the "exciter" wire. The drawback of this arrangement is that if the warning lamp burns out or the "exciter" wire is disconnected, no current reaches the field windings and the alternator will not generate power. Some warning indicator circuits are equipped with a resistor in parallel with the lamp that permit excitation current to flow if the warning lamp burns out [5]. The driver should check that the warning indicator is on when the engine is stopped; otherwise, there might not be any indication of a failure of the belt which may also drive the cooling water pump. Some alternators will self-excite when the engine reaches a certain speed. The field of the alternator is shown in Fig 8

Efficiency of automotive alternators is limited by fan cooling loss, bearing loss, iron loss, copper loss, and the voltage drop in the diode bridges. Efficiency reduces dramatically at high speeds mainly due to fan resistance. At medium speeds efficiency of today's alternators is 70-80%. This betters very small high-performance permanent magnet alternators, such as those used for bicycle lighting systems, which achieve an efficiency around 60%. Larger permanent magnet electric machines (that can operate as motors or alternators) can achieve today much higher efficiencies. Pellegrino et al., for instance, propose not particularly expensive designs that show ample regions in which efficiency is above 96%. Large AC generators used in power stations run at carefully controlled speeds and have no constraints on size or weight. They have very high efficiencies as high as 98%.

6. ADVANTAGES

Advantages of Electro magnets over Permanent magnets

- Permanent magnet strength depends upon the material used in its creation. The strength of an electromagnet can be adjusted by the amount of electric current allowed to flow into it. As a result, the same electromagnet can be adjusted for different strength levels.
- If a permanent magnet loses its magnetic properties, as it does by heating to a (maximum) temperature, it will be rendered useless and its magnetic properties can be only recovered by re-magnetizing. Contrarily, an electromagnet loses its magnetic power every time an electric current is removed and becomes magnetic once again when the electric field is introduced
- A permanent magnet's magnetic properties exist when the magnet is (magnetized). An electromagnetic magnet only displays magnetic properties when an electric current is applied to it. That is how you can differentiate between the two. The magnets that you have affixed to your refrigerator are permanent magnets, while electromagnets are the principle behind AC motors.
- The main advantage of an electromagnet over a permanent magnet is that the magnetic field can be quickly changed by controlling the amount of electric current in the winding. [10][11].

Advantages of Alternators over DC Generator (Dynamos)

- The alternator will produce its rated output at a much lower RPM than will the generator. This is a great advantage.
- The alternator is mechanically simpler than generator, it does not have the brushes that wear out, so the alternator normally last much longer with no maintenance.
- For producing same output the size of DC generator is much bigger than an alternator.
- They are lighter, cheaper and more rugged.
- They use slip rings providing greatly extended brush life over a commutator.
- The brushes in an alternator carry only excitation current, a small fraction of the current carried by the brushes of a DC generator, which carry the generator's entire output. A set of rectifiers (diode bridge) is required to convert AC to DC.
- To provide direct current with low ripple, a three-phase winding is used and the pole-pieces of the rotor are shaped (claw-pole) to produce a waveform similar to a square wave instead of a sinusoid. Automotive alternators are usually belt driven at 2-3 times crankshaft speed. The alternator runs at various RPM (which varies the frequency) since it is driven by the engine. This is not a problem because the alternating current is rectified to direct current.

Advantages of the Project

- The power is readily available any time.
- Can be implemented for various ratings.
- Continues energy conversion is possible with small energy input
- Eco friendly, pollution free Green energy.
- This energy source will remain forever.

7. CONCLUSION

The Drop Weight Generator mechanism of the present invention utilizes a gravity energy conversion unit which can provide a continuous and stable operation to convert the gravity potential energy into kinetic energy and finally into electric energy to perform a long-time, effective and stable energy output. The present invention not can independently generate electricity and can also be connected to wind power and solar power generation systems to generate electricity. This paper envisages a power generation mechanism that produces power from gravity having a simplified structure. It is eco-friendly and could overcome present problems of pollution and global warming faced by other power generation methods.

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EMPLOYEE ENGAGEMENT: EMPIRICAL EVIDENCE ON RECENT REPORTS

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ABSTRACT

Employee Engagement has been a buzz word in Human Resource Management. Managers are inducing companies to implement engagement strategies in order to increase profits and reduce attrition rate. Engaging employees is one of the top five most important challenges for management, according to a survey of 656 chief executive officers (CEOs) from countries around the world (Wah 1999). Employee engagement has become the top issue on the minds of business leaders, directing us to an entirely new model of management. The objective of this paper is to present a brief review on recent reports of Employee Engagement. The authors through this paper offer a comprehensive review of latest reports that are available to date.

Key words: Engagement, commitment, productivity, retention and loyalty.

1. INTRODUCTION

Employee engagement has emerged as a critical driver of business success in today's competitive marketplace. Further, employee engagement can be a deciding factor in organizational success. Not only does engagement have the potential to significantly affect employee retention, productivity and loyalty, it is also a key link to customer satisfaction, company reputation and overall stakeholder value. Thus, to gain a competitive edge, organizations are turning to HR to set the agenda for employee engagement and commitment. Thus, to foster a culture of engagement, HR leads the way to design measure and evaluate proactive workplace policies and practices that help attract and retain talent with skills and competencies necessary for growth and sustainability.

Employee Engagement is defined as "the extent to which employees commit to something or someone in their organization, how hard they work and how long they stay as a result of that commitment."[1]

2. WHY EMPLOYEE ENGAGEMENT

Employees who are engaged have a positive attitude about their organization and job. They are always enthusiastic to learn about new things. They often exhibit loyalty towards the organization. Engaged employees always go extra mile for the growth of individual and organizational development. They are hard working and always contribute to the overall success of the company.

In fact, there are many pathways to encourage Engagement, however only one 'kit' does not fit to all the organizations. While each organization may define Employee Engagement differently, ultimately, the key to effective Engagement will be rooted in the flexibility of approach most appropriate for each individual firm.

We know from many research institutions and studies, that companies which focus on engaging their employees typically enjoy better profits, a happier workforce and improved productivity. For example, here are just a handful of the statistics;

Highly engaged employees are 38% more likely to have above-average productivity.

Source: Workplace Research Foundation

Employees who report feeling valued by their employer are 60% more likely to report they are motivated to do their very best for their employer.

Source: American Psychology Association / Harrison Interactive

Companies who implement regular employee feedback have turnover rates that are 14.9% lower than for employees who receive no feedback.

Source: Gallup

Increasing employee engagement investments by 10% can increase profits by $2,400 per employee, per year.

Source: Workplace Research Foundation

3. ADVANTAGES OF EMPLOYEE ENGAGEMENT

There are number of advantages due to engaged employees in the organization.

- Engaged employees strive for the company's development and growth. Employees who are engaged in the organization leads to positive results like increased sales & profits and enhancing organization's reputation in the corporate world.
- Employees who are engaged take pride in their work which means they are careful at work and have lower rate of work accidents and mistakes.
- They enjoy going to work which reduces absenteeism in the organization.
- Engaged employees also tend to stay longer in their jobs which have less turnover and reduces recruitment cost.

4. IT'S TIME TO RETHINK ABOUT 'EMPLOYEE ENGAGEMENT'

In this era, one of the biggest challenges for the organizations are not just retaining talented employees, but fully engaging them for the growth and development of the company.

According to Deloitte Global Human Capital Trends (2014) research, 78% of business leaders opine that retention and engagement are the important and urgent issues to focus for the growth of the organizations.

According to Blessingwhite report, research confirms that four out of 10 workers are disengaged globally. According to State of the American workplace Report, 70 percent of U.S. employees don't like their job, emotionally disconnected from their workplace and disengaged.

Research (source: www.blessingwhite.com) shows four out of 10 workers are disengaged globally. In the U.S., the situation is worse. According to the latest State of the American Workplace Report, 70 percent of U.S. workers don't like their job, creating an environment where many workers are emotionally disconnected from their workplace and less productive than engaged counterparts.

The change what organizations need today is instead of measuring Engagement annually, redefine engagement in the organization. It must be a continuous and holistic approach. If employees really love their work and there is supportive environment in the organization, then they treat customers in a better way, innovates new products in the market and continuously strive for the improvement of the organization.

We can't "retain" people; we can only "attract them." We can't "engage them" but we can "inspire and support them." We can't only "train them" but we can "enable them to learn" and "give them the opportunities to develop."

Let's change our thinking and move beyond the concept of employee satisfaction that is engagement. If organizations really want to make "Irresistible" they need to make work fun, meaningful and enriching.

5. DRIVERS OR FACTORS OF EMPLOYEE ENGAGEMENT

There are many factors that influence Employee Engagement. They are

1. Effective Reward and Recognition
2. Frequent feedback
3. Shared values and guiding principles
4. Respect, trust, and emotional intelligence on the part of the employee's direct supervisor
5. Positive relationships with coworkers
6. Integrity and team work

6. EMPIRICAL EVIDENCE ON EMPLOYEE ENGAGEMENT

Dr. Ranjana Gujarati, Dr.Varuna Tygai and Rohan Thapur (2014) in their study "Employee Engagement in India and China: A Comparative Study" based on secondary data, aims to explore the ground level issues which affected the Employee Engagement level in India and China during 2011 and 2012. The study finds that in these two countries, Employee Engagement has been affected by organizational and economic issues both for short and long term. But simultaneously, culture of the country also plays a very important role in determining the Engagement level. It also affects the employees' perception about the drivers which they consider as the priority issues, essential for keeping and motivating them to be engaged [2].

M.Jabeen and Dr. Lalitha Balakrishnan (2014) in their research paper "Employee Engagement: Work Force": published in Global Journal for Research Analysis, explained that human resource management has undergone a paradigm shift in its approach towards Human Capital. This paper attempts to explain what constitutes the Employee Engagement, certain drivers or factors that will help in having an engaged work force include: Two-way Communication, Make available all resources, Appropriate training, Benefits linked to Engagement, and Strong feedback mechanism [3].

Ekta Joshi and Nisha Nagori (2014) compared the factors affecting Employee Engagement in two sectors i.e. Information Technology and Manufacturing Sector. They identified nine factors which are labeled as Culture Confrontation, WLB, Career development & Experimentation, Job Involvement, Organizational Commitment, Role Clarity, Autonomy, Constructive feedback. Findings indicate that there has been no significant difference in Work life balance, organizational commitment, Job involvement and Role clarity whereas culture, confrontation, career development & Experimentation, Constructive feedback and Autonomy showed a significant difference [4].

Dr. Shine David and Shefali Bose (2014) in their article "Employee Engagement in IT sector: A case study of Indore city" examined the antecedents and consequences of Employee Engagement in Jordanian Industry with a snowball sample of 250 respondents from different levels of experience in IT sector of Indore City. The results highlights that there is relationship between Employee Engagement and Perceived Organizational Support. The effect of Job Characteristics, Intrinsic and Extrinsic Rewards, Perceived Supervisor Support, Procedural Justice, and Distributive Justice on Employee Engagement was also confirmed [5].

Dr. Shruti Tripathi and Rashmi Singh (2014) in their research paper "Study of Employee Engagement and its effect on Employee Productivity: Case Study on Telecommunication Sector" undertook a sample size of 25 from four telecommunication companies collectively form a sample size of 100. The paper highlights that improving and maintaining

Employee Engagement lies in the hands of an organization which requires effort, time, dedication and investment to craft a successful endeavor and to help them being productive employees. The study also confirms that supervisor support, pay, job satisfaction and equal opportunities have significant influence on Employee Engagement [6].

Preethi Thakur (2014) in her article "A Research Paper on the Effect of Employee Engagement on Job Satisfaction in IT Sector" took a sample of 120 individuals including officers and clerks of IT sector. The findings confirm that there is a positive relationship between Employee Engagement and Job Satisfaction; work motivation can be improved through increasing job authority and accountability. At clerical level in IT sector, rewards are significantly related with job involvement [7].

Mrs. Jyoti Naganath Shinde and Dr. V K.Sawant (2015) in their paper "A Study of factors affecting Employee Engagement in IT Industry" provides an overview and the factors contributing for Employee Engagement. The research identified the factors affecting Employee Engagement in IT industry are motivation, reward system, appreciation and peer support, and leadership behaviour at workplace [8].

Vipul Saxena and R K Srivastava (2015) in their article "Impact of Employee Engagement on Employee Performance–Case of Manufacturing Sectors" undertook a sample of 600 white collared employees and 600 blue collared employees and 50 HR managers situated in around Maharashtra and Gujarat from different manufacturing companies. The results highlight that Employee Engagement is strongly related with Organizational culture, open communication with managers, superiors concern towards subordinates, participative decision making, safety precautions in the firm, training and development, career development, and compensation benefits leads to engaged employees, reduced attrition and increased performance and productivity. It also confirms that Employee Engagement is an important factor for job satisfaction, employee loyalty and retention which builds healthy culture in the firm ultimately increases productivity. Some of them identified are Organizations with high levels of Engagement provide employees with opportunities to develop their abilities, learn new skills, acquire new knowledge and realize their potential. When companies plan for the career paths of their employees and invest in them in this way their people invest in them [9].

"Deloitte's Global Human Capital Trends (2015)", surveyed 3,300 businesses and 106 countries all over the world, identified that this year (2015) Culture and Engagement (see fig 6.1) was ranked as first followed by leadership (which ranked first last year) emphasizes the significance of organization's culture and Employee Engagement and HR managers need to reconsider every HR program in way to enhance culture and Engagement. As worldwide economy grows and talent becomes more particular, the competition for skilled employees has increased. This has determined Culture and Engagement, Leadership, Training and Development has ranked top across regions and industries. The research identified that, 87% of the companies quote Culture and Engagement is very important issue and one of the top challenges, which has doubled this year (2015) from 26 % to 50% which is a drastic change [10].

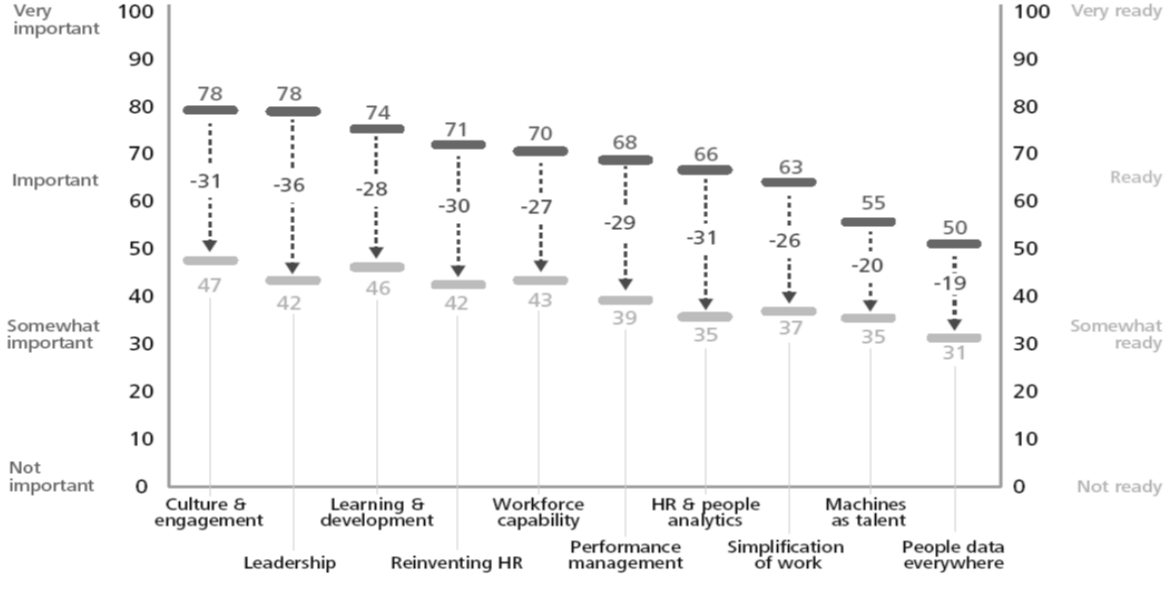

Fig 6.1 Talent trends: Global importance vs. readines

Source: Deloitte University Press | DUPress.com

6.1.1. Comparison of Capability gaps in the chosen areas, 2014-15:- Fig 6.2 shows a clear capability gaps in Culture and Engagement from 2014 (-23) to 2015 (-31) where companies must specifically focus to reduce gap by implementing Engagement strategies.

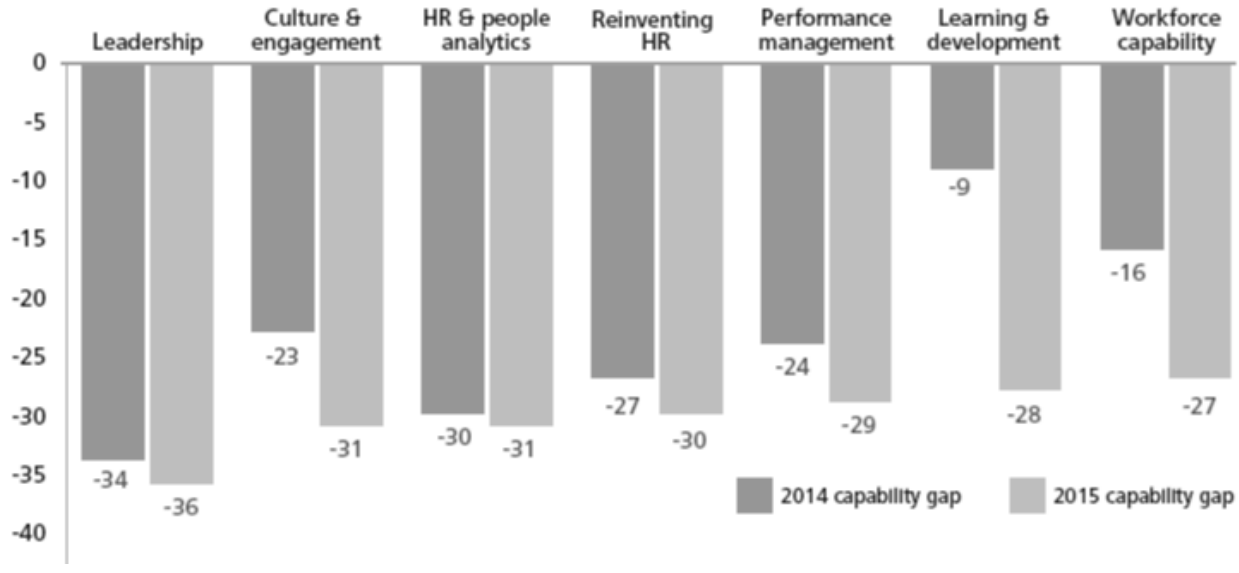

Fig.6.2. Comparison of Capability gaps in the chosen areas, 2014-15

Source: Deloitte University Press | DUPress.com

6.1.2. Culture and Engagement: Capability gap in selected countries

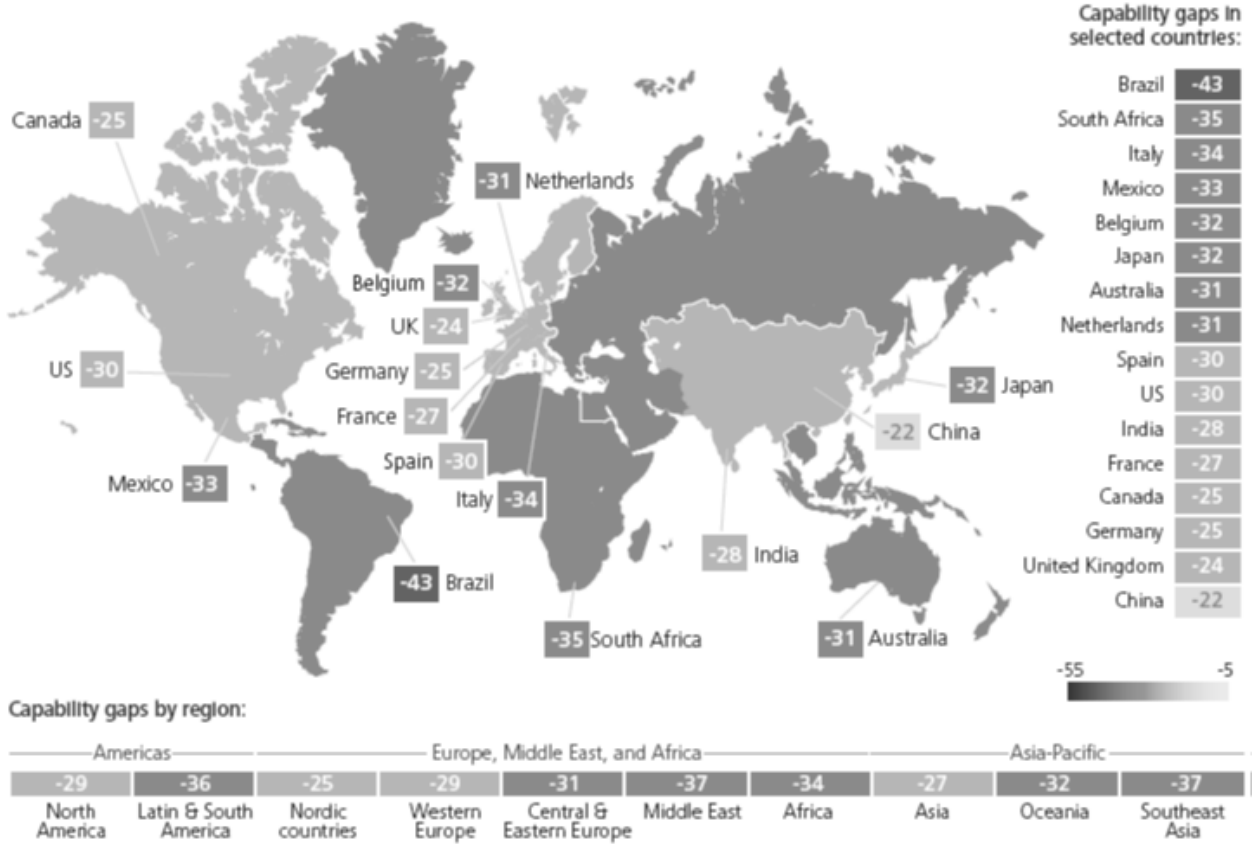

Fig 6.3: Culture and Engagement: Capability gap in selected countries

Source: Deloitte University Press | DUPress.com

Capability gap is computed by taking the "readiness" index score and subtracting the "importance" index score. For example, a trend with a readiness index score of 50 and an importance index score of 80 would produce a capability gap of -30. Negative values suggest a shortfall in capability, while positive values suggest a capability surplus. The above figure showed a significant gap in Culture and Engagement across regions and countries

6.1.3. Status of Retention and Engagement Strategy:-

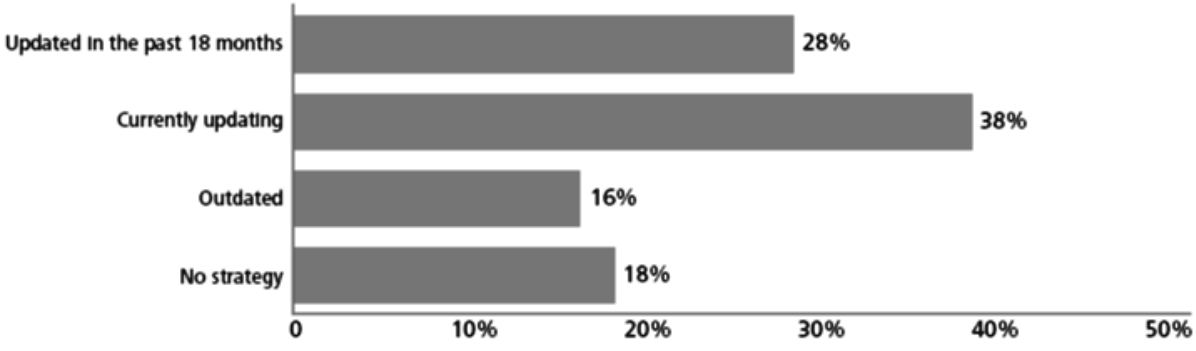

Fig 6.4: Status of Retention and Engagement Strategy Source: Graphic Deloitte University Press | DUPress.com

From the above figure 6.4, when HR employees were asked about status of Retention and Engagement strategy in the organizations, 28% rate that they are updated in the past 18 months, and 18% opine that they don't follow any strategy in the organizations. Fig 6.5 highlights that 7% of employees' rate that Retention and Engagement program are excellent in measuring, driving and improving, and 16% opine that they are poor.

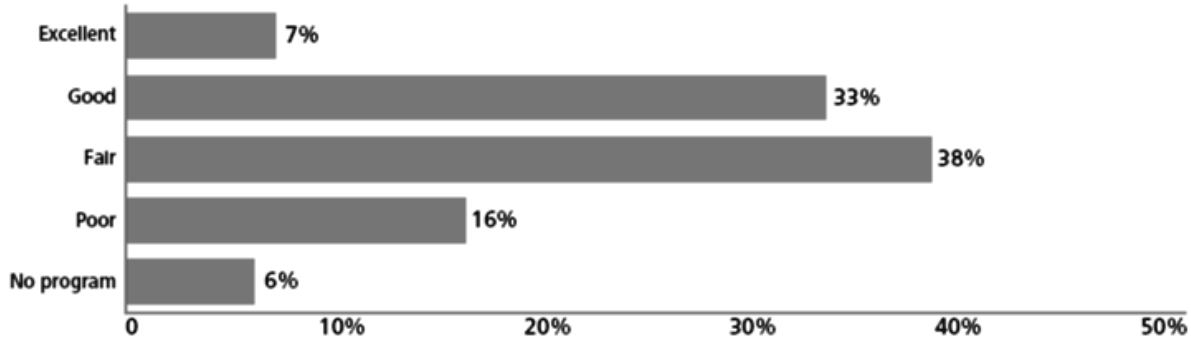

Fig 6.5: Employees' ratings of Engagement and Retention program capabilities in the organizations.

Source: Graphic Deloitte University Press | DUPress.com

As per the Gallup research, all over the world only 13% of the employees are highly engaged [11]. Research emphasizes different factors which contribute to Employee Engagement are Job design, work atmosphere, leadership and career and development. More number of employees rank that they are motivated by passion towards work rather than career ambition (12% vs 5%). Many studies rated that Google is the "best place to work" predominantly concentrates on Culture and Engagement[12].

The research suggests Engagement must start with top management, using better tools where the company is week in case of culture and Engagement, make employees work meaningful and listen to employees' needs, desire and values, simplify the work environment leads to enhanced Culture and Engagement in the organizations.

Dale Carnegie (2014-15) conducted a survey in India with more than 1200 executives, chief officers and managers across the country and he compared with the results of APAC research and Global studies on Employee Engagement. The

result highlights that Indian Employees (see fig 6.6) are highly engaged with 46%, when compared with APAC or the global studies [13]

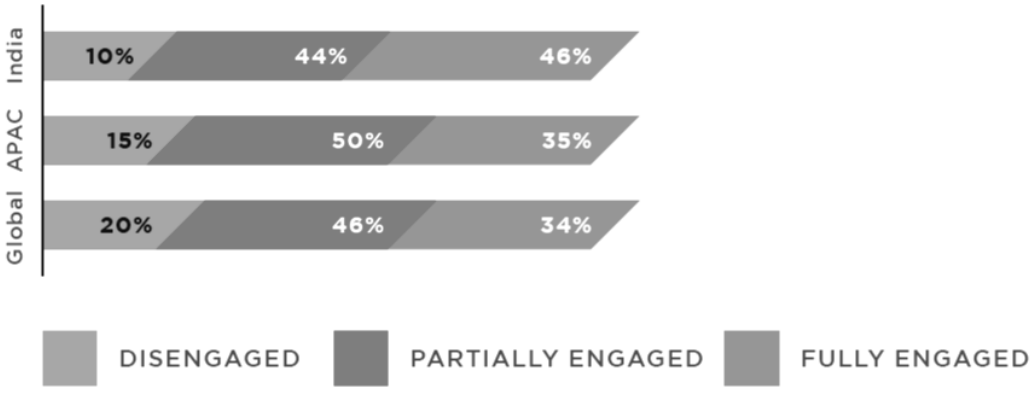

Fig 6.6. Comparative study of India, APAC & Global studies on levels of Employee Engagement

Source : Dale Carnegie report

The research emphasizes that 44% of the employees are partially engaged, 10% being disengaged which shows that there is still lot of scope for Enhancement of Engagement in India.

5.1.4. Employee Engagement in India

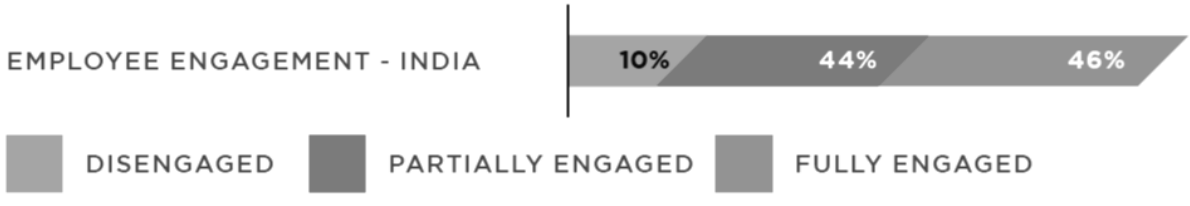

Fig 6.7. Overall Employee Engagement in India

Source : Dale Carnegie report

Deloitte's 2016 Global Human Capital Trends, conducted survey over 130 countries and interviewed 7000 business leaders and HR leaders.[14]

Figure 6.8 presents this year's (2016) trends ranked in order of their importance as rated by survey respondents.

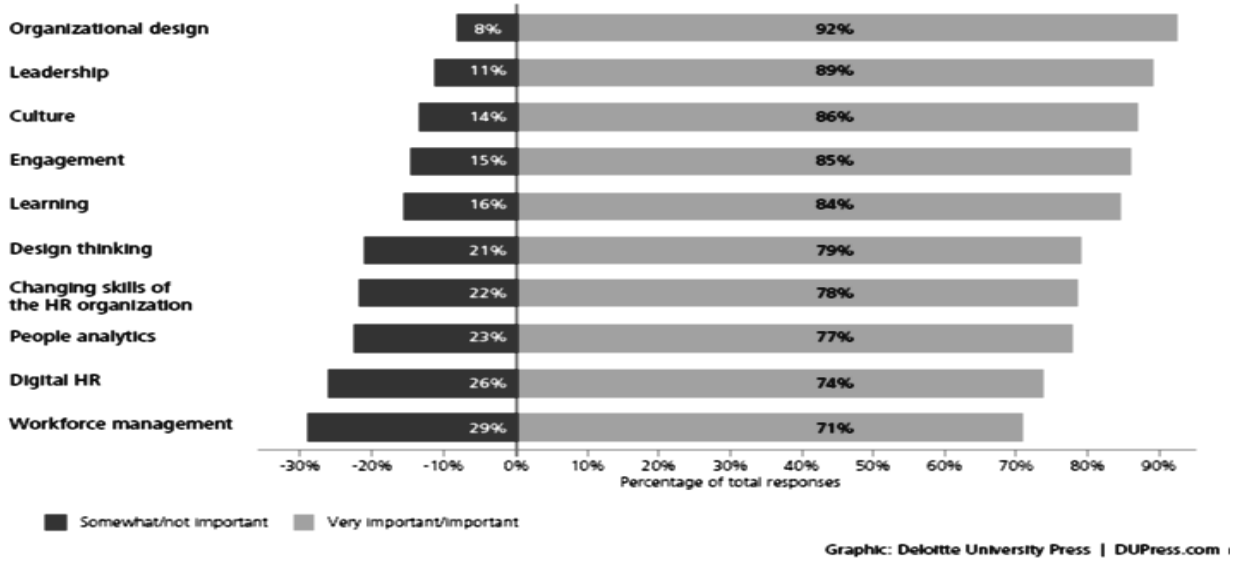

Fig 6.8 The 10 trends ranked in order of importance

Last year, most of the leaders and managers ranked “Culture and Engagement” as one of most important issue.

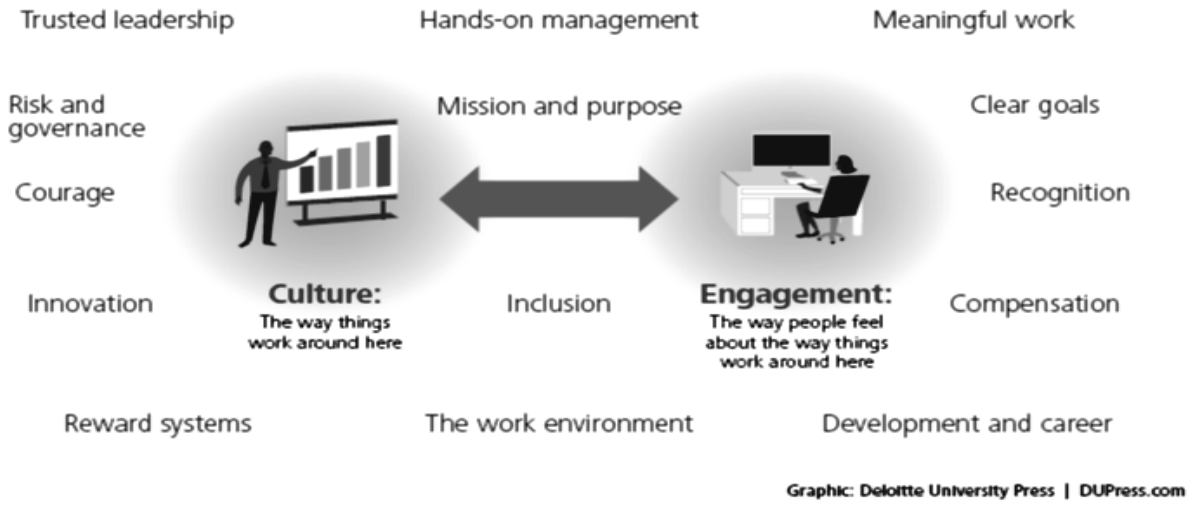

Fig 6.9 The relationship between culture and engagement

This year they placed Culture and Engagement again as the important issue with 86 percent. Culture may be defined as “the way things work around here”, while Engagement may be defined as “how people feel about the way things work around here”. It is clear that both culture and engagement are interlinked because when a company’s culture is aligned with its values, it attracts committed employees which leads to engaged employees (see fig 6.9)

According to this survey, 85% of the managers ranked engagement as an important issue. Now engagement surveys are being replaced by “employee listening” tools such as pulse surveys, anonymous social tools, and regular feedback from superiors. In 2015, 10% of executives opine that their organizations are “very ready” to deal with engagement where as in 2016 it increased to 12%.while those who feel they are “fully ready” rose to 31% to 34%. These are hopeful signs for the change in the organization.

“State of Employee Engagement 2016”survey was conducted by **Decisionwise** around the world for different companies of all sizes. Most of the respondents are professionals in Human resources and other executives. Over 200 organizations were participated in this survey and over hundred companies have 1000 employees or more [15]

The survey highlighted that HR professionals opine that only 29% of managers believe that employee engagement is the important issue.

In this survey, HR professionals also opine that Employee Engagement increases performance, satisfaction and retention rate in the organization.

Companies in this survey opine that Employee Feedback Programs, Company Events, Recognition Programs, and Wellness Programs are their top employee engagement initiatives.

Most of the companies in this survey highlight that Recognition and Employee feedback as the top Employee engagement initiatives that their organizations are planning to implement in the future.

Most of the managers in the survey opine that paper surveys, focus group and personal interviews are the popular methods to collect employee feedback. Among them online surveys is one of the easiest methods.

The survey highlight that most of the companies opine that they do not provide training on Employee Engagement.

Companies report higher Satisfaction, Retention, and Performance as a result of their investment in employee engagement.

Key Findings from this Research

This study provides several insights and actionable take-awaysfor HR professionals:

1. Organizations must consistently measure Employee Engagement.

2. Involve all the managers in the organizations in action planning.

3. Organizations must provide on training on Employee Engagement

7. CONCLUSION

The concept of employee engagement should not be regarded just another HR strategy. Employee's engagement is a long term process and linked to core tenets of business like value, culture and managerial philosophy. Employees require adaptation to the working environment which will lead them to display behaviour that organizations are looking for. An organization has to promote the factors which have a positive effect of engagement through every business activity that they do.

A close study of review of literature reveals that organizations need to communicate the importance of individual contribution to successful business outcomes. Organizations therefore have to develop such cultures where employees are not scared to offer upwards feedback and have candid communication at all the levels. Employers need to understand their employee's expectations and future plans.

After reviewing research, it can also be concluded that high levels of employee engagement may lead to improved employee commitment & involvement towards respective jobs and thus creating a motivated workforce – that will work together to achieve the common goals of the organization.

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COST EFFECTIVENESS IN QUALITY CONSTRUCTION

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ABSTRACT

In this paper, we discuss the problems of defining quality in the construction industry, examine possible benefits of implementing quality and look at barriers to quality implementation in construction. We use data collected during interviews with contractors and data from questionnaire surveys. Clients demand improved service quality, faster building and innovations in technology. It is no accident that the construction industry has turned to the manufacturing sector as a point of reference and source of innovation. Successful concepts derived from manufacturing, such as Total Quality Management (TQM Production and Reengineering, are being adopted and integrated into the construction industry. Implicitly, the successful implementation of these concepts is heavily dependent on a culture of teamwork and cooperation at both intra- and inters- organizational levels. Quality management has increasingly been adopted by construction companies as an initiative to solve quality problems and to meet the needs of the final customer 'if ever an industry needed to take up the concept of TQM it is the construction industry'. Advances the view that construction very probably promises a greater payback for performance improvement than any other service industry because of its magnitude. However, implementing TQM principles in construction is particularly difficult because of a lack of standardization and the many parties involved.

1. INTRODUCTION

As the market economy has developed, market competition has had an important role of the law of survival of the fittest in every corner. The pressure of construction enterprises from the market and competitors will be greater and greater, as well as the increasing requirements of customers of quality assurance, which require the construction companies to improve their internal quality, strengthen management, in particular, pay close attention to quality control.

Quality is the symbol of human civilization, and with the progress of human civilization, quality control will play an incomparable role in the business. It can be said that if there is no quality control, there is no economic benefit. Construction projects are an extremely complex process, involving a wide range. There are plenty of factors affecting the quality of construction, such as design, materials, machinery, topography, geology, hydrology, meteorology, construction technology, methods of operation, technical measures, management systems, and so on. Because of the fixed project location, large volume and different location of different projects, the poor control of these factors may produce quality problems. During controlling the whole process of construction, only accord with the required quality standards and user promising requirements, fulfilling quality, time, cost, etc., construction companies could get the best economic effects. Construction companies must adhere to the principle of quality first, and insist on quality standards.

2. NEED FOR QUALITY

For construction projects, quality control means making sure things are done according to the plans, specifications, and permit requirements. The days of easy federal money seem to be over, making it imperative that communities get the most out of their infrastructure projects. One of the best ways to assure good construction projects is to use an inspector. The first step an inspector should take is to become familiar with the plans, specification, and permit requirements and, equally important, to have some common sense. Quality control during all construction phases needs to be better, and the utility system needs to know what is being installed while the work is being done. On most construction jobs, the inspection is one of the last things to be done—if it gets done at all.

Factors affecting quality in a construction project:

1. 5-M Factors
2. Scant respect to planning
3. Cash flow
4. Productivity

5. Clients interference & procedural delay Broadly and in simplified way, the basic reason of quality failure and the success of any quality project depend on 5nos. M-factors, which are as follows:-

1. Money
2. Material
3. Manpower
4. Machinery and lastly,
5. Management

All the above 5 factors are co related, lake of any single factor the project can not be success. Due to the above 5 major issues cost overrun / delay / improper management in the project the contractor will sacrifice quality for sake completion of project.

Planning, Scheduling, Budgeting, Coordination, mismanagement etc. comes mainly under the heading of Management. So, whenever anybody thinks about the Failure/success of any project, we will ultimately get these 5 heads not anything else.

Objective And Scope Of The Study

The objectives of this study is to

- Identify a comprehensive list of factors (and their indicators) for measuring cost effectiveness in quality construction in the context of engineering consulting services.
- Conduct a survey on quality construction in Chennai.
- Use the survey data to establish a priority list that identifies the most and least lack of quality receives from engineering consulting firm.
- Use the survey data to establish a quality functions.
- Use the results of the analysis to derive strategies for construction firms to achieve cost effectiveness in quality construction.
- The approach of this work can be useful to engineering construction firms, not only in Chennai, but also in other places for identifying their own weak areas so that they may improve on these areas to enhance the cost effectiveness quality construction and satisfies the customer.

Definitions

Functional definitions for cost effectiveness, quality construction are prerequisites to measuring quality.

- **Cost effectiveness** is Economical in terms of the goods or services received for the money spent.
- **Quality** the standard of something as measured against other things of a similar kind; the degree of excellence of something.
- **Construction** the action of building something, typically a large structure.

Cost effectiveness in quality construction is to provide Customer satisfaction for the cost invested.

"Quality is not an act, it is a habit" Aristotle

3. EFFECTS OF TQM IMPLEMENTATION IN THE CONSTRUCTION INDUSTRY

The substantial economic benefits can be attained through the implementation of TQM. TQM in the jobsite has been proven to speed-up projects while increasing profitability. 'For the first time an empirical study has confirmed that implementation of TQM is positively associated with home-buyer satisfaction'.

Results showed increased customer satisfaction after ISO 9000 implementation. Furthermore, the average number of defects in housing projects built by companies with ISO 9000 certification was significantly less than the number of defects in housing projects built by companies without ISO 9000 certification.

Thus, although there are few studies that have examined the effects of quality implementation in construction industry, the results show that both customers and contractors can benefit from it.

Objective:

The main objectives of this research are as follows:

- To determine the cost effectiveness in quality construction
- By following standard specification and IS codes and construction quality standards.
- Measurement of quality of construction at present in Chennai, and suggesting suitable measures to improve with respect to cost.
- The ultimate aim of this project is to provide quality project to the costumer and to minimize maintained and repairs and satisfies the customer for their cost invested and this will also
-

Process involved:

The various processes involved in this phase are listed as follows:

1. Studding various quality standards been adopted in India.
2. Visiting major projects sites in Chennai, and analyzing the cost effective techniques and quality materials were use for construction.
3. Comparing various items of works been carried out with specified quality standard.
4. Suggestions been given to the contractors for cost effective quality construction

Hence the optimum reduce of time, cost and enhance safety in construction will improve construction industry and will also improve our economic growth of our nation.

Steps Involved

The detailed steps can be explained as follows

- Data collection

- Questionnaire survey
- Analysis

Data Collection

Data collection is any process of preparing and collecting data, for example, as part of a process improvement or similar project. The purpose of data collection is to obtain information to keep on record, to make decisions about important issues, or to pass information on to others. Data are primarily collected to provide information regarding a specific topic. Data collection usually takes place early on in an improvement project, and is often formalized through a data collection plan which often contains the following activity.

- Pre collection activity — agree on goals, target data, definitions, methods
- Collection — data collection
- Present Findings — usually involves some form of sorting analysis and/or presentation.

Questionnaire survey

A questionnaire is a research instrument consisting of a series of questions and other prompts for the purpose of gathering information from respondents.

Analysis

Once the survey is conducted the answers are analyzed using SPSS software and comparative study is done. Respondent's views specifically contractors view on consultant and vice versa can be easily studied using the graphs obtained through the analysis. Results and conclusion are then drawn out of this.

Learning Objectives

Here are the few things that will be included in "The basics of statistics" section.

1. Research design
2. Evaluation of measuring instruments
3. Sample size and selection
4. Mean, variance, standard deviation, degrees of freedom
5. T-test
6. Correlation and regression
7. Statistical abuses
8. Create frequency tables
9. Produce bar charts
10. Use cross tabulation and correlation.

DATASET

This document uses an example survey and considers some of the analyses that might be carried out on the data. An SPSS dataset is made up of a number of observations, each of which contains a value for each variable in the dataset. From completed questionnaires it is possible to create a dataset. This dataset has samples and variables. The data is in fixed column format; each measurement forms a column and the values in each column make up a variable.

GRAPHS

The data may be broken down further with tables, which shown the joint distribution of two variables values as graphs.

To get a cross tabulation

a) Select analyze.
b) Select descriptive statistics.
c) Select graphs
d) Select if any factor from the source variable list.

Process involved:

The various processes involved in this phase are listed as follows:

a) Studding various quality standards been adopted in India.
b) Visiting major projects sites in Chennai, and analyzing the cost effective techniques and quality materials been use for construction.
c) Comparing various items of works been carried out with specified quality standard.
d) Suggestions been given to the contractors for cost effective quality construction
e) Hence the optimum reduce of time, cost and enhance safety in construction will improve construction industry and will also improve our economic growth of our nation.

4. QUALITY AUDIT IN ORGANIZATION

First the pie chart is drawn to find the main key factors in this set of questionnaire and using this main key factors the cross tab is done. And the majority of people in construction industry concrete on conformance to requirements, drawing specifications & quality records, cost estimation and standard of work in systematic manner. But only 30.8% of the construction industry does both conformances to requirements drawing specification and quality records. This means only 30.8% of the organization do conformance to requirements and drawing specification and quality records effectively.

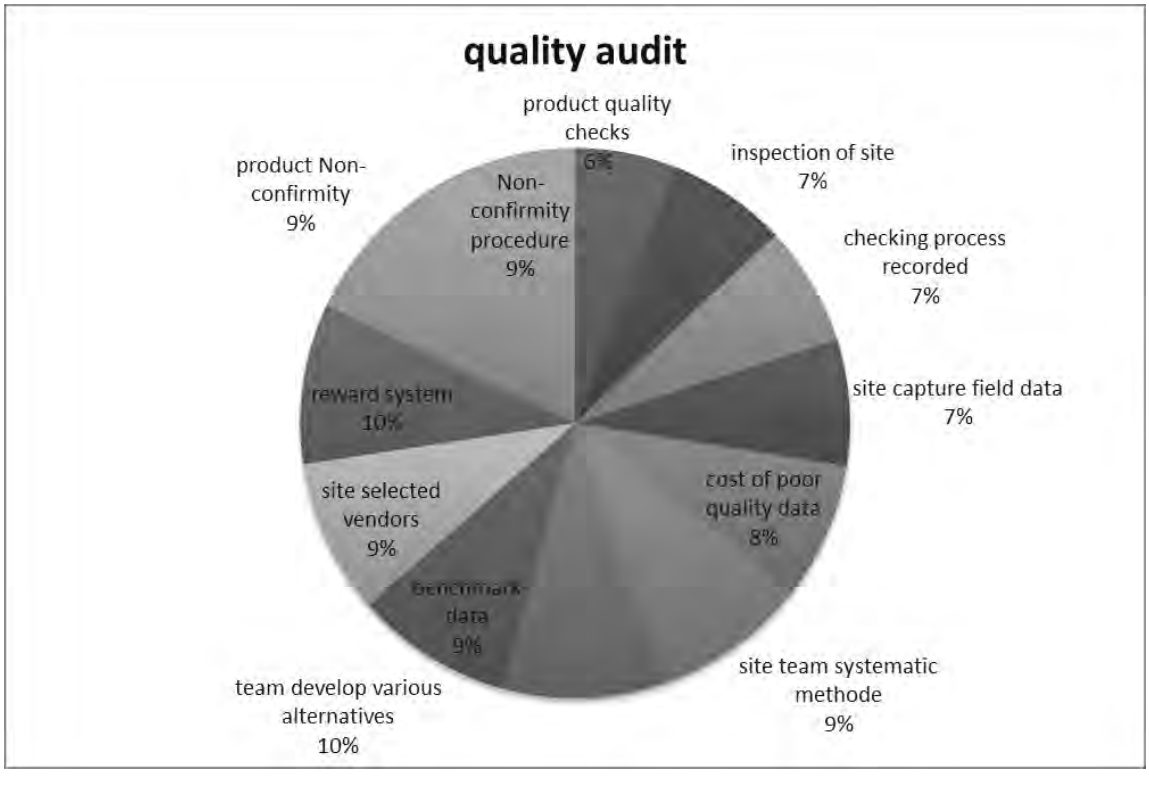

Fig 1.

Quality Audit in organization

The above figure represents the percentage classification of quality in organization.

Barriers to quality

Fig 2 Barriers to quality

The main barriers to implement quality in the organization bad seed effect and lack of skilled labours. And other minor criteria such as defect products, equipment, and financial status and supervisory level.

Improvement of quality performance

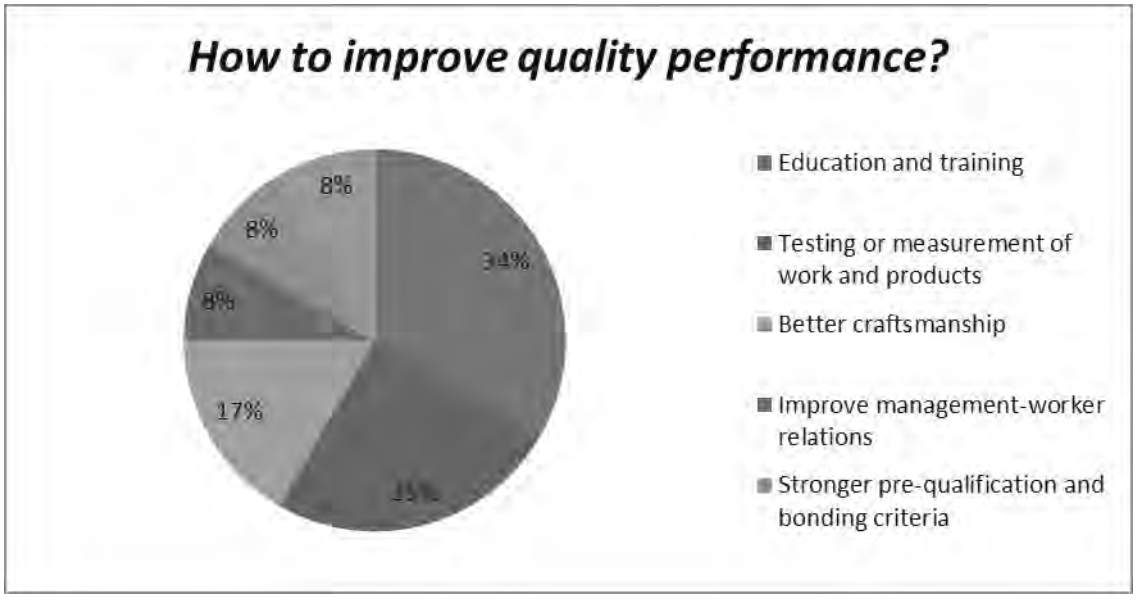

Fig 3

Quality performance can be achieved only giving labours training and information about 34% answered through questioner survey, proper testing 25%, the main criteria is better craftsmanship 17%, strong prequalification and bonding between organizations must be legally valid. Quality and safety norms must be clearly mentioned in the contract document. If all this are implemented quality performance can be achieved.

What do you consider the best measure / indicator of quality in the construction industry?

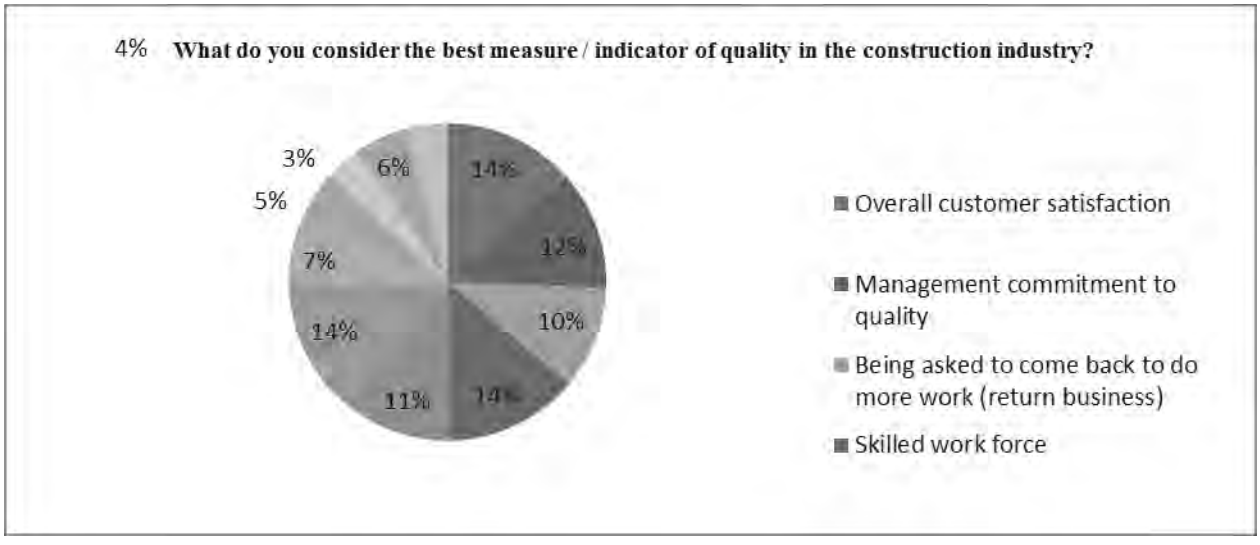

Fig 4. Best indicator to measure quality in construction industry

From the above questioner survey all contractors mainly focus upon customer satisfaction, from the above survey it was found only 25% - 30% of company maintain proper quality in construction. Other organizations lacks due to skilled labours, financial status of the company, bad seed effect, low bid system, top management pressure, timely completion of project, and expense to done i.e. training and education awareness to the working staff, providing healthy and safety environment to the worker.

5. POSSIBILITY TO IMPROVE THE QUALITY

This research indicated that the construction parties see quality to be inadequate. Therefore, there must be a scope for improvement. The research revealed that quality professionals saw clear improvements in their organizational operations after having implemented new work methods based on quality management. Their experience replicates the findings of other research presented in the literature research, where there were clear improvements in project performance (cost, time and quality) after having challenged existing working practices.

Some researchers have pointed out similarities between quality and safety. The research revealed that participants rated the overall safety status higher than the quality status. It is the author's impression that a change for the better has been ongoing with regards to safety culture over recent years. One factor that could have influenced these changes is the high demands that have been made in specific workplaces and projects, such as at the aluminum plants. The increased knowledge and improved safety culture that people have adopted there seems to be slowly transferring to the external environment and on to other projects. The point about making this connection is that there seems to be a domino effect in how the safety culture has been evolving for the better. Things do not change overnight. If more emphasis were to be put on raising quality, the quality culture would slowly begin change for the better. Project owners play the key role in this relationship, by setting higher demands; the rules of the game would then change.

6. CONCLUSION

The research discussed the use of quality management systems in terms of cost effectiveness and utility to organizations within the industry. Construction organizations identified clear improvements in the organization operation and cost effectiveness after implementation. Furthermore, personnel working with the system were seen to have a positive attitude towards it and its application. However, the research indicated that employers training on implementing quality management systems could be improved. Merely half of participants were satisfied with the training received on implementing the system. Furthermore the study suggests that there is a gap in the use and implementation of quality management and quality management systems and that knowledge about these matters is inadequate.

The construction jobsite is not only possible but has proven to be a success. Project results show improved cooperation, resulting in shorter schedules and punch lists. When a positive team attitude is developed, people will try to outdo each other in meeting customer expectations.

In a competitive market, businesses stay ahead by offering products that are different and /or superior in ways that matter to customers. Cost effectiveness has positioned itself at the top end of the modular buildings market in terms of quality, whilst at the same time providing value-for-money products that fully meet key standards set out in IS0 9001. The company should meet the required standards in all aspects of quality. This outcome is the result of a great deal of thought, careful planning and ongoing education and training of a skilled and dedicated workforce.

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COMPARISON OF EXISTING AND PREDICTED SOLID WASTE MANAGEMENT IN AN URBAN AREA

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ABSTRACT

The rising pressure of population together with the constantly changing technologies and development has contributed to the ever increasing volume of wastes in different forms. Unhygienic environment and solid waste accumulation coincides with mosquito breeding which causes, the spread of most epidemics. The best example is the present rampant spread of Dengue and Viral fever across Mysuru. As an environmental package, the disposal of varied solid waste generated from different sources, such as household markets, commercial areas, slaughter houses, hospitals and industries, makes it more difficult and challenging. In the present work, Mysuru city has been considered as the study area which has been declared as one of the smart cities in India. It was seen that during the year 2017, Mysuru city (Karnataka, India) alone contributed around **402 MT/Day** of solid waste from the present population of **9, 38,386 lakhs**. The Mysuru City Corporation is responsible for 65 wards which have set up 9 major solid waste collection units where the waste gets segregated based on the material and recycling of some of the plastics. The aim of this work is to highlight the importance of ***zero waste management*** and to bring in-sustainability aspects relating to waste disposal. As a result, the present study is aligned with treating the issues related to waste management in the city along with understanding the present scenario and prediction of quantity of waste that could be generated in future years which pose a serious threat to our society and eco-system. The

future population for two decades (based on 2011 population census) has been predicted by means of arithmetic increase method and its subsequent solid waste that would be generated has been estimated analytically. The results have shown that by the end of 2021, the population will be 10, 36, 755 lakhs with 451.11MT/Day of solid waste generated and by the end of 2031, around 519.147MT/Day of waste would be generated for a population of 11, 79,909 lakhs. An action plan has been devised to mitigate this serious issue which consists of 2 or 3 compost plant of each 200 tons per day capacity and 6 to 8 Biogas plants of capacity 1 ton per day in Zero waste Management.

***Keywords**:* Solid Waste Management (SWM) Municipal solid waste (MSW), Mysuru city cooperation (MCC),

Metric ton (MT)

1. INTRODUCTION

Increasing population levels, booming economy, rapid urbanization and the rise in community living standards have greatly accelerated the municipal solid waste (MSW) generation rate in developing countries `(Innocent Ndoh Mbue.,et.al. 2015).

Solid waste is defined as the organic and inorganic waste substances produced through the various societal activities and have lost value to the first user. Municipal Solid Wastes (MSW) is the commercial and residential wastes produced at the municipal level or a notified area. The waste could either be in solid or semi-solid form and excludes industrial hazardous wastes but includes treated bio-medical waste products (Murali Krishna Gurram.,et.al. 2014).

Solid waste generation rate is affected by variety of factors including the geographical location, season, use of kitchen food waste grinders, collection frequency, characteristics of service area, onsite processing, peoples food habits, economic conditions, recovery and reuse boundaries, existence of solid waste management laws, local culture and benefits, population growth, weather conditions and household size (Sama azadi., et.al. 2016).

Solid waste management is an integral part of urban and environmental management, like most of other infrastructural services has come under great stress, consider low priority areas, solid waste management has never been taken up seriously either by public or by concerned agency or authorities and now the piled up waste is threatening our heath, environment and well-being (Vipin Upadhyay et.al. 2012)

The disposal of solid waste is becoming a severe and costly logistical problem in many Asian countries. In most cities of developing countries, municipal solid waste management costs consume 20-50% of municipal revenues yet collection service levels remain low with only 5 to 70% of residents receiving service and most disposal being unsafe Municipal Solid Waste Management (MSWM) of developing countries have typical problem areas such as inadequate service coverage and operational inefficiencies of services, limited utilization of recycling activities, inadequate landfill disposal and inadequate management of hazardous and healthcare waste. Solid waste is regarded as one of the most adverse forms of pollution it requires environmentally sustainable solutions to reduce overall environmental burdens (Muzafar Ahmad Wani.et.al., 2013).

In order to plan, manage and use municipal solid waste (MSW) in a sustainable way the accurate forecasting of MSW generation and composition plays a key role in MSW management. Failure of accurate forecasting and assessment may cause several problems in the environment and waste management systems such as increased environmental impacts and over-or under-estimated capacity of MSW treatment facilities (Rotchana Intharathirat.et.al.,2014).

2. DESCRIPTION OF STUDY AREA

Mysore presently known as Mysuru is the third largest city in the state of Karnataka, India, which served as the capital city of Mysore Princely kingdom (kingdom of Mysore). According to the provisional results of the 2016 National Census of India, the population of Mysuru is 9, 38,386 and it is spread over an area of 128.42 km^2. Mysuru City Corporation is responsible for the civic administration of the city, which is also the headquarters of the Mysuru district and the Mysuru division (Adarsh S, et.al. 2017).

The Mysuru municipality was established in 1888 and the city was divided into eight wards. In 1897 an outbreak of bubonic plague killed nearly half of the population of the city and this paved the way for the establishment of the City

Improvement Trust Board (CITB) in 1903. Mysuru became one of the first cities in Asia to undertake a planned development of the city. At present, the city is divided into 65 wards. Mysuru city status in terms of population and few other important features is given below in Table 2.1.

Table 2.1: Mysuru City profile

FEATURES	STATUS
Population	9,38,386
Households	2,06,372
No. of municipal corporation wards	65
Area within corporation limit	128.42 km^2
Height above mean sea level(MSL)	770 m
Annual rain fall	798.2 mm
Total waste generated (exiting)	402 MT/day
Latitude & Longitude	12^o 18' 12" N, 76^o 38' 45" E

3. REVIEW OF EXISTING SCENARIO

Municipal Solid Waste Management involves interplay of seven functional elements, namely generation of waste, segregation, storage, collection, transport, processing and recovery and disposal (Swapan Das., et.al. 2014). It encompasses planning, organization, administration, financial, legal and technological aspects involving interdisciplinary relationships. Mysuru Municipal Corporation also performs the same procedure of MSWM in an attempt to minimize the health, environmental and aesthetic impacts of solid wastes in the city. MCC is responsible for the management of solid waste generated in the city. The city administration has been decentralized into 9 zones which includes all 65 wards in the city, as shown in table 3.1. The chief Health Officer of each zone is the overall in-charge of solid waste management in the corresponding zone of the city.

Table 3.1: Wards distribution Zone Wise.

ZONES	WARDS
Zone 1- Vidhyaranyapuram	6 (1,2,3,4,5,6)
Zone 2- Jayanagara	8 (7,8,9,10,11,12,13,14)
Zone 3- Mysuru University	9(15,16,17,18,19,20,21,22,24)
Zone 4- Gokulam	5 (23,30,31,32,33)
Zone 5- Kumbarakoppalu	5 (25, 26,27,28,29)
Zone 6- Jodi tengina Mara Burrial Ground	5 (34,35,36,37,38)
Zone 7- Jodi tengina Mara Burrial Ground	8 (39,40,41,42,43,44,45,64)
Zone 8- Old Kesare	9 (46,47,48,49,50,51,52,53,54)
Zone 9- New keasare	10 (55,56,57,58,59,60,61,62,63,65)

According to MMC, around 402 TPD solid waste is collected every day in Mysuru city. Waste was being transported each day which comprised fresh as well as old waste of backlog. Below Table 3.2 shows the waste generation, population, commercial establishments, educational institution, hotel and waste collected zone wise, finally table 3.3 shows the total quantity of waste generated in Mysuru City.

Table 3.2: Zone Wise Waste generation and collection.

Sl. No	Zone/Area	**Generator**	Population *	Commercial Establishments	Hotels & Restaurants	Marriage & Function halls	Street Sweeping & Others	Market	Estimated quantity/day (MT)
		Units	gram/ capita/ day	kgs per unit per day	kg/unit	kg/unit			
1	**Vidhyaranyapuram**	**Number**	71433	1885	59	19			
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	25.71	1.9	1.77	0.95	3		**33.33**
2	**Jayanagara**	**Number**	110908	1293	51	35			
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	40	0.8	1.2	1.8	2		**45.8**
3	**Mysuru University**	**Number**	146590	2751	112	12			
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	52.77	2.7	3.5	0.6	7.5		**67.07**
4	**Gokulam**	**Number**	60,152	1396	52	17			
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	21.65	1.4	1.6	0.85	5.6		**31.1**
5	**Kumbara koppalu**	**Number**	108194	4632	51	16			
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	25.96	4.63	1.5	0.8	3.2		**36.09**
6	**Jodi tengina Mara Burrial Ground**	**Number**	58731	8109	260	35	3		
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	21.14	8.1	7.8	1.75	7	2.1	**47.89**
7	**Jodi tengina Mara Burrial Ground**	**Number**	84795	1013	100	14			
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	30.526	1.013	1.68	0.7	12		**45.919**
8	**Old Kesare**	**Number**	1,44,041	652	113	28			
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	51.854	65.2	33.9	14	7.5		**54 MT**
9	**New Kesare**	**Number**	1,12,988	874	67	13			
		Unit generation/day	360	1	30	50			
		Estimated quantity (MT)	40.6	0.6	2	0.65	2		**45.85**

Table 3.3: Waste Generation Details of Mysuru city.

Sl. No	Generator	Number	Unit generation per day	Estimated quantity/day (MT)
1	Population	9,38,386	360 gram/capita/day	338
2	Commercial establishments	20,329	1.0 kg/unit/day	20
3	Hotels and Restaurant	716	30 kg/unit	21
4	Marriage and function hall	127	50 kg/unit	6
5	Street sweeping			17
	Total MSW generated/day in MT			**402 MT**

4. METHODOLOGY

Quantity and characteristics of the waste are the major factors, which decide technology to be used for waste disposal. On the basis of the waste quantity, infrastructure requirement can be estimated. It is also necessary to carry out waste analysis frequently in order to assess the changes in waste characteristics due to ever-changing scenario. This data will also serve as a basis for up gradation or switching over to better disposal/treatment option (Swapan Das., et.al. 2014).

Storage of waste at source is the first essential step of Solid Waste Management without affecting health and hygiene of population in the surrounding area. Every household, shop and establishment generates solid waste on day to day basis. The waste should normally be stored at the source of waste generation till collected for its disposal.

The future amounts of waste are closely coupled to economic growth given un-changed waste intensities in economic and human activities. Again the waste generation is directly proportional to the rate of change of population. A mathematical calculation is ultra process beginnings with the estimation of future population based on the average increase in population of last two decades and then calculate the future amount of municipal solid waste generation as below.

4.1 Arithmetical increase method (AIM)

Future Population, $P_n = P + n\,I$

Where, P_n = future population at n^{th} decade

P = Present population

I = average population increase in the known decade

n = no. of decades between now and future

4.2 Calculation of solid waste generated for future years

Quantity, $Wq = P_n \times W_r / 1000$

Here,

P_n = Predicted population, and
W_r = Waste generation Rate (kg/capita/day).

5. RESULTS AND DISCUSSION

The quantity of municipal waste generation will be in metric tonnes. The future population and waste generation is calculated from the formulation taken 2011 as a base year are shown in table 5.1. Calculation of predicted population and predicted solid waste quantity for the year 2021 and 2031 is given below.

5.1 Population determination using AIM

Total Increase = 286307

I = 286307/2 = 143153

$P_{2021} = P + n \times I$

P_{2021} = 893062 + 1x143153

P_{2021} = 10, 36, 755

P_{2031} = 893062 + 2x143153

P_{2031} = 11, 79,909

5.2 Total solid waste generation for future years per day (2021)

Population = 10,36,755 x 360 gram/capita/day = 373.23 MT

Commercial establishment = 22587 x 1 kg per unit per day = 22.587 MT

Hotels and restaurants = 1060 x 30 kg/unit = 31.80 MT

Marriage and function = 170 x 50 kg/unit = 8.5 MT

Street sweeping = 23 MT

Total waste generated per day = 451.11MT

5.3 Total solid waste generation for future years per day (2031)

Population=11,79,909*360 gram/capita/day = 424.76 MT

Commercial establishment = 25015*1kgs per unit per day = 25.587 MT

Hotels and restaurants = 1300*30 kg/unit = 31.80 MT

Marriage and function = 200*50 kg/unit = 10 MT

Street sweeping = 27 MT

Total waste generated per day = 519.147 MT

Table 5.1: Population and Waste Generation Projection of Mysuru City upto Design Year 2031

Year	Population	Waste generation Quantity (MTD)	% increase in Population	% increase in Waste generation
1991	606755	330.35	-	-
2001	755379	365.25	24.5	10.6
2011	893062	400.15	18.2	9.6
2021	1036755	451.11	16.1	12.7
2031	1179909	519.147	13.8	15.1

Projections for urban municipal solid waste generation in 2031 are made by factoring expected growth in population and estimated per capita waste generation. The population data collected from census conducted by Government of India as per the report of technical group on population projections constituted by the national commission on population to the office of the Registrar general & Census commissioner of India. The population projection is calculated by forecasting method. The population growth in Mysuru from 2011 to 2031 shall have a growth of 25% in 20 years at a rate of 1.2% of annum. This growth rate is considered in the model from 2011 to 2031 to predict the MSW generation. The MSW data collected from

MCC as per the office records and survey work. It is estimated that the amount of waste generated in Mysuru will increase at a per capita rate of approximately 1.2% annually is considered for estimate of MSW from the year 2011 to 2031. The population versus increase of municipal solid waste generation of year wise from 1991 to 2031 is obtained from forecasting method shown below in Fig. 5.1.

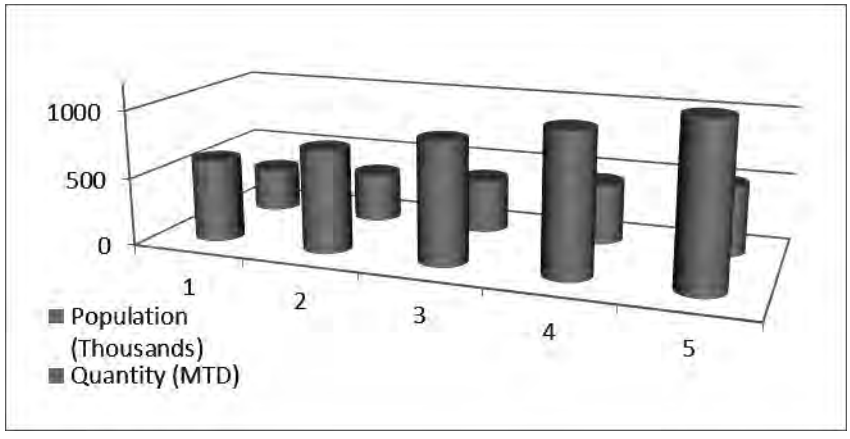

Fig. 5.1 Population and MSW generation projection in Mysuru.

From Fig. 5.2, it is seen that the percentage increase in population is inversely proportional to the percentage increase in waste generation. Even though there is a decrease in the increasing trend of population, the waste generation has an increasing trend in percentage increase for different decades.

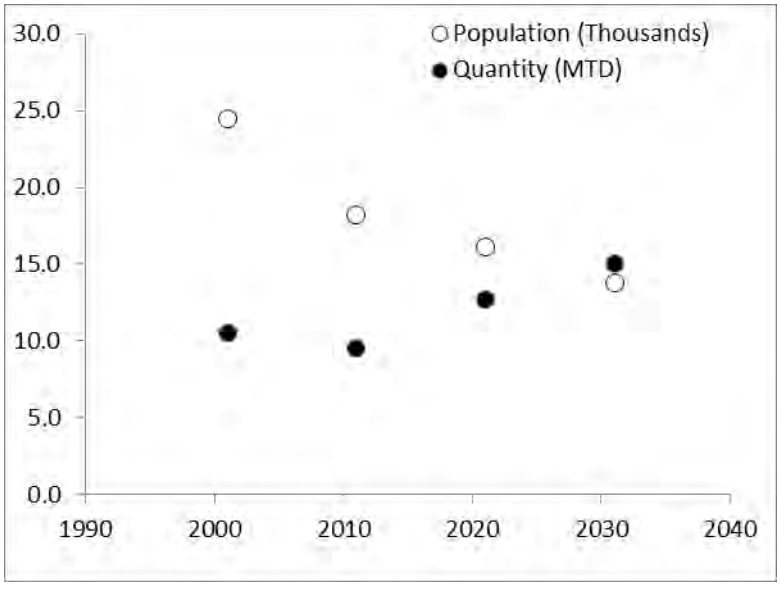

Fig. 5.2 Decade-wise percentage variation of population and waste generation

5.4 Existing SWM in Mysuru The waste arising from Residence, Hotels, Markets, Drain silt and Slaughter house is first segregated at the source point as wet waste and dry waste. The segregated waste is then collected through door to door service by auto or tippers provided by MCC. The collected primary waste is then sent to zero waste management unit. The management unit motivates the redesign of resource life cycles so that all products are reused which is called as secondary segregation. After the segregation process, wet waste is sent to composting unit in Mysuru, 200 ton capacity compost plant located near Vidyaranyapuram. Here 50% of the waste is land filled and remaining waste is composted to produce manure and sold to market. Dry waste is segregated in 11 categories and sold to the reprocessors to recycle and reuse. Presently, out of 402 MT generated in Mysuru city 200 MT is sent to a composting unit to produce a manure, 80 MT waste is sent to ZWM unit where secondary segregation is done which is the next step for recycle and reuse, 6 MT of slaughter house waste

is incinerated through pyrolysis process, remaining 6 MT waste is dumped into a biogas plant located at the ZWM unit to produce a compressed natural gas (CNG). Remaining 100 MT of solid waste is dumped open land, in the mean time MCC has proposed to setup 2 Compost plant at Rayanakere & Old Kesare of 200 TPD each for future waste generation**.** Figure 5.2 shows the existing SWM process flow sheet in Mysuru city.

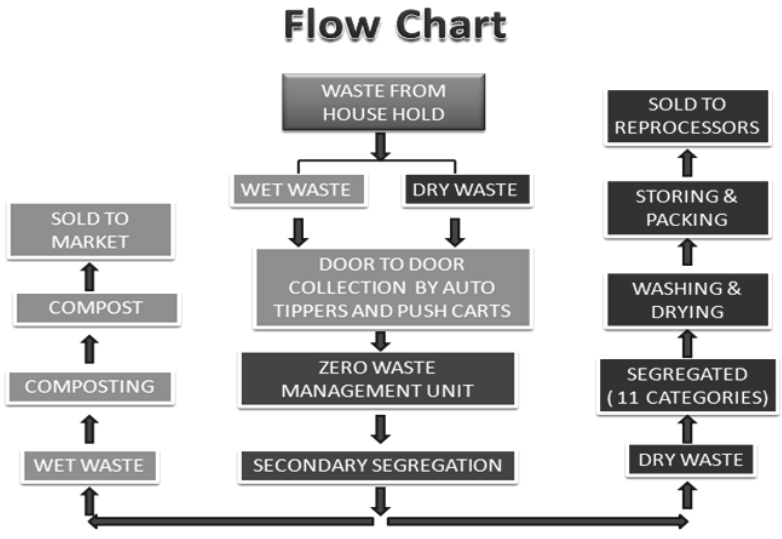

Fig 5.2: Flow sheet of Existing SWM in Mysuru

5.5 Proposed Action Plan of Predicted SWM The predicted solid waste by the end of the year 2031 is around 519.147 MT for which a necessary action plan is as follows.

- To treat the predicted solid waste, it is proposed to setup 1 new compost plant of 200 MT at Rayanakere or Old Kesare immediately. Where MCC has already proposed to setup 2 compost units to treat the excess waste.
- Presently there are 6 Biogas plant of capacity 1 MT each in ZWM Plants which can extend to install 3 more Biogas plant of 1 MT capacity.
- Incineration unit needs to be elaborated by installing extra Pyrolysis unit to treat extra 14 MT capacity of slaughter house waste.

Fig 5.3 shows the flow sheet of proposed action plan of predicted solid waste management

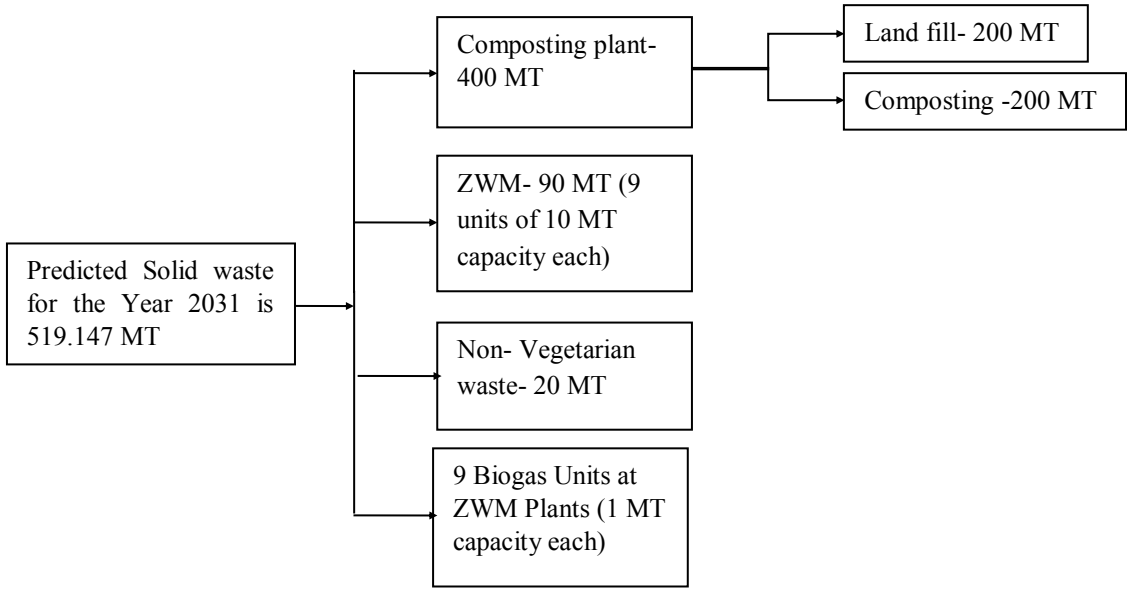

Fig 5.3: Flow Sheet of Proposed Action Plan of Predicted SWM.

6. CONCLUSION

This research work consists of essential findings that have implications for solid waste management. As a case study, the study area has been chosen as Mysuru city which has adopted an effective solid waste management system which includes proper collection, segregation, transportation and disposal of waste. The scope of future waste generation is analysed by forecasting method and illustration of the estimates of waste quantum for period from 2011 to 2031 is presented. The estimates show that, with the population growth, the percentage increase in per capita waste generation rate will be increase proportionally. The result shows that the expected municipal solid waste generation by Mysuru city in 2031 is 519.147 Metric tones. With rapid development of economy and change of living standard, waste composition is expected to change. For a decoupling to take place between economic growth and waste generation, the waste generation by firms and households in relation to their economic activities must decrease in the future. A number of studies have found that the higher the household income and standard of living, the higher the amount of MSW generated. The per capita waste generation rate is changing from decade to decade, due to change in economic growth. The present study also indicate that much larger land area need to be used for land filling and composting, because the municipal solid waste generation will be increased in the coming decades, where the initiative is already taken by MCC. The biodegradable waste can be processed by aerobic composting, which is already in progress in Mysuru city, MCC is working on other techniques like vermi-composting, anaerobic digestion or any other appropriate biological processing for stabilization of waste.

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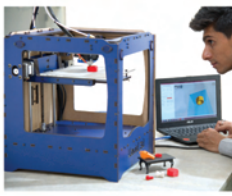

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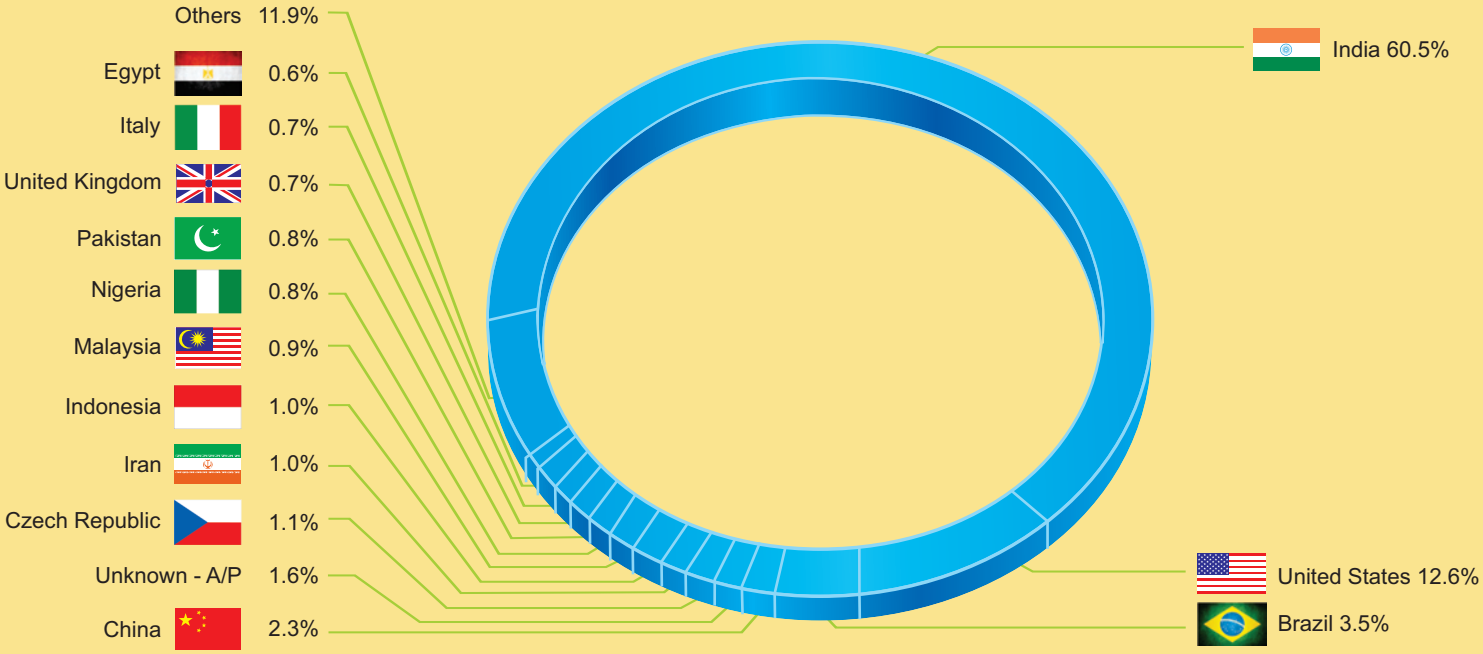

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