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FROM THE DESK OF
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Dear Readers,

The qualitative and timely publication of Vol. VII / Issue-I (Jan–Jun 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 five 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.VII | Issue II | Jul-Dec 2017 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
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Jan 2017

CONTENTS

INTEGRATING SECURITY IN SYSTEM DEVELOPMENT LIFE CYCLE (SDLC)

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ABSTRACT

System Development Life Cycle (SDLC) is a standard framework which came into existence around 1970s and articulates detailed process steps to build a system. Though the foundation of SDLC did not undergo major changes other than the introduction of various SDLC methodologies but the risk and threat landscape has changed drastically since then, prompting a need to introduce detailed security considerations in SDLC. It led to different school of thoughts with one supporting the security activities during the later phases of SDLC while the other integrating it throughout the SDLC. Given today's landscape of emerging risks, the latter approach is the most efficient way to secure the developed system as it enables to embed the security controls within the system. It is cost effective in long-term and also less prone to security breaches. This paper is inclined towards providing an overview about the significance of security and its integration in SDLC.

Keywords: *control, risk, SDLC, security, threat, vulnerability*

1. INTRODUCTION

With the growing business needs, the time to stand up systems has decreased considerably and the key focus is around the functionality of systems to satisfy the business requirements. This trend has some implications as security considerations take a back seat to achieve this goal. Network infrastructure has always been strong and secure as compared to a system [1]. This weakness at system level is being exploited by bad actors giving rise to security breaches like identity theft, fraud, intellectual property theft, disruption of service, etc. [1] In addition, large numbers of vulnerabilities [2] are being traced to weak design and improper coding techniques. It has made the organizations realize the significance of investing time and money in building security in the systems. It has also prompted a revisit to SDLC framework and the need to integrate security in SDLC. The question which is in front of all is what stage in SDLC is best suited to introduce security. Due to the lack of a standard framework for security in SDLC, there are different schools of thoughts around this area. However with the current landscape of risks and threats, it is pretty evident that security needs to be integrated throughout different stages of SDLC [2]. In order to achieve the objective of a secure system, no stage in SDLC can be overlooked in terms of security [1]. Each SDLC stage should have its own set of unique security requirements in conjunction with the functional requirements. It is similar to tying small pieces of threads together which can fall apart even with a single weak link. The biggest advantage of implementing security requirements in early stages of SDLC is that it helps them to mature and embed well within the system dynamics [3]. Another advantage is the cost effectiveness which is not there if security is introduced in the later stages of SDLC as designing a system with security is cheaper than adding security on a already

designed system. It is like designing a car with two entry points versus four requires less security and putting in door locks and anti-theft sensors at the same time saves the efforts of opening up the car again [3]. As we move further we will look at the specific security requirements for each stage of SDLC.

2. IMPORTANCE OF SDLC

A well-defined process is needed to build anything in this world. For example, while constructing a building architects need to carefully consider each and every minute detail which encompasses a number of important steps like building a strong foundation, creating a robust frame, using good materials and focusing on the exterior looks etc. Each and every step has its own significance and undermining even one of them can lead to adverse results. Building a system is no different. System development life cycle (SDLC) is a framework defining key stage gates which are needed to architect a system. A number of system development models [4] like waterfall, Agile, Rapid Application Development (RAD) etc. help to achieve a common goal in SDLC i.e. building good software in reasonable time. The key stage gates in SDLC framework are illustrated in figure 1 below.

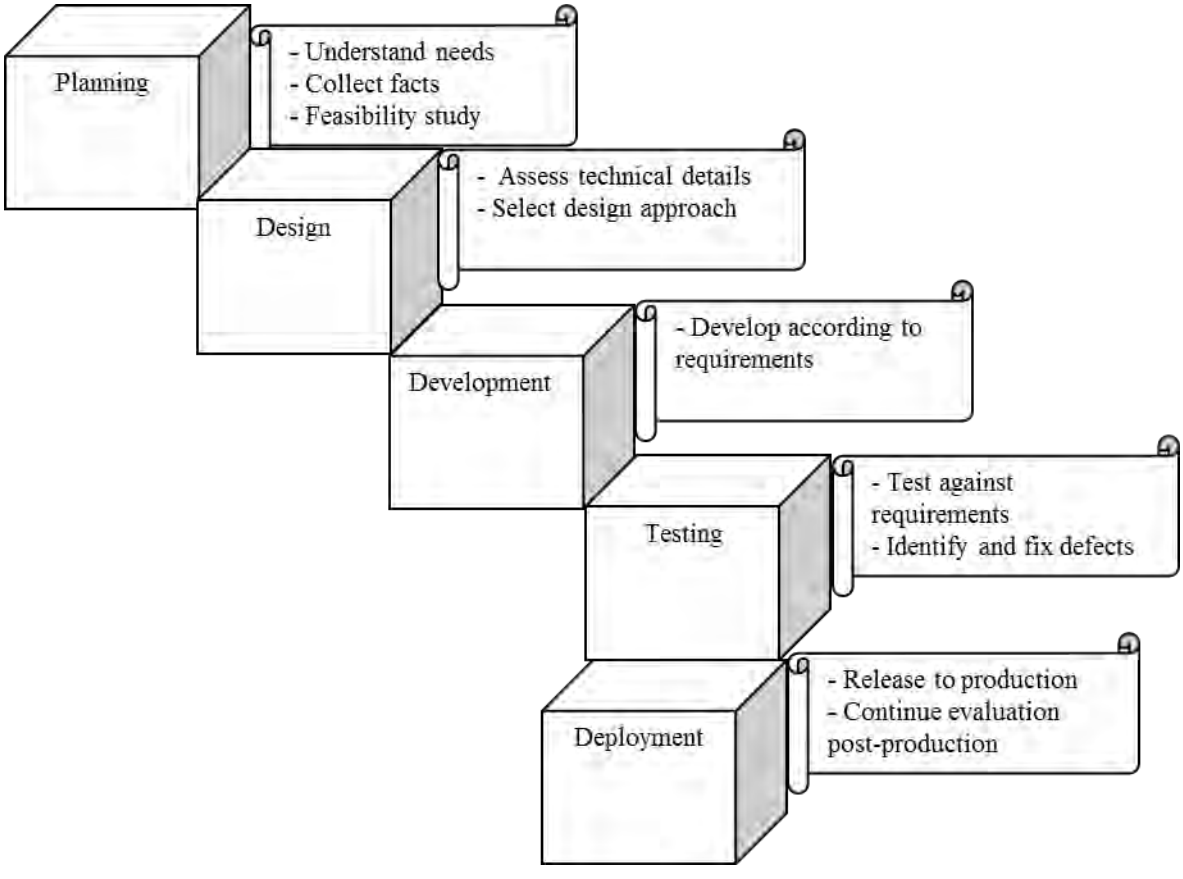

Fig. 1 Key stage gates in SDLC

The whole concept looks very simple and everybody who understands few nuances of information technology in today's world can easily relate to it. If this is the case then what is missing from the landscape which makes it complex? The answer to this question is visible when you shift gears and glance at it through a security lens. It becomes pretty evident that despite being a robust framework, it lacks security control which is an area of primary concern for all industries. The next section helps in understanding SDLC in the light of security across different stages.

3. INTEGRATING SECURITY IN SDLC

A common practice is to perform security related activities during the test phase of the SDLC which is not at all efficient as it is too late to identify the security gaps and remediate it. It is not only an overhead from a resource standpoint

but also hits the budget and timelines. According to data presented by Foundstone Professional Services, the return of security investment (ROSI) when defects are identified and fixed during design phase of SDLC is $21,000 compared to ROSI of $12,000 for every $100,000 spent when defects are identified and fixed during the testing phase of SDLC [5]. In addition, the unbudgeted time to fix security defects is around 1000 man-hours [5]. According to Dulos Inc., the cost to fix defects follow 1:10:100 rule i.e. a defect that costs $1 to fix in requirements or design phase of SDLC, costs $10 to fix in test phase of SDLC and $100 to fix post-deployment [6]. All the above data clearly articulates the significance of secure software to optimize time and available resources. The question now arises is how is it done and the answer to it is pretty straight forward i.e. security requirements need to be considered and integrated throughout different stages of SDLC.

3.1. Planning This first phase of SDLC needs to include security considerations at the macro level. It begins with identifying the individuals with key security roles who can work alongside technical teams throughout the SDLC [3]. As project plan is carved out, it should include security milestones similar to the regular project milestones. The next important step is to identify the criticality of the system to be developed and its impact on the business. This can drive the security requirements needed to safeguard the system based on its criticality. A privacy assessment should also be completed in order to assess the type of information the system will process to identify the need of specific security requirements. Security training [3] should be provided to the technical teams at this stage to help them better understand the threat and risk vectors along with secure design techniques prior to moving to next stage.

3.2 Design A risk assessment should be performed to identify the security controls required based on the criticality of the system [5]. It needs to be done prior to the finalization of the design specifications so that the outcome from risk assessment can be factored in the design specifications. The security controls should then be identified and finalized along with the design specifications including the identification of tools to be used for development. These finalized security controls then need to be architected in the design of the system prior to moving to the next stage. For instance, auditing should be enabled to capture the key system processes and configurations which if changed can impact the system in a negative manner. It will help in performing a root cause analysis related to any security breach. Threat modeling should be used to determine risks from various threat actors and potential vulnerabilities which will help to establish controls to mitigate these risks [3]. Layered security approach should be adopted along with the use of principle of least privilege to restrict excessive privileged access.

3.3 Development It is now time to develop the security controls as part of the system finalized during the design phase. The use of approved tools is highly recommended to avoid additional security risks. It sounds simple but it is challenging because on a lot of occasions the security controls will impact the system performance or other areas negatively and need to be reconsidered. In such a scenario where a finalized control from design specifications needs to be dropped due to the reasons discussed above, it should be replaced by a mitigating control [3]. In addition, secure development techniques like static code reviews should be used to identify unsafe functions and procedures in the code [1 and 7]. At this stage threat modeling [8] should be revisited to ensure appropriate controls are in place to mitigate all the risks prior to moving to the next stage.

3.4 Testing System being developed must be tested prior to release in production. The objective is to test compliance with functional and security requirements. Dynamic code reviews should be performed at this stage to achieve run-time verification checks [3]. Regular testing methodologies like unit testing, integration testing and system testing should be performed followed by a final secure code review. It will ensure all defects from development phase are identified and remediated and new vulnerabilities have not been introduced. If an additional layer of testing is warranted, random testing that involves providing invalid and unexpected data as inputs is a good option to identify security exceptions [8]. Finally, acceptance testing should be performed by both business users and the security team working alongside the technical teams from the planning phase to ensure functional and security requirements have been met. A vulnerability scan prior to deployment is highly recommended.

3.5 Deployment When a newly developed system is released in production, it may lead to certain configuration changes to the system. In such a case regression testing should be performed to ensure additional vulnerabilities have not been introduced [9]. Once a system is in production, any changes can have a significant security impact. Therefore, it is critical that change and configuration management is strictly followed. The saying 'Nothing lasts forever' is true in case of a system lifecycle as well because once a system is in production the job does not end here. Depending on the criticality of

the system, a periodic monitoring process should be implemented to ensure new risks are identified and mitigated [3]. It should include periodic assessments like vulnerability scan, patch management, risk assessment and disaster recovery/ business continuity exercises along with other forms of security testing as required. If the system undergoes any major upgrade, it should trigger a complete SDLC starting right from the planning phase and undergo the same checks and balances like a new system as illustrated in Figure 2 below.

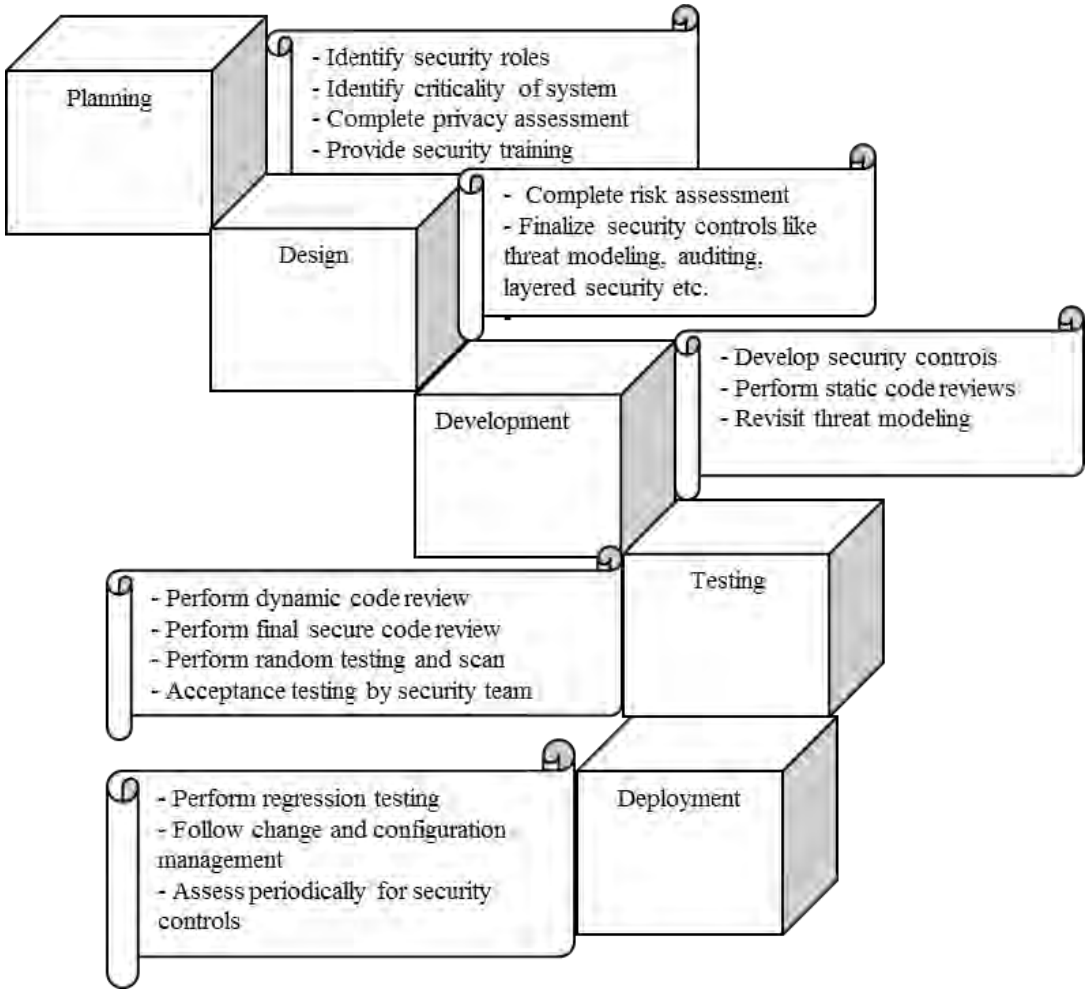

Fig. 2 Security in SDLC

4. CONCLUSION

Security in a developed system is a prominent area of concern for any organization. Security gaps post-deployment can be a big overhead in terms of time and money. Therefore, security requirements need to be baked in with functional requirements at each stage of the SDLC. It is only feasible when technical, security and business teams work together in their respective roles during entire SDLC with a common objective of building an effective and secure system. In this paper an overview was provided about the significance of security and its integration in SDLC. In addition, specific security requirements were provided for each stage of SDLC.

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COMPUTATIONAL BIOPSY TO ASSESS ACCURACY OF LARGE SCALE COMPUTATIONAL GROUNDWATER FLOW MODELS

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ABSTRACT

Due to the availability of comprehensive computational models of various computer modeling approaches to solving problems in computational engineering, mathematics, and science, and also due to the capacity of modern computers to computational solve the governing mathematical relationships involved in the problem solving procedures, the use of methods in Computational Engineering Mathematics to solve such problems has become a new standard of care in the design process as well as planning. However, sometimes the computational results are not sufficiently accurate or may be solving an alternate problem than what was contemplated. In this work, we propose the concept of "computational biopsy" where small portions of the global model are identified where a test problem is inserted into the global model and then the global model is rerun with the inserted test problems in place, producing another set of computational results that

include the small inserted test problems. For properly selected test problems, exact solutions typically exist and can be compared to the computational results obtained from the global model as modified to contain the inserted test problems.

Keywords: *Computational domain, FROST2D, SEEP/W, transient profiles*

1. INTRODUCTION

The use of computational models for the analysis of complex problems in small and large scale problems continues to gain in common usage in modern engineering design and planning. Background into the procedures and computational approaches used in such computational modeling approaches are thoroughly reviewed, and computer code provided in FORTRAN, in the book by C.A. Brebbia and A.J. Ferrante [1] entitled "Computational Hydraulics". Other texts and publications are available in the literature, but the book by Brebbia provides a particularly detailed and practical assessment of the technology still in modern use. As a result of such widespread use of computational models to solve problems in fluid transport processes, including but by no means limited to groundwater saturated and unsaturated flow in soils, experience with such computational approaches has accumulated. Additionally, commonly occurring difficulties (such as inadequate computational accuracy in predicting rapidly changing variables, among other issues) in the use and application of such computational models has drawn attention towards research in methods to reduce the impacts and occurrence of such modeling issues.

In the J. Hydraulic Research, Vol. 14, the research article entitled, "Computational Hydraulics: A Short Pathology" [2], states that "Several members of the IAHR section on the use of computers in hydraulics and water resources have expressed concern at the quality of many of the computational models currently used in hydraulic research and hydraulic and coastal engineering practice. The purpose of this article is to explain some of the grounds for their concern by illustrating some of the errors that commonly occur in this type of work...Difficulties and errors arise not only in the models themselves but also in their applications. Unless the entire investigation operation functions correctly, the consequences of these errors can be very serious in engineering practice. Finally, the need for more education in this area is emphasized." This paper was followed by the research article, "Computational Hydraulics: An Alternative View" published by M.B. Abbott et al in J. Hydraulic Research in Jan, 2010, which further examines issues involving modeling complexity and large scale modeling issues. In the second paper, a distinction is made between "traditional" modeling approaches that assess the entire global problem domain, versus a more modeling focused approach, or "alternative" methods, that concentrate modeling effort at the smaller but more involved hydraulic and transport process locations. Abbott et al [3] write that, "...The traditional approach can be used most efficiently when, roughly speaking, the same order of variation occurs in the dependent variables over most of the domain during most of the time. In a large number of real-life situations, however, nothing much happens in most of the domain during most of the time but the areas of interest are concentrated in small regions that may move across the domain in time. Examples are the spillage, transport and dispersion of pollutants in watercourses, the propagation of Tsunamis waves, halocline and thermocline decay, bio-chemical process at air-water and bed-water interfaces and haloclines and also the transport of short wave energy. The alternative methods provide a generally superior resolution in these situations, as compared with the traditional ones, but this advantage is bought at the cost of an increased complexity of the numerical scheme or code. Applications are shown to the transport processes, dispersion process and conservation (propagation) processes of hydraulics, so covering most common applications...".

In the current paper, an approach for assessing computational models of fluid transport, such as commonly encountered in the analysis of saturated and unsaturated groundwater (or soil-water) flow in soils, with or without soil-water phase change due to freezing and thawing effects, is considered by testing the global computational model through introduction and insertion of several test situations within the global problem domain where analytic solutions to the test problem is available. The revised global model is then re-run to obtain an alternative solution outcome that can then be assessed as to the revised global model's computational accuracy in predicting the computational results corresponding to the individual test problems. The focus of this assessment is at the test problem locations. Such specific location tests can be applied throughout the global model where, as distinguished by Abbot, "... the areas of interest are concentrated in small regions that may move across the domain in time..." These tests are referred to in this paper as computational "biopsies" in that small and specifically selected locations within the global computational model are being examined individually rather than the entire global model. Different tests can be conducted at these biopsy locations by modification of the boundary and initial conditions of the transport equation test problem selected. And similar to the usual biological biopsy procedure, the

success in the alternative or modified global model in achieving good computational results for the selected test problem is a "necessary" condition for global model success, but is not a "sufficient" condition to assure overall global model success.

Examples of computational model difficulties are presented in the Lecture entitled "Introduction to Computational Mathematics" [4]. In that lecture, standard computational issues are examined as well as complex topics. Of course, such computational issues continue to survive even today in the most modern computational models that are commonly used in design and planning of engineering and other works. In other words, the computational modeler still must address the same issues and difficulties (such as computational issues regarding stability, convergence, and consistency) in using computational models such as existed in the past, even though the computational modeling outcome is incredibly detailed because of modern visualization techniques.

Phil Roe, Professor of Aerospace Engineering at the University of Michigan published his video lecture on Feb. 19, 2014 entitled, "Colorful Fluid Dynamics", dealing with topics of modern Computational Fluid Dynamics ("CFD"), and mentions, "It's full of noise, it's full of color, it's spectacular, it's intended to blow your mind away, it's intended to disarm criticism." Roe then discusses some issues with CFD and the dangers of "colorful fluid dynamics", and references the statement by Doug McLean (for example, video lecture "Common Misconceptions in Aerodynamics", Oct 21, 2013, among other publications, retired Boeing Technical Fellow): "These days it is common to see a complicated flow field, predicted with all the right general features and displayed in glorious detail that looks like the real thing. Results viewed in this way take on an air of authority out of proportion to their accuracy...". The Computational Biopsy approach aids to illuminate possible sources of computational modeling error by demonstrating the magnitude of such errors using a well-known and well-understood test problem or set of problems.

Given the experiences with such computational modeling, there is value in developing methods to assess the potential of such computational issues occurring within an application of a computational model, such as modeling transport processes such as soil-water flow in saturated and unsaturated soils. Additionally, education is needed to highlight such computational issues in order to alert computational modelers that experience and advanced knowledge of the underpinnings involved in a selected computational model is still needed, even though the computational modeling outcome appears to be plausible and seem strikingly realistic. That is, there is still considerable need to know many of the elements of mathematics and computational methods that are studied in courses found in university programs of computational engineering mathematics.

2. CASE STUDY: ASSESSMENT OF GROUNDWATER FLOW USING TWO COMPUTATIONAL MODELS

For the current work, two computational models of groundwater flow are examined. The models selected to demonstrate the computational biopsy approach are computer program FROST2D and also computer program SEEP/W. Both computer codes solve the usual saturated and unsaturated flow equations of soil water movement in soils. Program FROST2D solves the coupled saturated and unsaturated soil water flow equations in a two-dimensional problem domain. The program includes an algorithm for modeling soil water phase change, however that process is not assessed in the current work. The computer code in FROST2D software (Guymon et al. 1993) was developed as part of a research effort funded in the later 1970's and early 1980's by the U S army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) and has been in use since its inception for a variety of problems. Program SEEP/W (Krahn 2012) is a world-wide distributed computer code for solving saturated and also unsaturated soil water flow in two-dimensional soil problem domains. Because both computer codes have been in use by a variety of end-users and because the FROST2D program has a long history of availability, the assessment of both programs in their application to a common problem may provide an interesting comparison in computational efficiency as well as accuracy. Both programs are applied to the same two-dimensional problem, and then both global models are then examined using the same "computational biopsy" test locations within the respective models. The resulting assessment is a comparison between three computational model sets of results in solving the identical test problem, including computational results from the two computer codes selected for examination, and computational results from the biopsy test problem which in this particular case has an exact solution available. The computational results from the selected test problem serve as a "baseline" to use in assessing modeling

performance. More details regarding the biopsy test problem are provided in a following section.

The two-dimensional groundwater flow equation for coupled saturated and unsaturated soil water flow is given by Eq. (1),

$$C\frac{\partial \emptyset}{\partial t} = \frac{\partial}{\partial x}\left(K_x\frac{\partial \emptyset}{\partial x}\right) + \frac{\partial}{\partial y}\left(K_y\frac{\partial \emptyset}{\partial y}\right) \quad (1)$$

Where, C is a capacitance coefficient; x, y, and z are the spatial coordinates; t is the model time coordinate; ∅ is the potential function; K_i for i = x, y is the hydraulic conductivity, with each subscript denoting the specific coordinate direction.

The three-dimensional formulation is readily obtained by simply including the third dimension flow transport term. Sources and sinks are not included in Eq. (1). Both computational programs FROST2D and SEEP/W numerically solve Eq. (1) given initial and boundary conditions appropriately defined.

3. THE SELECTED "COMPUTATIONAL BIOPSY" TEST AND RESULTS

The selected test situation is a one-dimensional diffusion transport model, such as used to describe one-dimension heat transport in a long rod. To apply this test scenario, locations are selected within the global model problem domain where the test problem can be included into the global model and where also the modified global model is not significantly altered except at the location of the "biopsy". In this way, the modified global model can be re-run as originally envisaged, but with the inserted test problems being solved as part of the global modeling solution effort. That is, the original global modeling computational discretization scheme and numerical algorithms employed remain in use as originally set up, but now the inserted test problems are being concurrently analyzed by the same computational global model.

The test problem (or test situation) being used for this work is the classic one-dimensional transient heat transfer problem with initial conditions at normalized model time t=0 defined as value 1.0, and with boundary conditions defined at normalized locations x = 0 and x = 1 with value 0. The governing partial differential equation describing the heat transfer problem is given in Eq. (2). The analytic solution of the test problem is the series given in Eq. (3).

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{\partial u}{\partial t} \quad (2)$$

$$u(x,t) = \frac{4u_o}{\pi}\sum_{n=1}^{3}\frac{\sin\big((2n-1)\pi x\big)}{(2n-1)}\exp(-(2n-1)^2\pi^2 t) \quad (3)$$

The similarity between the groundwater flow Eq. (1) and the selected test heat transport Eq. (2) is apparent. Other test problems can be used instead of the test problem selected for the current effort, where a suite of test problems can be formulated by revising initial conditions and boundary conditions, for example.

Figures 1 and 2 display the test problem computational results that are available with the analytic solution described by the generalized Fourier series shown in Eq. (3). In these Figures, the analytic solution as well as computational solutions developed by EXCEL, are compared. The figures compare computational results between the target computer programs FROST2D, SEEP/W, the analytic solution, and an (Microsoft) EXCEL computational model of the analytic solution. Convergence is examined by use and comparison of a 10 -node and also a 203-node computational discretization for all the models considered. As seen in the Figures 1 and 2, a higher level of discretization results in significantly improved computational results for the test problem examined. Furthermore, the computer programs SEEP/W and FROST2D both show significant improvement in their computational results for the increased level of discretization. Although it is true that these computational results in assessing convergence of the modeling can be obtained by simply increasing the level of discretization, it is also true that for large scale applications of such models involving perhaps

millions of computational elements, that increasing the level of discretization may be prohibitive. In such cases, among others, the considered computational biopsy approach for examining the veracity of computational results may be a useful approach for examining modeling accuracy.

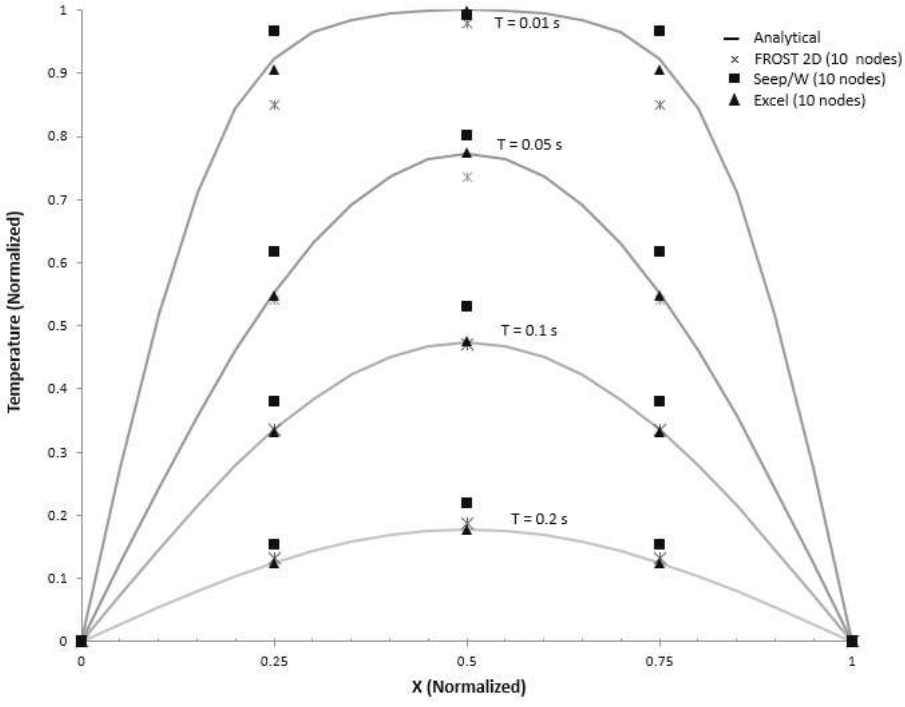

Figure 1. Comparison of Analytical, Frost2D, Seep/W and Excel solution (Number of nodes = 10)

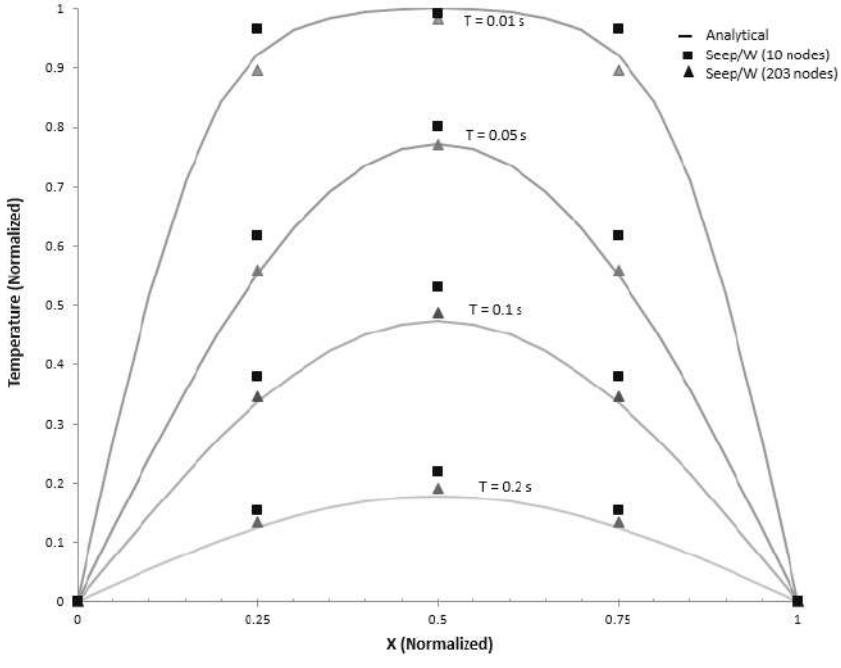

Figure 2. Sensitivity of Seep/w solution for 10 and 203 nodes in the computational domain

These various computational and analytic results can be used directly to compare with the two selected global computer models. Once the test problem is properly inserted into the global computational model, additional tests can be readily obtained by changing the test problem boundary conditions and initial conditions. Of course, such changes would necessitate re-running the global model in order to properly include the new test situations. Other computational biopsy locations can be examined by simply inserting the selected test problem situation into the global model and re-running.

4. CONCLUSION

A reproducible approach towards assessing computational veracity of large scale computational models is presented for the case of groundwater or soil-water flow modeling. The approach is called "computational biopsy" where samples of the global computational model are examined as to computational veracity using test situations where analytic solutions exists. Although use of several test locations and test situations may increase confidence in the global modeling computational results and their accuracy, such tests only provide a "necessary" condition is assessing modeling veracity and not a "sufficient" condition for the purposes of describing overall global modeling success.

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5 SECTION EDGE COUPLED STRIPLINE COUPLER FOR BROADBAND PLANAR MIC APPLICATIONS

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ABSTRACT

An edge coupled 25 dB stripline coupler has been designed for broadband microwave integrated circuit applications. The coupler has 5 sections to achieve minimum variation around 25 dB over wide frequency range. The designed coupler is planar and can be integrated with antenna, transmit receive module or amplifier to sample power for measurement purposes.

Keywords: *Edge coupled coupler, stripline, coupling and microwave integrated circuit.*

1. INTRODUCTION

Edge coupled coupler is a specific type of coupled line coupler in which the coupled lines lie in the same plane [1]. In such couplers, maximum coupling can be obtained if the length of coupled lines is quarter wavelength. These types of couplers are often realized in either microstripline or stripline configurations as they offer flexibility in integration with complex microwave integrated circuits. Another advantage of such coupler is that both input and coupled ports are on the same side of the planar structure as shown in the Fig.1.

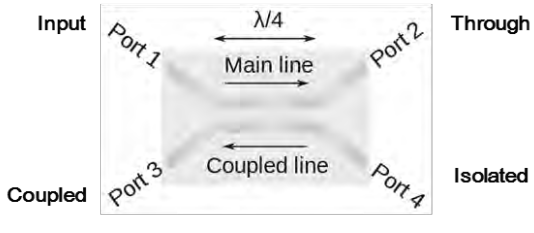

Fig. 1 Conical Antenna Geometry

The coupling ratio (C) in a coupled line coupler [2] is defined as:

$$\left|\frac{V_3}{V_1}\right| = C \tag{1}$$

The edge coupled couplers offer loose coupling and for 25 dB coupling, coupling ratio C comes out as 0.02364.

2. DESIGN PARAMETERS

For 5 section edge coupled coupler, the relationship between coupling ratio of overall coupler and individual sections [3] is given as:

$$C = 2C_1 - 2C_2 + C_3 \tag{2}$$

And

$$\left|\frac{dC}{d\theta}\right|_{\theta=\frac{\pi}{2}} = 0 \tag{3}$$

The coupler geometry with coupling ratio of each section is shown in Fig. 2. The length of each section is equal to quarter guide wavelength in order to maximize coupling at centre frequency.

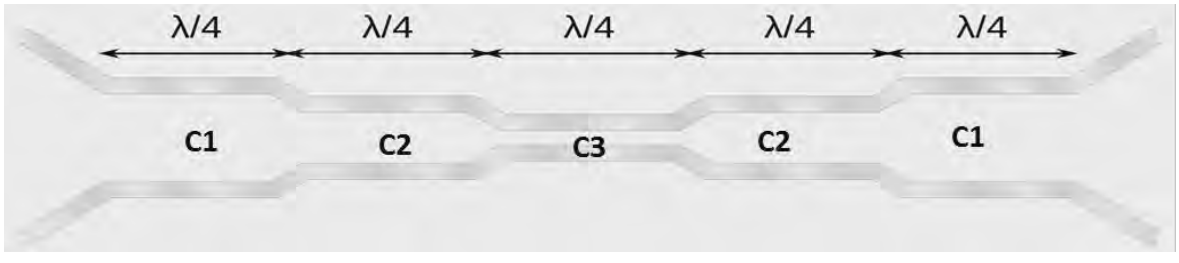

Fig. 2 Coupler Geometry

The coupler is designed in stripline configuration using 62 mil Rogers RT Duroid 5880 substrate. The design parameters are the width (W) and spacing (s) of each section which are obtained by odd-even analysis of coupled lines [4]. The odd-even mode analysis provides the odd and even mode impedances which are further used to obtain W/h and s/h ratio [5] for each section where h is the total thickness of substrate.

After doing the mathematical analysis, a theoretical design for 5 section coupler has been obtained. Based on the theoretical design, a CAD model has been designed and simulated in CST Microwave Studio [6]. The coupler ports have been extended (as shown in Fig. 3) because during the realization of this design; microwave coaxial connecters are soldered to the ports hence it is necessary to provide sufficient spacing between the ports designed and simulated.

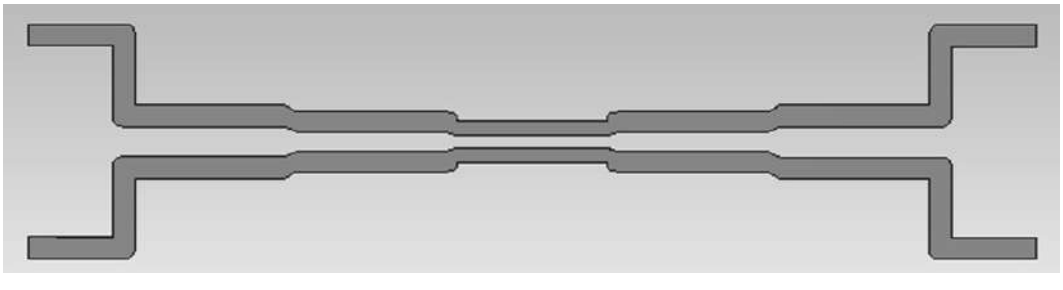

Fig. 3 CAD model of Coupler

3. PARAMETRIC STUDY

The spacing and impedance of each section is theoretically calculated and then simulated and optimized to achieve minimum variation for maximum bandwidth. The simulated result for coupling is presented in Fig.4. The results suggests that -2 dB variation in coupling has been achieved for 25dB coupling over 9:1 bandwidth.

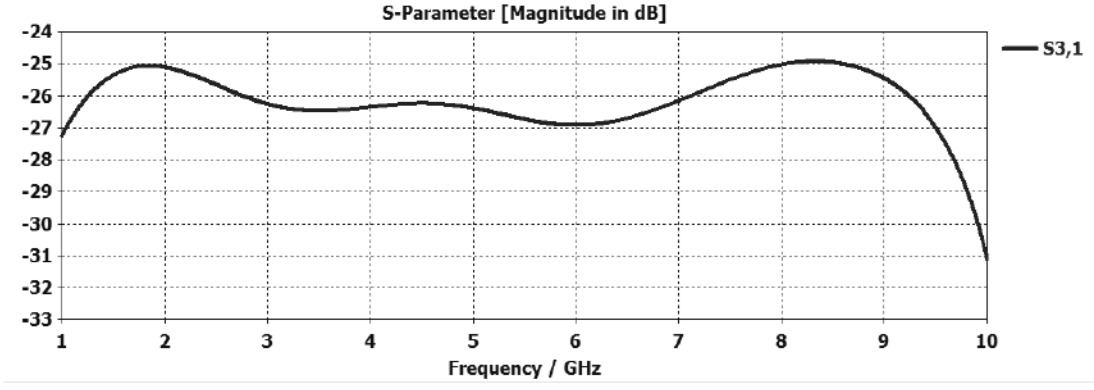

Fig. 4 Simulated S_{31} in dB

The other important parameter of the coupler is isolation. From the Fig. 5 it is clear that isolation is higher than 30 dB for 1-9GHz range. Hence from coupling and isolation results, it can be derived that directivity of this coupler is better than 55 dB over wide frequency range.

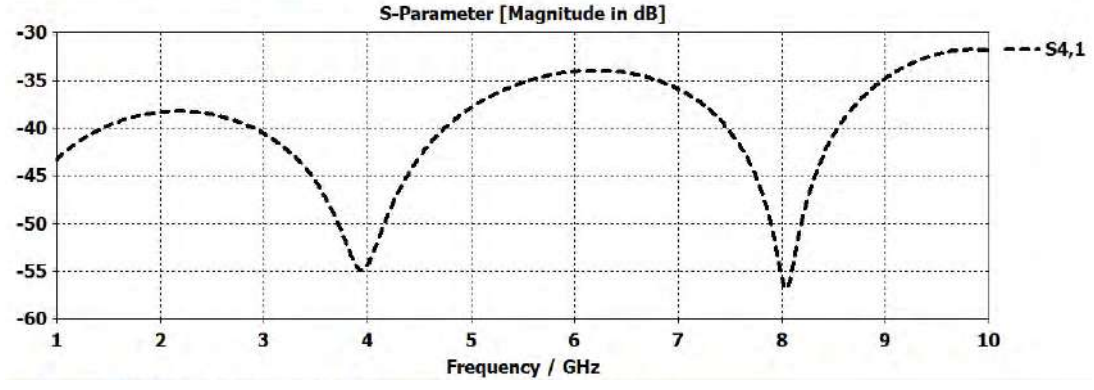

Fig. 5 Simulated S_{41} in dB

The insertion loss is represented in terms of S_{21} (dB). Fig. 6 suggests that the designed coupler offers less than 1 dB loss over the entire frequency band of interest. Hence it is a useful design which can be realized in stripline configuration and can be integrated with other planar circuits without much additional loss.

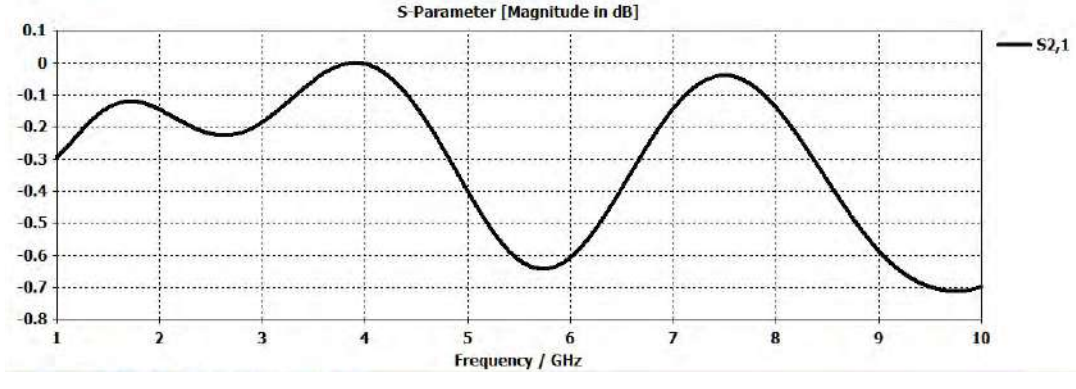

Fig. 6 Simulated S_{21} in dB

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

Table -1: Design Parameters

Parameter Name	Optimized value
Spacing between section 1	1.8mm
Spacing between section 2	1.2mm
Spacing between section 3	0.7mm
Width of section 1	1.3mm
Width of section 2	1.2mm
Width of section 3	0.9mm
Length of each section	8.9mm

4. CONCLUSION

A 25 dB coupler has been designed and simulated using CST Microwave studio. This coupler can be easily integrated with planar microwave passive and active circuits. One such application of these couplers is found in Active Phase Arrays where the phase calibration can be done by sampling the input power fed to the antenna. In such case, the input of the coupler acts as the feeding line to the antenna while the coupled port is used to get the sampled input power and the phase information is extracted from that sampled power.

The coupled line coupler discussed in this paper will be useful in broadband applications also as it covers 9:1 bandwidth with -2 dB variation over the 25 dB coupling and insertion loss lesser than 1 dB. Therefore calibration system using the coupled power gets almost flat coupling without additional loss which is a necessary requirement in system design.

As an extension of this work, the same coupler can be optimized to achieve more bandwidth and its performance when integrated with microwave circuits can be simulated and measured after realizing the actual circuit.

5. ACKNOWLEDGEMENTS

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MONITORING THE PRESENCE OF HEAVY METALS IN K.G.F SOIL RESIDUE FOR BIO-REMEDIATION

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ABSTRACT

K.G.F or Kolar gold fields is a mining town in Bangarpet taluk, in the Kolar district of Karnataka state, India. The town was known for gold mining over a century. It was closed in 2001 because of low production of gold and being uneconomical. Mining is one of the main sources of heavy metal pollution in the environment. It is a well-known fact that because of mining, there will be contamination of soil thereby creating environmental hazard. Some heavy metals both in soil as well as water have been found in the samples. Heavy metals may lead to serious health effects including reduced growth and development, cancer, organ damage and in extreme cases can also be fatal. Hence remediation is necessary for the removal of heavy metals from soils

This paper is about monitoring the presence of heavy metal in K.G.F soil residue for bio-remediation. The main objective of this paper is to evaluate the quantum of heavy metals and suggest remedial measures to remove the same. There are many methods for removal of heavy metals from contaminated soil. In this paper Bio-remediation method which is an inexpensive, safe, environment friendly technology and harmless end products has been presented.

***Keywords*:** Kolar Gold Field (KGF), Bio- Remediation, Indigenous Bacteria, Cow Dung, Pseudomonas Aeruginosa.

1. INTRODUCTION

Soil contamination is the presence of man-made chemicals or other alterations to the natural soil environment. This type of contamination typically arises due to rupture of underground storage tanks, application of pesticides and herbicides, percolation of contaminated surface water to subsurface strata, leaching of wastes from landfills or direct discharge of industrial wastes to the soil (Bahi Jalili Seh-Bardan, et.al. 2012).

Soil contamination or soil pollution is caused by the presence of xeno-biotic (man-made) chemicals or other alteration in the natural soil environment. It is typically caused due to industrial activity, agricultural chemicals, or improper disposal of waste (Hadis Ghodsi, et.al. 2011). The most common chemicals involved are petroleum hydrocarbons, poly-nuclear aromatic hydrocarbons such as naphthalene and solvents, pesticides, lead, and other heavy metals (Muhammad Iqbal, et.al. 2007). Contamination is correlated with the degree of industrialization and intensity of its chemical usage. (B. Dhal, H.N. Thatoi, et.al. 2013).

The concern over soil contamination stems primarily from health risks, from direct contact with the contaminated soil, vapors from the contaminants and from secondary contamination of water supplies within and underlying the soil. Mapping of contaminated soil sites and the resulting cleanup are time consuming and expensive tasks. It involves technical skills in geology, hydrology, chemistry, computer modeling and GIS (J. Jeya Singh and Ligy Philip 2005).

2. STATEMENT OF THE PROBLEM

K.G.F or Kolar Gold Fields is a mining town in Bangarpet Taluk, in the Kolar District of Karnataka state, India. KGF is about 30 kilometers from Kolar and 100 kilometers from Bangalore, Karnataka, India. To the east of KGF is a ridge of hills - DodBetta hill, 3195 feet above sea level. The town was known for gold mining for over a century, which was eventually closed in 2001 due to uneconomical and low level of gold production. Fig 1 depicts the location map of study area.

Presently, the resources remaining under the ground are only about 3 million tons of gold ore. Due to reduced percentage of gold in the ore, mining of gold ore has been eventually stopped. Mining of gold ore is followed by the use of many heavy metals to assist mining and procure pure form of gold for the production of ornaments. The main cause of soil contamination in KGF is thus by the use of heavy metals in the process of mining.

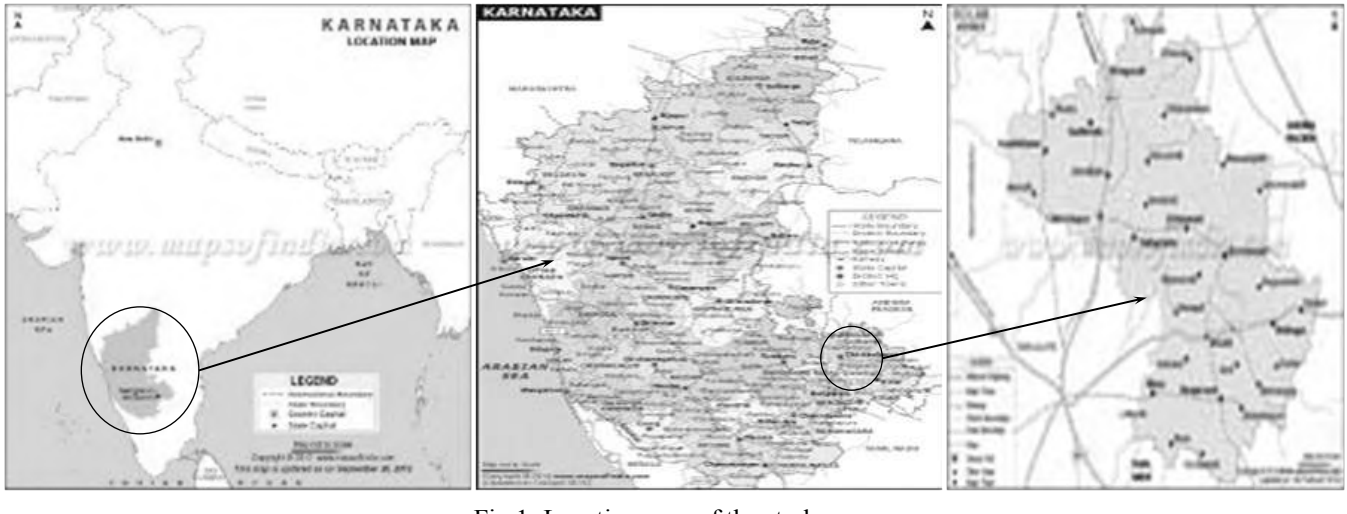

Fig 1: Location map of the study area

Soil contamination in the long run is the result of groundwater contamination due to rain water infiltration (Rajesh Singh, et.al.2013). Heavy metal has several ill effects on the health of plants, animals and human life (Purnima Khanna, et.al.2011).

Thus, it becomes necessary to analyze the extent of contamination and to propose suitable remedial measures to improve the quality of both soil and groundwater and reduce the extent of contamination.

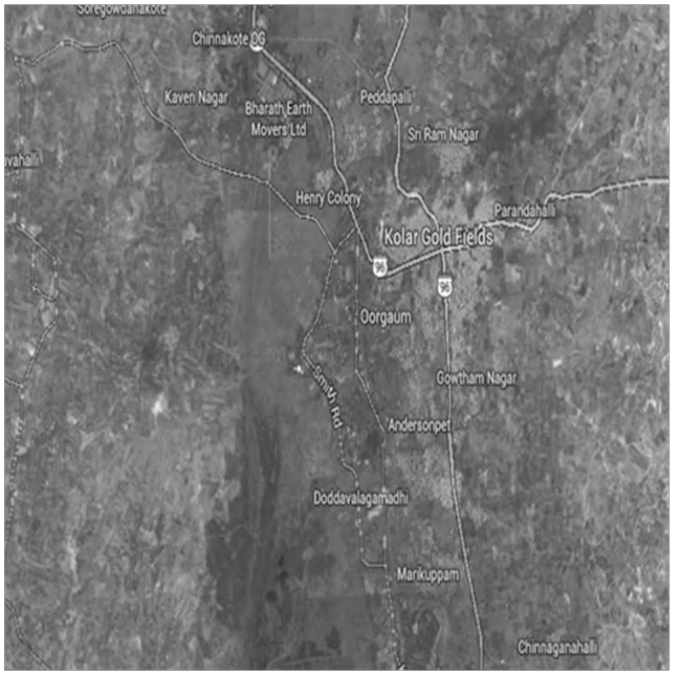

Fig 2: GIS map of KGF

Fig 3: Gold Mining Field

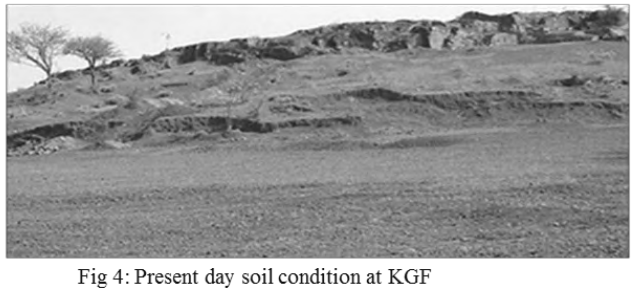

Fig 4: Present day soil condition at KGF

3. SOCIO ECONOMIC BACKGROUND OF THE STUDY AREA

The tradition of mining gold at Kolar started at least as early as the first millennium BC with linkages to the Indus Valley civilization. Golden objects found in Harappa and Mohenjo-Daro have been traced to KGF through an impurities-analysis assay, as the impurities include 11% silver concentration, found only in KGF ore. The Champion reef at the Kolar gold fields was mined to a depth of 50 meters during the Gupta period in the fifth century A.D.

Supreme Court approved the central government's plan to float global tenders to revive the gold mines, 12 years after they were closed down. Champion Reefs is one of the main mining areas in the Kolar Gold Fields. The area is situated near Andersonpet in Kolar District. The deepest mining shaft in Asia is found here. The Kolar Gold Fields is spread around 17 square kilometers and goes down to a depth of 17,000 feet. Presently, the mines have been closed. It is estimated that the total gold production in Karnataka to date is 1000 tons.

Three hundred thousand people lived in the Kolar gold fields when the mine was at its peak production, but since the closing of mines in 2003 the population has reduced to less than a hundred thousand. The older generations of KGF employees are staying on in the hope that the mines will be revived, but the younger generation is either moving away to urban areas. The population of KGF is cosmopolitan, including Kannada, Tamil, Telugu, Oriya, Hindi, Marwari, Urdu and Anglo Indian, Tamil being widely spoken language. KGF also has a population that is representative of the rest of Kolar district being primarily Kannada and Telugu speaking. Fig 2 shows the GIS map of KGF, Fig 3 shows the Gold mining field at KGF and Fig 4 shows the present day soil condition at KGF.

4. SITE SELECTION

4.1 Soil Sample KGF site is spread over an area of 58.12 km^2.Through Random sampling, 10 samples were collected by core cutter method.

4.2 Water Sample Existing bores in this study area largely define the potential sites for groundwater sampling.

Totally 6 bore well (BW) water samples were collected randomly, in and around the KGF mining area and residential areas.

5. EXPERIMENTAL SET UP

A set of three reactors per cycle were set up as shown in Figure 5. The soil sample is tested under three different bacterial medium viz, Indigenous Bacteria, Cow Dung and Pseudomonas Aerigunosa. Set up of reactors are done as mentioned below:

Materials required:

- Bottles -dia 250mm
- Coarse aggregate – 20 mm down size
- Soil particle size – 2 mm
- Nitrogen gas.

Reactor Setup:

- 250 mm diameter bottle is first filled with 20 mm down size coarse aggregate for a depth of 50–75 mm.
- Soil sample is filled for a depth of 250 mm in the bottle above the coarse aggregate, thus completing the setup of reactor.
- Bacteria are added to each of these bottle-reactors for observation.
- Anaerobic media is set by filling the remaining space by nitrogen pumping.
- Water passing from the reactor is collected at 24, 48, 72, 96 and 120 hours and sent for heavy metal analysis to laboratory to know the final percentage removal of heavy metals from the sample.

Fig 5: Reactor Setup

6. ANALYSIS AND RESULTS

To monitor the presence of heavy metals in KGF, preliminary investigation was carried out by collecting soil sample (SS) and bore well (BW) water sample in and around the study area. A total of ten soil samples and six bore well water samples were collected and analyzed in the laboratory. Table 1 depicts the soil samples results for various heavy metals; Table 2 and 3 depicts the bore well water sample results for various heavy metals. The analysis of soil and water showed the presence of heavy metals viz; Chromium (Cr), Copper (Cu), Nickle (Ni), Lead (Pb), Arsanic (Ar).

Based on the preliminary investigation results which showed the traces of heavy metals like Chromium (Cr), Copper (Cu), Nickle (Ni), Lead (Pb), Arsanic (Ar)., A reactor was set up (Fig 5) in a sophisticated laboratory condition for different bacterial medium (Indigenous Bacteria, Cow Dung and Pseudomonas Aerigunosa) and the analysis was carried out upto 120 Hrs to check the efficiency of heavy metals removal by different bacterial medium. At the end of 120 Hrs 21.6% of Cr, 23.6% of Cu, 22.8% of Ni, 20.3% of Pb, 28.9% of Ar were removed using Indigenous Bacteria Medium, 40.2% of Cr, 36.9% of Cu, 34.6% of Ni, 35.6% of Pb, 37.7% of Ar were removed using Cow dung, 43.9% of Cr, 42.2% of Cu, 41.6% of Ni, 43.6% of Pb, 41.7% of Ar were removed using pseudomonas aerugonasa, the results Comparison of Heavy

metals removal (%) by three Bacteria Medium is as shown in table 4. Fig 6 shows the Comparison of Heavy metals removal (%) by Three Bacteria Medium at the end of 5 days.

Table 1: Results of heavy metals analysis conducted for soil sample

SAMPLE DETAILS	SOIL SAMPLE ANALYSIS								
	pH	Zn (mg/kg)	Fe (mg/kg)	Cu (mg/kg)	Mn (mg/kg)	Cr(ppm)	Ar (mg/kg)	Cn (mg/kg)	Ni (mg/kg)
SS1	8.24	1.435	8.156	1.734	0.109	No traces	4826	No traces	1.8
SS2	8.14	1.368	9.652	2.123	0.203	No traces	4367	No traces	1.876
SS3	8.02	1.283	8.029	1.903	1.364	No traces	3876	No traces	1.86
SS4	4.01	2.044	23.52	11.11	2.637	0.045	5396	No traces	1.1
SS5	3.39	0.685	11.5	2.583	14.1	No traces	3826	No traces	1.87
SS6	3.68	0.28	23.76	2.141	2.632	No traces	3987	No traces	1.9
SS7	6.02	1.185	9.075	2.828	1.617	0.158	4286	No traces	1.213
SS8	6.15	0.902	22.5	1.19	4.228	No traces	2146	No traces	1.73
SS9	6.2	1.04	19.37	1.12	3.944	No traces	2010	No traces	1.692
SS10	6.1	0.904	20.38	1.019	4.323	No traces	2190	No traces	1.772

SS1-Tailing dump adjacent to grave yard (top), SS2-Tailing dump adjacent to grave yard (middle), SS3-Tailing dump adjacent to grave yard (bottom), SS4-Near factory (Near K.G.F mines),SS5-Top of the cyanide mountain SS6-Middle of the cyanide mountain , SS7-Bottom of the cyanide mountain , SS8-Near PWD, SS9-BEML, SS10-Residential area.

Table 2: Results of heavy metals analysis conducted for water sample

S. No.	Sample name	1	2	3	4	5	6	7	8	9	10	11	12
Constituents		Ca	Mg	Na	K	Fe	H	CO_3	CI	F	NO_3	SO_4	TDS
		Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
Permissible limit		200	100	-	-	1	-	-	1000	1.5	50	400	2000
1	Bw1	624	100	200	28.2	4.48	1286	Nil	280	0.24	3.2	949	2860
2	Bw2	632	80	201	31.2	1.44	1312	Nil	280	0.22	3.62	885	2810
3	Bw3	504	185	233	35.7	1.92	937	Nil	302	0.21	4.53	1322	3100
4	Bw4	269	124	126	3.02	0.61	265	Nil	476	0.17	306	310	1780
5	Bw5	206	42	122	11.4	0.43	288	Nil	176	0.11	30.4	448	1220
6	Bw6	104	50	46	2.45	0.07	196	Nil	62	0.21	11.4	299	710

Table 3: Results of heavy metals analysis conducted for water sample

Sl No	Sample name	13	14	15	16	17	18	19	20	21	22	23
Constituents		SC	TH	pH	Cr	Pb	Cu	Zn	Ar	Mn	Cd	CN
		Uh mos /cm	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/ L	Mg/ L	Mg/L	Mg/L
Permissible limit			600	6.5-8.5	0.05	0.05	1.5	15	0.01	0.3	0.01	0.05
1	Bw1	4875	1960	7.12	0.07	0.12	0.05	1.68	6.2	1.44	Nil	Nil
2	Bw2	4780	1900	7.24	Nil	0.07	0.02	0.93	5.82	1.17	Nil	Nil
3	Bw3	5140	2000	7.61	0.11	Nil	0.02	0.27	6.22	1.12	Nil	Nil
4	Bw4	2915	1168	7.43	Nil	0..06	0.01	0.43	0.011	0.02	Nil	Nil
5	Bw5	1930	684	7.35	Nil	0.01	0.01	0.61	0.46	0.07	Nil	Nil
6	Bw6	1130	460	8.06	0.1	Nil	Nil	0.42	0.012	0.01	0.03	Nil

Table 4: Comparison of Heavy metals removal (%) by three Bacteria Medium.

Parameter	Bacteria medium	24 hours	48 hours	72 hours	96 hours	120 hours	% removal
Cr	Indigenous Bacteria	100.0	98.9	91.4	80.4	78.4	**21.6**
	Cow dung	95.0	81.0	78.0	70.0	59.8	**40.2**
	Pseudomonas Aerugonasa	94.1	82.1	76.6	69.8	56.1	**43.9**
Cu	Indigenous Bacteria	99.8	94.8	89.5	86.3	76.4	**23.6**
	Cow dung	93.0	82.0	79.0	71.0	63.1	**36.9**
	Pseudomonas Aerugonasa	92.7	86.4	72.9	65.9	57.8	**42.2**
Ni	Indigenous Bacteria	100.0	97.2	89.0	82.4	77.2	**22.8**
	Cow dung	96.0	84.0	77.0	70.0	65.4	**34.6**
	Pseudomonas Aerugonasa	93.4	87.2	77.4	69.3	58.4	**41.6**
Pb	Indigenous Bacteria	100.0	96.4	89.8	83.9	79.7	**20.3**
	Cow dung	93.0	81.0	76.0	70.0	64.4	**35.6**
	Pseudomonas Aerugonasa	95.6	83.4	74.8	67.8	56.4	**43.6**
Ar	Indigenous Bacteria	100.0	97.3	89.4	86.9	71.1	**28.9**
	Cow dung	94.0	80.0	74.0	69.0	62.3	**37.7**
	Pseudomonas Aerugonasa	96.1	82.9	77.9	69.1	58.3	**41.7**

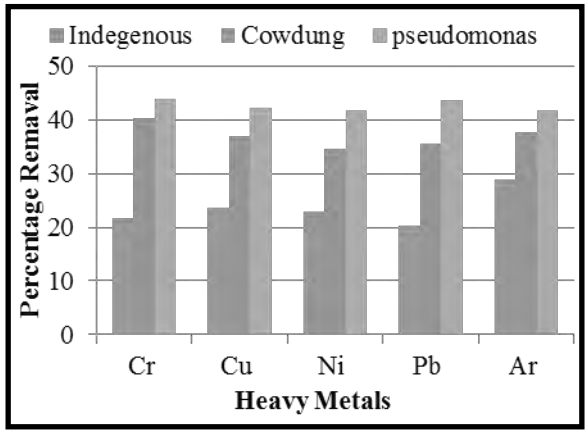

Fig 6: Graph Showing Comparison of Heavy metals removal (%) by Three Bacteria Medium.

7. CONCLUSION

- Preliminary investigation, to monitor the presence of heavy metals in a selected location area showed the presence of heavy metals viz; Chromium (Cr), Copper (Cu), Nickle (Ni), Lead (Pb), Arsanic (Ar).
- Bioremediation using Pseudomonas Aeruginosa, cow dung can be successfully used for the removal of heavy metals which gives corresponding efficiencies of 44% and 40% at the end of 120 hours.
- Bioremediation is a viable, environmental friendly technology for cleaning up the heavy metals contaminated sites like KGF.
- From the above results it can be concluded that Pseudomonas Aeruginosa is more successful in removing heavy metals than cow dung and indigenous bacteria. In addition, post implementation of bioremediation, the area can be utilized for plantation having tap root system, which in turn can further improve the quality of soil by root action.

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A COMPREHENSIVE STUDY ON EXISTING SOLID WASTE MANAGEMENT IN MYSURU CITY

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ABSTRACT

Solid waste management is one of the basic essential services provided by municipal authorities in the country to keep urban centers clean. Solid Waste management practices are not uniform among countries (developed and developing nation), regions (urban and rural) and sectors (residential and industrial). The management of solid waste typically involves its collection, transport, processing and recycling or disposal.

The present study is taken to understand the updated technologies adopted by Mysuru City Corporation to minimize the harmful effects of Municipal solid waste.

A detailed investigation is made regarding the methods and practices associated with sources, quantity generated, collection, transportation, storage, treatment and disposal of Municipal solid waste in Mysuru city.

The data concerning to Solid waste management in Mysuru was obtained through questionnaire, individual field visit, interaction with people and referring to available records of municipal corporation. Photographic evidences were also made about generation, storage, collection, transportation, treatment and disposal of Municipal Solid Waste.

Keywords: *Solid Waste Management (SWM) Municipal solid waste (MSW), Mysuru city cooperation (MCC), composting, Zero waste management (ZWM).*

1. INTRODUCTION

The rising pressure of Population, together with the constantly changing technologies, and development perspectives, contribute to the ever increasing volumes of wastes in different forms (K.S. Ashalakshmi, et.al. 2010).

Human activities create waste, and the ways this waste is handled, stored, collected and disposed off can pose risks to the environment and to the public health. Solid waste management (SWM) includes all activities that seek to minimize health, environment and aesthetic impacts of solid waste. (Lateef Ahmad.et.al., 2015).

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 was never 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).

1.1 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, 38,386and it is spread over an area of 128.42 km2.MysuruCity Corporation is responsible for the civic administration of the city, which is also the headquarters of the Mysuru district and the Mysuru division.

Table 1.1: 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	MT/day
Latitude & Longitude	12^o 18’ 12” N, 76^o 38’ 45” E

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 1.1

2. SOURCES OF WASTE GENERATION

Solid waste can be classified into different types depending on their source:

a) Household waste is generally classified as municipal waste, such as household waste, construction and demolition debris, sanitation residue, and waste from streets, residential and commercial complex. (Arvind Kumar.et.al., 2013).

b) Industrial waste as hazardous waste: such as tin, aluminum, highly inflammable or explosive, metals, chemicals, paper, pesticide, dye, refining and rubber goods etc. (Arvind Kumar.et.al., 2013)

c) Biomedical waste or hospital waste as infectious waste such as: formaldehyde, phenols, disinfectants, mercury (used in thermometers or other equipment) sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical waste etc. (Arvind Kumar.et.al., 2013)

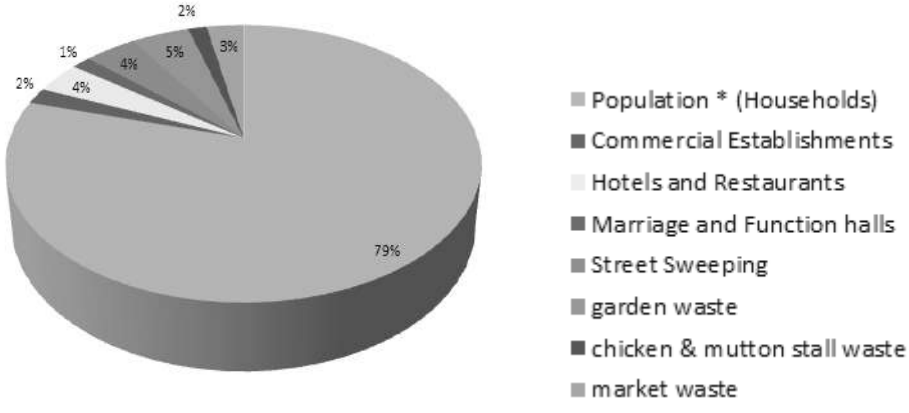

Fig 2.1: Source of waste

Major source of waste is generated form population (house hold) which is 79%, remaining 21% is generated from commercial establishments, hotels and restaurants, marriage and function halls, street sweeping , garden waste, chicken and mutton stall waste and market waste. The exact classification of generation of waste is been represented in Fig 2.1.

3. COLLECTION OF WASTE

a) Primary collection

i) Door todoor collection system Door to door collection system is implemented in all 65 Wards as shown in Fig 2, in which 62 wards are handled by 620 Outsourced labours, and 3 wards are handled by federation of Mysuru City Wards Parliament by engaging 30 workers. A total of168 auto tippers and 396 pushcarts deployed for the waste collection. The chicken and mutton market wastes are being collected separately by 5 Auto tippers and one canter. More than 1, 50,000colour coded bins are distributed to the slum and BPL families to encourage segregation at household level.

Fig 3.1: Door to door colletion of household waste.

ii) Street sweeping activity Seventeen (17) wards are being handled by MCC which includes 652 Pourakarmikas, 1 wardis handled by federation of Mysuru City Wards Parliament by 22 workers (Ward-28 kumbarkoppal) and 47 wards are handled by 973 outsourced labors. The Street and drain cleaning activity during day time from 6.30 A.M to 2.30 P.M. The Truck mounted street sweeping machine is being used for night sweeping of core area main roads.As per New tender additional 1021 workers are required for cleaning activities.

iii) Secondary collection and transportation In all 65 wards, 255 No's of single compartment containers (Fig 3.2.a) and 130 No's of 4 compartment of 4.5 cubic meter containers (Fig 3.2.d)are placed. In all 65 wards, for collection of bulk waste from markets/choultry/Hotel etc., 66 No's of 4.5 cubic meter Skip Containers (Fig 3.2.b) are placed. For transportation of secondary collected wastes, 20 No's of Dumper placers and 2 No's of Compactors are used. For transportation of street sweeping waste and silt waste, 55 No's of Tipper Lorries(Both MCC and Contractors vehicles) are used. All SWM vehicles in MCC are monitored through GPS system.

Fig 3.2(a) compartment Fig 3.2(b) Skip

Container **Container**

Fig3.2(c)Dumper placer Fig3.2(d)4.5 cubic meter container

4. SEGREGATION AND TREATMENT

Waste segregation means dividing waste into dry and wet. Dry waste includes wood and related products, metal, plastics, and glass. Wet waste, typically refers to organic waste usually generated by eating establishment and are heavy in weight due to dampness. Waste can also be segregated on basis of biodegradable or non-biodegradable waste (Niyaz Ahmad Khan.et.al., 2014).

In MCC, Micro plan for segregation is adopted. Out of 65 wards, segregation is initiated in 18 wards as 1st stage implementation, another 18 wards is under process for 2nd stage and remaining 29 wards is yet to be plannedfor 3rdstage as shown in Fig 4.1. The ward wise micro-segregation of the selected area represented on Google map is shown in Fig 4.2(a) &4.2 (b). Further, a pictorial representation of segregation and screening is shown in Fig 4.2 (c) & 4.2 (d).

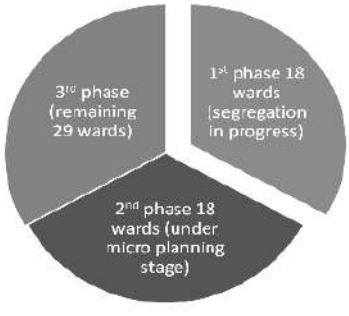

Fig 4.1 Segregation at source in phased manner

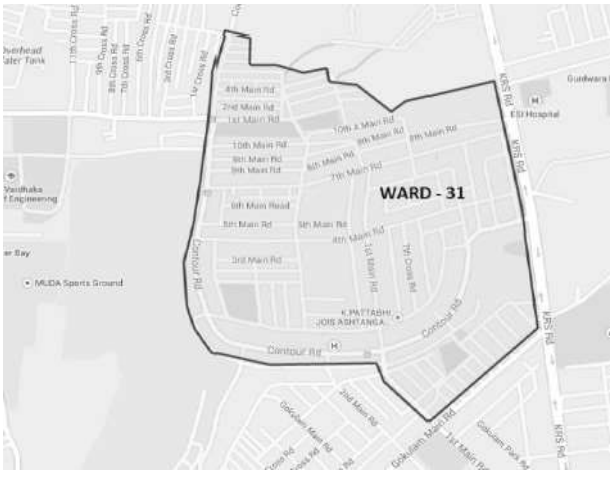

Fig 4.2(a)ward wise micro segregation

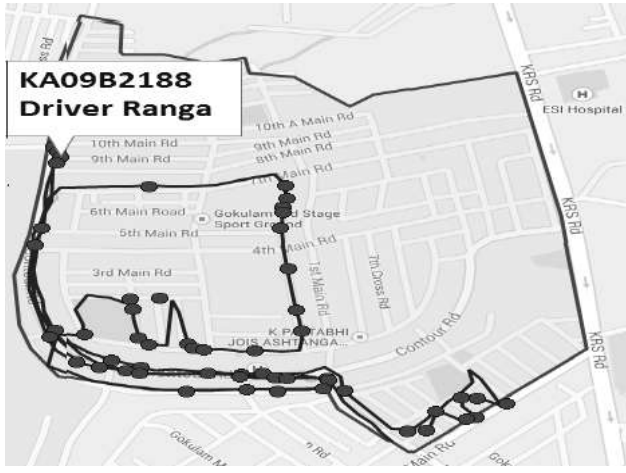

Fig 4.2(b)ward wise micro segregation

Fig4.2(c) Segregation

Fig4.2(d) Screening & shredding of waste

Treatment of dry waste It is essential to save the recyclable waste material from going to the waste processing and disposal sites and using up landfill space (Samuel Twumasi Amoah.et.al., 2014). Recycling is a resource recovery practice that refers to the collection and refuse of waste materials . The materials from whichthe items are made can be reprocessed into new products. Material for recycling may be collected separetely and efficiently using a concept called as **"** ZERO WASTE MANAGEMENT".

5. ZERO WASTE MANAGEMENT

Zero waste management is a philosophy that encourages the redesign of resource life cycles so that all products are reused. ZWM should be taken in the direction that it becomes ethical, economical and a guide to people in changing their lifestyles and practices to emulate substainable natural cycles, so that all discarded materials are designed to become a resource for others to use. Implementing zero waste management will eleminate all discharges to land, water or air that are threat to planetary, human, animal or plant health.

Table 5.1: Details of zero waste management units

Zone no	Location of ZWM	DETAILS OF SHG'S MAINTAINING THE ZWM UNIT'S
1	Vidhyaranyapuram	ShriLaxmiSwaSahayaSangha (R), Mysuru.
2	Jayanagara	Solid and Liquid Waste Management Sangha(R), Mysuru.
3	Mysuru University	Mysuru University
4	Gokulam	GokulamBurrial Ground
5	Kumbarakoppalu	Fedaration of Mysuru City Ward Parliament (R), Kumbarakoppalu, Mysuru
6	Jodi tengina Mara Burrial Ground	Jai BharathiSamrudhiSamsthe,Mysuru
7	Jodi tengina Mara Burrial Ground	Sri JayashriNagara and GraminaKshemabbhivruddhiSamsthe, Mysuru.
8	Old Kesare	Page Trust India,Mysuru

Zero waste management is classified into nine zones described as below:

ZONE 1

Zone 1 comprises of 6 wards(Ward No.1, 2, 3, 4, 5, 6).Fig 5.1 shows the plant location of zone 1 and approximate waste generation of all 6 zones is mentioned in table 5.2.ZWM unit is maintained by, ShriLaxmi SHG's (R), Mysuru.At present segregation is done in 2 wards (Ward No's 2, 4).

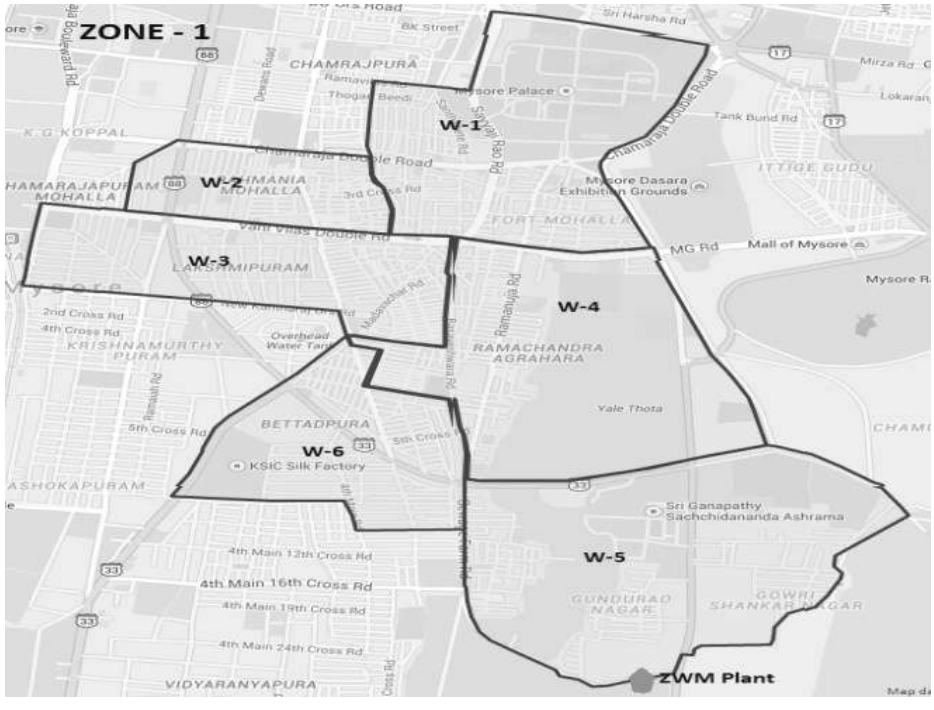

Fig 5.1 ZWM plant location in zone 1

Table 5.2:Daily waste collection in zone 1

Ward No's	Quantity of Wet waste received in Kg	Quantity of Dry waste received in Kg	Total Quantity of Waste in Kg
1	945	405	1350
2	630	270	900
3	840	360	1200
4	840	260	1200
5	560	240	800
6	840	260	1200
Total	4655	1995	6650

ZONE 2

Zone 2 comprises of 8 wards (Ward No's 7, 8, 9, 10, 11, 12, 13, and 14) Fig 5.2 shows the plant location of zone 2. At present Source segregation is done in 2 wards (Ward No.11 & 12) mentioned in table 5.3. ZWM unit is maintained by, Solid and Liquid Waste Management Sangha(R), Mysuru.

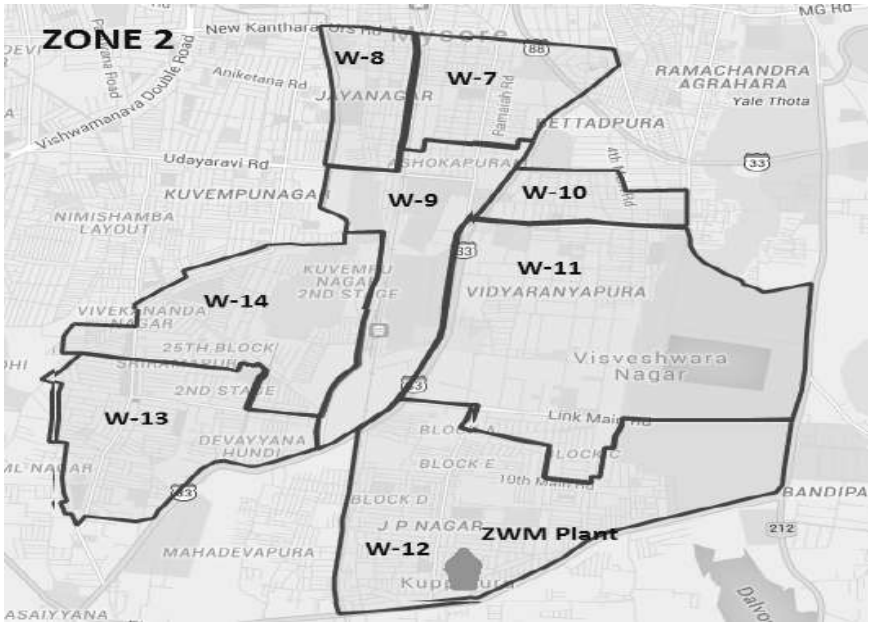

Fig5.2 ZWM plant location in zone 2

Table5.3: Daily waste collection in zone 2

Ward Nos	Quantity of Wet waste received in Kg	Quantity of Dry waste received in Kg	Total Quantity Of Waste in Kg
12	3600	400	4000
11	1200	200	1400
Total	4800	600	5400

ZONE 3

Zone 3 comprise of 9 wards (ward No's 15, 16, 17, 18, 19, 20, 21, 22, 24) Fig 5.3 shows the plant location of zone 3. At present ZWM unit at zone 3 is maintained by University of Mysuru wherein dry leaves compost is being done at ZWM plant as shown in Fig 5.4.

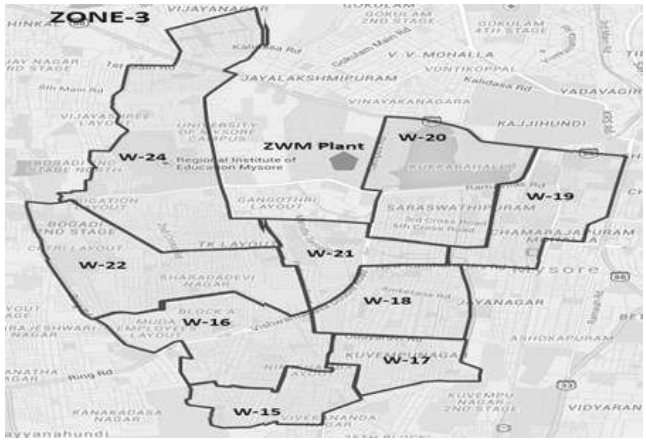

Fig 5.3: ZWM plant location Zone 3

Fig 5.4 : Dry leaves composting

ZONE 4

The total Number of Wards included in zone 4 are 5 (wards no's 23, 30, 31, 32, 33)Fig 5.5 shows the plant location of zone 4 and at present segregation is done in 2 wards (Ward No 30, 31) mentioned in table 5.4. Waste is transported to ZWM unit in Zone 5 which is maintained by, Federation of Mysuru City Ward Parliament (R), Kumbarakoppalu, Mysuru

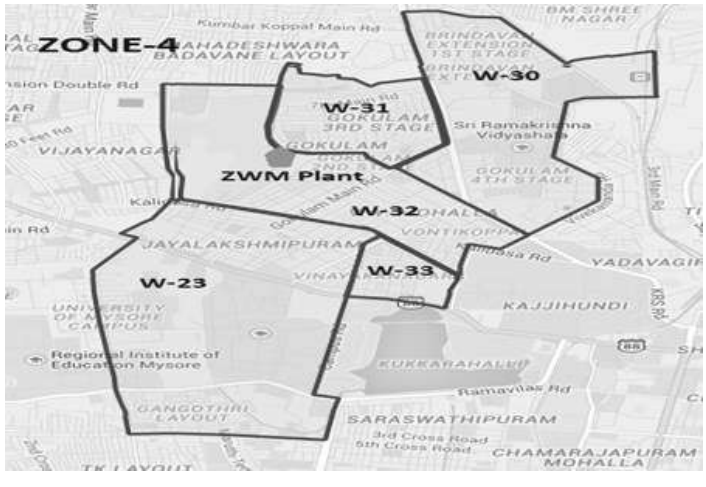

Fig 5.5: ZWM plant location in zone 4

Table5.4:Daily waste collection in zone 4

Ward Nos	Quantity of Wet waste received in Kg	Quantity of Dry waste received in Kg	Total Quantity Of Waste in Kg
30	1782	18	1800
Total	1782	18	1800

ZONE 5

The total Number of Wards included in zone 5 are 5 (wards no's 25, 26, 27, 28, 29) Fig 5.6 shows the plant location of zone 5. ZWM unit is maintained by, Fedaration of Mysuru City Ward Parliament (R), Kumbarakoppalu, Mysuru. At present segregation is done in 3 wards (Ward No's 26, 28, 29) mentioned in table 5.5.

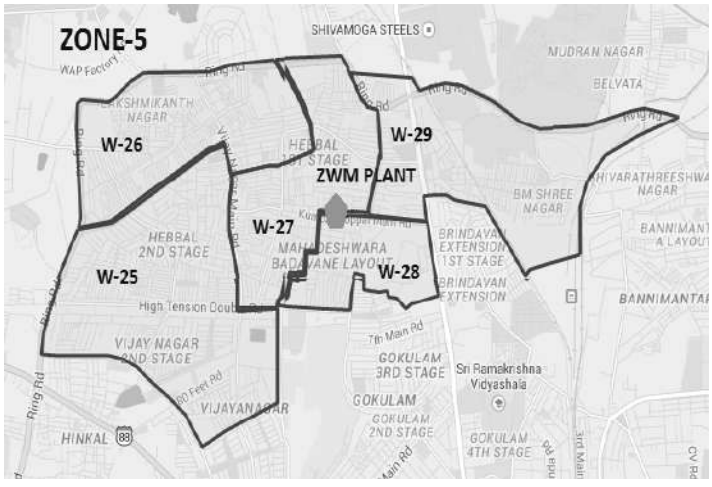

Fig 5.6: ZWM plant location in zone 5

Table5.5 :Daily waste collection in zone 5

Ward Nos	Quantity of Wet waste received in Kg	Quantity of Dry waste received in Kg	Total Quantity Of Waste in Kg
26	788	12	800
28	2673	27	2700
29	1782	18	1800
Total	5243	57	5300

ZONE 6

The total Number of Wards included in zone 6 are 5 (ward no's 34, 35, 36, 37, 38)Fig 5.7 shows the plant location of zone 6. ZWM unit is maintained by, Jai Bharathi Samrudhi Samsthe, Mysuru. At present Source segregation is done in 2 wards (Ward no'34, 36)mentioned in table 5.6.

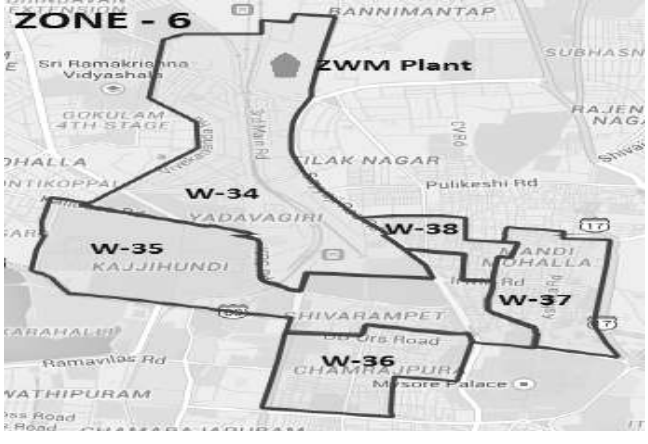

Fig5.7: ZWM plant location in zone 6

Table 5.6 :Daily waste collection in zone 6

Ward Nos	Quantity of Wet waste received in Kg	Quantity of Dry waste received in Kg	Total Quantity Of Waste in Kg
34	864	371	1235
36	626	269	895
37	630	270	900
35	280	120	400
Total	2400	1030	3430

ZONE 7

The total Number of Wards included in zone 7 are 8 (ward no's 39, 40, 41, 42, 43, 44, 45, 64) Fig 5.8 shows the plant location of zone 7. ZWM unit maintained by, Sri Jayashri Nagara and Gramina Kshemabbhivruddhi Samsthe, Mysuru. At present segregation is done in 3 wards (Ward No's 43, 44, 45)mentioned in table 5.6.

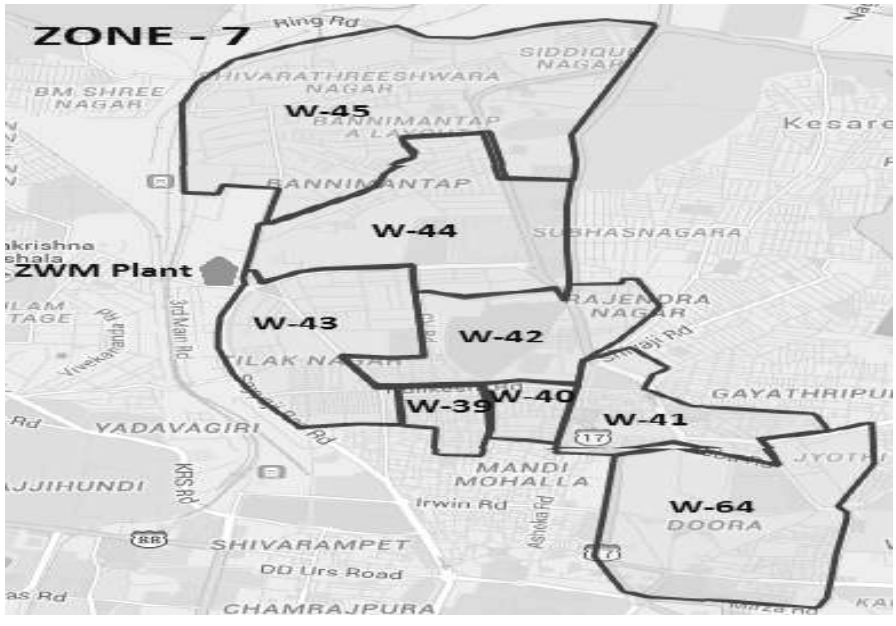

Fig 5.8: ZWM plant location in zone 7

Table5.7:Daily waste collection in zone 7

Ward Nos	Quantity of Wet waste received in Kg	Quantity of Dry waste received in Kg	Total Quantity Of Waste in Kg
43	1728	432	2160
44	1152	288	1440
45	1504	376	1880
Total	4384	1096	3480-

ZONE 8

The total Number of Wards included in zone 8 are 9(ward no's 46,47,48,49,50,51,52,53,54).Fig 5.9 shows the plant location of zone8. ZWM unit maintained by, Page Trust India, Mysuru.

At present Source segregation is done in 2 wards (Ward No's 47,52) mentioned in table 5.8.

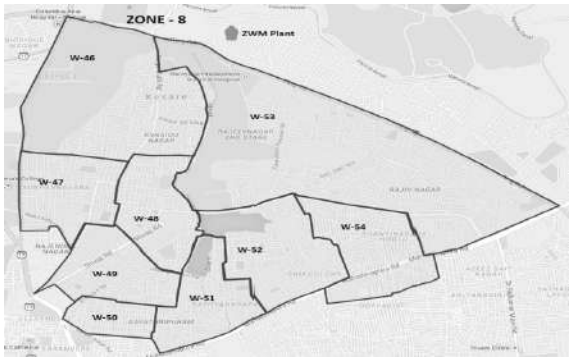

Fig 5.9: ZWM plant location in zone 8

Table 5.8 : Daily waste collection in zone 8

Ward Nos	Quantity of Wet waste received in Kg	Quantity of Dry waste received in Kg	Total Quantity Of Waste in Kg
47	592	254	846
52	577	247	824
Total	1169	501	1670

ZONE 9

The total Number of Wards included in zone 9 are 10 (ward no's55,56,57,58,59,60,61,62,63,65).Fig 5.10 shows the plant location of zone9.ZWM unit maintained by, Page Trust India, Mysuru.At present segregation is done in 2 wards (Ward No's 55, 63) mentioned in table 5.9.

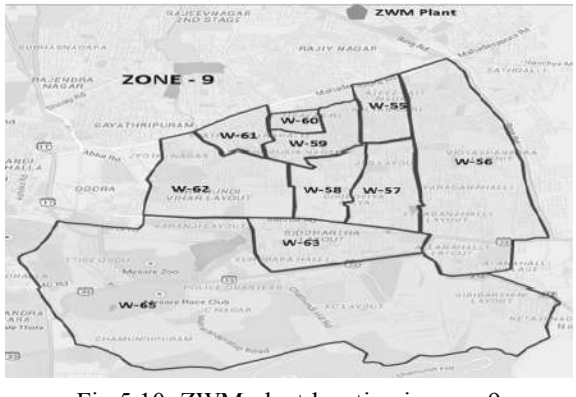

Fig 5.10: ZWM plant location in zone 9

Table 5.9 : Daily waste collection in zone 9

Ward Nos	Quantity of Wet waste received in Kg	Quantity of Dry waste received in Kg	Total Quantity Of Waste in Kg
55	6956	2981	9937
63	4804	2059	6863
Total	11760	5040	16800

(b) Treatment of wet waste

Recoverable materials that are organic in nature, such as plant material, food scraps, and paper products, can be recoverd through composting and reject output can be sent to landfill.

COMPOSTING

Composting is a digestion process to decompose the organic matter .The resulting organic material is then recycled as mulch or compost for agriculture or landscaping purposes. In addtion, waste gas from the process (such as methane) can be captured and used for generating electricty and heat (CHP/ cogeneration) maximising efficienices. In Mysuru, 200 ton capacity compost plant located near Vidyaranyapuram (Fig 5.11) was established in 2001 under ADB project & is outsourced to M/s IL & FS Company for O & M on PPP Basis. The composting plant Produce 30 – 35 MTPD of manure (Yadav I. C. et.al. 2000). The step by step process of composting which includes screening, windrows and organic manure formed is as shown in Fig 5.12, 5.13 and 5.14 respectively. The mass flow diagram of composing process is as shown in Fig 5.15.

Fig 5.11 : Composting plant in

Fig 5.12: Screening Process Vidyaranyapuram

Fig 5.13: Windrows

Fig 5.14 : Organic manure

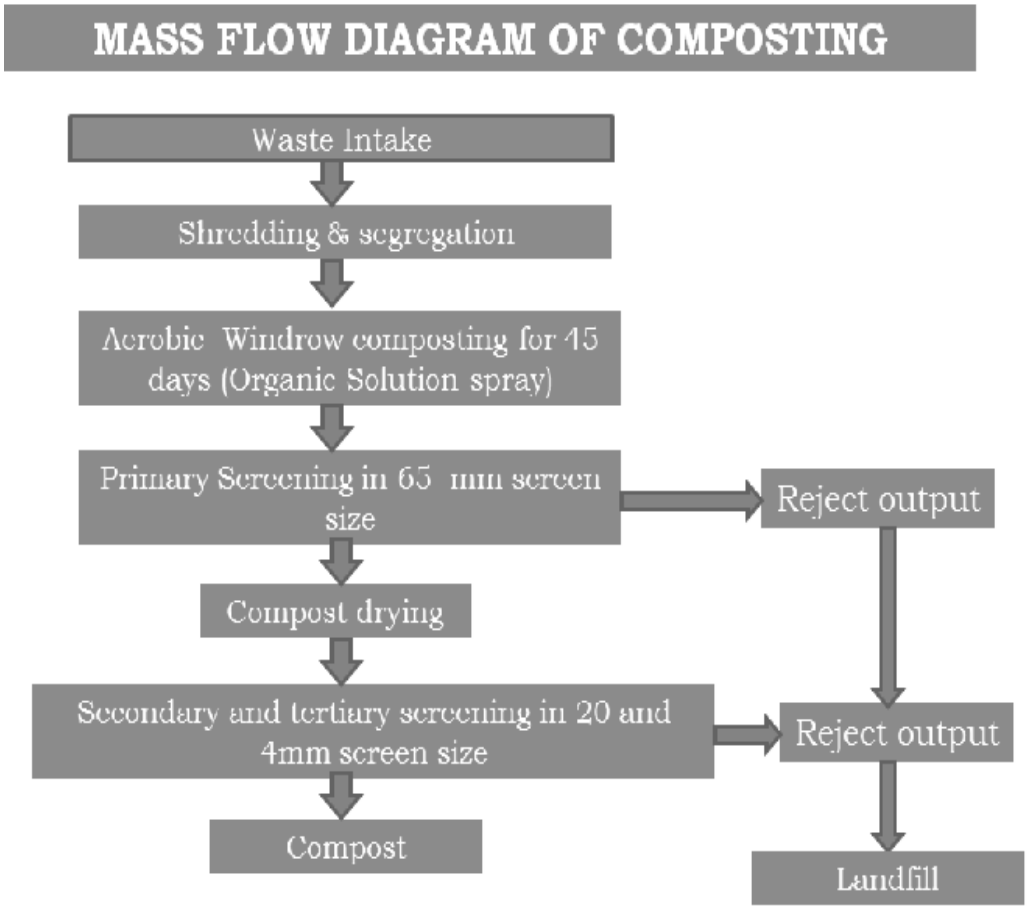

Fig 5.15 : Mass flow diagram of composting

LANDFILL

A landfill site is a site for the disposal of waste materials by burial and is the oldest form of waste treatment. Some landfills are also used for waste management purpose, such as the temporary storage, consolidation and transfer, or processing of waste materials. Poorly managed landfills have the potential of causing a number of issues. Infrastructure disruption, pollution of local environment (Gaurav K. Singh, et.al., 2014). Methane is naturally generated by decaying organic wastes in a landfill. It is a potent greenhouse gas, and can itself be a danger because it is flammable and potentially explosive. Landfill may become nuisances because of vectors such as rats and flies which can cause infectious diseases (Sunil Kumar.et.al., 2008).To overcome all the disadvantage of landfill, Mysuru MCC have implemented Geosynthetic clay layer and HDPE liner (Fig 5.16 and 5.17).

Fig 5.16: Geosynthetic clay layer & 1.5mm HDPE sheets above GCL

Fig 5.17:Laying of drainage layer above HDPE sheets

6. CONCLUSION

The herigate city Mysuru having been rightly awarded as the cleanest city, has adopted an effective solid waste management system which includes proper collection, segregation, transportation and diposal of waste.

Global positioning system (GPS) technique has succesfully helped in tracking a transportation vehicle from its point of collection to the diposal ranging about 65 wards. The technology effeciently tracks the transportion of all vehicles.

Zero waste management is an innovative method involving recycling and reuse of waste. This has been effectively implimented in Mysuru city.

Composting unit of 200TPD is a old unit established in 2001, which needs to be expanded keeping the future growth of the city.

An effective landfill treatment laying a HDPE layer which controls the leachet movement to ground water table has been adopted. This makes the Mysuru city different from other cities where an effort is made to maintain a good landfill system.

Though, the city has been rightly applauded from several agencies, the beneficiaries must instill the thought of green culture in their way of living to make this place a better and healthier community.

Credit must be given to the Mysuru City Coorporation for an effective solid watse management practice in Mysuru.

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USING GA TO PREDICT THE COMPRESSIVE STRENGTH OF CONCRETE CONTAINING NANO-SILICA

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ABSTRACT

Nanotechnology creates new possibilities to improve material properties for civil construction and also improve the quality of construction. Finding of this work is the optimized value of various materials used in making concrete containing nano-silica so as to optimize the 28-days compressive strength. To solve this problem, the Genetic Algorithm (GA) based optimization model is applied. The data has been taken from various literatures [1-16] and is modeled by using multiple regression technique, based on least square curve fitting. After function approximation, GA is applied to optimize the strength.

Keywords: *Genetic Algorithm, Nano-silica, Concrete, Compressive strength, partial replacement.*

1. INTRODUCTION

Concrete is said to be one of the oldest and the most useful materials in the construction industry which is a mixture of paste and aggregates. Production of concrete is a complex process that involves the effect of several processing criterion on the quality control of concrete pertaining to workability, strength, durability, etc. These parameters are all effective in producing a single strength quantity of compressive strength. Nanotechnology creates new possibilities to improve material properties for civil construction. Attracting civil engineers to adopt nanotechnology could empower them to provide pioneering solution to the tangled problems of construction today. It is well known that materials such as concrete; are the core elements of construction industry and these materials could be developed by using nanotechnology. Nano-silica is a highly productive pozzolanic material and normally, it consists of very fine vitreous particles approximately 1000 times smaller than the average cement particles. It has proven to be an eminent admixture for cement to improve strength and durability and decrease permeability [1]. A wide spread of concrete materials in structural engineering in recent decades has led to many different optimization problems improving the design and overall performance of concrete. This could enhance the application of concrete in various practices thereby reducing the amount of hazardous material and improving the use in construction.

The present study was envisaged to develop a relation between various input parameters and an output parameter i.e. 28 days compressive strength, using Genetic Algorithm (GA) technique. The objective was to study the application of GA for predicting the 28-day compressive strength of concrete containing nano-silica which is partial replacement of cement, with data obtained from various literatures. Over the last two decades, different data mining methods such as the fuzzy logic, genetic algorithm and artificial neural network, have become popular and have been used by many researchers

1`for a variety of engineering applications. Over the years, the ability to reason has been developed on the basis of evidence available to achieve the required goals. To deal with the problem of uncertainty, the theory of probability had been established and successfully applied to many areas of engineering and technology [2-5].

The purpose of this article is to provide a methodology for predicting the strength of concrete where the partial replacement of cement is done with nano-silica which uses the features of genetic algorithm and it is presented as an improved approach.

2. GENETIC ALGORITHM (GA)

Data mining has as goal to extract knowledge from large databases. Genetic algorithm (GA) is an adaptive heuristic search algorithm premised on the evolutionary ideas of natural selection and genetic. The basic concept of GA is designed to stimulate processes in natural system necessary for evolution, especially those that follow the principles first laid down by Charles Darwin of survival of fittest. As such, they represent an intelligent exploration of a random explore within a defined search space to solve the problem. GA is a method of "breeding" computer programs and solutions to optimization or search problems by means of stimulated evolution, processes based on natural selection, crossover, and mutation are repeatedly applied to a population of binary strings which represent potential solutions. Over time, the numbers of above average individuals are created, until a good solution to the problem at hand is found. However, GA has its own shortcomings such as lower local convergence speed inkling to premature convergence etc. Genetic algorithms belong to the larger class of evolutionary algorithms (EA), which generate solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection, and crossover. Genetic algorithms find application in bioinformatics, computational science, engineering, economics, chemistry, manufacturing, mathematics, physics and other fields.

3. DATABASE

The database was collected from available literature on concrete containing nano-silica, as summarized in Table 1. The success of the models depends upon the comprehensiveness of the data. Thus, large varieties of data were collected and in total 32 datasets have been used with the following input and output variables. The basic parameters considered in this study were cement content, fine aggregate content, coarse aggregate content, nano-silica content, diameter of nano-silica, water-to-binder ratio and superplasticizer dosage. The exclusion of one or more of concrete properties in some studies and the ambiguity of mixtures proportions and testing methods in others was responsible for setting the criteria for identification of data. The successful model to predict the 28 days compressive strength depends upon the magnitude of the training data. The predicted results were compared with the values obtained experimentally [1-16].

Table 1: Details of data used in modelling

S.No	Cement (kg/m3) (x1)	FA (kg/ m3) (x2)	CA (kg/ m3) (x3)	W/b Ratio (x4)	SP (kg/ m3) (x5)	nS (kg/ m3) (x6)	D (nm) (x7)	28-d CS (MPa) (y)	Researcher (Year)
1	396.6	826	722	0.37	7	16.5	15	75.2	Morteza H. Beigi et al. (2013)
2	380	826	722	0.35	7	33	15	86.1	
3	363.5	826	722	0.33	7	49.6	15	85.4	
4	318.4	840	1040	0.5	2.71	1.6	15	36.8	Ali Heidari (2013)
5	316.8	840	1040	0.5	4.75	3.2	15	40.2	
6	390	783	1175	0.4	1.78	23.4	35	70	A.M. Said et al. (2012)
7	390	774	1162	0.4	3.56	46.8	35	76	
8	390	769	1154	0.4	1.27	23.4	35	60	
9	390	762	1143	0.4	2.54	46.8	35	66	
10	356.4	650	1260	0.42	5.4	3.6	10	66.36	Mao-hua Zhang et al. (2011)
11	349.2	650	1260	0.42	7.2	10.8	10	61.16	

S.No	Cement (kg/m3) (x1)	FA (kg/ m3) (x2)	CA (kg/ m3) (x3)	W/b Ratio (x4)	SP (kg/ m3) (x5)	nS (kg/ m3) (x6)	D (nm) (x7)	28-d CS (MPa) (y)	Researcher (Year)
12	447.75	492	1148	0.4	0	2.25	80	39.2	Alireza Naji Givi et al. (2010)
13	445.5	492	1148	0.4	0	4.5	80	40.3	
14	443.25	492	1148	0.4	0	6.75	80	41.2	
15	441	492	1148	0.4	0	9	80	38.1	
16	447.75	492	1148	0.4	0	2.25	15	42.7	
17	445.5	492	1148	0.4	0	4.5	15	43.6	
18	443.25	492	1148	0.4	0	6.75	15	42.9	
19	441	492	1148	0.4	0	9	15	39.7	
20	394	811	915	0.45	1.68	12	15	53.8	
21	388	811	915	0.45	2.32	24	15	56.5	
22	382	811	915	0.45	3	36	15	60	M.Nili et al. (2010)
23	247.5	625	0	0.5	4.5	7.5	40	54.3	Byung Wan Jo et al. (2007)
24	240.6	626	0	0.5	5.8	14.4	40	61.9	
25	241.8	627	0	0.5	7	23.2	40	68.2	
26	227.7	628	0	0.5	7.5	27.3	40	68.8	
27	370	647	1088	0.49	13.5	13.9	15	44	Tao Ji et al. (2005)
28	568.36	1757.8	0	0.5	8.85	17.5	15	32.9	Hui Li et al. (2004)
29	556.64	1757.8	0	0.5	14.58	29.3	15	33.8	
30	527.34	1757.8	0	0.5	29.3	58.59	15	36.4	
31	556.64	1757.8	0	0.5	10.28	11.71	15	35.4	
32	480	647	1140	0.28	10	20	10	75.8	Gengying Li (2004)

Note: All type of SP have been considered to be same.

The variables used are as follows: Cement, FA (fine aggregates), CA (coarse aggregates), W/b ratio, SP (superplasticizer), nS (nano-silica) and Diameter of nano-silica.

The ranges of various input and the output parameters used in data mining techniques are given in Tables 2.

Table 2: Input and Output variables

Variables	Parameter	Abbreviation	Database Range	
			Minimum	Maximum
Input	**Cement (kg/m3)**	Cement	227.70	568.36
	Fine aggregate (kg/m3)	FA	492	1757.80
	Coarse aggregate (kg/m3)	CA	0	1260
	Water to binder ratio	W/b ratio	0.28	0.50
	Super Plasticizer (kg/m3)	SP	0	29.30
	Nano-silica (kg/m3)	nS	1.60	58.59
	Diameter of nano-silica (nm)	D	10	80
Output	**28 days Compressive Strength (MPa)**	28-d CS	32.90	86.10

4. FUNCTION APPROXIMATION

With help of multiple regressions value of a output variable based on the value of seven input variable is prediction. When y is a function of more than one predictor variable, the matrix equations that express the relationships among the variables must be expanded to accommodate the additional data. This is called multiple regression problems. Consider a problem of measuring a output variable y for independent variable of x1,x2,x3,x4,x5,x6,x7 i.e. want to form a model of this data is of the form'a0+a1*x1+a2*x2+a3*x3+a4*x4+a5*x5+a6*x6+a7*x7'.

Multiple regression solves for unknown coefficients a0,a1, a2,a3,a4,a5,a6,a7 by minimizing the sum of the squares of the deviations of the data from the model (least-squares fit).

Construct and solve the set of simultaneous equations by forming a design matrix, X
X = [ones (size(x1)) x1 x2 x4 x5 x6 x7];
Solving for the parameters by using the backslash operator:
a = X\y
To validate the model, find the maximum of the absolute value of the deviation of the data from the model:
Y = X*a;
Validation Max Err = max(abs(Y - y))

Solution:
a0=221.364265226088,a1=-0.175546705711193,a2=0.0218338476779627,a3=-0.00411624974491635,
a4=-260.894997850725,a5=-0.207507335152316,a6=0.232271784522169,a7=-0.0731846372091189 and
y=221.364265226088+-0.175546705711193x1+0.0218338476779627x2+
-0.00411624974491635x3+-260.894997850725x4+0.207507335152316x5+0.232271784522169x6+
-0.0731846372091189x7
Max Err= 10.9937*10^(-1)
This value is much smaller than any of the data values, indicating that this model accurately follows the data.

5. OPTIMIZATION USING GENETIC ALGORITHM TECHNIQUE

Flow chart representation of action of GA Technique for parameter optimization in the present problem (Figure 1) is as follows:
Maximize f(x), for ximin <= xi <=ximax
Where i=1,2,3……N

6. AVAILABILITY OPTIMIZATION USING GENETIC ALGORITHM

- Problem definition: Find maximum value of 28 DCS

y=221.364265226088+-0.175546705711193x1+0.0218338476779627x2 +0.00411624974491635x3+
-260.894997850725x4 + -0.207507335152316x5 + 0.232271784522169x6+ -0.0731846372091189x7

- Bounds of input variables are shown in Table 3

Table 3: Bound of input variables

Variable	Minimum	Maximum
Cement(x1)	227.70	568.36
FA(x2)	492	1757.80
CA(x3)	0	1260
W/b ratio(x4)	0.28	0.50
SP(x5)	0	29.30
nS(x6)	1.60	58.59
D(x7)	10	80

- Element of a input vectors are (x1,x2,x3,x4,x5,x6,x7)

A MATLAB program was prepared for compressive strength- based optimization using genetic algorithm and Optimum value of the compressive strength corresponds to specific value of system parameters is calculated. Effect of number of cross-over, population size and generation on the compressive strength of concrete are shown graphically Figure 2, 3 and 4 respectively.

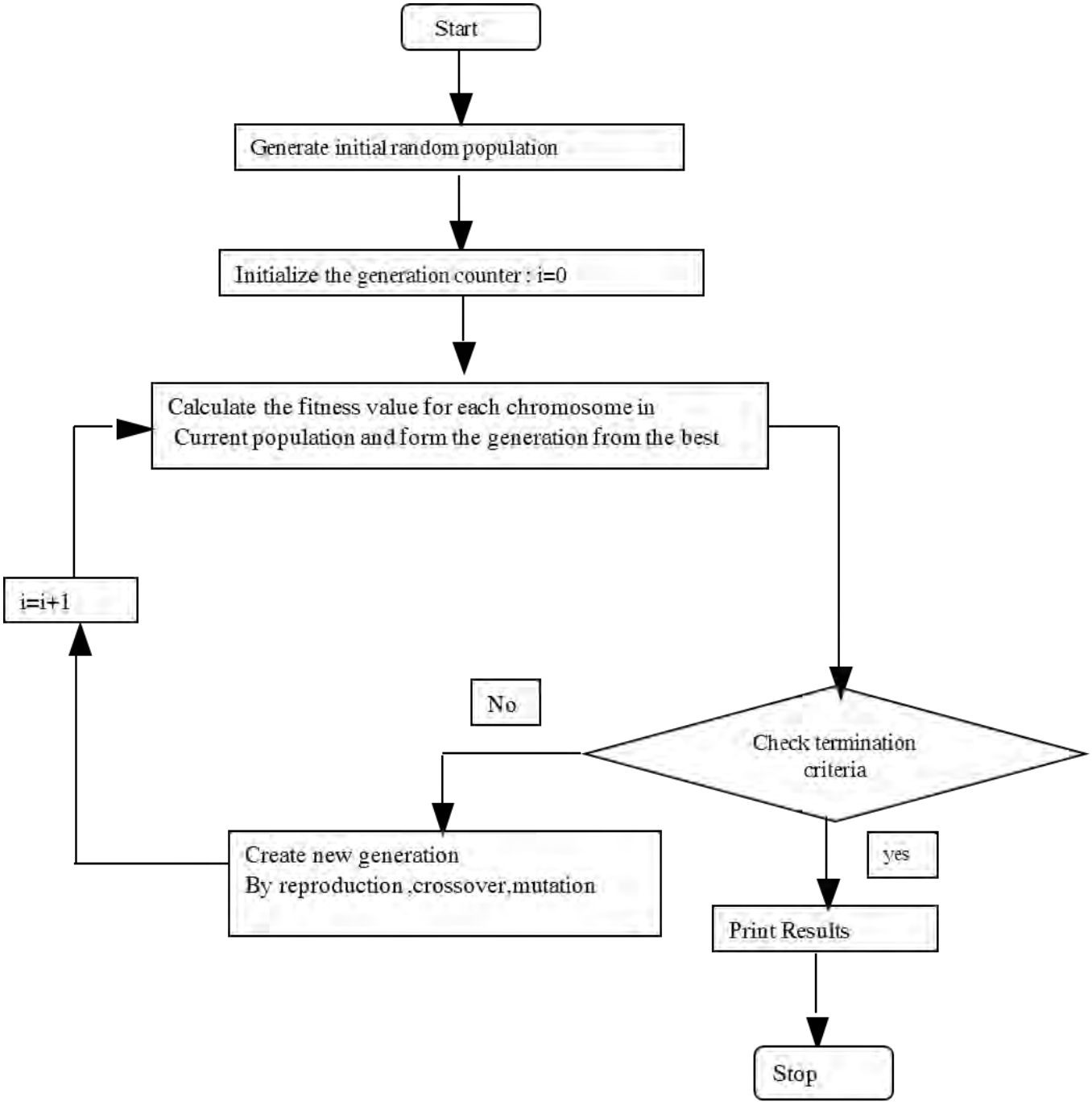

Figure 1: Flowchart depicting the action of GA technique

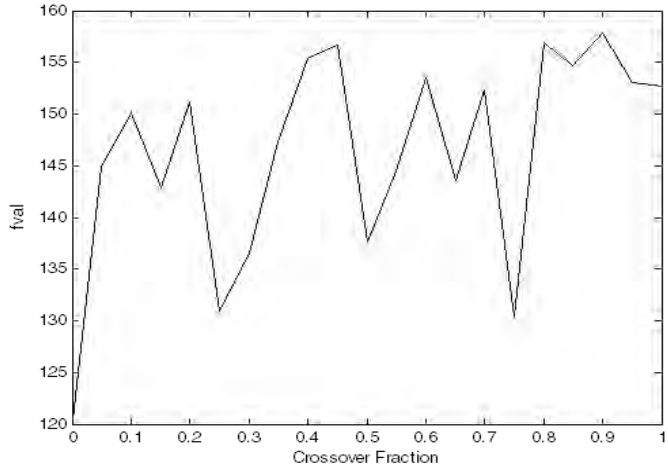

Figure 2: Variation of 28-days Compressive strength w.r.t. Crossover Fraction

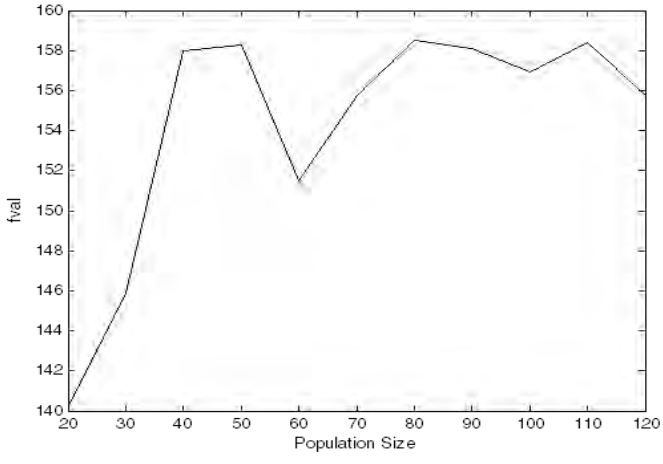

Figure 3: Variation of 28-days Compressive strength w.r.t. Population Size

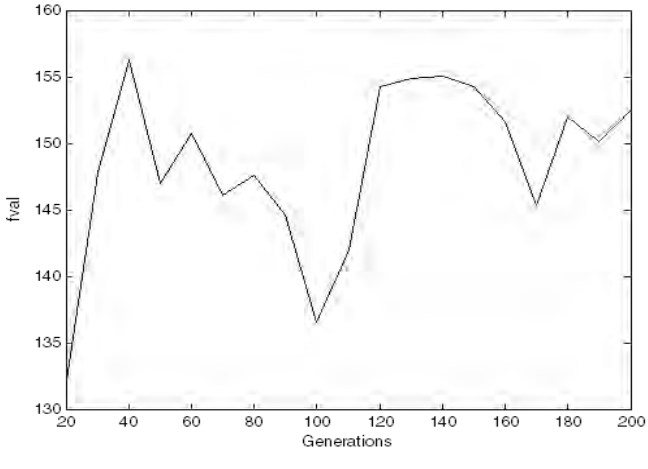

Figure 4: Variation of 28-days Compressive strength w.r.t. Generations

The optimum value of compressive strength of concrete 151.523 kN/m2. For which best possible combination values of cement, FA, CA, W/b, SP, Ns, D are shown in Table 4:

Table 4: Best fit values of the variables

Cement (x1)	FA x2	CA x3	W/b x4	SP x5	Ns x6	D x7
239.1292	1739.835	0.12137	0.299922	0.005305	58.5536	16.40384

7. CONCLUSIONS

In the present study, the genetic algorithm model for 28-day compressive strength has been developed. The model was trained with input and output experimental data. As in this study, there are 7 inputs and 1 output, as a result, compressive strength values of concrete can be predicted in GA models without attempting any experiments in a quite short period of time with tiny error rates. The GA results were compared with the random optimization where prediction of function was done using Artificial Neural Network for 28-days compressive strength [16]. It is found that the optimized value for 28-days compressive strength for concrete containing nano-silica using GA based optimization is 151.523 MPa as compared to ANN prediction which was 95.909 MPa. The nano-SiO2 particles fill the voids and act as nucleus to tightly bond with C–S–H gel particles, making binding paste matrix denser, resulting increase in long-term strength and durability of concrete. Thus, the use of nano-particle materials in concrete can add many benefits that are directly related to the durability of various cementitious materials, besides the fact that it is possible to reduce the quantities of cement in the composite thereby gaining the optimized cost benefits and material saving.

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REDUCTION OF REAL POWER LOSS & IMPROVING VOLTAGE PROFILE INDEX BY IMPROVED ANT COLONY ALGORITHM

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ABSTRACT

In this paper, an innovative approach Improved Ant colony Algorithm (IACA) for solving optimal reactive power dispatch problem has been presented. Ant Colony Algorithm (ACA) is utilized as a mutation of Genetic algorithm (GA) and the output of the GA is given as an input to the Ant Colony Algorithm (ACA). Projected Improved Ant colony Algorithm (IACA) algorithm has been tested in standard IEEE 30 bus test system and simulation results show the better performance of the proposed algorithm in reducing the real power loss & voltage profile index has been enhanced.

Keywords: *Improved Ant Colony algorithm, Reactive Power problem, Transmission loss, Genetic algorithm*

1. INTRODUCTION

Reactive power optimization plays a key role in optimal operation of power systems. Many numerical methods [1-7] have been applied to solve the optimal reactive power dispatch problem. The problem of voltage stability plays a strategic role in power system planning and operation [8]. So many Evolutionary algorithms have been already proposed to solve the reactive power flow problem [9-11]. In [12, 13], Hybrid differential evolution algorithm and Biogeography Based algorithm has been projected to solve the reactive power dispatch problem. In [14, 15], a fuzzy based technique and improved evolutionary programming has been applied to solve the optimal reactive power dispatch problem. In [16, 17] nonlinear interior point method and pattern based algorithm has been used to solve the reactive power problem. In [18-20], various types of probabilistic algorithms utilized to solve optimal reactive power problem. This paper introduces an Improved Ant colony Algorithm (IACA) for solving optimal reactive power dispatch power problem.Genetcic Algorithm (GA) and Ant Colony Algorithm (ACA) [21-27] has been united to solve the optimal reactive power dispatch problem. Proposed IACA algorithm has been evaluated in standard IEEE 30 bus test system & the simulation results show that our proposed approach outperforms all reported algorithms in minimization of real power loss and voltage profile index also improved.

2. VOLTAGE STABILITY EVALUATION

2.1. Modal analysis for voltage stability evaluation Modal analysis is one among best methods for voltage stability enhancement in power systems. The steady state system power flow equations are given by.

$$\begin{bmatrix}\Delta P\\ \Delta Q\end{bmatrix} = \begin{bmatrix} J_{p\theta} & J_{pv} \\ J_{q\theta} & J_{QV}\end{bmatrix} \begin{bmatrix}\Delta\theta\\ \Delta V\end{bmatrix} \quad (1)$$

Where

ΔP = Incremental change in bus real power.

ΔQ = Incremental change in bus reactive Power injection

Δθ = incremental change in bus voltage angle.

ΔV = Incremental change in bus voltage Magnitude

Jpθ , JPV , JQθ , JQV jacobian matrix are the sub-matrixes of the System voltage stability is affected by both P & Q.

To reduce (1), let ΔP = 0, then.

$$\Delta Q = \left[J_{QV} - J_{Q\theta} J_{P\theta^{-1}} J_{PV}\right]\Delta V = J_R \Delta V \tag{2}$$

$$\Delta V = J^{-1} - \Delta Q \tag{3}$$

Where

$$J_R = \left(J_{QV} - J_{Q\theta} J_{P\theta^{-1}} JPV\right) \tag{4}$$

J_R is called the reduced Jacobian matrix of the system.

2.2. Modes of Voltage instability: Voltage Stability characteristics of the system have been identified by computing the Eigen values and Eigen vectors.

Let

$$J_R = \xi \wedge \eta \tag{5}$$

Where,

ξ = right eigenvector matrix of JR

η = left eigenvector matrix of JR

∧ = diagonal eigenvalue matrix of JR and

$$J_{R^{-1}} = \xi \wedge^{-1} \eta \tag{6}$$

From (5) and (8), we have

$$J_{R^{-1}} = \xi \wedge^{-1} \eta \tag{7}$$

Or

$$\Delta V = \sum_{I} \frac{\xi_i \eta_i}{\lambda_i} \Delta Q \tag{8}$$

Where ξi is the ith column right eigenvector and η the ith row left eigenvector of JR.

λi is the ith Eigen value of JR.

The ith modal reactive power variation is,

$$\Delta Q_{mi} = K_i \xi_i \tag{9}$$

where,

$$K_i = \sum_{j} \xi_{ij^2} - 1 \tag{10}$$

Where

ξji is the jth element of ξi

The corresponding ith modal voltage variation is

$$\Delta V_{mi} = [1/\lambda_i]\Delta Q_{mi} \tag{11}$$

If | λi | =0 then the ith modal voltage will collapse .

In (10), let ΔQ = ek where ek has all its elements zero except the kth one being 1. Then,

$$\Delta V = \sum_i \frac{\eta_{1k}\, \xi_1}{\lambda_1} \tag{12}$$

η_{1k} k th element of η_1

V –Q sensitivity at bus k

$$\frac{\partial V_K}{\partial Q_K} = \sum_i \frac{\eta_{1k}\, \xi_1}{\lambda_1} = \sum_i \frac{P_{ki}}{\lambda_1} \tag{13}$$

3. PROBLEM FORMULATION

The objectives of the reactive power dispatch problem is to minimize the system real power loss and maximize the static voltage stability margins (SVSM).

3.1. Minimization of Real Power Loss Minimization of the real power loss (Ploss) in transmission lines is mathematically stated as follows.

$$P_{loss} = \sum_{\substack{k=1 \\ k=(i,j)}}^{n} g_{k(V_i^2 + V_j^2 - 2V_i V_j \cos\theta_{ij})} \tag{14}$$

Where n is the number of transmission lines, gk is the conductance of branch k, Vi and Vj are voltage magnitude at bus i and bus j, and θij is the voltage angle difference between bus i and bus j.

3.2. Minimization of Voltage Deviation Minimization of the voltage deviation magnitudes (VD) at load buses is mathematically stated as follows.

$$\text{Minimize VD} = \sum_{k=1}^{nl} |V_k - 1.0| \tag{15}$$

Where nl is the number of load busses and Vk is the voltage magnitude at bus k.

3.3. System Constraints Objective functions are subjected to these constraints shown below.

Load flow equality constraints:

$$P_{Gi} - P_{Di} - V_i \sum_{j=1}^{nb} V_j \begin{bmatrix} G_{ij} & \cos\theta_{ij} \\ +B_{ij} & \sin\theta_{ij} \end{bmatrix} = 0, i = 1,2 \ldots., nb \tag{16}$$

$$Q_{Gi} - Q_{Di} - V_i \sum_{j=1}^{nb} V_j \begin{bmatrix} G_{ij} & \sin\theta_{ij} \\ +B_{ij} & \cos\theta_{ij} \end{bmatrix} = 0, i = 1,2 \ldots., nb \tag{17}$$

where, nb is the number of buses, PG and QG are the real and reactive power of the generator, PD and QD are the real and reactive load of the generator, and Gij and Bij are the mutual conductance and susceptance between bus i and bus j.

Generator bus voltage (VGi) inequality constraint:

$$V_{Gi}^{min} \leq V_{Gi} \leq V_{Gi}^{max}, i \in ng \quad (18)$$

Load bus voltage (VLi) inequality constraint:

$$V_{Li}^{min} \leq V_{Li} \leq V_{Li}^{max}, i \in nl \quad (19)$$

Switchable reactive power compensations (QCi) inequality constraint:

$$Q_{Ci}^{min} \leq Q_{Ci} \leq Q_{Ci}^{max}, i \in nc \quad (20)$$

Reactive power generation (QGi) inequality constraint:

$$Q_{Gi}^{min} \leq Q_{Gi} \leq Q_{Gi}^{max}, i \in ng \quad (21)$$

Transformers tap setting (Ti) inequality constraint:

$$T_{i}^{min} \leq T_{i} \leq T_{i}^{max}, i \in nt \quad (22)$$

Transmission line flow (SLi) inequality constraint:

$$S_{Li}^{min} \leq S_{Li}^{max}, i \in nl \quad (23)$$

Where, nc, ng and nt are numbers of the switchable reactive power sources, generators and transformers

4. GENETIC ALGORITHMS

Genetic algorithms (GA's) are search algorithms that work via the process of natural selection. They begin with a sample set of potential solutions which then evolves toward a set of more optimal solutions. Within the sample set, solutions that are poor tend to die out while better solutions mate and propagate their advantageous traits, thus introducing more solutions into the set that boast greater potential (the total set size remains constant; for each new solution added, an old one is removed). A little random mutation helps guarantee that a set won't stagnate and simply fill up with numerous copies of the same solution.

In general, genetic algorithms tend to work better than traditional optimization algorithms because they're less likely to be led astray by local optima. This is because they don't make use of single-point transition rules to move from one single instance in the solution space to another. Instead, GA's take advantage of an entire set of solutions spread throughout the solution space, all of which are experimenting upon many potential optima.

However, in order for genetic algorithms to work effectively, a few criteria must be met:

a. It must be relatively easy to evaluate how "good" a potential solution is relative to other potential solutions.

b. It must be possible to break a potential solution into discrete parts that can vary independently. These parts become the "genes" in the genetic algorithm.

c. Finally, genetic algorithms are best suited for situations where a "good" answer will suffice, even if it's not the absolute best answer.

Basic Mechanics of Genetic Algorithms The basic operations of the genetic algorithm are simple and straight-forward: **Reproduction**: The act of making a copy of a potential solution: **Crossover**: The act of swapping gene values between two potential solutions, simulating the "mating" of the two solutions. **Mutation**: The act of randomly altering the value of a gene in a potential solution.

Fitness Functions and Natural Selection As mentioned earlier, it's necessary to be able to evaluate how "good" a potential solution is relative to other potential solutions. The "fitness function" is responsible for performing this evaluation and returning a positive integer number, or "fitness value", that reflects how optimal the solution is: the higher the number, the better the solution.

The fitness values are then used in a process of natural selection to choose which potential solutions will continue on to the next generation, and which will die out. It should be noted, however, that natural selection process does not merely choose the top *x* number of solutions; the solutions are instead chosen statistically such that it is more likely that a solution with a higher fitness value will be chosen, but it is not guaranteed. This tends to correspond to the natural world.

A common metaphor for the selection process is that of a large roulette wheel. Remembering that fitness values are positive integers, imagine that each potential solution gets a number of slots on the wheel equal to its fitness value. Then the wheel is spun and the solution on which it stops is selected. Statistically speaking, solutions with a higher fitness value will have a greater chance of being selected since they occupy more slots on the wheel, but even solutions with just a single slot still have a chance.

5. ANT COLONY ALGORITHM

Based on the fact that ants are able to find the shortest route between their nest and a source of food. This is done using pheromone trails, which ants deposit whenever they travel, as a form of indirect communication .when ants leave their nest to search for a food source, they randomly rotate around an obstacle, and initially the pheromone deposits will be the same for the right and left directions. When the ants in the shorter direction find a food source, they carry the food and start returning back, following their pheromone trails, and still depositing more pheromone. An ant will most likely choose the shortest path when returning back to the nest with food as this path will have the most deposited pheromone. For the same reason, new ants that later starts out from the nest to find food will also choose the shortest path. Over time, this positive feedback process prompts all ants to choose the shorter path. Ant chooses direction using roulette wheel selection applied to the pheromone amounts. Than it moves arbitrarily to the place the vector points and does an arbitrary walk inside a local search radius. This radius can shrink in time to do more detailed searches around the point. The ant Fitness is then calculated from its position and the amount of pheromone on choosing direction vector is proportionally increased. If a better solution is found, the vector is changed to actual ant position.

6. PROPOSED IMPROVED ANT COLONY ALGORITHM (IACA)

In this phase, the ant colony algorithm is used as a mutation of GA, the output of the GA is given as an input to the ACA. The genetic algorithm undergoes the selection, crossover process and it gives the result. The result contains only one value which is optimal value. This is the procedure utilized in EACA.

A. Preliminary population

Genetic algorithm initiate its work with a group of chromosomes (solutions) known as the preliminary population, members of this population be configured up arbitrarily.

B. Fitness Function

This step is the appraisal of solutions (chromosome).

C. Creation of new generations

a. Selection

There are many different selection methods, such as elitist selection, rank selection and roulette wheel selection. In this paper, the roulette wheel selection technique is used. In roulette wheel selection, the individual is selected based on the relative fitness with its contestants. This is a like to dividing the wheel into a number of slices.

b. *Crossover*

There are many different crossover methods, in this paper, the arithmetic crossover is used. Arithmetic crossover operator linearly combines two parent chromosome vectors to create two new offspring according to the equations:

$$offspring1 = a * parent\ 1 + (1 - a) * parent2 \quad (24)$$

$$offspring2 = (1 - a) * parent\ 1 + a * parent2 \quad (25)$$

Where is "a" arbitrary weighting factor chosen before each crossover operation.

Proposed IACA for solving optimal power dispatch problem

1. Chromosomes that have been obtained from the procedure of mating (crossover) is pass in into ant colony algorithm, is calculate the probability (P_{ij}) of each chromosome according to the equation Probability,

$$P_{ij} = \frac{T_{ij}}{\sum_{j=1}^{P} T_{ij}} \quad (26)$$

Where T_{ij} is an amounts of pheromone, T_{ij} =1 for each chromosome (solution) in preliminary state of algorithm, P number of chromosome, Set the iteration number L=1.

2. Create arbitrary numbers in the range (0,1), one for each ant. Number of ants = number of chromosomes

3. Each ant chooses specific value (specific chromosome) if the ant be within the range of probability of the value (chromosome), this step is repeated for each ant.

4. Calculate the objective function values; determine the best and worst values among the values chosen by different ants.

F_{best} = min (values)

F_{worst} =max (values)

The greatest value is stored during each iteration within a matrix.

5. Test for the convergence. The procedure is assumed to converge if all ants take the same best value. If convergence is not attained, then assume that all the ants return home and start again in search of food. Set the new iteration number as L = L + 1, and modernize the pheromones on different values as,

$$T_{ij}^{(L)} = T_{ij}^{(old)} + \sum_{K} \Delta T^{(K)} \quad (27)$$

Where $T_{ij}^{(old)}$ symbolizes the pheromone amount of the preceding iteration left after evaporation, which is taken as,

$$T_{ij}^{(old)} = (1 - PP) * T_{ij}^{(L-1)} \quad (28)$$

and $\sum_K \Delta T^{(K)}$ is the pheromone deposited by the best ant k and the summation extends over all the best ants k (if multiple ants take the same best path). The evaporation rate or pheromone decay factor PP is assumed to be in the range 0.48 to 0.79 and the pheromone deposited $\sum_K \Delta T^{(K)}$ is computed using,

$$\sum_k \Delta T^{(K)} = \frac{F_{best}}{F_{worst}} \quad (29)$$

With the new values of $T_{ij}^{(L)}$, go to step 1. Steps

1, 2, 3, 4 and 5 are repeated until the process converges, that is, until all the ants select the same best path. In some cases, the iterative process is stopped after completing a pre-specified maximum number of iterations (L max).

6. Modernized generation: The matrix contains that best value is enter to genetic algorithm as population.

7. End Criterion: The iterative process is stopped after completing a pre-specified maximum number of generations of genetic algorithm.

7. SIMULATION RESULTS

The efficiency of the proposed Improved Ant colony Algorithm (IACA) is demonstrated by testing it on standard IEEE-30 bus system. The IEEE-30 bus system has 6 generator buses, 24 load buses and 41 transmission lines of which four branches are (6-9), (6-10) , (4-12) and (28-27) - are with the tap setting transformers. The lower voltage magnitude limits at all buses are 0.95 p.u. and the upper limits are 1.1 for all the PV buses and 1.05 p.u. for all the PQ buses and the reference bus. The simulation results have been presented in Tables 1, 2, 3 &4. And in the Table 5 shows the proposed algorithm powerfully reduces the real power losses when compared to other given algorithms. The optimal values of the control variables along with the minimum loss obtained are given in Table 1. Corresponding to this control variable setting, it was found that there are no limit violations in any of the state variables.

Table 1. Results of IACA – ORPD optimal control variables

Control variables	Variable setting
V1	1.046
V2	1.044
V5	1.043
V8	1.032
V11	1.002
V13	1.031
T11	1.00
T12	1.00
T15	1.01
T36	1.01
Qc10	3
Qc12	3
Qc15	2
Qc17	0
Qc20	2
Qc23	3
Qc24	3
Qc29	2
Real power loss	4.2851
SVSM	0.2475

Optimal Reactive Power Dispatch problem together with voltage stability constraint problem was handled in this case as a multi-objective optimization problem where both power loss and maximum voltage stability margin of the system were optimized simultaneously. Table 2 indicates the optimal values of these control variables. Also it is found that there are no limit violations of the state variables. It indicates the voltage stability index has increased from 0.2475 to 0.2487, an advance in the system voltage stability. To determine the voltage security of the system, contingency analysis was conducted using the control variable setting obtained in case 1 and case 2. The Eigen values equivalents to the four critical contingencies are given in Table 3. From this result it is observed that the Eigen value has been improved considerably for all contingencies in the second case.

Table 2. Results of IACA-Voltage Stability Control Reactive Power Dispatch Optimal Control Variables

Control Variables	Variable Setting
V1	1.047
V2	1.045
V5	1.044
V8	1.030
V11	1.003
V13	1.032
T11	0.090
T12	0.090
T15	0.090
T36	0.090
Qc10	3
Qc12	3
Qc15	2
Qc17	3
Qc20	0
Qc23	2
Qc24	2
Qc29	3
Real power loss	4.9891
SVSM	0.2487

Table 3. Voltage Stability under Contingency State

Sl.No	Contingency	ORPD Setting	VSCRPD Setting
1	28-27	0.1419	0.1434
2	4-12	0.1642	0.1650
3	1-3	0.1761	0.1772
4	2-4	0.2022	0.2043

Table 4. Limit Violation Checking Of State Variables

State variables	limits		ORPD	VSCRPD
	Lower	upper		
Q1	-20	152	1.3422	-1.3269
Q2	-20	61	8.9900	9.8232
Q5	-15	49.92	25.920	26.001
Q8	-10	63.52	38.8200	40.802
Q11	-15	42	2.9300	5.002
Q13	-15	48	8.1025	6.033
V3	0.95	1.05	1.0372	1.0392
V4	0.95	1.05	1.0307	1.0328
V6	0.95	1.05	1.0282	1.0298
V7	0.95	1.05	1.0101	1.0152
V9	0.95	1.05	1.0462	1.0412
V10	0.95	1.05	1.0482	1.0498
V12	0.95	1.05	1.0400	1.0466
V14	0.95	1.05	1.0474	1.0443
V15	0.95	1.05	1.0457	1.0413
V16	0.95	1.05	1.0426	1.0405
V17	0.95	1.05	1.0382	1.0396
V18	0.95	1.05	1.0392	1.0400
V19	0.95	1.05	1.0381	1.0394
V20	0.95	1.05	1.0112	1.0194
V21	0.95	1.05	1.0435	1.0243
V22	0.95	1.05	1.0448	1.0396
V23	0.95	1.05	1.0472	1.0372
V24	0.95	1.05	1.0484	1.0372
V25	0.95	1.05	1.0142	1.0192
V26	0.95	1.05	1.0494	1.0422
V27	0.95	1.05	1.0472	1.0452
V28	0.95	1.05	1.0243	1.0283
V29	0.95	1.05	1.0439	1.0419
V30	0.95	1.05	1.0418	1.0397

Table 5. Comparison of Real Power Loss

Method	Minimum loss
Evolutionary programming [28]	5.0159
Genetic algorithm [29]	4.665
Real coded GA with Lindex as SVSM [30]	4.568
Real coded genetic algorithm [31]	4.5015
Proposed IACA method	4.2851

8. CONCLUSION

In this paper, the Improved Ant colony Algorithm (IACA) has been successfully applied to solve Reactive Power problem. The key advantages of the Improved Ant colony Algorithm (IACA) are easily handling of non-linear constraints. Projected IACA approach has been tested on the IEEE 30-bus system to minimize the active power loss. The optimal setting of control variables are well within the limits. The results were compared with the other heuristic methods and proposed IACA demonstrated its effectiveness and robustness in minimizing the real power loss and voltage profile index also enhanced.

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HYDROELECTRIC GENERATING SET FABRICATION AND IMPLEMENTATION WITH BANKI TURBINE

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ABSTRACT

This paper describes the design and development of Pico-hydro generation system using water distributed to houses. Water flow in the domestic pipes has kinetic energy that has the potential to generate electricity for energy storage purposes in addition to the routine activities such as laundry, cook and bath. Pico hydro refers to the smallest scale in a hydropower plant with a capacity of less than10 kW. Pico hydro setup is well suited in remote rural areas where transmission of power proves uneconomical. The Pico hydro plants can be installed at much lower financial requirements compared with solar plants and wind mills [1]. The setup can be installed at run-of- stream (without dam) and the pipes divert some flow down a gradient through penstock and through the turbine before being exhausted back to the stream. The power requirement at such location is minimal during off periods which can be utilized for charging batteries and other electronic gadgets. Hence, this project is conducted to develop a small scale hydro generation system using consuming water distributed to houses as an alternative electrical energy source for residential use.

Keyword: *Pico hydro, Banki turbine, Induction turbine, Blade angle, Cross flow.*

1. INTRODUCTION

"Pico-hydro generator set" is hydro power generator which produces a maximum output of ten kilowatts (10kW). This type of system is proven to be lesser expensive and simpler in construction than other type of hydro systems. AC-Electricity can be produced enabling standard electrical appliances[2]. In this project we are utilizing a turbine, called the "**BANKI TURBINE**". This specific type of turbine is used because it functions at low rate of water supply also. This type of turbine helps this system to be placed in small streams, hospitals, farms, resorts and even residential areas. In residential

areas we can use the water from the tank, to create a sufficient head. This forces the water to strike the blades at required force. Thus, the turbine will rotate the alternator to produce electricity. This project has been done to use the water for electrical power generation along with routine activities such as gardening, filling the swimming pools, car wash and so on. . The main function of the system is to store the generated power by means of battery charging for future use particularly during electricity blackouts.

2. OBJECTIVE OF WORK

The aim of our projects is to construct smaller turbine systems at cheaper prices and to produce sufficient electricity by maintaining the balance of the ecology. In a place called Yetthinaholle in Karnataka, there was a proposal to set up hydro power systems by constructing channel dams. Our system could be used in these dams as it very small in size so it could produce sufficient electricity for the nearby villages. Our system can be used at certain residential areas also to generate electricity[3]. The water used to run the turbine can be further used for any other purposes. The electricity can be generated without disturbing the daily consumption.

3. TYPES OF TURBINES

Turbines play a very important role in the field of electricity generation. Most of the electricity is produced from waterfalls, running water, burning coal and so on. However all these processes require a turbine which is coupled o the generator. Therefore a turbine is an essential part which cannot be excluded. Turbines help to convert the energy obtained from running water , wind or steam into mechanical energy which can be then used to drive the generator. There are two types of turbines firstly impulse and second type is reaction turbines[4]. There are many turbines such as Kaplan, Francis, Banki, Pelton and so on.

Francis Turbine: This was invented by James Bicheno Francis (1815-1892). He was an American engineer. He invented it 1849. This is the most commonly used turbine in Hydroelectricity power system. Bansagar dam in Madhya Pradesh, Nagarjunasagar dam in Hyderabad are two such examples.

Kaplan Turbine: It is named after its Austrian Engineer Victor Kaplan (1876-1934). This is similar to the propeller turbine. The blades of this turbine are adjustable so the turbine's position can be set based on the available flow of the water. Hirakud dam in Odisha is an example.

Propeller Turbine: These kinds of turbines are used for low heads, which makes it effective for run-of -river power stations. This can rotate at very high speed.

Pelton Turbine: Lester Pelton invented this type of turbine. It has a spoon shaped buckets which harnesses the energy of the falling water. One of the dams where this type is used is in Idukki dam in Kerala.

Banki Turbine: This is also known as cross-flow turbine or Ossberger turbine. This was invented by Banki Michell. This was invented in early 1900s. This is used where heads are low and the rate of water flow is less. It can be easily fabricated by a student and it is cost effective compared to other turbines.

4. BANKI TURBINE AND ITS FABRICATION

The turbine selection can be done using various calculations[5].We choose banki turbine because it can operate with a minimum head of approx 3m. The flow rate of the water required to run the turbine is also less and it is easy to construct. The Banki Turbine set consists of two parts, a nozzle and a turbine runner. The runner is built up of two parallel circular disk joined together at the rim with a series of curved blades. The speed of the turbine can be calculated [6].The nozzle is actually used to project the water at a certain angle on the blades to obtain the cross flow property. The nozzle's cross-sectional area is rectangular, discharges the jet the full width of the wheels and enters the wheel at an angle of sixteen degrees to the tangent of the periphery of the wheel. The shape of the jet is rectangular, wide, and not very deep. The water strikes the blades on the rim of the wheel, flows through the blade, leaving it, passing through the empty space between the inner rims, enters a blade on the inner side of the rim, and discharges at the outer rim. The wheel is therefore an inward jet wheel and because the flow is essentially radial, the diameter of the wheel is practically independent of the amount of water

impact, and the desired wheel breadth can be given of the quantity of water. The thickness of the water jet can be calculated with the help of formulas [7], Figures 1 and 2.

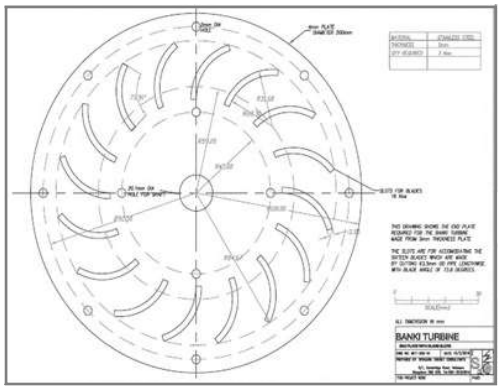

Fig-1. AutoCAD design of Banki turbine

Fig-2. Assembled turbine

In general, the feasibility of the proposed pico-hydro system is based on the following potential input power eqn1 and output power equation eqn2:

Pin = H x Q x g .....Eqn(1)

Pout= H x Q x g x η .....Eqn(2)

Where, Pin = Input power (Hydro power)

Pout = Output power (Generator output)

H = Head (meter)

Q = Water flow rate (liter /second)

g = gravity (9.81 m/s2)

η = efficiency

BLADES: The dimensions of the blades can be simulated using MATLAB of any version for different heads and water discharge. The formulas which were used to obtain the required values were taken from a Banki Manual. The simulation will give information about the number of blades to be used and the length of each blade. It also gives an idea about the angle of each blade at which the water should strike it for obtaining the maximum efficiency. Once the values are obtained, cut the blades as per the values. The blades can be fabricated from PVC, aluminium, stainless steel and so on. The method preferred is laser cutting which results in a better fabrication of the blade.

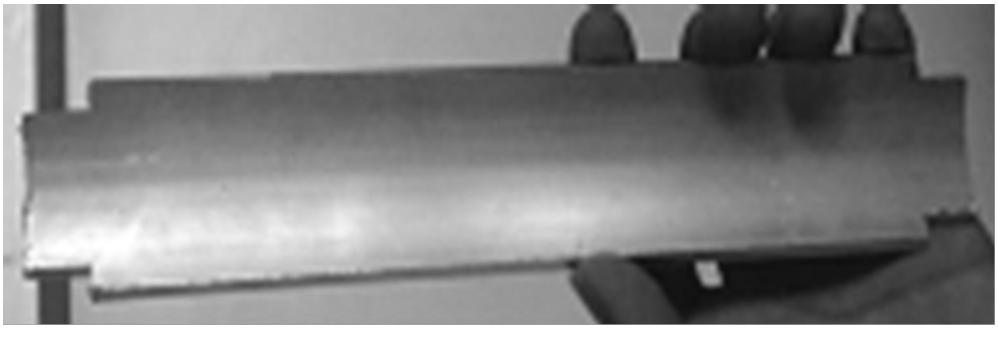

Fig-3 Aluminium blade

Figure 3 shows one such blade. In our project AUTOCAD SOFTWARE 2010 was used to obtain the dimensions The cutting process was done by laser cutting firm. The angle of the blade is 74o (this value is obtained by simulation). The blades were cut from an aluminium pipe, which proved to be economical as we obtained four blades from one cylindrical piece. The figure 4 shows AUTOCAD diagram of how the blades were cut.

Fig-4 Blades cut from an aluminium pipe

CIRCULAR END DISC: The outer disc is required to hold the blades. The radius of the circular disc was designed based on the number of blades, length of the blade and the strength required to hold the blades during running condition. This helps in cross flow of water. To get a better finish laser cutting is recommended. Figure 5 shows an end disc which was cut using laser. The circular holes are meant for the shaft and support rods.

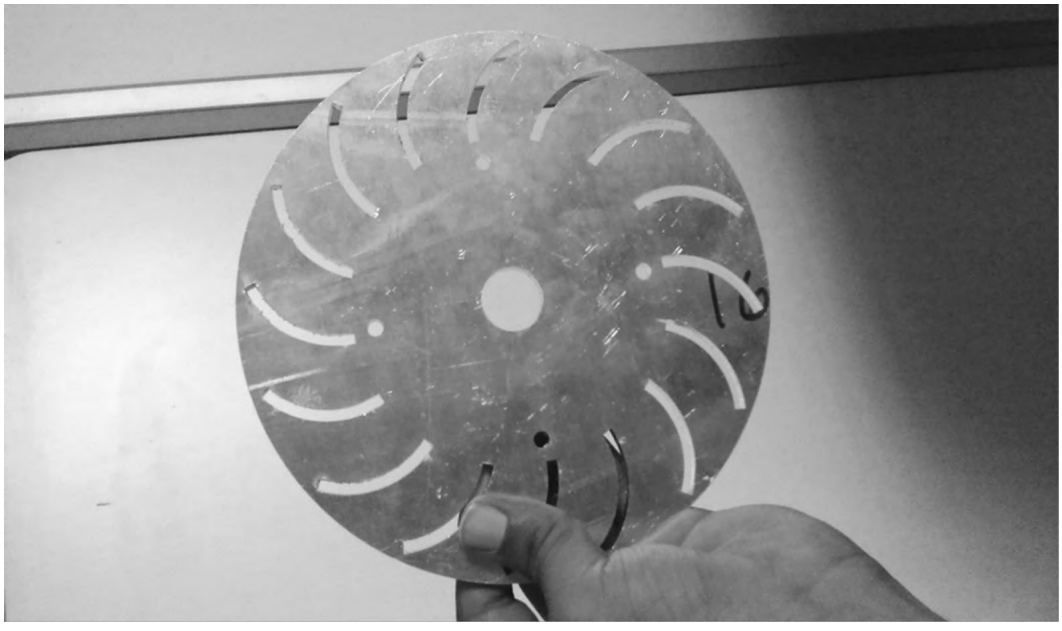

Fig-5 Circular end disc

NOZZLE*:* The nozzle is an important part as it forces the water to strike at the spot. By setting up the nozzle in a right way we can increase the efficiency of the turbine set. The turbine nozzle is functioned to direct water jet to hit the turbine blades so that the turbine runner could rotate. The cross flow turbine performance is strongly influenced by the water jet effectiveness produced by the nozzle to move the turbine blades. The nozzle is fabricated in such a way that the water is allowed to strike the blades at an angle of 62 degrees. The nozzle can be of the same material. It can be cut from aluminium sheet and then welded. It is advisable to make it out of stainless steel as it is stronger. Figure 7 shows a nozzle that was fabricated for our use.

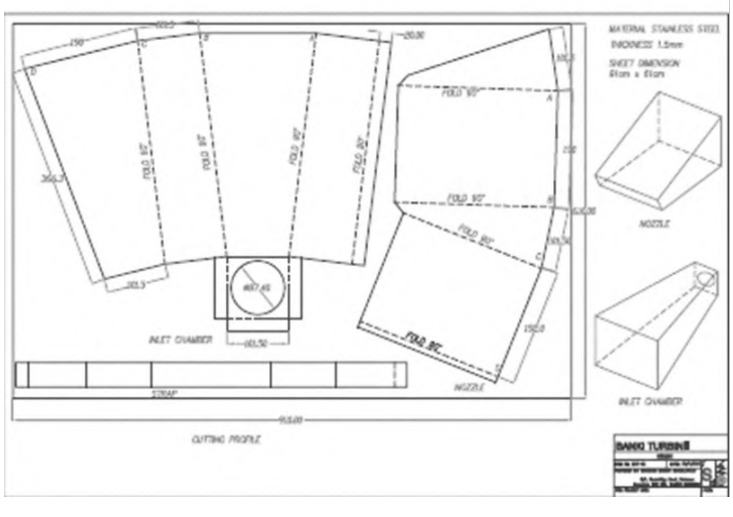

Fig-6 AutoCAD design of the nozzle

Fig-7 Nozzle

FLANGE: The flanges are required to keep blades and the end discs intact. It is bolted on the outer part of aluminium disc. The aluminium disc alone cannot transmit the force of water. It helps the aluminium disc to withstand the force of water and transfer the same to the shaft. This actually increases the strength of the turbine. It can be made of any

material like aluminium or stainless steel. It is preferred to choose nylon as it is cheap and provides good strength. Figure 8 shows a metal flange.

Fig-8 Flange

OUTER CASING: The outer case or the cover is used to prevent the water from splashing during running condition of turbine. The outer case helps to catch the water which falls after running the turbine and it can be collected to lead to some pipe or tank. This is not really important as this is meant to prevent water splashing around and to protect the generator if it is placed closed to the turbine. If the turbine is meant for operating in rivers or streams then this is not required.

In our project the turbine was meant to run for an apartment so we had to prevent the water splashing out. Since our generator was placed on top of the turbine we provided these casings. It was designed using AUTOCAD SOFTWARE version 2010(fig-9). It was also cut using laser cutting. It was manufactured using aluminium material.

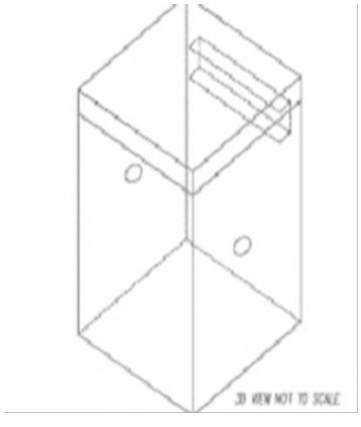

Fig-9 Outer case for the turbine

From the above information a banki turbine can be fabricated and assembled.

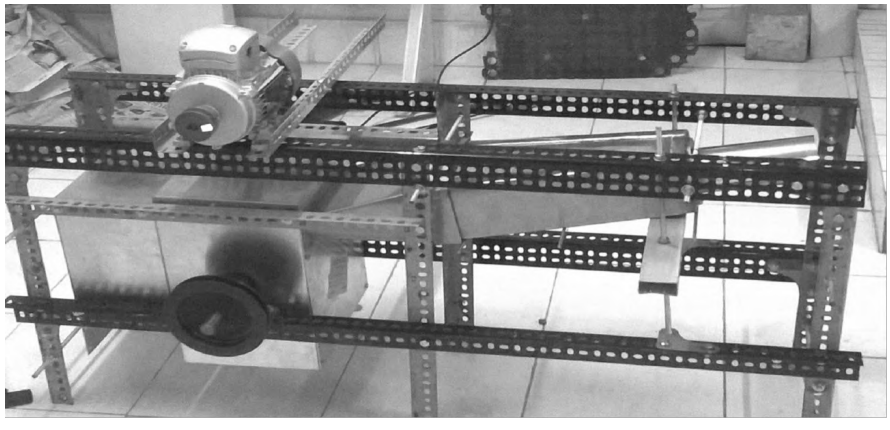

Fig-10 Assembled turbine

5. BLOCK DIAGRAM AND WORKING

The water from certain head is led to the turbine with the help of pipelines or penstock. The water is made to strike the blades of the turbine with the help of fabricated nozzle. This is done to make the water-jet strike the turbine blade at the specific angle to obtain maximum efficiency. The water jet causes the turbine to rotate and since banki turbine has cross-flow property the turbine rotates at a high velocity. After running the turbine, this water can be used for other purposes as it does not get polluted. This in-turn runs the induction generator with the help of belt and pulley system. Induction generators and synchronous generators produce AC power. Induction generators are preferred in remote areas because they are robust and very reliable. The generator is connected to the load

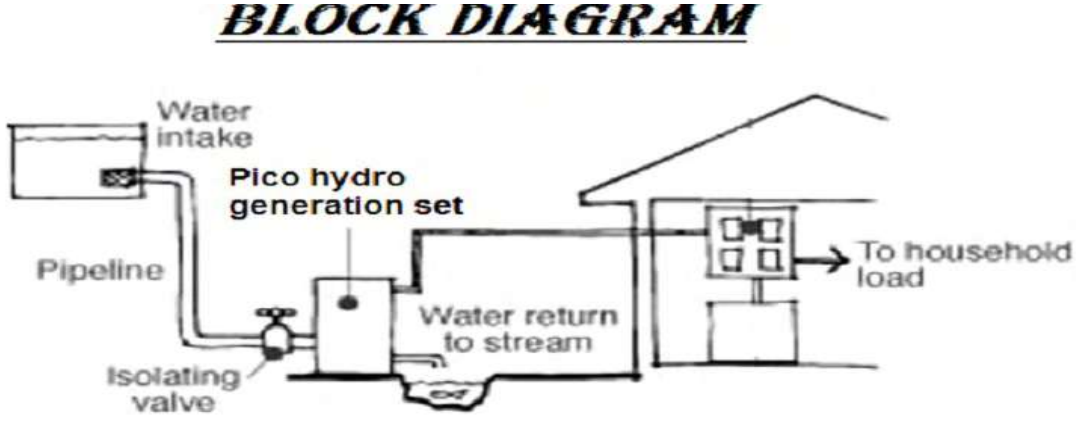

Fig-11 Block diagram

6. CONCLUSION

In relation to rural development the simplicity and low cost of Pico hydro systems open up new opportunities for some isolated communities in need of electricity. With only a small stream needed, remote areas can access lighting and communications for homes, medical clinics, schools, and other facilities. Pico-hydro can even run a certain level of machinery supporting small businesses. Cross flow turbine proves to be a suitable turbine for low flow and low head implementation and when significant variation of flow rate occurs seasonally. Given enough head and flow rate this low cost turbine can provide as little as three times enough power compared to the one provided by solar panels at lower rate. The research results through a precise testing and observation. The fabricated Pico hydro electricity generating set is capable of producing a current upto10KW.

Advantages of this system:

- No current is required for starting up the project.
- Cross flow turbine will continue its efficiency for long period.
- Can be used for small range of head 2 m to 10 m and for projects with less than 2 MW.
- Sustainable and renewable, Pico hydro a power plant the most environmentally friendly also does not pollute and destroy nature, because it uses water as the energy source instead of fuel. Pico hydro also does not pollute streams.
- The technology used is reliable and sturdy so it can operate more than15years.
- Low operational costs
- Simple maintenance.
- Easy operation
- Not consumptive of water usage.

Limitations of Pico Hydro

Site specific technology: In order to take full advantage of the electrical potential of smallstreams, a suitable site is needed. Factors to consider are: distance from the power source to the location where energy is required (this is not very common to find), stream size (including flow rate, output and drop), and a balance of system components - inverter, batteries, controller, transmission line and pipelines.

Energy expansion not possible: There is always a maximum useful power output (size and flowfrom small streams for example) available from a given hydropower site, which limits the increase in power generation and the level of expansion of activities which can make use of the power.

Seasonal variations: In many locations the flow in a stream fluctuates seasonally and this canlimit the firm power output to quite a small fraction of the possible peak output. During summer months there is likely to be less flow and therefore less power output. Advanced planning and investigations are needed to ensure adequate energy generation and power demands are met.

7. ACKNOWLEDGEMENTS

We express our sincere gratitude to **A.S Chelvaraj (former director of Central Electricity Authority, Govt of INDIA)** and **A.C.Sivaguru, M.D of SECSD(Sivaguru Energy Consultants and software Developers), consultants to World Bank** for teaching us everything about this topic, supporting us and also for allowing us to carry out the project at their facility.

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HEAT TRANSFER ANALYSIS ON DOUBLE PIPE HEAT EXCHANGER USING LONGITUDINAL FINS

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ABSTRACT

This paper deals with the heat transfer analysis in a double pipe heat exchanger with longitudinal fins. The double pipe heat exchanger consist of inner circular pipe made of copper for better heat transfer rate with longitudinal fins made of copper for providing larger surface area for heat transfer and outer circular pipe. The experimental analysis is carried out with both parallel flow and counter flow and a comparative study is being done with both the types of flow using longitudinal fins and without fins.

Keywords: *Copper, Efficiency of Fins, Heat exchanger, Heat Transfer, Thermal energy.*

1. INTRODUCTION

A heat exchanger is a device that is used to transfer thermal energy between two or more fluids, between a solid surface and a fluid, or between solid particulates and a fluid, at different temperatures and in thermal contact. There are basically two types of heat exchangers i.e. direct transfer type heat exchanger and indirect contact type heat exchanger. The heat exchangers where the fluids are separated by a heat transfer surface, and ideally they do not mix or leak, such heat exchangers are referred to as direct transfer type. In contrast, heat exchangers in which there is intermittent heat exchange between the hot and cold fluids-via thermal energy storage and release through the exchanger surface or matrix are referred to as indirect transfer type. Basically there are two type of heat exchangers i.e. parallel flow and counter flow. In parallel-flow heat exchangers, the two fluids enter the exchanger at the same end, and travel in parallel to one another to the other side. In counter-flow heat exchangers the fluids enter the exchanger from opposite ends. The counter flow design is more efficient as it can transfer more heat per unit mass due to the fact that the average temperature difference along any unit length is higher. For increase in the efficiency of heat exchanger, the heat exchanger are designed in such a way to maximize the heat transfer surface and reduce the resistance to flow and this can be done by the use of fins on the outer surface of the pipe.

2. DOUBLE PIPE HEAT EXCHANGER

Double pipe heat exchangers are the simplest and cheapest type of heat exchangers used in industries due to their low maintenance cost. But due to their low efficiency coupled with the high space required in large scales, has led modern industries to use more efficient heat exchangers like shell and tube or plate heat exchanger. But double pipe heat exchangers are simple and they are used as a basic for all heat exchangers. These heat exchangers can handle higher pressure and temperature.

3. EXPERIMENTAL SETUP

The apparatus consist of concentric pipe heat exchanger in which the hot water is flowing through the inner tube coming from the electric geyser and the cold water is flowing through the outer annular space. The experiment is carried out for both parallel flow type and counter flow type.

A. SPECIFICATIONS

Inner tube material = Copper

Inner tube (circular) inner diameter (d_i) = 18.5mm

Inner tube outer diameter (d_o) = 20mm

Length of heat exchanger (L) = 1100mm

Outer tube material = GI

Outer tube (circular) inner diameter (Di) = 54mm

Outer tube outer diameter (Do) = 57mm

Fins:

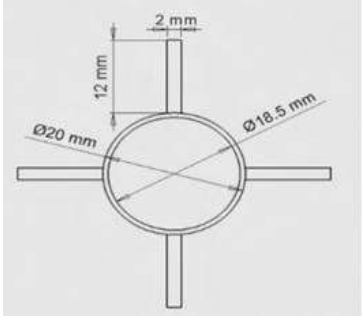
Fin material = Copper

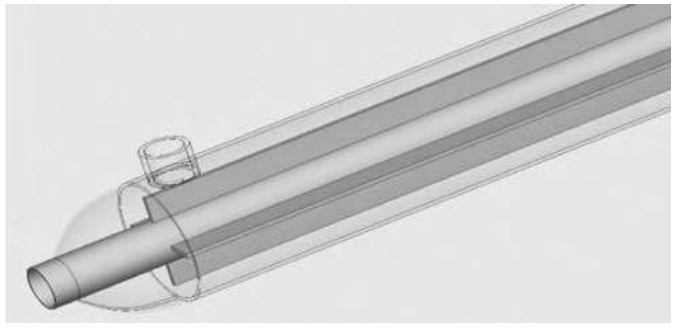
Thickness = 2mm

Length = 1100mm

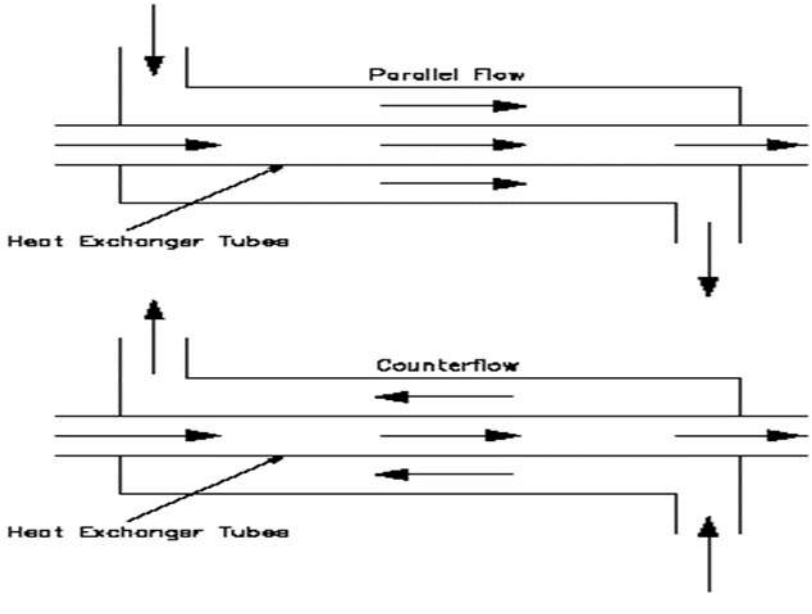
Height = 12mm

B. CROSS SECTONAL DESIGN OF HEAT EXCHANGER

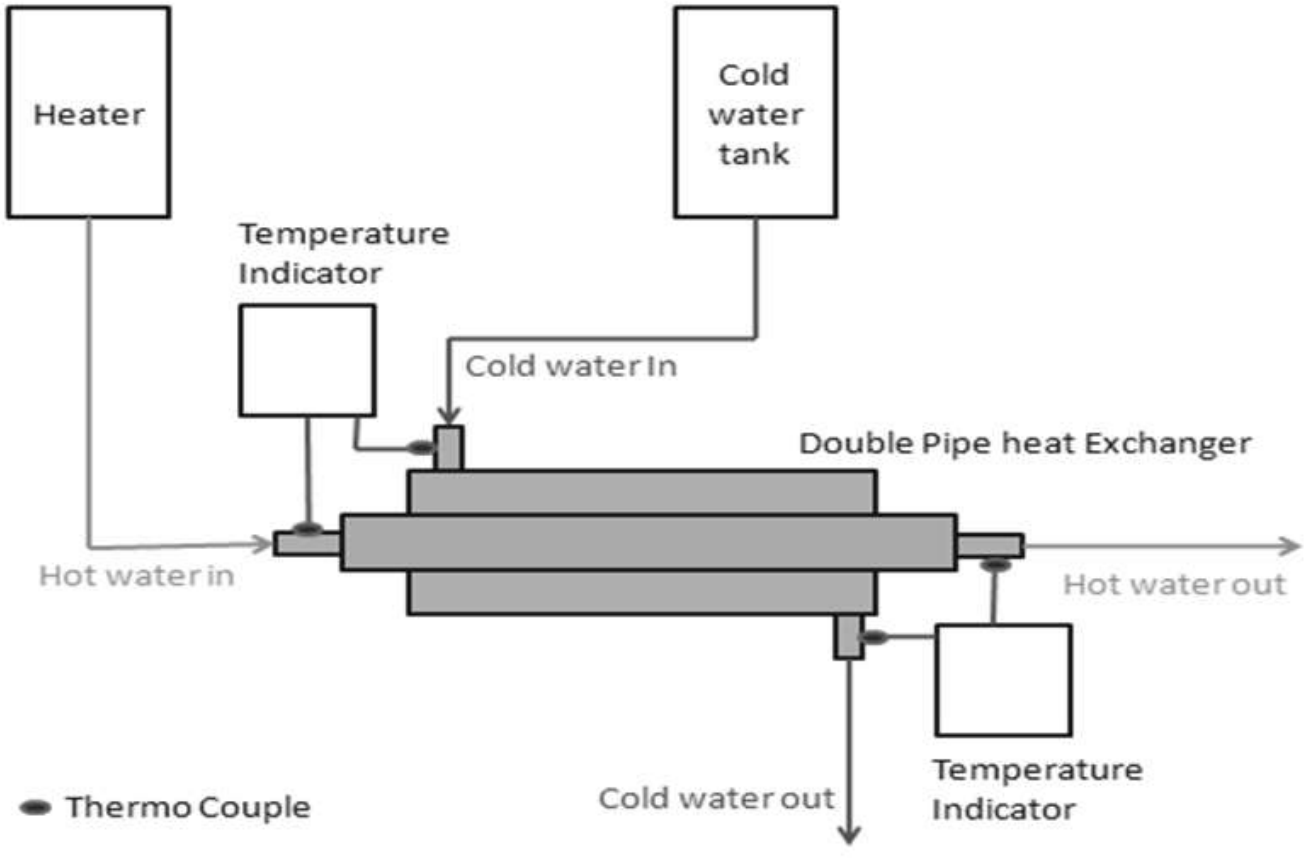




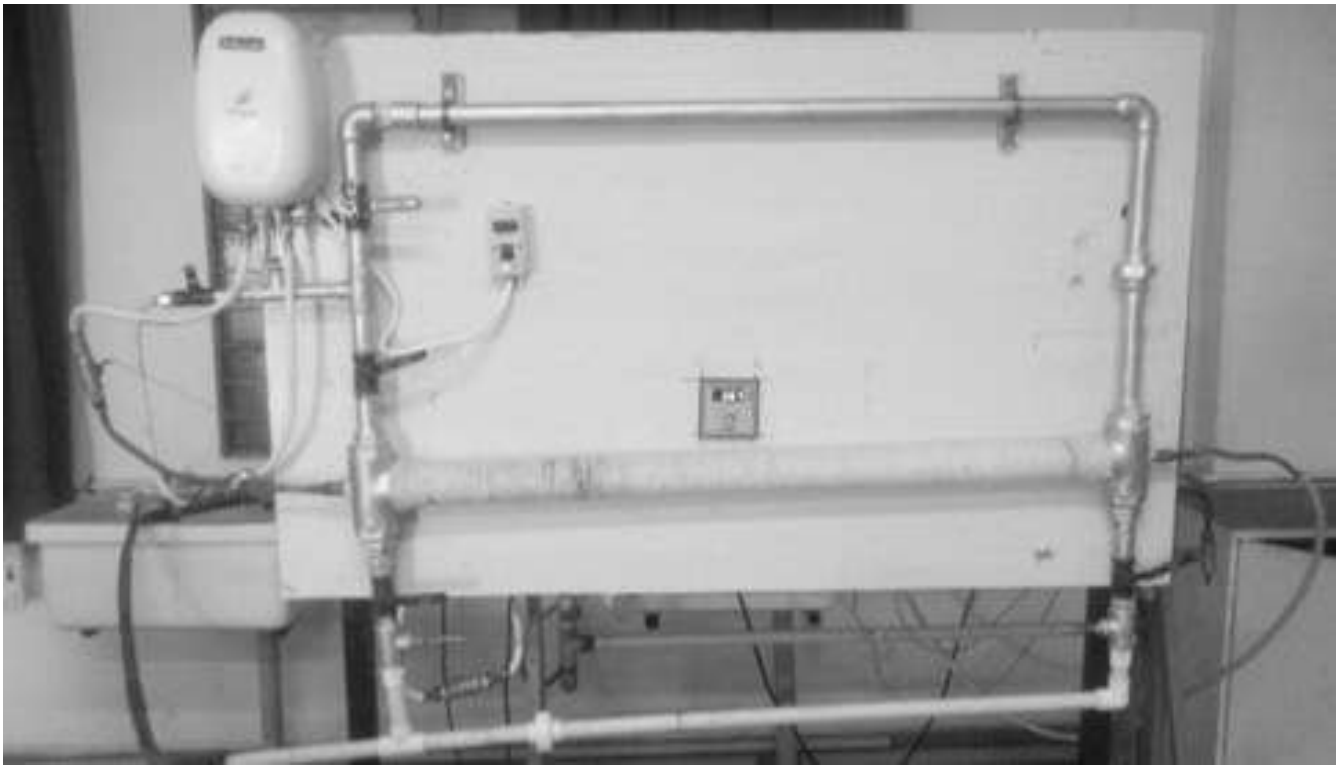
C. PARALLEL FLOW AND COUNTER FLOW SKETCH



D. SCHEMATIC DIAGRAM



E. EXPERIMENTAL SETUP VIEW



4. TABULATION

A) Double pipe heat exchanger without fins

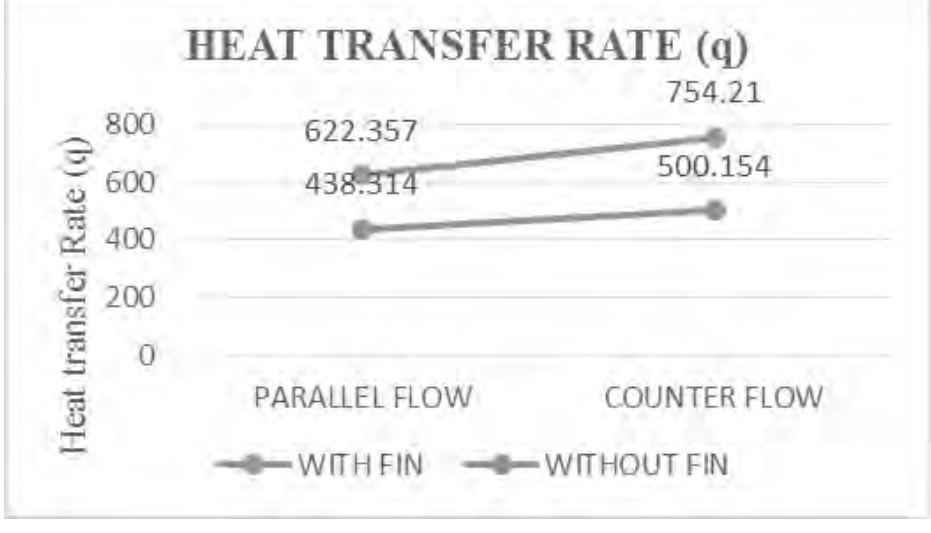
Type of flow	Hot water			Cold water		
	Time for collecting 1 litre of water (t_h) (sec)	Inlet temp (T_{hi}) (°C)	Outlet temp (T_{ho}) (°C)	Time for collecting 1 litre of water (tc) (sec)	Inlet temp (T_{ci}) (°C)	Outlet temp (T_{co}) (°C)
Parallel flow	34.57	58	54	27.64	32	35
	36.73	60	56	30.18	32	35
	38.84	62	58	31.08	32	35
	37.33	62	59	28.74	32	36
	37.46	64	60	29.38	32	35
Counter flow	30.89	57	53	33.15	30	33
	31.36	58	53	32.86	30	33
	31.49	61	56	33.19	30	33
	31.86	60	55	32.46	30	34
	32.5	62	58	30.18	30	33

B) Double pipe heat exchanger with longitudinal fins

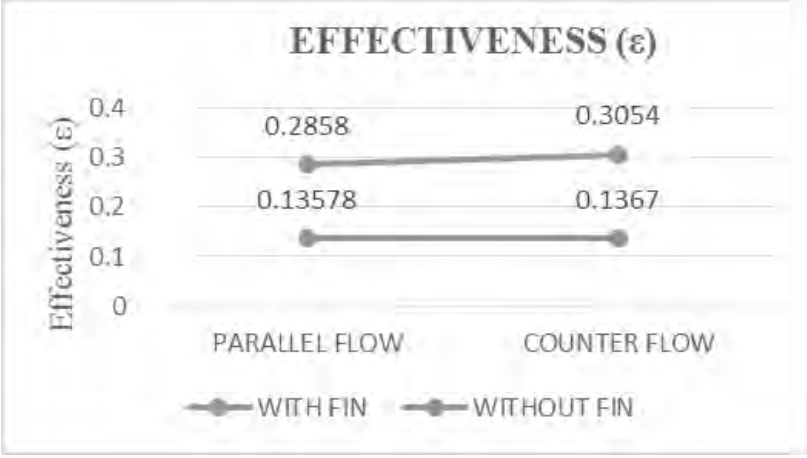
Type of flow	Hot water			Cold water		
	Time for collecting 1 litre of water (t_h) (sec)	Inlet temp (T_{hi}) (°C)	Outlet temp (T_{ho}) (°C)	Time for collecting 1 litre of water (tc) (sec)	Inlet temp (T_{ci}) (°C)	Outlet temp (T_{co}) (°C)
Parallel flow	30.78	57	53	63.04	34	41
	32.89	59	55	54.52	34	41
	36.13	61	55	46.51	35	42
	35.55	60	54	45.36	34	41
	38.34	63	55	41.23	34	41
Counter flow	22.86	51	46	34.19	34	38
	30.02	59	52	54.63	34	42
	38.11	63	56	41.42	34	42
	40.12	63	56	39.2	34	42
	38.43	63	56	40.39	34	41

5. GRAPH

A) HEAT TRANSFER RATE (q) OF COUNTER FLOW vs PARALLEL FLOW



B) EFFECTIVENESS (ε) OF COUNTER FLOW vs PARALLEL FLOW



6. RESULTS

TABLE- A

S. No	Description	Without Fins		With Fins	
		Parallel Flow	Counter Flow	Parallel Flow	Counter Flow
1	Heat transfer rate (q) (W)	438.314	500.154	622.357	754.21
2	LMTD	25.53°C	25.43°C	22.54°C	18.89°C
3	Overall heat transfer co-efficient (U)	270.936 W/ m^2K	308.23 W/ m^2K	515.64 W/m^2K	647.882 W/m^2K
4	Effectiveness (ε)	0.1357	0.1367	0.2858	0.3054

TABLE- B

S. No	Description	Actual
1	Fin Efficiency (η)	98.4%
2	Fin Effectiveness (ε)	47.31

7. CONCLUSION

Through this experimental study following results were derived-

- Efficiency of fin and effectiveness of fin are 98.4% and 47.31 respectively
- Heat transfer rate increased by 31.29% when comparing without fins.
- Over all heat transfer co-efficient 49.9% increased when comparing without fins.
- Counter flow gives more effectiveness compared to parallel flow with fin study 54% increment.

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HARMONIC ANALYSIS OF STANDARD IEEE 14 BUS USING PASSIVE FILTER

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ABSTRACT

In recent years there has been widespread use of power electronics devices and nonlinear elements in rectification and switchgear applied to various areas of power system. At the same time the power quality and safe operation becomes inferior. Therefore mitigation of harmonics is very necessary under the situation. Due to non linear loads in Power systems generate different levels of harmonics which can no longer be ignored by engineers. For harmonic analysis, the network was investigated using MiPower software package. it was found that MiPower software is the preferred package for power system harmonic analysis. As harmonic reduction solution, passive filter is used to decrease the distortion. This paper includes the method to design the passive filter and its impact on Power quality. The simulation has been performed on the IEEE 14-Bus power system and accurate harmonic models considering voltage distortions are established for a nonlinear load. To reduce the harmonic voltages impressed upon specific parts of the sample power system, passive filter is being installed.

Keywords: *Harmonic analysis, Mi Power software, Total harmonic Distortion (THD), passive filters, Current distortion limits.*

1. INTRODUCTION

Nowadays industries prefer to use power electronics based devices due to their effectiveness. Though these power electronics based devices are advantageous to the electronics and electrical industry, these devices generate and inject the harmonics in the power industry. These harmonics are known as electrical disturbances which are the main cause of the power quality associated harms. The main problems due to the harmonics are additional power losses in the electrical equipment, irregular function of protective devices, errors in measurement of metering devices and interference with the telecommunication lines. Therefore mitigation of harmonics and improvement of the power quality is essential under the situation. Fortunately, the available software for harmonic analysis has also grown. Also guidelines for the acceptance of harmonic distortion are well-defined in IEEE Standard 519-1992, It defines the current distortion limits and Voltage distortion limits for the system design which should be met at the point of common coupling (PCC) with the utility.

2. POWER QUALITY MEANING AND IMPROVEMENT

Power system is suffering from the power quality problem like notching, noise, interruption of supply, voltage sag, destroy the wave shape of the waveform of the voltage, current, power etc….That last one is called harmonic, which is severe problem that power system engineers face now a days. Issue of harmonic distortion is primarily due to the incorporation of more non-linear loads in a typical industrial plant. Power electronic based devices are widely used for inversion, rectification and other applications. Though these devices are more effective they generate and inject harmonics into the power system. A harmonic is a sinusoidal component of a periodic wave having a frequency that is an integral

multiple of the fundamental frequency.

Some examples of nonlinear loads are:

- Adjustable drive systems
- Cycloconverters
- Arc furnaces
- Switching mode power supplies
- Computers, copy machines, and television sets
- Static var compensators (SVCs)
- HVDC transmission
- Electric traction
- Wind and solar power generation
- Battery charging and fuel cells
- Slip recovery schemes of induction motors
- Fluorescent lighting and electronic ballasts

Harmonic can lead to power system inefficiency. Some of the negative ways that harmonics may affect plant equipment are increasing "skin effect" in conductor or cables, dielectric failure or rupture the capacitor, false or spurious operations and trips, damaging or blowing components for no apparent reason, Transformers have increased iron and copper losses etc, in short it change in characteristics of the electric loads, and causing equipment to fail prematurely, so this is the reasons behind the growing concern about power quality.

Several different solutions are proposed for harmonic mitigation like multiphase arrangement, active filter, passive filter or hybrid filter etc.. The right choice is always dependent on a variety of factors, such as the activity sector, the applicable standards, the power level.

3. ROLE OF PASSIVE FILTERS

Passive filters can be used in the power systems to reduce harmonic voltages and notch effects at particular points. It consists of reactors and capacitors set up in a resonant circuit configuration which is tuned to the frequency of the harmonic order to be mitigated.

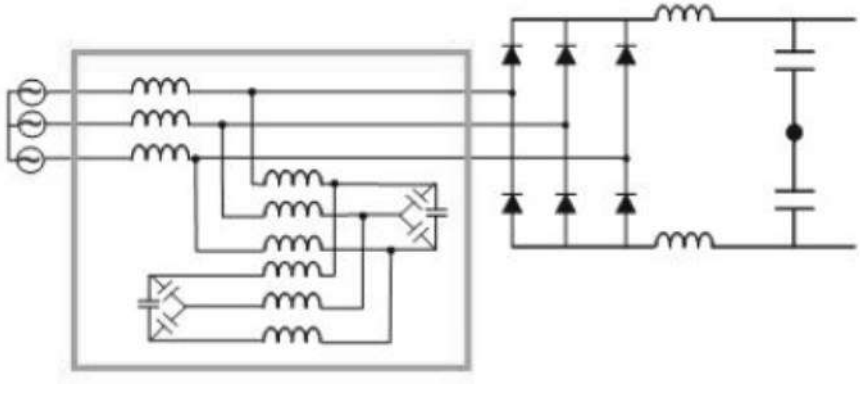

Fig. 1. Passive filter

Usually, the passive filters include different types of parallel paths that present relatively low impedance to the various harmonics. There exists a flow of harmonic currents into this reduced impedance such that the harmonic voltage at that point is reduced. Passive filters are widely used in conjunction with utility-type static VAR compensators and ac electric arc furnaces with megawatt ratings.

This research paper makes use of a passive filter while computing THD for a nonlinear load. In this paper power quality improvement with passive filter has been verified by the simulation results with MIPOWER software.For designing the single tuned filter it is essential to select the appropriate capacitor value that enables good power factor at system frequency.

4. ABOUT MIPOWER SOFTWARE

The manual calculation for a sample power system with a non linear load can be rather repetitive and tiresome and there is also a significant chance of human error being introduced. So it is better to use software packages such as 'MiPower' software.

MiPower is the state-of-the-art windows based power systems software. It is highly interactive and user friendly software for all analysis, planning, design and simulation of any given power system irrespective of the geographical and environmental constraints. With the use of this software, power system engineers can become productive with minimum effort and time and results are emphatically visible.

The software is armed with robust power system engine in the backend and a lucid top-notch Windows Graphical User Interface (GUI) in the front end. Highly intuitive GUI makes the learning curve smooth to a great extent. It has widely been used by power utilities, academic & research institutes for more than a decade. The software, significantly, holds field proven & time tested approach, technique &methodology. This conforms to world-wide accepted standards such as ANSI, IEEE, IEC and other standards.

5. SIMULATION CIRCUIT AND RESULT

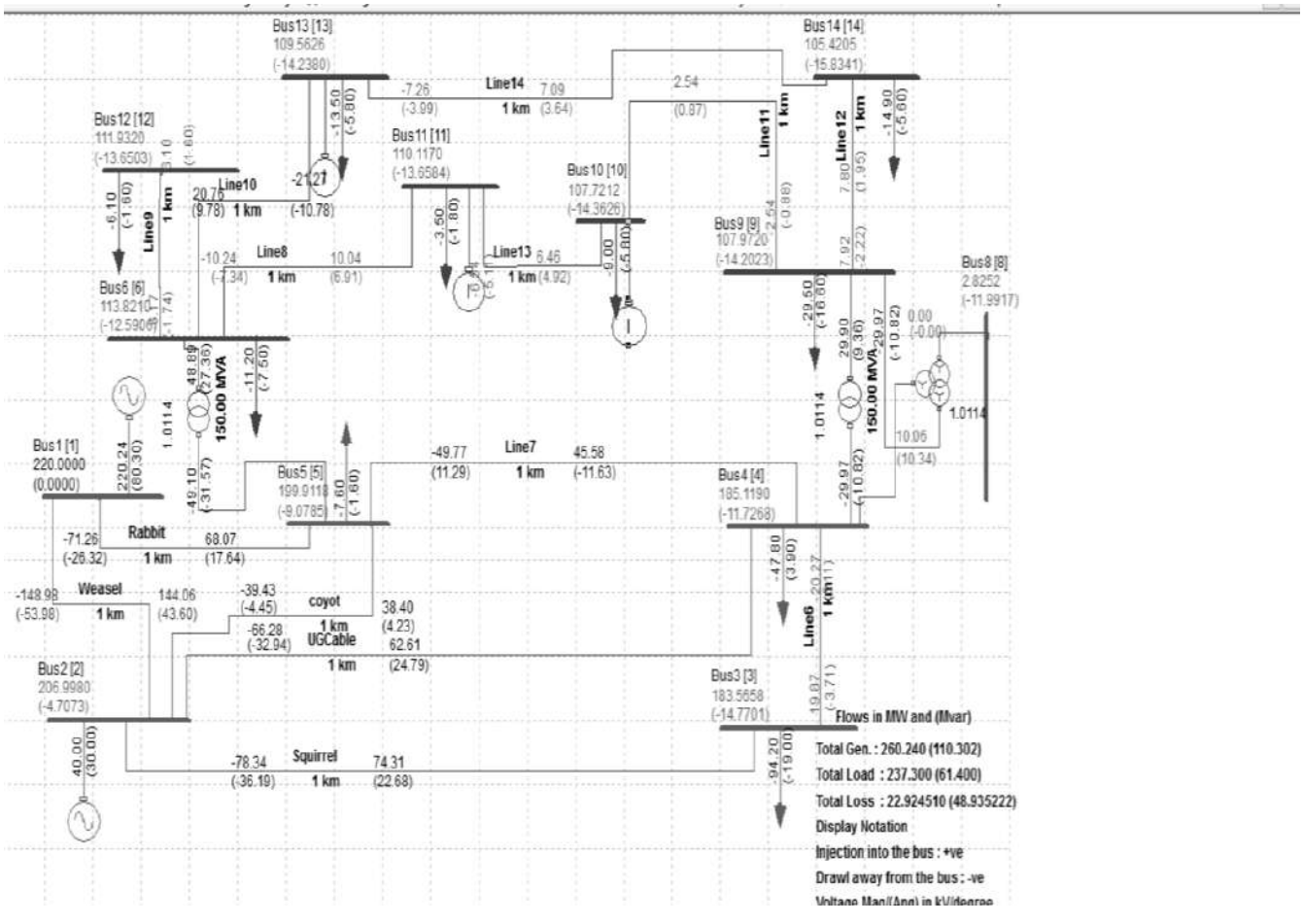

Figure:-2 Simulation Circuit of Ideal IEEE 14 Bus System in MI-POWER **(CASE-I, Without Filter)**

Table 1. Generator Data

MVA rating	50
MW rating	40
Rated voltage inkV	220
R_a	0.004593 p.u
X_2	0.149 p.u
X_0	0.066 p.u
X_d	2.036 p.u
X_d'	0.237 p.u
X_d''	0.185 p.u
X_q	1.8 p.u
X_q'	0.33 p.u
X_q''	0.1678 p.u

Table 2. Bus Data

Bus No.	Base Voltage(kV)	Minimum Voltage(kV)	Maximum Voltage(kV)
1	220	209	231
2	220	209	231
3	220	209	231
4	220	209	231
5	220	209	231
6	132	125.4	138.6
8	3.3	3.135	3.465
9	132	125.4	138.6
10	132	125.4	138.6
11	132	125.4	138.6
12	132	125.4	138.6
13	132	125.4	138.6
14	132	125.4	138.6

Table 3. Line data

Line No.	From bus No.	To bus No.	Positive sequence resistance (p.u.)	Positive sequence reactance (p.u.)	Positive sequence susceptance (p.u.)	Zero Sequence resistance (p.u.)	Zero Sequence reactance (p.u.)	Zero sequence susceptance (p.u.)
1	1	5	0.05403	0.22304	0.0246	0.0035	0.0035	0.0035
2	1	2	0.01938	0.05917	0.0246	0.0035	0.3298	0.000001099
3	2	3	0.04699	0.19797	0.0219	0.0035	0.3298	0.000001099
4	2	4	0.05811	0.17632	0.0187	0.0035	0.3298	0.000001099
5	2	5	0.05695	0.17388	0.017	0.0035	0.3298	0.000001099
6	3	4	0.06701	0.17103	0.0173	0.0035	0.3298	0.000001099
7	4	5	0.01335	0.04211	0.0064	0.0035	0.3298	0.000001099
8	6	11	0.09498	0.1989	0	0.0035	0.3298	0.000001099
9	6	12	0.12991	0.25581	0	0.0035	0.3298	0.000001099
10	6	13	0.06615	0.13027	0	0.0035	0.3298	0.000001099
11	9	10	0.03181	0.08450	0	0.0035	0.3298	0.000001099
12	9	14	0.12711	0.27038	0	0.0035	0.3298	0.000001099
13	10	11	0.08205	0.19207	0	0.0035	0.3298	0.000001099
14	12	13	0.22092	0.19988	0	0.0035	0.3298	0.000001099
15	13	14	0.17093	0.34802	0	0.0035	0.3298	0.000001099

Table 4. Load data

Load No.	Bus No.	MW rating	MVAr rating
1	2	21.7	12.7
2	3	94.2	19
β	4	47.8	-3.9
4	5	7.6	1.6
5	6	11.2	7.5
6	9	29.5	16.6
7	10	9	5.8
8	11	3.5	1.8
9	12	6.1	1.6
10	13	13.5	5.8
11	14	14.9	5.6

Table 5. Two winding Transformer data

Rated MVA	Rated Voltage (kV)	% impedance
150	220/132	10

Table 6. Three winding Transformer data

Rated MVA			Rated Voltage(kV)			%impedance (Positive)			%impedance (Zero)		
Pri.	Sec.	Tertiary	Pri.	Sec.	Tertiary	Pri.	Sec.	Tertiary	Pri.	Sec.	Tertiary
150	105	50.25	220	132	3.3	0.31913	0.28616	0.038527	0.01	0.022	0.028

Fig. 3. THD Result: (Without harmonic filter) (Case-I)

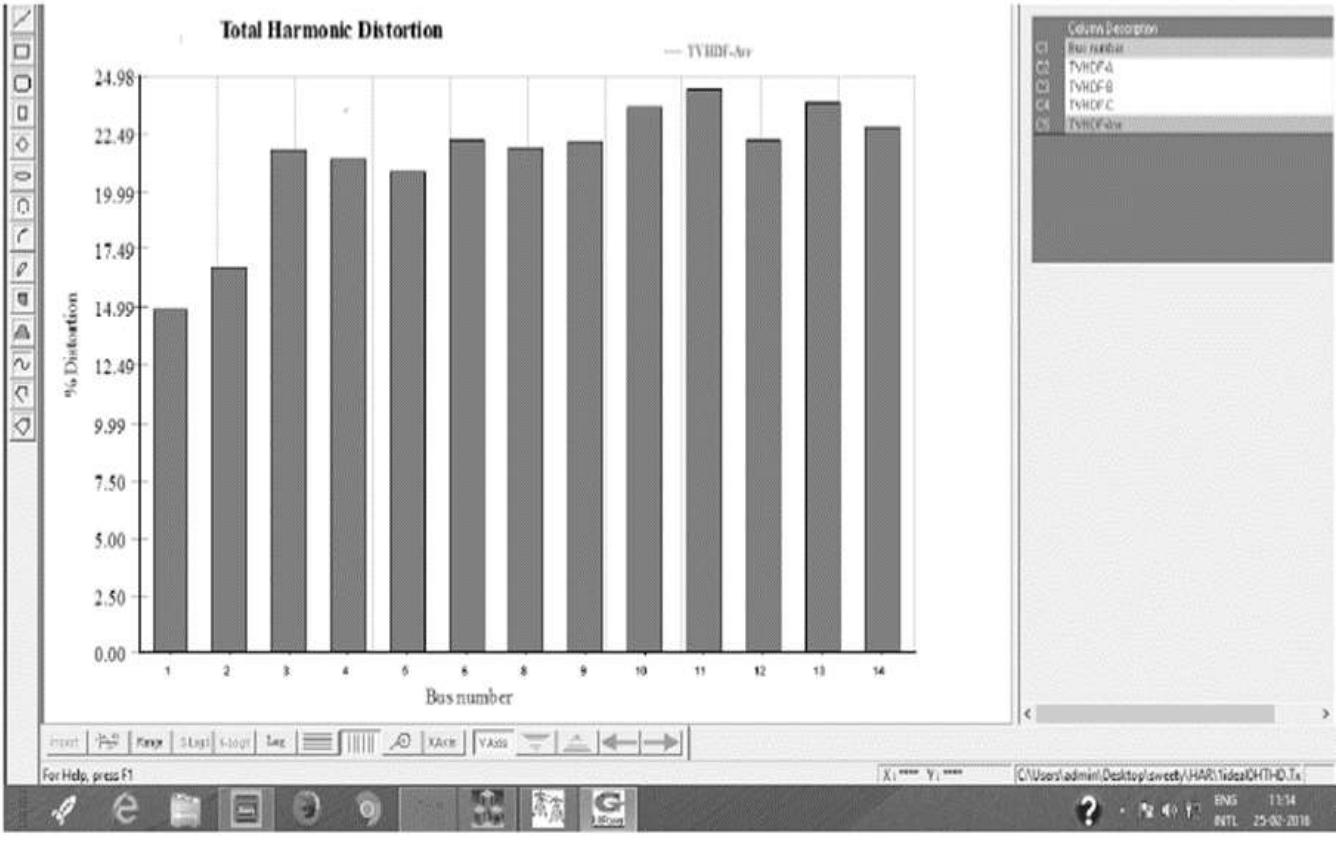

Table 7. Individual Voltage Harmonic Distortion on all bus (Phase A) (Case-I)

NAME	%HDF-T	%HDF-5	%HDF-7	%HDF-11
Bus1	15.2092	11.3329	9.9224	2.1049
Bus2	17.0168	13.0321	10.6908	2.333
Bus3	22.2185	17.6925	13.0418	3.248
Bus4	21.8193	18.8301	10.9118	1.5631
Bus5	21.3003	18.3415	10.7227	1.4897
Bus6	22.7264	21.2735	7.9736	0.5922
Bus8	22.3473	19.4483	10.9144	1.4291
Bus9	22.6725	20.7867	9.0503	0.2137
Bus10	**24.1146**	**23.0653**	**6.875**	**1.4967**
Bus11	**24.9845**	**24.2308**	**5.5747**	**2.4524**
Bus12	22.7264	21.2735	7.9736	0.5922
Bus13	**24.3147**	**23.4433**	**6.1319**	**2.0044**
Bus14	23.698	21.9477	7.7711	0.8042

Table 8. Total Voltage Harmonic Distortion on all bus: (Case-I)

NAME	%HDF-A	%HDF-B	%HDF-C	%HDF-Avg
Bus1	15.2268	15.203	15.1978	15.2092
Bus2	17.0363	17.0099	17.0041	17.0168
Bus3	22.2432	22.2099	22.2025	22.2185
Bus4	21.8411	21.8105	21.8034	21.8193
Bus5	21.3246	21.2918	21.2846	21.3003
Bus6	22.751	22.7176	22.7105	22.7264
Bus8	22.3636	22.3219	22.3563	22.3473
Bus9	22.6976	22.6635	22.6563	22.6725
Bus10	**24.1396**	**24.1056**	**24.0986**	**24.1146**
Bus11	**25.009**	**24.9755**	**24.9688**	**24.9845**
Bus12	22.7511	22.7176	22.7105	22.7264
Bus13	**24.3393**	**24.3058**	**24.299**	**24.3147**
Bus14	23.3218	23.2878	23.2808	23.2968

CASE II: WITH PASSIVE FILTER

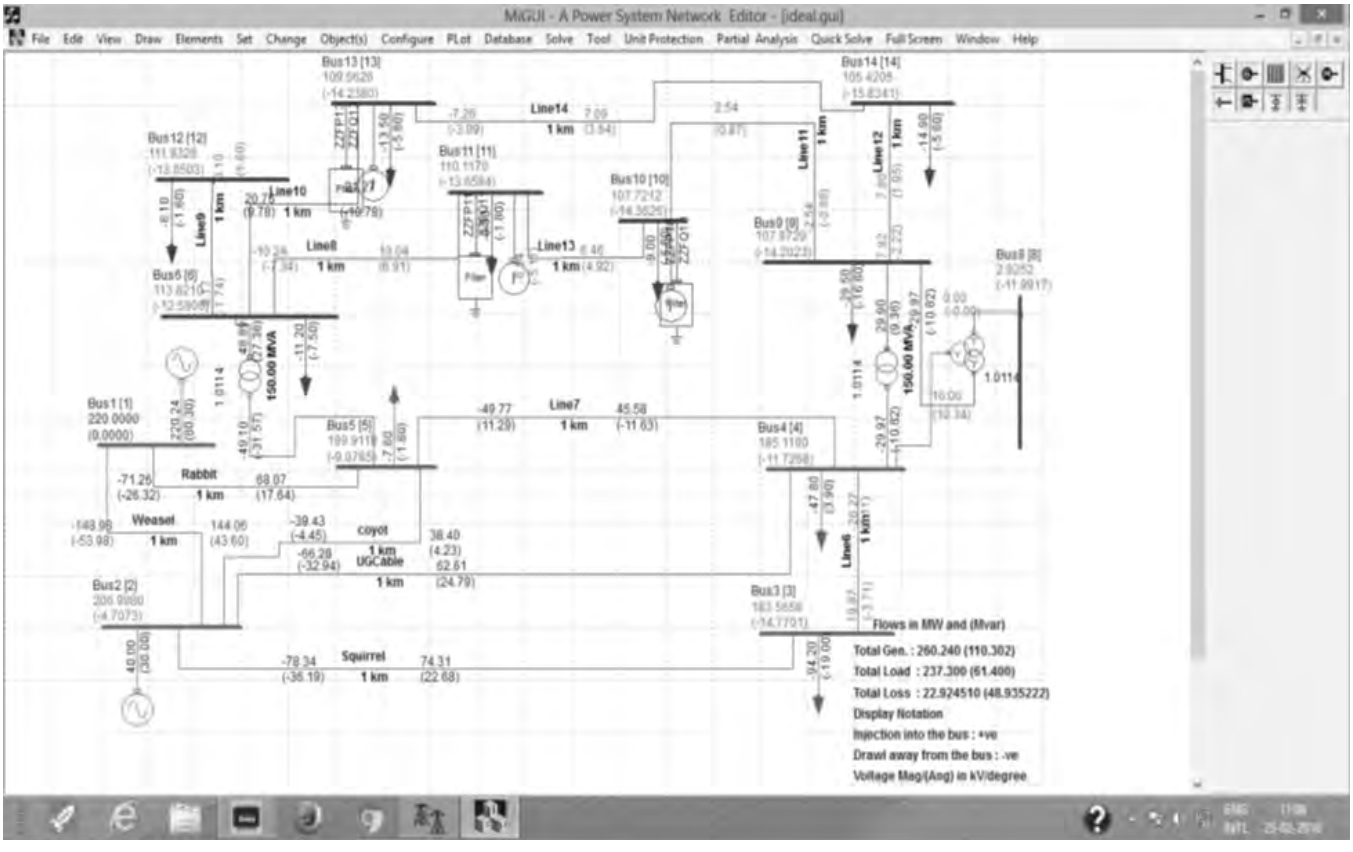

Fig. 4. IEEE- 14 bus system model in MiPower with Passive filter

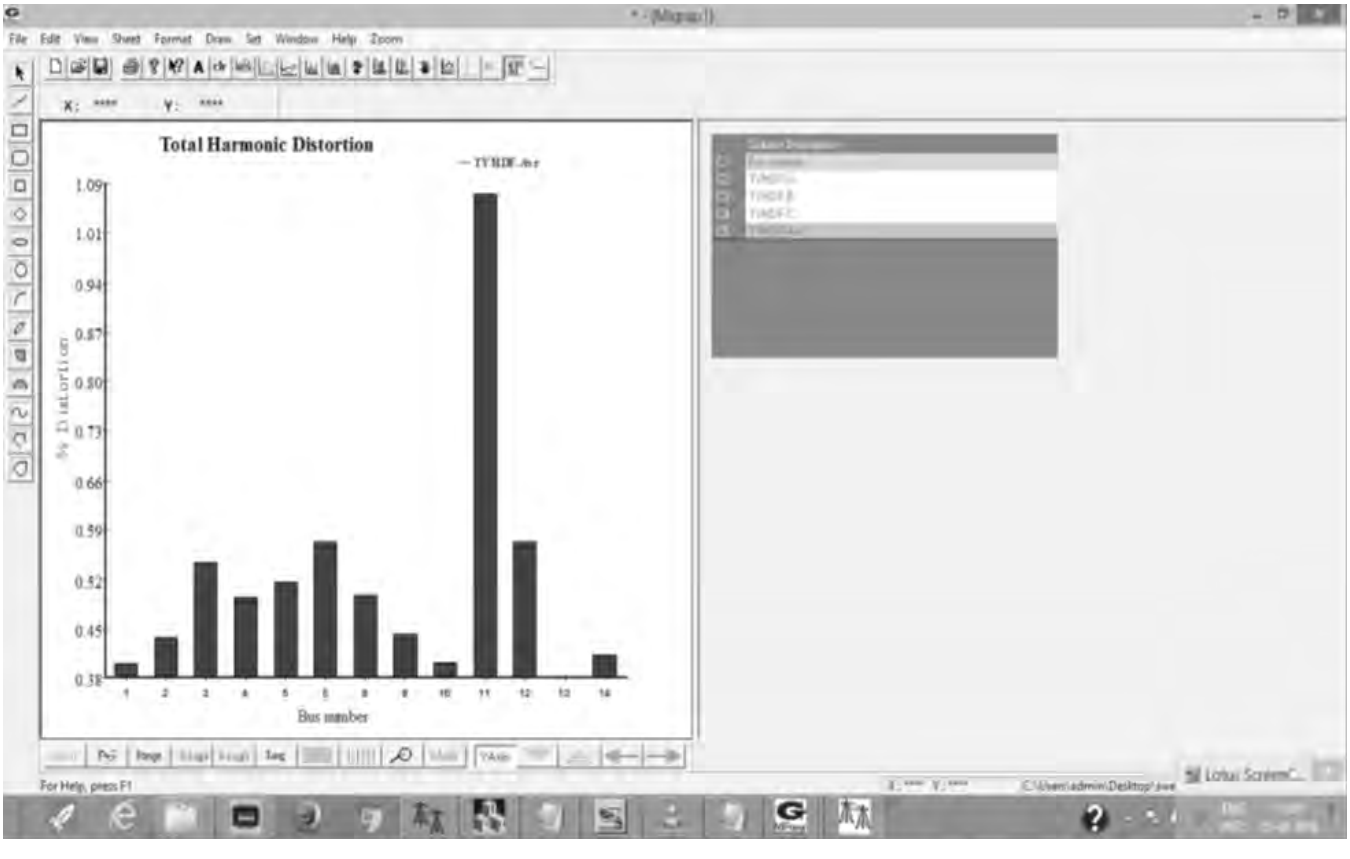

Fig. 5. THD Result: (With Passive Filter) (Case-II)

Table 9. Individual Voltage Harmonic Distortion on all bus (Phase A): (Case-II)

NAME	%HDF-T	%HDF-5	%HDF-7	%HDF-11
Bus1	0.399	0.2219	0.3237	0.0722
Bus2	0.4364	0.2524	0.3469	0.0803
Bus3	0.5467	0.3344	0.4176	0.1126
Bus4	0.4951	0.3506	0.3453	0.0547
Bus5	0.5159	0.3694	0.3567	0.0502
Bus6	0.5761	0.4851	0.3096	0.0266
Bus8	0.4981	0.3583	0.3423	0.0505
Bus9	0.4411	**0.356**	**0.2603**	0.0106
Bus10	**0.4007**	**0.3656**	**0.1574**	**0.04569**
Bus11	**1.085**	**0.9666**	**0.4706**	**0.1466**
Bus12	0.5761	0.4851	0.3096	0.0266
Bus13	**0.3773**	**0.3418**	**0.153**	**0.0458**
Bus14	0.41	0.3498	0.2133	0.0156

Table 10. Total Voltage Harmonic Distortion on all bus : (Table-6) (Case-II)

NAME	%HDF-A	%HDF-B	%HDF-C	%HDF-Avg
Bus1	0.399	0.399	0.399	0.399
Bus2	0.4364	0.4364	0.4364	0.4364
Bus3	0.5467	0.5467	0.5467	0.5467
Bus4	0.4951	0.4951	0.4951	0.4951
Bus5	0.5159	0.5159	0.5159	0.5159
Bus6	0.5761	0.5761	0.5761	0.5761
Bus8	0.4981	0.4981	0.4981	0.4981
Bus9	0.4411	0.4411	0.4411	0.4411
Bus10	**0.4007**	**0.4007**	**0.4007**	**0.4007**
Bus11	**1.085**	**1.085**	**1.085**	**1.085**
Bus12	0.5761	0.5761	0.5761	0.5761
Bus13	**0.3773**	**0.3773**	**0.3773**	**0.3773**
Bus14	0.41	0.41	0.41	0.41

6. CONCLUSION

This paper has dealt with the standard IEEE-14 Bus power system, for which the considered harmonic analysis program has been found to be extremely fast. The effective use of the software has drawn several conclusions related to the harmonic distortions for the power system to operate under two following different cases:

The first case, where the system has not considered any filter, has described the THD for the voltages at all the buses considering the simulation of the nonlinear load. And we consider buses 10,11,13. The maximum value of the distortion has come as 24.98(%).

The second case, where the system has been considered with a single passive filter at respective buses have described the THD for the voltages at all the buses considering the simulation of the nonlinear load. The specific conclusion that has been drawn is that the distortions get reduced to a reasonable extent comparatively to the system considered without any filter. The distortion has been observed as maximum at bus 11 as the nonlinear load has been simulated at that bus. The maximum value of the distortion has come as 1.085(%).

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MEASURING CARBON FOOTPRINT IMPACTS OF MICROFINANCE: AN EMPIRICAL STUDY OF DEOGHAR DISTRICT, JHARKHAND

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ABSTRACT

Although, Microfinance has received significant academic attention, the impact of Microfinance on the environment has recently started to appear in academic research. The novel phenomenon of Green Microfinance has been the center of analysis of some recent research work. However, most empirical work in this fledgling field has focused on the Micro Finance Institutions (MFIs) level. This study attempts to study the environmental impact of Microfinance loans by considering individual loanees as the unit of analysis. The study presents summarized findings of 214 microfinance beneficiaries from the district of Deoghar, Jharkhand using Carbon Footprint calculations across rural and urban settings. The empirical analysis suggests that rural carbon footprint of agricultural activity is significantly more than urban micro-enterprises suppored by Microfinance. The reason for this difference seems to be non-environment friendly agricultural techniques and raw materials. Policy implications of the findings are also briefly discussed.

Keywords: *Carbon Footprint, Environment Protection, Green Microfinance, Microfinance*

1. INTRODUCTION

The need for Financial Inclusion and Environmental protection have received significant independent academic attention. (for ex. Allet, 2014; Desjardins et al., 2012; Gutiérrez-Nieto, Serrano-Cinca, & Mar Molinero, 2007; Pandey, Agrawal, & Pandey, 2011; Serino & Klasen, 2015) However, lately, the field of Green Microfinance has attempted to combine the two important practical and academic fields to better combine endeavors of Financial Inclusion and

Environmental Protection. (Moser & Gonzalez, 2015) Studies in Green Microfinance have almost exclusively looked at Microfinance Institutions (MFIs) as the unit of analysis. However, the actual use of loan amounts by Microfinance customers has not received significant academic attention. Further, there is a paucity of studies measuring the environmental impacts of Microfinance operations in India. This study attempts to measure the Carbon Footprint of actual utilizations of Microfinance loans across four distinct economic activities: Agriculture, Livestock, Microenterprises and Households from respondents in the Deoghar District of Jharkhand. The study compares loan utilizations across both rural and urban settings within the district and their environmental impacts. The main conceptual premises of the paper are presented below.

2. FINANCIAL INCLUSION AND MICROFINANCE

"Financial inclusi[=;-[p'l/ kcxz\on may be defined as the process of ensuring access to financialservices and timely and adequate credit where needed by vulnerable groups such asweaker sections and low income groups at an affordable cost." (The Committee on Financial Inclusion (Chariman: C. Rangarajan), 2008, p. 1)

Microfinance is one of the tools used to promote Financial Inclusion. In India, the Eleventh Five Year Plan aimed at an inclusive growth and faster reduction of poverty. Their reports state "Micro Finance can contribute immensely to the financial inclusion of the poor without which it will be difficult for them to come out of the vicious cycle of poverty." The report acknowledges the fact that in order to enable the poor people to access credit , there is a need to strengthen all the available channels of providing credit to the poor such as SHG- Bank Linkage programmes, Micro Finance Institutions, Cooperative Banks, State financial corporations, Regional Rural Banks and Primary Agricultural Credit Societies. While appreciating the need for adequate regulation and standardization of the various processes and practices adopted by the Micro Finance Institutions, the report underlines the fact that the strength of the micro finance industry lies in its informality and flexibility which should be protected and encouraged.

The World Bank defines Microfinance as the "the provision of financial services to low-income clients, including the self-employed."(Ledgerwood, 1999, p. 1) It applies to both rural and urban settings where low-income households might be devoid of access to the formal banking structure. The microfinance revolution, particularly the success stories of institutions like Bangladesh's Grameen Bank (Yunus, 2007), Bolivia's Banco Sol and Indonesia's Bank Rakyat attracted several economists to study microfinance in the latter half of the 1990s. Since then, innovation in microfinance has continued and providers of financial services to the poor continue to evolve.

Microfinance means providing very poor families with very small loans (micro credit) to help them engage in productive activities /small businesses. Over time, microfinance has come to include a broader range of services (credit, savings, insurance, etc.) as we have come to realize that the poor and the very poor lack access to traditional formal financial institutions and require a variety of financial products customized to their requirements. United Nations' previous Secretary General Kofi Annan emphatically stated that microfinance was "…in no way charity; rather, it offered the same rights and services to low-income households as everyone else and recognized that they were the solution, not the problem." (United Nations, 2004)

In the Indian setting, Microfinance has been defined as: "… an economic development tool whose objective is to assist the poor to work their way out of poverty. It covers a range of services which include, in addition to the provision of credit, many other services such as savings, insurance, money transfers, counseling, etc." (Reserve Bank of India, 2011)

The big question globally is whether Microfinance is a potent tool for poverty reduction/alleviation and other related outcomes. Various aspects of Microfinance impacts have been studied in the recent past. Some of the aspects that have received significant attention are: women empowerment, for ex. (Selome & Tshuma, 2014)(Arora & Meenu, 2011) (Chowdhury & Chowdhury, 2011), financial performance, for ex. (Ngo, Mullineux, & Ly, 2014)(Kar & Bali Swain, 2014) poverty alleviation, outreach for ex. (Abate, Borzaga, & Getnet, 2014) (Hudak, 2012) Each of the impacts mentioned above has been studies both through the use of case studies as well as empirical tests.

However, the impact of microfinance on the environment has not received considerable academic attention till recently. The recently evolving Green Microfinance concept has begun to explore the various perspectives of environmental impact related to Microfinance activity.

3. GREEN MICROFINANCE

Recently, concern for climactic impacts have been included into the discussion of Microfinance "Green microfinance is a new research field that has emerged from the combination of two a priori distinct concepts: microfinance (MF) and climate change (CC)."(Moser & Gonzalez, 2015, p. 242) One of the most cited examples of Green Microfinance is the efforts of Grameen Shakti which focuses on combining micro-credit to bring solar lighting to rural Bangladesh. (Allet & Hudon, 2013) The Microfinance sector comprises of various players which vary in their sizes, maturity, focii and strategies. (Gutiérrez-Nieto et al., 2007) However, as the field of Green Microfinance is new, scholars and organizations alike have not agreed on the applicability and objectives of Green Microfinance. (Allet & Hudon, 2013) A group of studies have focused on the environmental impacts of Microfinance Institutions (MFIs). (Allet & Hudon, 2013; Forcella & Hudon, 2014) However, studies understanding

4. CARBON EMISSIONS AND MEASUREMENT

The field of Carbon Footprint estimation has been argued to start from the work on "ecological footprint" of Wackernagel and Reese, 1996. Based on the broad understanding of human induced global warming, The *Kyoto Protocol*, 1997,and the *Paris Agreement*, 2015, binds both developed and developing nations to systematically reduce their Green House Gases (GHGs) (including six important gases: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), set of perfluorocarbons, and hydrofluorocarbons) (Pandey et al., 2011)

Carbon Footprint estimation is an evolving area of research. The kinds of greenhouse gases to be included in the analysis and the estimation formulae are subjects of intense debate. (Pandey et al., 2011)A wide variety of works in this field only consider Carbon-di-oxide emissions in their calculations (Wiedmann & Minx, 2007) while developments in the estimation methods have led to the inclusion of other gases in the Carbon Footprint Calculations. (Pandey et al., 2011)

Significant attention has being paid recently to develop area specific frameworks of Carbon Footprint estimation. (Desjardins et al., 2012; Hillier et al., 2009; Serino & Klasen, 2015) Applying both top-down and bottom-up approach to Life Cycle Assessment of Green House Gas Emissions, many recent academic works suggest the use of hybrid methods of Carbon Emissions (CE) estimation. (Pandey et al., 2011) However, there are still outstanding issues in specific cases of estimation. (Johnson, 2008)

5. RESEARCH METHODOLOGY

The present study focuses on the actual utilization of Microfinance loans and places individual Microfinance loan customers as the unit of analysis. The study utilizes Self Help Group members in the Deoghar district of Jharkhand. The study utilizes previously established Carbon Footprint estimation frameworks related to the following four economic activities: Agriculture, Livestock, Micro-enterprises and Household activities. The Carbon Footprint impact of all four mentioned economic activities have been studied in non-Indian settings in the extant literature. This study utilizes the same frameworks for their analysis. (Agriculture: Hillier et al., 2009, Livestock: Desjardins et al., 2012, Microenterprises and Households: Serino & Klasen, 2015) Based on the responses of Microfinance loan customers regarding the actual utilization of loans, Carbon Footprints of individual loan uses were calculated using questionnaires derived directly from extant frameworks (as mentioned above). A Life-Cycle approach is used to calculate Carbon Emissions (CE) For example, in the case of Livestock, the Carbon Footprints of maintaining the Livestock across average life of such animals is used. Similarly, in case of micro-enterprises dealing with multi-year assets like generator sets, the average life cycle of such assets and their average yearly use were incorporated to calculate the Carbon Footprints of such activities. Further, only those aspects of the economic activity were considered which directly resulted from the utilization of the Microfinance loan. For example, existing agricultural activity of the Microfinance consumer not related to the loan were not analyzed.

The study includes respondents which are customers of five difference Microfinance Institutions (MFIs) operating in the district of Deoghar. Respondents are classified according to their rural or urban residences and statistical tests (Independent Sample t-test) are applied to check for significant differences between rural and urban Carbon Footprints across the four economic activities mentioned earlier. The results and their analysis are discussed below briefly.

6. RESULTS AND DISCUSSION

Deoghar, one of the 24 districts of Jharkhand, is located in the North Eastern edge of the state. It is famous for being a pilgrimage center and attracts many tourists every year. The district is located in the western portion of the Santhal Parganas division and its administrative headquarters are based in the town of Deoghar. (Government of Jharkhand, 2016)

It constitutes of the following 10 administrative blocks: Deoghar, Mohanpur, Sarwan, Sona Rai Tharhi, Devipur, Madhupur, Margo Munda, Karon, Sarath and Palojori. (Department of Planning and Development, Government of Jharkhand, 2014) Key social indicators of Deoghar are presented in Table 1. (Department of Planning and Development, Government of Jharkhand, 2014)

Deoghar has a total of 142 banks (21) and cooperative societies (121) with 224 branches across the district. As of 2010, 4 MFIs and 4000 SHGs were operating in the district. (NABARD, 2012)

Based on the research methodology described above this study collected respondent data from 232 Microfinance loan customers engaged in one of the four economic activities: Agriculture, Livestock, Microenterprises and households. After analysis of collected responses, 18 responses were omitted from further analysis due to the presence of incomplete date. A total of 113 rural respondents and 101 urban respondents were interviewed with detailed questions on the use of raw materials, energy usage and technical processes used.

The summarized findings of the study are presented in Table I below.

Table I

Summarized Findings

Total Respondents	Type of Location	Nbr of Respondents	Types of Activities	Nbr of Respondents	Average Total Carbon Footprint (kgCE)	Statistical Significance (Ind Sample t-test)
214	Rural	113	Agriculture	46	15.48	*
			Livestock	23	2.09	**
			Micro-enterprises	23	10.77	*
			Household	21	1.89	**
	Urban	101	Agriculture	14	9.29	*
			Livestock	28	2.34	**
			Micro-enterprises	38	12.56	*
			Household	21	2.12	**

* - Significant at 95% Confidence Level
** - Significant at 90% Confidence Level

As can be observed in the summarized findings above, there are some significant findings that need more analysis. Firstly, the Carbon Footprint estimations of Agricultural activities are higher than the other three economic activities in both rural and urban settings. The most plausible reason for the same is the use of fertilizers and pesticides as well as carbon fuel based energy sources for irrigation and plowing. Secondly, there is a significant difference between rural and urban Carbon Footprints of Agricultural activities. (95% confidence level) The most likely reason for the same is the smaller urban agricultural land holdings per respondents.

The second largest Carbon Footprint contributors are Microenterprises in both rural and urban settings. However, Carbon Footprints of Urban micro-enterprises are significantly higher than their rural counterparts. (95% confidence level) This finding seems to be due to more use of carbon fueled power sources, use of plastics, refrigeration etc. in urban micro-enterprises.

Finally, the minimum contributors to GHGs are Household uses of Microfinance loans in both rural and urban settings.

7. FUTURE RESEARCH AND LIMITATIONS

The results presented above suffer from the following limitations. As discussed above, only four economic activities have been considered for analysis in the study. As research on carbon footprint estimation covers more economic activities, future studies couldinclude other economic activities as well. Further, as the quantum of microfinance loans are small, in some cases, carbon footprint estimations could not be calculated exactly. Also, the data on energy usage of agriculture and microenterprises were not exact due to the lack of formalized usage metrics. Future studies could ensure more exact measurements especially in energy use. Also, the underlying reasons behind the contrasting figures of rural and urban settings need further analysis.

8. CONCLUSION

The study presented above describes a novel approach to measuring the Carbon Footprints of Microfinance loan use in India. Analyzing 214 respondents from the Deoghar district in the state of Jharkhand, the study unearths some key findings. The relatively larger Carbon Footprints of rural agricultural activities points to the environmentally unfriendly processes and raw materials used in agriculture in some Indian settings. Policy makers across financial inclusion and environmental policies need to consider new collaborative policies encouraging eco-friendly agricultural practices across districts in India. Also, policy makers need to consider putting more emphasis on renewable energy use in microenterprises across rural and urban settings.

Combining two highly important yet historically disparate fields of research, this study is a novel attempt to understand the practical environmental impacts of Microfinance loans. In extending the research on Green Microfinance, this research also points to the need of more research in understanding the various impacts that Microfinance has on the environment.

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OBJECT REMOVAL AND REGION FILLING IN IMAGE

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ABSTRACT

There has been a need to remove unwanted artefacts or damaged areas from photographs. This is something previously conducted by experts, using computer tools and extensive user input to produce a visually realistic result. The difficulty of the problem lies in how to fill the missing regions, such that they are perceptually unnoticeable, whilst minimizing user input.

Object removal and region filling algorithm exist for removing unwanted objects from digital images. The challenge is to fill the space that is left behind in visually plausible way. This problem has been addressed by two classes of algorithms: i) "Texture synthesis" for generating large image regions from sample textures, and ii) "In-painting" techniques for filling in small gaps,each being used for images with different characteristics. This paper is concerned with investigating whether advances in texture synthesis techniques contain the necessary functionality to cross the divide between the two and successfully fill holes in a variety of images. The advantage of the proposed techniques is that it limits the amount of knowledge required by the user and performs the region filling autonomously, once started.

1. INTRODUCTION

A. Overview

For years people have been taking photographs of where they have been and who they have been with as a way of remembering occasions that mean a lot to them. This whole time there has been the problem of what to do when such photographs get damaged or have artefacts in the image that are not wanted. The options have always been limited previously with only a few tools out there to help fix the problems at hand. In addition, these tools rely on the experience of the user to ensure that the repairing of the image is done to a satisfactory level. This is not the sort of skill that the average user will have and so the results that they would obtain would not necessarily be satisfactory or of a high standard. Ever since the computer started to become a common appliance in people's homes, the prospect of being able to produce applications to help users repair their own images has started to become more realistic. Initially the algorithms to perform this did not exist and when they started to appear, they only really worked on a small subset of images. Currently, people only have a few options if they wish to have an image repaired, or want an artefact removed from an image. There are tools in popular programs such as Adobe's Photoshop and Corel Draw Pro that aim to help users to repair the images using

information in the image. However, these are not perfect, and require the user to be quite computer literate or have experience of manually fixing images to make the best use of the program they have. Over the years there have been many algorithms put forward to repair images, with varying amounts of autonomy and effectiveness. The advances that have been made have occurred due to different demands from the research areas, with the region filling/repairing problem being broken up into texture synthesis and image in-painting based techniques. This diversion of the techniques away from one unified approach for all images has brought the technology to where it is today. The ideal solution is to have an algorithm that will still enable experienced users the ability to tune it to the images, but allow less experienced users to use it. This however presents a challenge due to the complete division of the techniques used for structure and texture reproduction. There have been numerous attempts to create algorithms that try to maximize the possible range of images they can work on, but these have tended to use a merge process to combine result from different techniques on the same image. The results of implementing an algorithm proposed by Criminisi et al [1] showed that the basic ability did appear to exist in these techniques with some very promising results. However, it did show that there are areas where further work is needed to ensure that the techniques its full potential.This paper addresses the problem of how to fill holes in visual images in a plausible way so that when someone view altered image, they cannot tell that anything has been done to it.The key issue here is filling in the hole in a way that makes the end result look realistic, and where the filling done is not detectable by an outside observer from the intended viewing distance.

Hole filling or region filling as it is sometimes referred to in literature as 'to fill in gap of missing data in a form that it is not detectable by an ordinary observer'. The hole in an image could be caused by a number of factors. For example, a user could want to remove an object from a photograph so they would chop out the part of the image they do not want and then this area would require infilling.

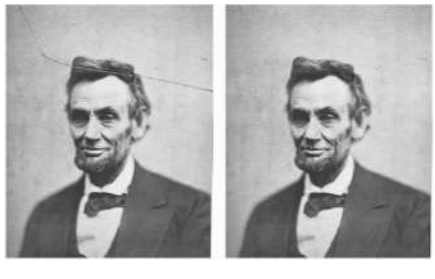
A. Why Infill

There are many areas where hole filling techniques have an important role to play. One of the most obvious area is probably the film industry, in particular the special effect business. The wages and insurance costs for well known actors involved in films these days are very high, and film producer cannot afford to risk the actors being injured during stunts or filming. Therefore safety equipment must be brought in to make sure they are safe when filming the scenes. This is where the problems start to arise; how to avoid the safety equipment obviously should not appear in the final scene, and needs to be carefully removed so that the viewer never realizes that it was there. There are basically two techniques available for infilling, inpainting and texture synthesis.

1. Inpainting

A very good description of the role inpainting plays is given by "to restore and fix small scale flaws in an image, like scratches or stains" [2] [4]. Wilczkowiak et al state that inpainting techniques are best suited for small, low textured holes in images. Criminisi, Perez and Toyama [1] state that inpainting techniques have been developed for the task of 'image restoration, where speckles, scratches and overlaid text are removed'. Inpainting is solely concerned with the propagation of structures into the hole from the image, and so in effect has no interest in the textures that are on the shapes themselves. The algorithms just see lines and curves, and as the texture is not represented as shapes, the algorithm struggles to propagate this information.

The main concern of inpainting techniques is the propagation of information relating to the lines and 2D objects in an input image into the hole in the image. Region Filling states that these techniques fill holes 'by propagating linear structures (called isophotes in inpainting literature) into the target region via diffusion'. The structures (lines and 2D shapes are just a type of structure with given attributes) that meet the boundary of an image hole, are propagated inside it, to try to complete the interactions between the structures that already exist outside the hole.



a b

Fig. 1 – Before and After Image of Inpainting

Fig. 1(a) is the original one with a small scratch. Fig. 1(b) shows the image when the scratch has been removed using inpainting.

2. Drawbacks of Inpainting

Image inpainting concentrates on the structures contained within the image itself, but the way that it does this creates serious drawbacks to the approach. Criminisi et al [1] state that "the drawback is that the diffusion process introduces some blur, which becomes noticeable when filling large image regions". As stated earlier, it is broadly accepted that the inpainting technique is best used on small scale image 'flaws', where the blurring problem is not such an issue.

It is very easy to see the problem is when you look at an image where inpainting has been applied. Inpainting on a large scale is very difficult due to the nature of the process that you are trying to replicate. Currently the best way we have of doing this kind of work is with a person skilled in the art that "repairs images mostly through his experience and knowledge". The difficulty is how to represent this skill, knowledge and experience in an algorithmic form.

3. Texture Synthesis

This is the other technique that is used for image hole filling. It approaches the problem of how to realistically fill the hole, not based on the image structure but on its content. Wei and Levoy. And Efros and Leung [5] are two well known for texture synthesis, which concentrate on techniques for filling of large holes in images by finding the best texture matches from the rest of the image.

According to Heeger and Bergen [8], textures are normally categorised into two distinct categories, structure textures and stochastic textures.

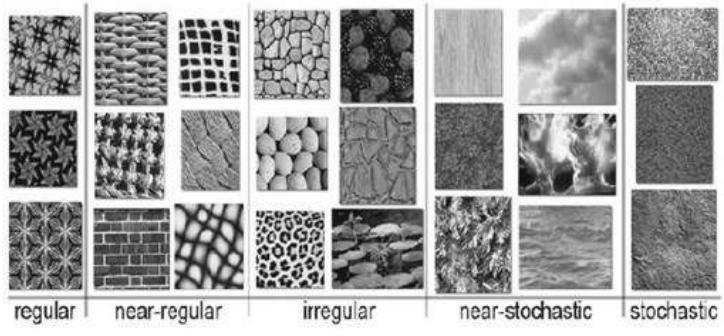


Fig 2. Types of Texture

Examples of stochastic textures are sand, granite, bark etc owing to the irregularity of the patterns in the textures. Images normally do not contain a single type of texture, but are usually an amalgamation of different parts that will be different types of texture.

a b

Fig. 3 – Before and After Image of Texture Synthesis

Fig. 3(a) is the original one with two persons. Fig. 3(b) shows the image when the one person has been removed using texture synthesis.

4. Drawbacks to Texture Synthesis

Bertalmio et al [2] say that the downfall of texture synthesis algorithms is that to fill large areas they need user help to specify textures in certain areas. They also have problems when trying to fill a hole which is surrounded by hundreds of backgrounds, not just textures. This aim is to create a fully automated algorithm that can fill large holes, with both texture and structure in a plausible way.This problem is something that needs to be addressed.

5. Texture synthesis techniques

Depending on reference, texture synthesis can either be split into two. As such, there seems to be no completely accepted division of the techniques within texture synthesis. Texture synthesis can be divided into two distinct areas:-

- Pixel based texture synthesis
- Patch based texture synthesis

5.1 Pixel-Based Texture Synthesis

Efros and Leung's Non-Parametric Sampling synthesizes a texture by repeatedly matching the neighborhood around the target pixel in the synthesis result with the input texture. They perform an exhaustive search for each synthesized pixel. Wei and Levoy's algorithm is based on Efros/leung, extending it to a synthesis pyramid which allows the use of smaller neighborhoods at possibly improved quality. Ashikhmin's [3] intelligent modification significantly reduces search space and achieves interactive frame rates. His paper also thoroughly discusses drawbacks of previous, pixel-based methods, such as blurring.

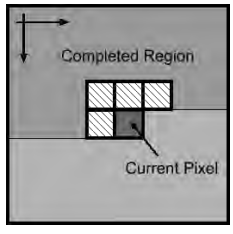
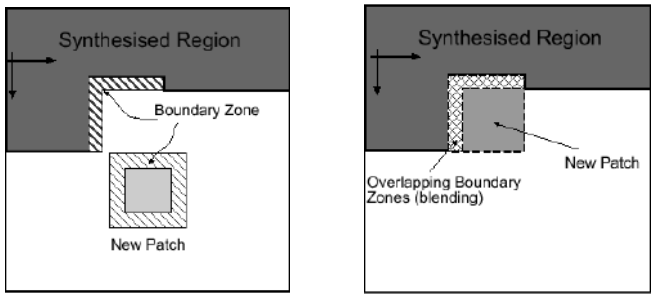


Fig. 4.Pixel based Texture Synthesis

In fig. (4) synthesis process takes place by using pixels. Arrow shows the direction of synthesis process. Current pixel is the pixel which we want to synthesis. Each small square shows the pixel and four white pixels are already synthesized. The value of current pixel depends on already synthesized pixels.

5.2 *Patch-Based Texture Synthesis*

These methods preserve global structure by generating the texture on a per patch basis. Efros and Freeman's Image



a b

Fig. 5 –Patch based Texture Synthesis

Quilting algorithm aligns adjacent patch boundaries, constrained by overlap, and then performs a minimum-error-boundary-cut (MEBC) within the overlap region to reduce overlap artifacts.

In fig. 5(a) considers a rectangular image patch instead of a single pixel at each step of the synthesis. Each rectangular patch has a *boundary zone*, being the area surrounding four borders inside the patch. The difference between boundary zones provides a measure of similarity for two related patches. At each step, a patch, which has the closet boundary zone to the patch at the current location, is selected from the training image and is then stitched into the output image such that its boundary zone overlaps with that of the last synthesized patches (See Fig 5(b)). A blending algorithm has to be used in order to smooth the transition between overlapping patches.

5.3 Method of Texture Synthesis

Non-parametric techniques[5] involve sampling from a series of filters in order to generate textures. Non-parametric sampling as "rather than having a fixed number of parameters they use a series of exemplars to model the texture". The one

characterising feature of all non-parametric sampling techniques is that they sample 1 pixel at a time in order to generate the textures.

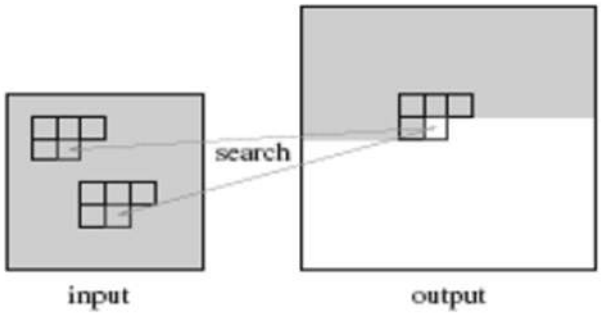


Fig. 6 –Pixel-based Non parametric Texture Synthesis

The sampled pixels are normally obtained from areas in the texture where the neighbourhood of pixels are the closest match to the pixels in the neighbourhood of the pixel to be replaced. The most common approach taken to find this pixel is to consider the sum of squared differences of pixel values, and then use a method to minimise the value so you get the best matching pixel colour. Non-parametric techniques are very good at reproducing very structured textures. This is more specific to actual hole filling with texture, than the texture synthesis process itself, but it is a problem with the technique fundamentals.

2. APPLICATIONS

There is wide range of application area for object removal and region filling. There are many areas where hole filling techniques have an important role to play. One of the most obvious area is probably the film industry, in particular the special effect business. The wages and insurance costs for well known actors involved in films these days are very high, and film producer cannot afford to risk the actors being injured during stunts or filming. Therefore safety equipment must be brought in to make sure they are safe when filming the scenes. This is where the problems start to arise; how to avoid the safety equipment obviously should not appear in the final scene, and needs to be carefully removed so that the viewer never realizes that it was there.

3. CONCLUSION

The characteristics of images and the way people have divided has created existence of different types of hole filling techniques. To replace missing 'Region' the real technique used are that of inpainting and Texture Synthesis which propagates linear structure into the hole from the known regions. Each technique is good at synthesising the specific types of texture for which it is designed with each one using a different method in order to accomplish the required results.

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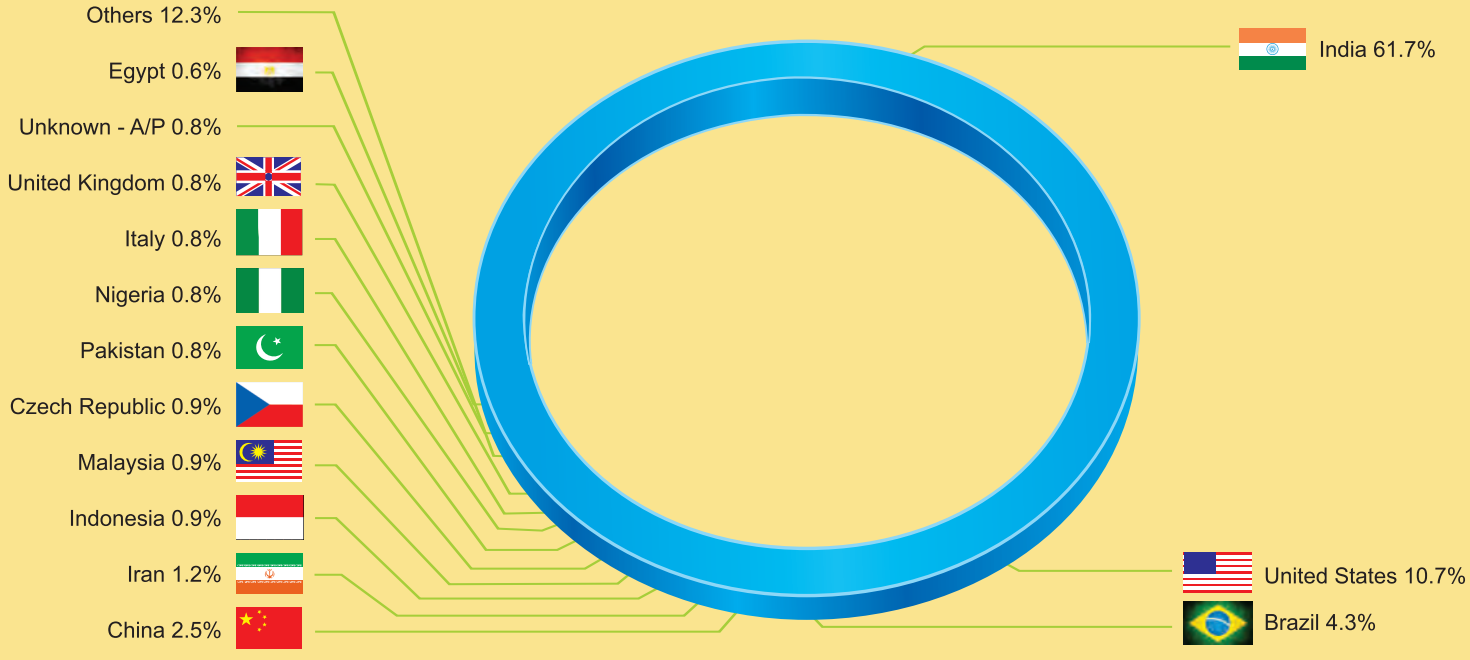

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