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Design and Development of Water Cooled Condenser for Domestic Refrigerator

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ABSTRACT

Increasing the Coefficient of Performance is very essential due to energy crisis and there is vast scope exists in domestic refrigerator system. In this paper a combination of tube in tube heat exchanger and shell and tube heat exchanger for domestic refrigerator is studied numerically in this paper. For obtaining higher COP we have to cool dawn refrigerant below sub cooled region. This can be achieved by use of this heat exchanger to great extent. Designed heat exchanger permits large heat transfer by providing more heat transfer area.

KEY WORDS:- Domestic refrigerator, R134a,COP,Combined tube in tube and shell and tube heat Exchanger.

INTRODUCTION

Extracting heat from lower temperature to higher temperature is achieved by use of refrigeration. Improvement in COP of domestic refrigerator is studied in this paper. For getting higher COP we have different options like decrease compressor work or improve design of evaporator or use of better heat exchanger as a condenser.

According to construction heat exchangers are classified into Tubular,Plate type, Extended surface, Regenerative. Amongst all we are focusing over tubular heat exchangers, mainly shell and tube and tube in tube heat exchanger. In tube and tube heat exchanger the heat transfer area is the surface of inner tube, between them both fluids are flowing either parallel flow or counter flow axially. In case of shell and tube heat exchanger heat transfer area is surface of tube over which a fluid is flowing in transverse direction.

In this work we are taking advantage of both types of heat exchangers. In this way, getting better results with compact as well as effective design. Also for better performance both the fluids are flowing in transverse direction.

By replacing air cooled condenser with designed water cooled condenser, temperature after condenser reduced drastically. In this way achieving sub cooling, significantly refrigerant effect increases and we get better COP.

LITERATURE REVIEW

Sahu et al [5],presented an experimental analysis of domestic refrigeration system by using wire-on-tube condenser with different spacing of wire, they found that the operating parameters like heat transfer rate, condenser pressure and condenser temperature, refrigerating effect was increased by using wire-on-tube condenser comparatively power consumption remains the same as with air cooled condenser in a domestic refrigeration system. Therefore wire-on-tube condenser can replace the ordinary air cooled condenser in a domestic refrigeration system.

Collicott et al [6] presented an experimental study to calculate heat transfer factor by free convection and shape factor for wire-and-tube condenser. It was found that the diameter of tube or wire proportional to space between the tube or wire.

Taib et al [7] presented the development process of refrigeration, reliable test rig and performance analysis of a domestic refrigerator. The indicator of COP was about 2.75 and refrigeration capacity was ranging from 150 to 205 W.

Fatemeh et al [8] highlighted that a 23.6 % energy consumption reduction of refrigerator by hot wall condenser removal, 19.3 % R134a refrigerant charge amount reduction of refrigerator cycle, reduction of the production cost by eliminating of nearly 10 m of pipe. As can be seen from the literature, there are not enough studies on the effect of changing condenser design to enhance the COP of the refrigeration cycles. So, the purpose of the present work is an experimental study on different condenser designs to enhance COP of the refrigeration cycles.

Naser R. M. AL-Ajmi [9] They studied three condenser designs in their work. These condensers are regular condenser of domestic refrigerator. The results showed that the average COP of Cond.1 and Cond.2 are increased up to 20 % and 14% respectively more than regular condenser design under no load. The evaporator load effects on the machine performance, where the COP of the machine increases with the increase of the evaporator load. They use copper tube condensers welded with stainless steel flat plate. During a 120 minute working time with no load inside the evaporator, the heat rejected from the condenser increased gradually to reach a steady state of an average of 130 kJ/kg for a regular condenser design.

Che´rifBougriou• KhireddineBaadache [10] studied a new type of heat exchanger for cooling industrial oil from 120°C to 60°C and compare the data with each other. they modified the simple shell and tube heat exchanger with concentric tube heat exchanger. The performance and the heat exchanger length are strongly dependent upon the tube radii that form the heat exchanger. Optimizing a shell-and-double concentric tube heat exchanger lengthwise provides a considerable amount of savings in space and material when compared with a shell and-tube heat exchanger with the same outer tube diameter of the double concentric-tubes and the shell diameter.

Moin Ahmad S. Shaikh, Dr. M. K. Chopra [11] in their work they are focusing experimentally over enhancing the surface area of condenser fins and by installing the Thermoelectric cooler in the evaporator sections.Heat transfer is increase by increasing the surface area of the condenser once heat is dissipated from the condenser it improves the performance of refrigerator. Also they install a Thermoelectric cooler into the refrigerator. The Thermoelectric cooler is also provide cooling effect simultaneously with Vapour compression cycle. Initially COP variation with final temperature is same as and the curves overlap to existing one and then after some drop in temperature its shows slightly improvement in COP.

Sukani Sunny, SavajJayesh [12] they experimentally use the thermoelectric module in a model of domestic refrigerator for sub cooling the refrigerant and the effect of condenser temperature on COP and refrigerating effect is in investigated. They measured energy consumption of the refrigerator during experiment with F-12 as a refrigerant. They obtained COP with their system installed is 20.12.

SYSTEM RELATED DATA:-

COMPRESOR:-Hermatically sealed compressor with standard make.

CONDENSER:-

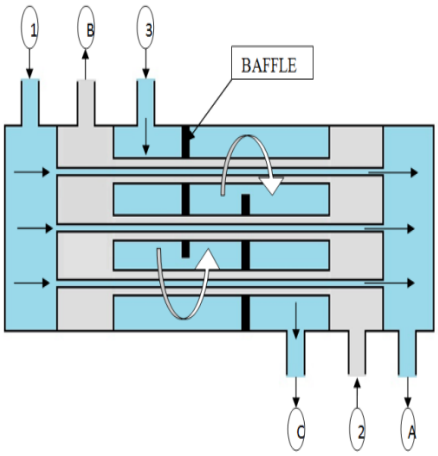

Fig.1 Double Concentric Shell & Tube Heat Exchanger

CONSTRUCTION:-

Heat exchanger is consisting of combination of shell and tube and tube in tube heat exchanger. Three ports for inlet i.e.1,2,3 and three ports for outlet i.e. A,B,C are mounted. Copper tubes are installed concentrically. Baffles are provided etc.

WORKING:-

Refrigerant R134a is allow to flow through port 1 and 3 and goes out through A and C simultaneously cold water is flowing through port 2 and goes out through port B. As shown in fig. both the fluids flowing in counter flow direction.

Also for comparison we also use air cooled condenser in setup. Experiment is conducted by changing valve positions for both air cooled and designed condenser.

After condensation of refrigerant capillary tube of standard make with specifications 8’ X 0.036 is installed. Evaporator of standard manufacturer is use in this paper for investigation.

MATHEMATICAL MODELING:-

Design data for theoretical calculations [1] [2] [3][10]

Table no. 1

notation		Values	Unit
T_1	Temperature before compressor	19	°C
T_2	Temperature after compressor	70	°C

P_h	Pressure after compressor	12.411	bar
P_L	Pressure before compressor	2.413	bar
T_3	Temperature after condenser	39	°C
T_4	Temperature after capillary	7	°C
T_{wi}	Water inlet temperature	19	°C
T_{wo}	Water outlet temperature	23	°C
m_1	Mass flow rate	0.003055	Kg/s
C_{p1}	Specific heat	1408	j/(kg K)
C_{p2}	Specific heat	4180	j/(kg K)
D_1	Outer Copper tube outer diameter	0.01	m
D_2	Outer Copper tube inner diameter	0.008	m
ρ_2	density	1000	Kg/m^3
N_t	Number of tubes	9	
μ_2	Dynamic viscosity	8.9-10^-4	Pa S
λ_2	Thermal conductivity	0.607	w/(m K)
p	Pitch	0.012	m
b	Baffle distance	0.05	m
δ	Baffle thickness	0.003	m
ρ_1	density	1146.7	Kg/m^3
D_c	Shell diameter	0.09	m
μ_1	Dynamic viscosity	0.000143	Pa S
λ_1	Thermal conductivity	0.0747	w/(m K)
λ_t	Thermal conductivity of copper tubes	387	w/(m K)
d_1	Inner tube outer diameter	0.005	m
d_2	Inner tube diameter	0.003	m

CONDENSER DESIGN:-

In this work design of shell and tube heat exchanger and designed heat exchanger is done with the help of logarithmic mean temperature difference (ΔTml) and various non dimensional parameters ex. Re (Reynolds number), Pr (Prandtl number), Nu (Nusselt number) etc.[10][14]

SHELL AND TUBE HEAT EXCHANGER

$q=m_1Cp(T_{i1}-T_{i2})$ in W

$m_2=\frac{q}{Cp2(2-Ti2)}$ in Kg/s

$Z=\frac{(T_{o2}-T_{i2})}{(T_{i1}-T_{o1})}$

$\eta=\frac{(T_{i1}-T_{01})}{(T_{i1}-T_{i2})}$

$V_2=\frac{m_2}{\rho_2 N_{tp} S_{p2}}$ in m/s

$Re_2=\frac{\rho_2 V_2 D_2}{\mu_2}$

$Pr_2=\frac{\mu_2 C}{\lambda_2}$

$Nu_2=0.023Re_2^{0.8}Pr_2^{0.33}$

$Sp_1=(p-D_1)(b-\delta)$ in m^2

$V_1=\frac{m_1 p}{\rho_1 D_c S_{p1}}$ in m/s

$Re_1=\frac{\rho_1 V_1 D_1}{\mu_1}$

$Pr_1=\frac{\mu_1 C}{\lambda_1}$

$Nu_1=0.36Re_1^{0.55}Pr_1^{0.33}$

$h_1=\frac{\lambda_1 Nu_1}{D_1}$ ∈w/(m^2 K)

$K=\frac{1}{\frac{D_2}{D_1 h_1}}+\frac{1}{\frac{D_2}{2\lambda_t}\in\frac{D_1}{D_2}}+\frac{1}{\frac{1}{h_2}}$ in w/(m^2 K)

$\Delta T_{ml}=\frac{(T_{i1}-T_{02})-(T_{o1}-T_{i2})}{\frac{(T_{i1}-T_{02})}{(T_{o1}-T_{i2})}}$ in °C

$S=\frac{q}{FK\Delta Tml}$ in m^2

$L=\frac{S}{\pi D_{2N_t}}$ in m

SHELL-AND-DOUBLE CONCENTRIC-TUBE HEAT EXCHANGER

$V_3=\frac{\left(\frac{m_1}{2}\right)}{\rho_1 N_{tp} S_{p3}}$ in m/s

$Re_3=\frac{\rho_1 V_3 d_2}{\mu_1}$

$Nu_3=0.023Re_3^{0.8}Pr_3^{1/3}$

$h_3=\frac{\lambda_1 Nu_3}{d_2}$ in w/(m^2 K)

$V_2 = \frac{m_2}{\rho_2 N_{tp} S_{p2}}$ in m/s

$Sp_2 = (p - D_1)(b - \delta)$ in m^2

$Re_2 = \frac{\rho_2 V_2 d_h}{\mu_2}$

$Nu_2 = 0.023 Re_2^{0.8} Pr_2^{1/3}$

$h_2 = \frac{k_2 Nu_2}{d_h}$ in $w/(m^2 K)$

$V_1 = \frac{(\frac{m_1}{2})p}{\rho_1 D_c S_{p1}}$ in m/s

$Re_1 = \frac{\rho_1 V_1 D_1}{\mu_1}$

$Nu_1 = 0.36 Re_1^{0.55} Pr_1^{0.33}$

$h_1 = \frac{k_1 Nu_1}{D_1}$ in $w/(m^2 K)$

$K_{1\text{-}2} = \frac{1}{\frac{D_2}{D_1 h_1}} + \frac{1}{\frac{D_2}{2k_t} \in \frac{D_1}{D_2}} + \frac{1}{\frac{1}{h_2}}$ in $w/(m^2 K)$

$K_{2\text{-}3} = \frac{1}{\frac{d_2}{d_1 h_2}} + \frac{1}{\frac{d_2}{2k_t} \in \frac{d_1}{d_2}} + \frac{1}{\frac{1}{h_3}}$ in $w/(m^2 K)$

$L = \frac{q}{\pi N_t (K_{1,2} D_2 F + K_{2,3} d_2) \Delta Tml}$ in m

RESULT AND DISCUSSION:-

From numerical calculations for various diameter ratios we get following results.

For same heat extraction from hot refrigerant after compressor, tube length required for designed condenser is much smaller than air cooled and shell and tube heat exchanger. This reduce cost as well as weight of system, also COP of system is improved significantly.

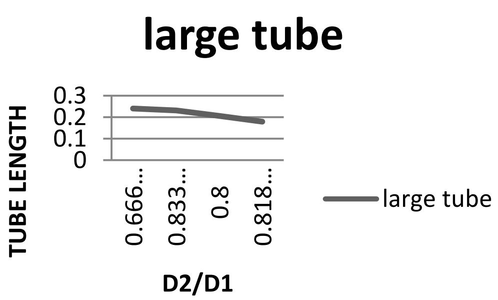

Fig.2 Variation in length for outer tube length

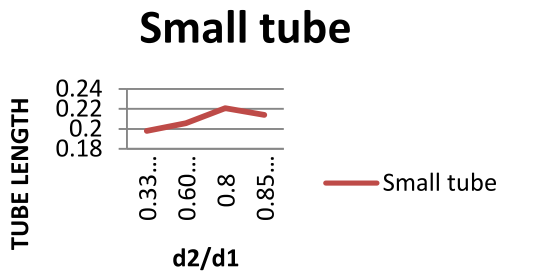

Fig.3Variation in length for inner tube length

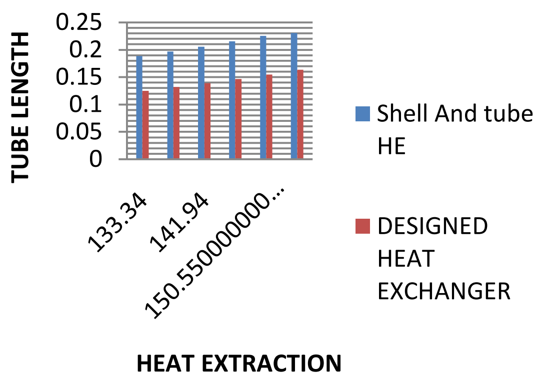

Fig.4-Heat extraction Vs Tube Length for different condensers

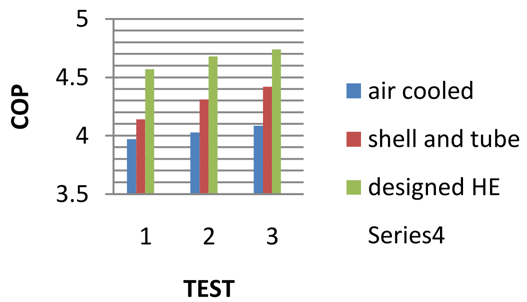

Fig.5- Comparison of COP for different condenser

CONCLUSION:-

From above discussion we concluded that the tube length required for designed heat exchanger is smaller than other heat exchangers for same heat rejection. By increasing tube length of designed condenser we obtain more heat rejection from system i.e. sub cooling.

Also if we compare water cooled condensers i.e. shell and tube & designed condenser with each other we can achieve better effectiveness in case of designed condenser. Also counter flow arrangement for heat transfer is reason behind better effectiveness of designed condenser.

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A Review on Economic Feasibility of Ethanol Production from Damaged Sorghum and Corn Grains

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Abstract:
The possibility of obtaining a renewable, available, safe and effective source of energy is one of challenges that world is facing today. The bio-fuels, particularly the bio-ethanol, are an environmentally clean source of energy. Production costs of fuel ethanol are higher than production costs of gasoline in some cases, although there is a strong influencing cost factor as feed-stocks for ethanol production. Nevertheless, many research scholars in different countries are continuously carrying out investigations aimed at reducing ethanol production costs. Diverse research trends and process improvements got success in the task of lowering ethanol costs by different steps of processing, nature of utilized feedstocks, and tools of process engineering, mainly process synthesis, integration and optimization. Grains are wasted every year all over the world that needs to be better utilised quickly and easily. Exhaustive review of literature is done for economical use of damaged sorghum and corn grains in ethanol production. These damaged or inedible sorghum and corn grains are harmful if consumed. It is observed that vast potential exists for economical conversion of damaged or inedible sorghum and corn grains into ethanol.

Keywords: Damaged Grains, Ethanol, Fermentation, Sorghum, Corn

1. INTRODUCTION

Definition of damaged food grains as per Federal Grain Inspection Service (FGIS) is simply grain that lacks the characteristics of quality grain. Grain damages are mechanical damages during harvesting and handling grain size reduces due to breakage. Moisture content and due to insecticides deterioration of grain occurs heavily. After identification of sorghum and corn grain in damaged condition, that is these grains are not usable as food or feed. The next one of option for its utilization is as fuel energy production. Food loss and damaged grain have many negative economic and environmental impacts. The most important issues in industrial ethanol production are yield, efficiency, and energy consumption. Laboratory results in terms of ethanol yield and ethanol fermentation efficiency from artificially germinated high-tannin sorghum suggest that huge potential energy savings exist in production of ethanol from germinated sorghum grain. Using germination-damaged sorghum for industrial ethanol production might benefit the producer and end user by expanding market uses of what has been historically considered a low-value commodity. Germination not only causes compositional changes in the sorghum grain but also initiates a series of biochemical and physiological changes. Intrinsic enzymes such as amylases, proteases, lipases, fibre-degrading enzymes, and phytases are activated. Current fuel ethanol research and development deals with process engineering trends for improving biotechnological production of ethanol [1].

2. REVIEW OF LITERATURE ON ETHANOL PRODUCTION:

In this paper exhaustive review of literature is carried out for determination of main causes and type of sorghum and corn grains damages. Major causes of sorghum and corn grains damages are briefly discussed in this paper. It is revealed that grain gets damaged during harvesting, handling, and storage due to breakage. This cause reduction in grain size and protective shield of grains becomes weak. On these weak grains an insect infestation is able to reduce its chemical or nutritional value which is very important for its further utilization. The intensity of grain damage is difficult to quantify accurately but it can be measured with the help of physical and chemical tests [1].

All damaged grains lose some of the starch and increased soluble sugars, ash and crude fiber. It is observed that sprout-damaged grains contained the highest amounts of reducing sugars. Ethanol yields based on the already damaged grains indicated that sprout-damaged grains yielded similar amounts compared to undamaged grains. The insect-damaged and mold-damaged corn and sorghum have reduced ethanol yields. As per exhaustive study it is observed that already damaged insect, mold or sprouted, corn and sorghum grains are having vast potential for ethanol production and could be good alternative for fossil fuel [2].

Ethanol production from corn and sorghum starch requires the use of amylase and amyloglucosidase for the pre-treatment starch before fermentation. Yeast ferments different sugars at different rates depends on the process conditions, several factors affect the production rate of ethanol by fermentation, and thus through the review of literature in this paper need to develop a suitable mathematical description of the fermentation process is identified. This reveals in interpreting fermentation measurements for early detection of poor fermentation performance. The ability to predict future fermentation behavior, application to design, advanced control of fermentation and optimization for economical ethanol production is possible. Because of rapid depletion of fossil fuel reserves, alternative energy sources that are renewable, sustainable, efficient, cheaper and eco-friendly options [3].

The most important issues in industrial ethanol production are yield, efficiency, and energy consumption. Laboratory results in terms of ethanol yield and ethanol fermentation efficiency from artificially germinated high-tannin sorghum suggest that huge potential energy savings exist in production of ethanol from germinated sorghum grain. Using germination-damaged sorghum for industrial ethanol production might benefit the producer and end user by expanding market uses of what has been historically considered a low-value commodity. Germination not only causes compositional changes in the sorghum grain but also initiates a series of biochemical and physiological changes. Intrinsic enzymes such as amylases, proteases, lipases, fiber-degrading enzymes, and phytases are activated [4].

Currently, approximately 80 % of total world ethanol production is obtained from the fermentation of simple sugars by yeast. In this paper, a review of the state of the art in bio ethanol production and availability is discussed. Pointing out the progress possibilities on starch-based production are discussed, in the respect of feedstock choice, pre-treatment, optimization of fermentation and process integration [5].

Ethanol production from starchy raw materials specifically damaged corn and sorghum grains by direct bioconversion are potential source for non-edible option. Ethanol production from damaged corn and sorghum starch requires the use of amylase and amyloglucosidase for the pre-treatment starch before fermentation. Preparation of damaged corn and sorghum grains for ethanol production is concentrated by study of separation for damaged grains to removing waste part and constituents reducing bio-ethanol conversion. It is observed that Process of Ethanol production from damaged Sorghum and Corn grains is having vast potential and it would be very useful source of renewable energy [6].

In recent years, attention is focused on the conversion of grain starch into fuel ethanol, considering it the cleanest liquid fuel alternative to fossil fuels. Grain alcohol is much cleaner because of low sulfates and aldehydes. Alcohol from molasses gives sulfurous odour and bad taste, later may have deleterious effects on health, if consumed in large quantities. Significant advances have been made by the researchers towards the technology of ethanol fermentation. Ethanol produced by fermentation of biomass may be used as extender or octane booster in motor fuel. The carbohydrate raw materials have to be hydrolysed to fermentable sugars. Enzymes are the catalytic tools in the production of these sugars for simultaneous saccharification and fermentation of starch containing raw materials. Current fuel ethanol research and development deals with process engineering trends for improving biotechnological production of ethanol [7].

In this paper, fermentation of damaged sorghum grains for bio-ethanol production is revealed by co-cultures of A. Niger (NCIM 1248) and S. Cerevisiae (MTCC 170). It is observed that at 2% substrate concentration ethanol yield was 0.40 g/100ml, while ethanol concentration increased to a maximum of 1.81 g/100ml at 10% substrate concentration. When culture conditions were optimized, ethanol yield further increased to 1.91 g/100ml at a temperature of 35 0 C, pH 5.0, 300 rpm agitation rate and reduced fermentation period of 5 days. In the present analysis of a simultaneous single step system for production of ethanol from damaged sorghum grains using symbiotic co-cultures of A. Niger and S. Cerevisiae is carried out for determination of optimal culture conditions [8].

Generally, economic restrictions force industrial processes to work in a very small range of operating conditions. For some batch processes which have long operating times in each cycle and depend strongly on the operating variables. It is very important to define the optimum conditions to achieve sufficient profitability. From the review of literature it is observed that kinetic models describing the behaviour of microbiological systems are very useful tool and it would reduce testing for elimination of possibilities.

Mathematical models are effective tool for analyzing biological process and microbial growth phenomenon. The studied model shows more insight into the environmental conditions that is surrounding bio-process and can be used for further development and optimization of bio-processes. This paper reviews the various process options and kinetic models adopted towards resolving the technological challenges to develop a low-cost commercial process [9].

Purpose of this work is to optimize ethanol production process from damaged sorghum grains with specific objective to study process parameters of ethanol production by fermentation. To determine the optimum response, surface plots for desirability and overlay plots are generated. Flour from damaged sorghum grains yielded 2.30 (g/100ml) ethanol by fermentation with co-culture of A. Niger (NCIM 1248) and S. Cerevisiae (MTCC 170) under optimized conditions of pH 5.5, temperature (30 0 C), and inoculum level (7.5 % v/v).Thereby damaged sorghum grains those are non-edible could be utilized optimally for ethanol production [10].

Genotype, environment, location, and their interactions have a significant effect on end-use quality characteristics of grain sorghum (Sorghum bicolour (L.) Moench). The objective of this research was to study the effect of sorghum genotype and production environment on ethanol and lactic acid production. Eight sorghum varieties from two locations were used. Whole sorghum grain was ground, liquefied, saccharified, and fermented to ethanol using Saccharomyces cerevisiae (S. cerevisae, ATCC 24860). For lactic acid fermentation, whole ground sorghum grain was liquefied and fermented to lactic acid with Rhizopusoryzae NRRL 395; saccharification depended upon native gluco-amylase. Results with this limited number of sorghum varieties and locations showed that both sorghum genotype and location had a significant effect on ethanol and lactic acid yields. Variations of 5 and 15% in ethanol and lactic acid yields were observed among the 16 sorghum samples. The effect of location on the fermentation yields was as much as 5% for ethanol and 10% for lactic acid. The effects of variety and location on ethanol and lactic acid production are strongly related to chemical composition and physical properties of grain sorghum samples. Ethanol and lactic acid production increased as starch content increased, whereas the ethanol and lactic acid production decreased as protein content increased. Chemical composition had a greater effect on the ethanol and lactic acid yields than physical properties of the sorghum kernels. The effect of physical properties on ethanol and lactic acid yields was not significant ($P > 0.05$) [11].

Reducing the use of non-renewable fossil energy reserves together with improving the environment are two important reasons that drive interest in the use of bio-ethanol as an automotive fuel. Conversion of sugar and starch to ethanol has been proven at an industrial scale in Brazil and the United States, respectively, and this alcohol has been able to compete with conventional gasoline due to various incentives. In this paper, we examined making ethanol from the sugar extracted from the juice of sweet sorghum and/ or from the hemicelluloses and cellulose in the residual sorghum bagasse versus selling the sugar from the juice or burning the bagasse to make electricity in four scenarios in the context of North China. In general terms, the production of ethanol from the hemicelluloses and cellulose in bagasse was more favourable than burning it to make power, but the relative merits of making ethanol or sugar from the juice was very sensitive to the price of sugar in China. This result was confirmed by both process economics and analysis of opportunity costs. Thus, a flexible plant capable of making both sugar and fuel–ethanol from the juice is recommended. Overall, ethanol production from sorghum bagasse appears very favourable, but other agricultural residues such as corn Stover and rice hulls would likely provide a more attractive feedstock for making ethanol in the medium and long term due to their extensive availability in North China and their independence from other markets. Furthermore, the process for residue conversion was based on particular design assumptions, and other technologies could enhance competitiveness while considerations such as perceived risk could impede applications [12].

In this study a number of different process flow sheets were generated and their feasibility evaluated using simulations of dynamic models. A dynamic modelling framework was used for the assessment of operational scenarios such as, fed-batch, continuous and continuous with recycle configurations. Each configuration was evaluated against the following benchmark criteria, yield (kg ethanol/kg dry-biomass), final product concentration and number of unit operations required in the different process configurations. The results show that simultaneous saccharification and co-fermentation (SSCF) operating in continuous mode with a recycle of the SSCF reactor effluent, results in the best productivity of bio-ethanol among the proposed process configurations, with a yield of 0.18 kg ethanol/kg dry-biomass [13].

Progressive depletion of conventional fossil fuels with increasing energy consumption and greenhouse gas (GHG) emissions have led to a move towards renewable and sustainable energy sources. Lignocellulosic biomass is available in massive quantities and provides enormous potential for bio-ethanol production. However, to ascertain optimal bio-fuel strategies, it is necessary to take into account environmental impacts from cradle to grave. Life cycle assessment (LCA) techniques allow detailed analysis of material and energy fluxes on regional and global scales. This includes indirect inputs to the production process and associated wastes and emissions, and the downstream fate of products in the future. At the same time if not used properly, LCA can lead to incorrect and inappropriate actions on the part of industry and/or policy makers. This paper aims to list key issues for quantifying the use of resources and releases to the environment associated with the entire life cycle of lignocellulosic bio-ethanol production [14].

Bio-ethanol research has focused on improving the economics of the process through cultivar selection, method development for low-quality grain and pre-processing to recover valuable by-products. Sorghum has potential for being used in the production of bio-industrial products, including bioethanol. Sorghum is a starch-rich grain with similar composition to maize, and, as with all cereals, its composition varies significantly due to genetics and environment (Rooney and Serna-Saldivar, 2000). Starch ranges of 60–77% and 64–78% have been reported for sorghum and maize, respectively (Shelton and Lee, 2000). Raw flour starch was saccharified by Bacillus subtilis and fermented by Saccharomyces cerevisiae. Their damaged grain sample comprised 50% damaged and 50% sound grains, and the damaged portion included kernels that were broken, cracked, attacked by insects, dirty or dis-coloured. In addition to breeding sorghum specifically for fermentation quality, pre-processing the grain can be used to improve ethanol yields and process efficiency. Corredor et al. (2006) investigated decorticating sorghum prior to starch hydrolysis and ethanol fermentation. In general, decortications decreased the protein content of the samples up to 12% and increased starch content by 5–16%. Fibre content was decreased by 49–89%. These changes allowed for a higher starch loading for ethanol fermentation and resulted in increased ethanol production. Ethanol yields increased 3–11% for 10% decorticated sorghum and 8–18% for 20% decorticated sorghum. Using decorticated grain also increased the protein content of the distillers dried grains with soluble (DDGS) by 11–39% and lowered their fibre content accordingly. Using decorticated sorghum may be beneficial for ethanol plants as ethanol yield increases and animal feed quality of the DDGS is improved. The bran removed before fermentation could be used as a source of phyto-chemicals (Awika et al., 2005) or as a source of kafirin and wax. Isolated sorghum starch could also be used in other industrial applications in a similar fashion to corn starch. However, a problem particular to sorghum is that where polyphenolic pigments are present in the pericarp and/or glumes, they stain the starch (Beta et al., 2000a–c). Park et al. (2006) reported the use of ultrasound to rapidly purify starch from sorghum. This procedure resulted in very high-purity starch with only 0.06% residual protein in the starch. New developments in wet-milling procedures for sorghum as well as breeding sorghum hybrids with improved wet-milling characteristics should be of benefit to the industrial use of sorghum starch, either directly for the production of bio-ethanol [15].

The bioconversion into ethanol of insect (Sitophiluszeamais), mold (Aspergillusflavus) and sprout-damaged maize and sorghum was investigated. This research demonstrated that there was a clear negative impact of insect, molds and intrinsic enzymes in the physical and chemical composition of maize and sorghum. Insect and mold-damaged kernels were mainly affected at the endosperm level. These kernels had reduced amounts of starch and NFE and higher levels of reducing sugars and FAN. Conversions into bio-ethanol of insect, mold and sprout-damaged maize and sorghum were lower calculated in relation to the original grain weight, indicating that the dry matter loss incurred during storage was the main reason for the observed detrimental effect. Nevertheless, all already damaged kernels had similar fermentation efficiencies, indicating that these feedstocks are suitable for fuel ethanol production [16].

Utilization of waste crops or by-products from other industries such as starch processing, could also be a very rational approach. The efforts and investments in promoting the second generation of bio-ethanol on lignocellulosic biomass in Serbia should be intensified, especially due to the fact that this biomass is vastly available in the country and it doesn't compete with food production. In addition, a proper utilization of by-products from bio-ethanol production for the production of animal feed and lactic acid can significantly improve the economy of bio-ethanol production [17].

The most important and promising research priorities linked to process engineering for improving the ethanol production process are briefly summarized here. An important part of the research trends on fuel ethanol production is on reduction of feedstock costs, especially through the utilization of less expensive damaged corn and sorghum grains.

Most of the research efforts are on the conversion of food grains into fermentable sugars. The development of genetically modified microorganisms capable of converting starch or biomass directly into ethanol and with a proven stability under industrial conditions will allow the implementation of the consolidated bio-processing of the feedstocks.

Process synthesis will play a very important role in the evaluation of different technological proposals, especially those related to the integration of reaction–separation processes, which could have the major effects on the economy of the global process. Similarly, the integration different chemical and biological processes for the complete utilization of damaged sorghum and corn grains should lead to the development of big ‘‘bio-refineries’’ that allow the production of large amounts of fuel ethanol and many other valuable co-products at smaller volumes, improving the overall economicaleffectiveness of the conversion of a given raw damaged sorghum and corn grains material. Integration opportunities may provide the ways for a qualitative and quantitative improvement of the process so that not only techno-economical, but also environmental criteria can be met. The increasing energy requirements of the humanity will augment the pressure over R&D centers, both public and private, for finding new renewable sources of energy and for optimizing their production and utilization. The employ of bio-ethanol as an energy source requires that the technology for its production from waste biomass like damaged sorghum and corn grains be fully developed. Growing cost of energy, the design of more intensive and compact processes, and the concern of the humanity by the environment, have forced the necessity of employing totally new approaches for the design and operation of bio-ethanol production processes. Every time, the spectrum of objectives and constraints that should be taken into account for the development of technologies for bio-ethanol production is wider and more diverse.

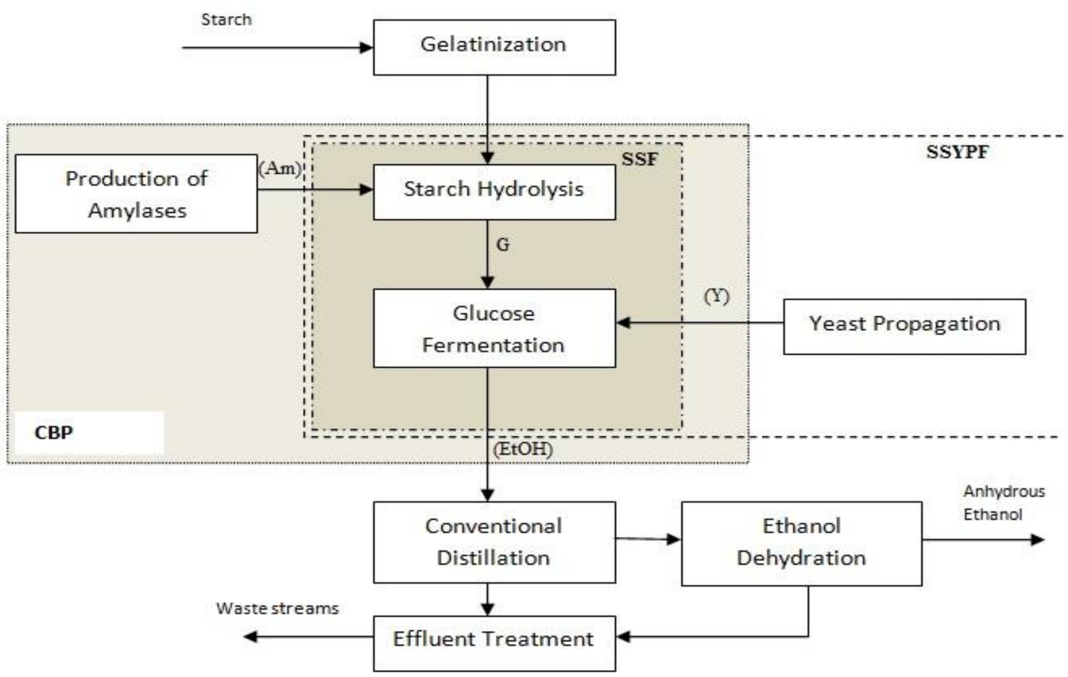

Fig. 1. Generic block diagram of fuel ethanol production from starchy materials. Possibilities for reaction–reaction integration are shown inside the shaded boxes: SSF, simultaneous saccharification and fermentation; SSYPF, simultaneous saccharification, yeast propagation and fermentation; CBP, consolidated bioprocessing. Main stream components: Am, amylases; G, glucose; Y, yeasts; EtOH, ethanol.

Current fuel ethanol research and development deals with process engineering trends for improving biotechnological production of ethanol. In this work, the key role that process design plays during the development of cost-effective technologies is recognized through the analysis of major trends in process synthesis, modelling, simulation and optimization related to ethanol production. Main directions in techno-economical evaluation of fuel ethanol processes are described as well as some prospecting configurations. The most promising alternatives for compensating ethanol production costs by the generation of valuable co-products are analyzed. Opportunities for integration of fuel ethanol production processes and their implications are underlined. Main ways of process intensification through reaction–reaction, reaction–separation and separation–separation processes are analyzed in the case of bio-ethanol production. Some examples of energy integration during ethanol production are also highlighted. Finally, some concluding considerations on current and future research tendencies in fuel ethanol production regarding process design and integration are presented [18].

Field sprouting damaged starch granules, protein matrices, and cell walls in sorghum kernels, consequently decreasing kernel hardness, kernel weight, and kernel size. Field sprouting also changed the chemical composition and pasting properties of field-sprouted grain sorghum, which could shorten fermentation time without decreasing ethanol yield. Field-sprouted grain sorghum had relatively high FAN content. The FAN provided efficient buffering capacity and optimal yeast performance, and field- sprouted sorghum had a more rapid fermentation rate than non- sprouted sorghum. FAN played a key role in increasing conversion efficiency for ethanol production. Using weathered and/or sprouted sorghum from regions affected by unusually high moisture events during grain fill and harvest may provide an opportunity for ethanol producers to maintain ethanol production efficiency, while shortening processing time. This could offer sorghum producers an opportunity to receive a premium, or at least a fair market value, for sorghum when such environmental events occur [19].

Steam-flaked sorghum was more susceptible to alpha-amylase hydrolysis compared to whole sorghum. The moist thermal process improved performance during the subsequent steps of saccharification and yeast fermentation. The end result was a substrate that yielded higher amounts of ethanol in approximately 30 h fermentation. Steam-flaking of sorghum allowed the production of similar amounts of ethanol compared to maize in similar liquefaction and fermentation times. Compared to the whole sorghum conventionally processed, the steam-flaked sorghum yielded 44% more ethanol. Steam-flaking might be used as a preliminary process to pregelatinize and disrupt the kernel structure, improving the rate of starch conversion into fermentable carbohydrates and ethanol yields [20].

A process and cost model for a conventional corn dry-grind processing facility producing 119 million kg/year (40 million gal/year) of ethanol was developed as a research tool for use in evaluating new processing technologies and products from starch-based commodities. The models were developed using Super Pro Designer ® software and they handle the composition of raw materials and products, sizing of unit operations, utility consumptions, estimation of capital and operating costs, and the revenues from products and co-products. The model is based on data gathered from ethanol producers, technology suppliers, equipment manufacturers, and engineers working in the industry. Intended applications of this model include: evaluating existing and new grain conversion technologies, determining the impact of alternate feedstocks, and sensitivity analysis of key economic factors. In one sensitivity analysis, the cost of producing ethanol increased from US$ 0.235 l^{-1} to US$ 0.365 l^{-1} (US$ 0.89 gal^{-1} to US$ 1.38 gal^{-1}) as the price of corn increased from US$ 0.071 kg^{-1} to US$ 0.125 kg^{-1} (US$ 1.80 bu^{-1} to US$ 3.20 bu^{-1}). Another example gave a reduction from 151 to 140 million l/year as the amount of starch in the feed was lowered from 59.5% to 55% (w/w) [21].

This techno-economic study compares several process technologies for the production of ethanol from lignocellulosic material, based on a 5 to 8 year time frame for implementation. While several previous techno-economic studies have focused on future technology benchmarks, this study examines the short-term commercial viability of biochemical ethanol production. With that goal, yields (where possible) were based on publicly available experimental data rather than projected data. Four pretreatment technologies (dilute-acid, 2-stage dilute-acid, hot water, and ammonia fiber explosion or AFEX); and three downstream process variations (evaporation, separate 5-carbon and 6-carbon sugars fermentation, and on-site enzyme production) were included in the analysis. Each of these scenarios was modeled and economic analysis was performed for an ‘‘nth plant” (a plant with the same technologies that have been employed in previous commercial plants) to estimate the total capital investment (TCI) and product value (PV). PV is the ethanol production cost, including a 10% return on investment. Sensitivity analysis has been performed to assess the impact of process variations and economic parameters on the PV. The dilute-acid pretreatment process has the lowest PV among all process scenarios, which is estimated to be $1.36/l of gasoline equivalent [LGE] ($5.13/gal of gasoline equivalent [GGE]). Sensitivity analysis shows that the PV is most sensitive to feedstock cost, enzyme cost, and installed equipment costs. A significant fraction of capital costs is related to producing heat and power from lignin in the biomass [22].

For the first time, a single source of cellulosic biomass was pretreated by leading technologies using identical analytical methods to provide comparative performance data. In particular, ammonia explosion, aqueous ammonia recycle, controlled pH, dilute acid, flow through, and lime approaches were applied to prepare corn Stover for subsequent biological conversion to sugars through a Biomass Refining CAFI among Auburn University, Dartmouth College, Michigan State University, the National Renewable Energy Laboratory, Purdue University, and Texas A&M University. An Agricultural and Industrial Advisory Board provided guidance to the project. Pretreatment conditions were selected based on the extensive experience of the team with each of the technologies, and the resulting fluid and solid streams were characterized using standard methods. The data were used to close material balances, and energy balances were estimated for all processes. The digestibilities of the solids by a controlled supply of cellulase enzyme and the fermentability of the liquids were also assessed and used to guide selection of optimum pretreatment conditions. Economic assessments were applied based on the performance data to estimate each pretreatment cost on a consistent basis. Through this approach, comparative data were developed on sugar recovery from hemicelluloses and cellulose by the combined pretreatment and enzymatic hydrolysis operations when applied to corn Stover [23].

Lignocellulosic biomass can be utilized to produce ethanol, a promising alternative energy source for the limited crude oil. There are mainly two processes involved in the conversion: hydrolysis of cellulose in the lignocellulosic biomass to produce reducing sugars, and fermentation of the sugars to ethanol. The cost of ethanol production from lignocellulosic materials is relatively high based on current technologies, and the main challenges are the low yield and high cost of the hydrolysis process. Considerable research efforts have been made to improve the hydrolysis of lignocellulosic materials. Pretreatment of lignocellulosic materials to remove lignin and hemicellulose can significantly enhance the hydrolysis of cellulose. Optimization of the cellulase enzymes and the enzyme loading can also improve the hydrolysis. Simultaneous saccharification and fermentation effectively removes glucose, which is an inhibitor to cellulase activity, thus increasing the yield and rate of cellulose hydrolysis [24].

This study investigated the potential for utilization of wasted biomass and lignocellulosicfeedstocks for bioethanol. The lignocellulosicfeedstocks have much more favorable utilization potential for biobased industrial products because of their quantity and competitive price. Furthermore, lignocelluloses can generate electricity and steam, which can be used in a bio-refinery and also exported into the power grid. Importantly, lignocellulosicfeedstocks do not interfere with food security. However, facilitating the utilization of lignocellulosic materials requires tremendous efforts in achieving a high ethanol yield, establishing infrastructure for the collection system, increasing the thermal efficiency of generating electricity and steam, and so on. Regarding the data quality of FAOSTAT, some nations may have a large gap between values in their national database and the data in FAOSTAT, as shown in Table 1. Technology for utilizing wasted crop, defined as crop lost in the distribution, as a raw material for biobased product will depend strongly on regional conditions, e.g., climate, storage facility, e efficiency of transportation [25]. Cellulosic plant material represents an as-of-yet untapped source of fermentable sugars for significant industrial use. Many physio-chemical structural and compositional factors hinder the enzymatic digestibility of cellulose present in lignocellulosic biomass [26].

The state of the art of hydrolysis-fermentation technologies to produce ethanol from lignocellulosic biomass, as well as developing technologies, is evaluated. Promising conversion concepts for the short-, middle- and long-term are defined. Their technical performance was analysed, and results were used for economic evaluations. The current available technology, which is based on dilute acid hydrolysis, has about 35% efficiency (HHV) from biomass to ethanol. The overall efficiency, with electricity co-produced from the not fermentable lignin, is about 60%. Improvements in pre-treatment and advances in biotechnology, especially through process combinations can bring the ethanol efficiency to 48% and the overall process efficiency to 68%. We estimate current investment costs at 2.1 kh/ kW HHV (at 400 MW HHV input, i.e. a nominal 2000 tonne dry/day input). A future technology in a 5 times larger plant (2 GW HHV) could have investments of 900 kh/kW HHV. A combined effect of higher hydrolysis-fermentation efficiency, lower specific capital investments, increase of scale and cheaper biomass feedstock costs (from 3 to 2 h/GJ HHV), could bring the ethanol production costs from 22 h/GJ HHV in the next 5 years, to 13 h/GJ over the 10–15 year time scale, and down to 8.7 h/GJ in 20 or more years [27].

The increased concern for the security of the oil supply and the negative impact of fossil fuels on the environment, particularly greenhouse gas emissions, has put pressure on society to find renewable fuel alternatives. The most common renewable fuel today is ethanol produced from sugar or grain (starch); however, this raw material base will not be sufficient. Consequently, future large-scale use of ethanol will most certainly have to be based on production from lignocellulosic materials. This review gives an overview of the new technologies required and the advances achieved in recent years to bring lignocellulosic ethanol towards industrial production. One of the major challenges is to optimize the integration of process engineering, fermentation technology, enzyme engineering and metabolic engineering [28].

3. BIOETHANOL PRODUCTION PROCESS:

Utilization of damaged corn and sorghum grains needs these four steps for ethanol production by means of process engineering that should be followed i.e.) Process synthesis Process synthesis by different approaches (e.g. optimization- based process synthesis)-Integration of corn dry milling plants with facilities for ethanol production - Process flow sheet development considering different pre-treatment methods. This step is required for damaged corn and sorghum grains separately for both materials. ii) Process analysis - Improvement of process control and operation (e.g. modelling, non- linear analysis) Improvement of simulation and optimization tools (e.g. optimization under uncertainty, metabolic-flux models, etc.) Full pilot-plant process analysis, especially for continuous processes. This step is required for damaged corn and sorghum grains separately for both materials. iii) Step 3: Process integration - Integration of fermentation and separation processes for reduction of product inhibition, Application of membrane technology (e.g. for ethanol removal or dehydration), Energy integration (e.g. by pinch technology) - Development of CBP, Recombinant microorganisms for conversion of starch into ethanol - Increase of effectiveness of SSF and SSCF processes (e.g. by improvement of cellulase activity), Development of CBP, Increase of ethanol tolerance in microorganisms converting cellulose into ethanol, Development of recombinant microorganisms for CBP, Development of efficient co-generation technol. using solid residues of the process (as BIG/CC). iv) Other process engineering issues - Improvement of environmental performance considering the whole life cycle of bio-ethanol Production of valuable co-products (retrofit to bio-refineries) Integrate with petrochemical Industry (e.g. ETBE prdn.) and bio-fuels production (e.g. biodiesel).

4. OPTIMIZATION OF PROCESSES:

Each process involve must be operated at optimum values of the design variables so that the maximum conversion of damaged corn and sorghum grains into bio-ethanol could be achieved. Research and development are the heart and soul of improvement efforts in manufacturing, and it's fast becoming standard practice to employ design of experiments methods in industrial R&D. In the early stages of their work, experimenters typically use screening experiment designs that normally consist of trials run at the extreme lower- and upper-bound level setting combinations of the variable study ranges. They provide information on the direct additive effects of the study variables and on pair wise (two-variable) interaction effects. Screening designs enable experimenters to select the best materials and equipment from available alternatives and to focus on the correct variables and ranges for further work.

5. CONCLUSION:-

Every year damaged sorghum and corn grains are wasted, since these grains are of poor quality to be used as food or feed. Already work is being done and in progress on ethanol production from sorghum and corn grains. Here in this paper available methods are studied for separation or removal of damaged and ethanol non productive portion to maximize further conversion process of sorghum and corn grains into ethanol production. Four steps for ethanol production by means of process engineering that should be followed are discussed in this paper with optimization for each process involve. It is revealed that damaged or inedible sorghum and corn grains could be further economically converted into ethanol right from damaged or poor quality that is cheaper grains available.

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A Survey of Street Food Sellers in Jalgaon City Regarding Awareness of Diet Along with Hygienicness

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ABSTRACT: The term "food hygiene" is used to describe the preservation and preparation of foods in a manner that ensures the food is safe for human consumption. This term typically refers to these practices at an individual or family level, whereas the term "food sanitation" usually refers to these types of procedures at the commercial level within the food industry, such as during production and packaging or at stores or restaurants. Food hygiene in the home kitchen includes things such as the proper storage of food before use, washing one's hands before handling food, maintaining a clean environment when preparing food and making sure that all serving dishes are clean and free of contaminants. A majority of Food borne illnesses result from microbial hazards. According to WHO microbes are responsible for approximately 85 % of reported food borne disease outbreaks throughout the world. The basic objective of this research is to create awareness about importance of food safety and hygiene's among street food sellers in Jalgaon city.

I. INTRODUCTION

Food is one of the three essentials for maintenance of life. The first and foremost goal of any country is to increase the food supply in sufficient amounts of the right nutrient content to meet the needs of an ever increasing population. Such food has to be safe, which implies that its consumption should not give rise to any Food Borne Disease whether from infection, intoxication, contamination, adulteration or other sources.

Food is the most complex part of the environment through which human population is exposed to a variety of contaminants. Further, the WHO conference on nutrition has declared that "Access to safe and nutritionally adequate food is the right of every individual". But it seems that the right of an individual is misused due to improper safety of foods. This can be said so because millions of people worldwide suffer from diseases of food borne origin.

A majority of Food borne illnesses result from microbial hazards. According to WHO microbes are responsible for approximately 85 % of reported food borne disease outbreaks throughout the world. WHO estimated that the diseases caused due to food borne pathogens leads to 76 million human illness each year, 3,25,000 hospitalizations and an unknown number of chronic conditions.

Food hygiene is very important aspect, which refers to the many practices needed to safeguard the quality of food from production to consumption. This is sometimes referred to as 'from farm to fork' or 'from farm to table', because it includes every stage in the process from growing on the farm, through storage and distribution, to finally eating the food. It also includes the collection and disposal of food wastes.

II. OBJECTIVES OF THE STUDY

- To Undertake a Survey Street food Seller in Jalgaon City regarding Hygienicness of their Food.
- To create awareness about importance of Hygienic Food among street food vendors.

REVIEW OF LITERATURE

- Sylvia AngubuaBaluka, RoseAnn Miller and John BaligwamunsiKaneene in their research paper pointed that there is a critical need for improving food safety at restaurants and dining halls at Makerere University. They further suggest that, there is a need for governmental support to improve food safety management system, and education and awareness programs. Tambekar D H, Kulkarni R.V, S.D.Shirsat, D.G.Bhadange in their research paper opined that, for the contamination of street food, personal hygiene of vendor is also

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responsible. Vendors touch the floor, wash the utensils most of the time without using soap, handling of dish cloths and after all they touch food without glows for preparing and serving water without washing the hands, this may lead to cross contamination of bacterial pathogens. They further insist that the local government and the ministry should consider establishment of adequate facilities and utility services as well as provision of necessary information, education and training programmes for vendors and consumers.

- Nurudeen, A.A., Lawal, A.O, Ajayi S.A in their research paper found that 53.6% of the vendors did not cover their hair and 7.3% of them had undressed skin lesion. The authors in their paper concluded that, in order to sustain the benefits of street-vended food while assuring the safety of the food sold, authorities must implement policies aimed at supporting, controlling and maintaining the street food sector. Further they opined that, the policy should be implemented in relation to an integrated consultation with vendors and consumers in order to meet the needs of government, consumers and vendors.
- Margaret Githiri, Judith Kimiywe and Paul Okemo in their research paper opined that, there is really need for educational programmes to enhance the knowledge of food handlers regarding food borne diseases. Further they concluded that food safety inspection guidelines should be developed.

IV. RESEARCH METHODOLOGY

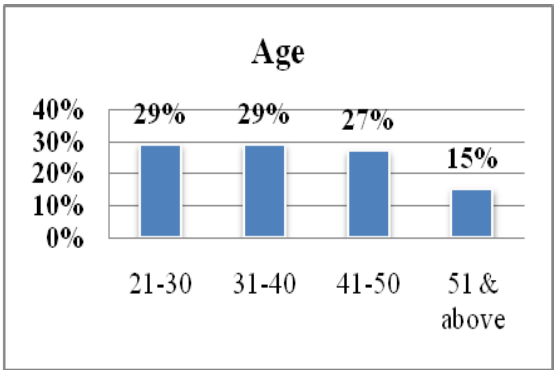
The type of research used in this research project is qualitative in nature. In this research the researcher has collected primary data using structured questionnaire and through observation method. A survey was done in various crowded places in Jalgaon city, especially at places where the street food vendors are available in mass. The sampling units in this research were sellers of PaniPuri, Chaat, Ice Cream sellers, PavBhaji and Chinese food sellers. The respondents' i.e the street food vendors were asked questions regarding food safety and hygienic practices adopted by them. The questionnaire was also organized into distinctive sections to obtain information pertaining to respondents' socio-demographic characteristics; level of knowledge and training on food hygiene; status of medical screening and an observation checklist to determine personal hygiene and food handling practices. The data obtained from 100 respondents are logically screened, analyzed with the help of pie and bar chart.

V. SCOPE OF THE STUDY

The purpose and scope of this research work is to creating, maintaining and developing the code of hygienic food practices among street food vendor in Jalgaon city regarding their foods. The survey will definitely useful for street food sellers in maintaining proper care regarding their food making process and will definitely create awareness about food hygienicness.

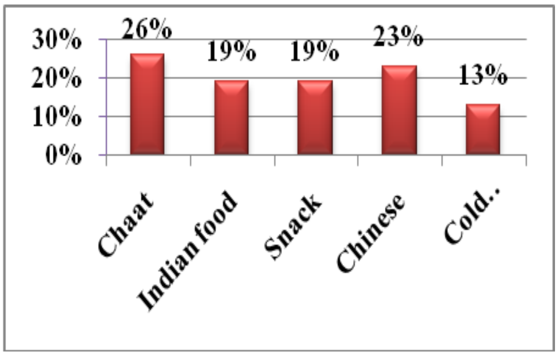
VI. DATA INTERPRETATION & ANALYSIS

1) Age of street food vendor



Inference-From the above chart it is disclosed that, 29% food sellers are in the age group in between 21-30 as well as 31- 40.

2) Category of food sellers

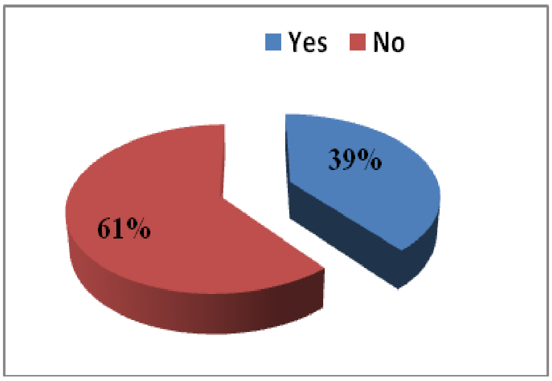


Inference -from the above bar chart it is noted that, the maximum food sellers are engaged in selling Chaat followed by Chinese foods.

3) Do you feel that, you should offer hygiene food to customer?

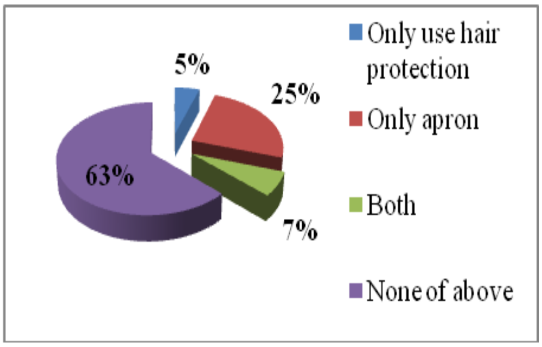
Inference -From the above pie chart it is observed that, in view of 94 percent food sellers, serving hygiene food to customers is important.

4) Do you use hand glows to keep your food hygienic?



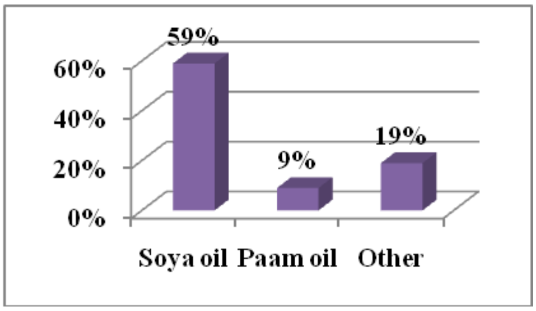
Inference -from the above pie chart, it can be seen that 61 percent street food sellers are using hand glows to keep their food hygienic whereas 39 percent are not using hand glows.

5) Do you use apron & other hair wearing mask for keeping your food hygienic and safe?



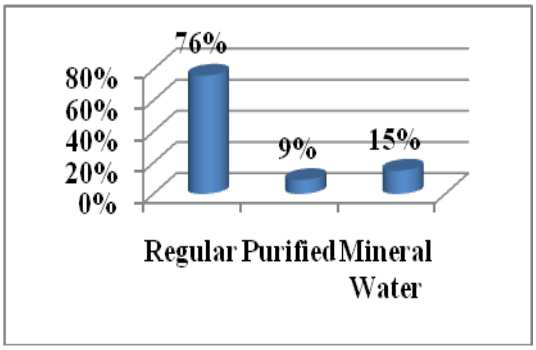
Inference- From the above pie chart it is depicted that, 25 percent street food sellers wear apron whereas only 5 percent sellers are engaged in hair protection.

6) Which type of oil you use for preparing food?



Inference- From the above bar chart it is disclosed that, 59 percent street food sellers use soya oil whereas 9 percent food sellers use Paam oil.

7) Which type of water you use for preparation of food?



Inference- From the above bar chart it is disclosed that, 76 percent food sellers uses regular water to prepare food whereas 15 percent food sellers are using mineral water.

8) According to you what is important?

Inference- In above chart, it can be seen that, in view of 76 percent food sellers selling hygienic and safe food is important whereas 24 percent food sellers think that, only selling food is important according to them.

VII. CONCLUSION

Food hygiene is the conditions and measures necessary to ensure the safety of food from production to consumption. Street food vending plays an important role in the economy of Jalgaon city. Considering the growing number of street food vendor in Jalgaon city, it is utmost very important to create awareness about maintaining continuous hygienicness of food as it is directly related to health of the people. Also it is important that the local food and safety authorities should take periodic review and should visit to street food sellers to check the quality of their food along with hygienicness. As a customer and a wise citizen, an individual must see that the surrounding of food sellers is clean & the foods consume by him is of good quality and hygiene.

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A Review on Band Heaters for Heating Performance Enhancement

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Abstract: Band heaters are available with elements of different diameters and heights, designed to heat and maintain the temperature of cylindrical parts. Heat transfer is usually achieved by conduction or radiation for high power heaters. They are suitable for solid heating, liquids or gases heating. Applications for band heaters are various they can be fitted to nozzles or extruder barrels, process plastics or today's materials such as resins that requires high temperature or for heating conducts. They can also be used in plastic injection moulding as process of materials requires high heating power and high temperatures.

Key words: Injection Moulding, Band/Barrel Heater, Watt Density.

I. INRTODUCTION

To bring the injection moulding machine (IMM) or extruder machine to a functioning temperature, heat is required; this heat brings the machine to a proper temperature for startup and for maintaining the desired temperature under normal operations. There are three methods of heating the extruder: electric heating, fluid heating, and steam heating. The electric heating is the most common method of heating the extruders or injection moulding machine.

Electric resistance heaters which are widely use in extruder/IM machines are called band/barrel heaters since they are in the form of a circular band, which fits over the screw barrel of the machine. The heat generated by the extruder heaters is made possible by passing a certain amount of current through a conductor of certain resistance, as the resistance creates barrier to the flow of electrons, heat is generated. The amount of heat generated is given by the equation below:

$$Q_C = I^2R = VI = V^2/ R$$

Where I is the current, R is the resistance, and V is the voltage. This equation is valid for direct current (DC) as well as single phase alternating current (AC), provided the current and voltage are express as root mean square (rms) values and the circuit being purely resistive (phase difference zero).With three phase circuit the heat generation is;

$$Q_C = 3VI \quad \text{.........} \quad [1]$$

II. BAND HEARER

In IM machine, the raw material, called resin, is usually in the form of granules. These granules

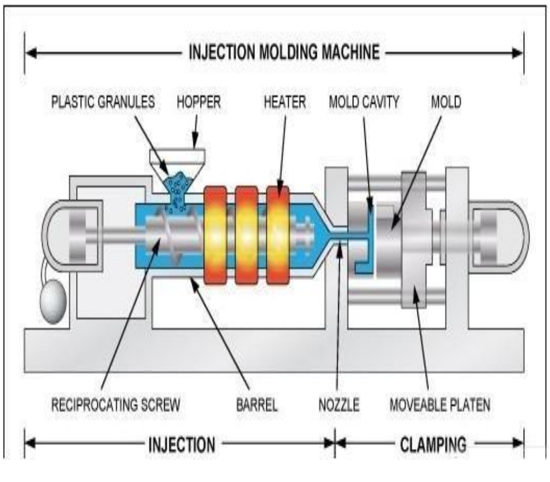

Figure No.**Error! No sequence specified.** Injection Moulding Machine

is stored in a feed hopper, a bottom opened bottle which feeds the press with resin, shown in Figure. The granules need to be molten to enable an injection into the tool cavity chamber, i.e. a cavity that reflects the final shape of the plastic product, the IM machine is therefore equipped with a plasticizing unit in order to melt the resin. Initially in the plasticizing unit a screw, which rotates with help of a motor, melts the granules. Most of the heat is created by friction in the screws rotation but heating bands are often added to supplement the heat generating. When the granules are melted the screw inject the polymer into the cavity chamber with an axial movement.

In band heaters the heating element is sandwiched between an insulating material which is a good conductor of heat and bad conductor of electricity. The band heaters used now a day are classified according to the insulators used in them, as below;

1) Mica band heater
2) Ceramic band heater
3) Mineral insulated band heater **[1]**

III. MICA BAND HEATER

Mica strip are usually used to insulate resistance band heaters. These heaters are low cost but not quite durable and are not very reliable. They can withstand temperatures of up to 500^{o}C and have a loading capacity of about 50 kW/m^2. Recent types of mica heaters can handle power densities up to165 kW/m^2. The durability of a heater depends on the usage and the contact between the barrel and the surface of the heaters. Inadequate surface contact will cause overheating and the outcome will reduced heater life or even premature burnout of the heater element. Commercially, are available special paste to improve the heat transfer between the heater and the barrel. A mica core produces a thin, efficient heater. Heat from the precisely wound resistance element is quickly transferred to the working surface for fast heat-up and response. Mica provides excellent dielectric strength and heat transfer capability for long heater life. The mica core is encased in a continuous corrosion resistant sheath and formed.

Figure No.2 Mica Band Heaters

All full mica band heaters are designed with closed ends to protect against contamination. Maximum sheath temperature is 800°F.

A. Construction

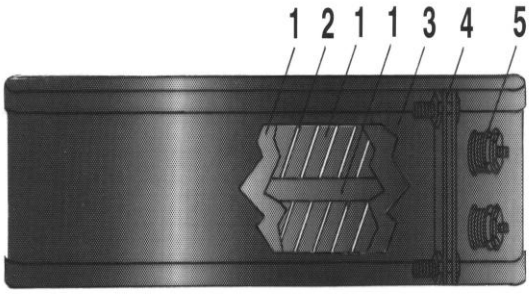

Figure No.3 Construction of Mica Band Heaters

1. Mica insulation.
2. Element ribbon.
3 Rust resistant steel sheath.
4. Radial lock-up tabs.
5. Post terminals.

B. Features

- The Standard Band Heaters are manufactured in one or two piece constructions with maximum inside diameters of 111⁄2"and 221⁄2" respectively. Three or more sections are employed when heaters of larger diameters are needed (as for blown film extrusion dies).
- Holes and cutouts are available. Maximum wattage may be reduced with the addition of holes and cutouts. Drawing required for specific location.

C. Sizes

Construction of units with inside diameters over 111⁄2" must be manufactured in accordance with the following table.

Table No.1 Inside Diameters

Construction	Inside Diameter Range
Two Piece	Over 111⁄2" to 221⁄2"
Three Piece	Over 221⁄2" to 36"
Four Piece	Over 36" to 48"

The above is based on a watt density of 30 watts per square inch of surface.

D. Wattage

The watt density may be varied, depending on operating temperature in accordance with the following table.

Table No.2 Watt density

Operating Temperature(ºF)	^{0}C	Watts Per Square Inch
300ºF	149ºC	40
400ºF	204ºC	30
500ºF	260ºC	21
600ºF	316ºC	12
700ºF 900ºF Max.	371ºC to 482ºC	10

The following information will helps to understand watt density in order to select the proper wattage for our application.

Wattage will affect the durability and performance of band heater. To prevent heater failure, do not exceed the maximum recommended watt density for a specific heater size.

$$Wattdensity(W/\quad) = \frac{WATTAGE}{(3.14xInnerDiameterxWidth) - (ColdSection)}$$

Table No.3 Length of Cold Section

Model	Cold Section
One-Piece	1" X Width
Two-Piece	2" X Width
Holes And Cutouts	(Size + 1/2") X Width

Factors to be considered while selecting watt density.

- Select narrower heaters for superior heat transfer (1" – 2.5" wide).
- Select watt density according to the operating temperature.
- Select the corresponding wattage for your application in order to prevent short cycling and inefficient operation.
- Consider the safe heating pattern of the heated material, the thermal conductivity, and coefficient of expansion of the cylinder when determining puissance.

E. Operation

When heating a material for the first time, the material temperature should be monitored with a temperature indicating device and the final drum heater control setting recorded for future reference. The material should be mixed to get an accurate temperature since the material near the outside of the drum will heat faster than the material near the center. This initial set-up should be done with the three heat switch set on high. If the material you are heating exhibits excellent heat receptivity you may maintain your desired temperature with the three heat switch set on medium or low, thus reducing power consumption.

- Use on all metal drums only.
- For use indoors only.
- Do not use to heat flammable materials.
- Do not use in hazardous areas.
- Vent container to prevent pressure build-up.

Time vs. Temperature:
Achieved at maximum setting, Covered 55 gallon drum filled with water at 70°F.

F. Applications

Mica band heaters are used in Cylinders, Dies, Drums, Holding Tanks, Injections and Blow Molding Machines, and Plastic Extruders.[2]

IV. CERAMIC INSULATED BAND HEATERS

Ceramic Insulated Band Heaters are specifically designed and engineered to meet the ever increasing demand for energy conservation and to improve operation efficiency. The ceramic band heaters are capable of generating the higher temperatures essential to process today's high temperature resins. Electrical energy savings are achieved by using a 6 mm (1⁄4") thick ceramic fiber insulating blanket, reducing power consumption by 25 to 30%. Because of the low thermal conductivity of the ceramic fiber insulation, the external surface temperature of the ceramic band heater is approximately 204°C (400°F) while running the inside surface temperature at 649°C (1200°F). Ceramic band heaters transmit heat through both conduction and radiation. The element winding is designed to run at maximum temperature and heat the ceramic blocks to the point at which they radiate energy into the barrel as well as conduct energy by being in contact with the barrel. Therefore, the fit is not as critical as in other types of bands. Ceramic band heaters have become extremely popular among Original Equipment Manufacturers as the standard heaters for the barrels of plastic injection molding machines, extruders, and blow molding equipment.

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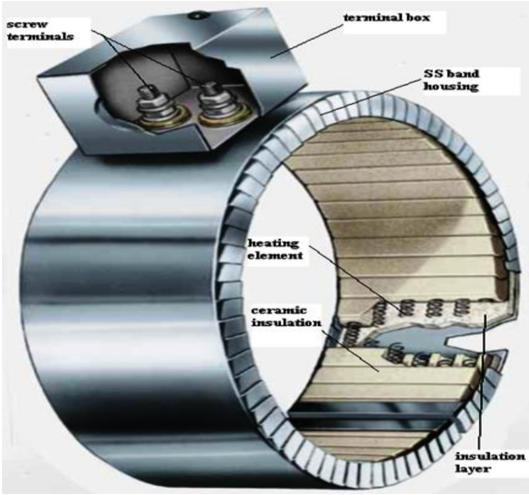

Figure No.4 Ceramic Insulated Band Heater

A. Construction

Standard: The basic ceramic band heater design consists of a helically wound resistance coil made from nickel-chrome wire, evenly stretched and precisely strung through specially designed ceramic insulating bricks, forming a flexible heating mat. The ceramic heating mat along with 1⁄4" thick ceramic fiber insulation is installed in a stainless steel housing made with serrated edges, providing maximum flexibility for ease of installation. This allows the use of wider band heaters, eliminating the need for numerous narrow width and two-piece band heaters.

Double Insulated: For situations requiring additional insulation for lower external temperatures and increased electrical energy savings, offers double insulated ceramic bands with full 13 mm (1⁄2") thick ceramic fiber insulation. This will decrease power consumption by 35 to 37% when compared to uninsulated band heaters.

B. Specification

Performance Ratings:

Maximum Temperature: - 760°C (1400°F)
Nominal Watt Density: - 3 to 7 Watt/cm2 (20 to 45 Watt/in2)
Maximum Watt Density: - 45 Watt/cm2 (45 Watt/in2)

Electrical Ratings:

Maximum Voltage: - 480 Vac per termination
Dual Voltage: -Available depending on heater configuration
Maximum Amperage per Circuit:-
Lead Wire Termination: - 10 A
Screw Terminations: -25 A
Resistance Tolerance: - 10%, −5%
Wattage Tolerance: -5%, −10%

C. Features

- Built-In Thermal Insulation
- Conserves Electrical Energy
- Minimum Heat Loss
- Fully Flexible For Easy Installation
- Good Temperature Uniformity
- Longer Heater Life
- Various Constructions and Terminations
- Heats Through Conduction and Radiation
- Designed to Specifications
- Reduce Heat Loss
- Conserve Energy
- Maximize Operator Comfort
- Reduce Overall Operation Cost

D. Features for Power Saver Construction

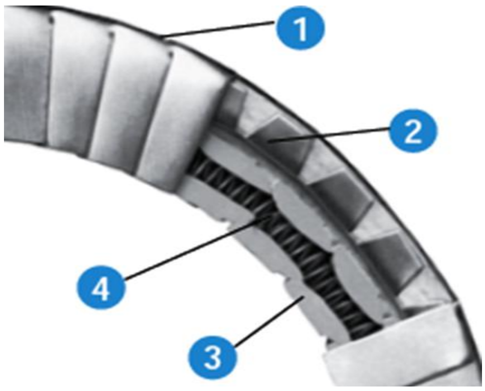

Figure No.5 Construction Details of Ceramic Band Heater

1. **Chrome Nickel Steel sheathing.** Chrome Nickel Steel housing with serrated edges provides maximum flexibility for ease of installation.

2. **Thermal insulation.** Built-In heat saving Thermal Insulation standard (4mm) on all Ceramic Bands "Premium Heat" will reduce power consumption. Further reduction can be obtained with higher thickness insulation which prevents heat loss, thereby lowering energy costs.

3. **High Grade Ceramic Insulators.** Interlocking Steatite bricks designed for best combination of physical & dielectric strength, good thermal conductivity to heat cylindrical parts, good for sheath temperature up to 500 Deg C. provides flexibility for ease of installation on the barrel.

4. **Ni-chrome Heating coil.** Helically wound superior quality (60/16, 80/20) Nickel Chrome resistance wire designed for maximum current carrying capacity is strung through specially designed ceramic insulating bricks providing even heat distribution, thus eliminating hot spotting that can cause premature heater failure.

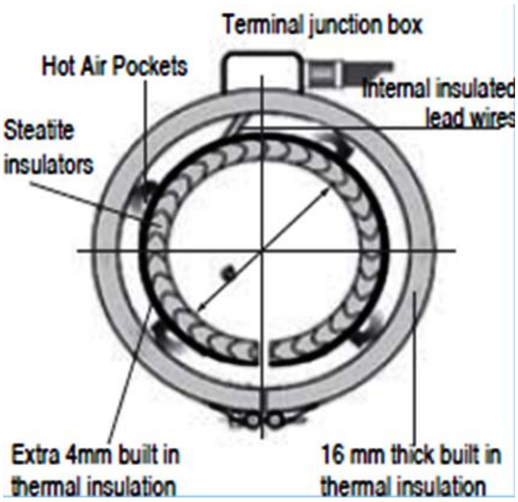

Figure No.6 Features for Power Saver plus Construction

1. **Chrome Nickel Steel sheathing.** Chrome Nickel Steel inner housing as well as External Insulated housing with serrated edges provides maximum flexibility for ease of installation.

2. **Additional Heat Optimizing Thermal insulation.** Apart from the in built 4mm Insulation A Special Additional HEAT OPTIMIZING Thermal Insulation (16mm) along with an AIR POCKET which preserves the heat inside producing a uniform hot air layer between the Heater & the outer Insulation (as shown in sketch above) This helps reduce power consumption up to 30% AND MORE (subject to working conditions) & prevents heat loss thereby lowering energy costs, improves Heating Efficiency for faster productivity and simultaneously also helps improve working atmosphere.

3. **High Grade Ceramic Insulators.** Interlocking Steatite bricks designed for best combination of physical & dielectric strength, good thermal conductivity to heat cylindrical parts; good for sheath temperature up to 500 Deg C provides flexibility for ease of installation on the barrel.

4. **Nickel-chrome heating coil.** Helically wound Nickel-Chrome resistance wire designed for maximum current carrying capacity is strung through specially Designed ceramic insulating bricks providing even heat distribution, thus eliminating hot spotting that can cause premature heater failure.

E. Technical data

Sheath material: Chrome Nickel Steel

Insulators: High Grade Steatite Ceramic Insulators (High Temperature)

Heat Saving Thermal Insulation: Ceramic Fiber (std.)

Heating Elements (coil): NiCr 60:16, NiCr 80:20

Connection: Fiber Glass Insulated- Metal Braided Flexible Cable (std. 500mm long) mounted on rigid screw post terminals

Voltage Range: 110V - 440V

Power Rating: Depending upon application

Power Tolerance: ± 10%

Insulation Resistance (Cold):< 20 M Ohms
Sheath Temperature: Up to 500°C maximum (Chrome Nickel Steel sheath)

Inner Diameter: Minimum 60mm in case of Premium 75mm in case of Power saver & 100mm for Power Saver PLUS

F. Temperature vs. Heat Loss

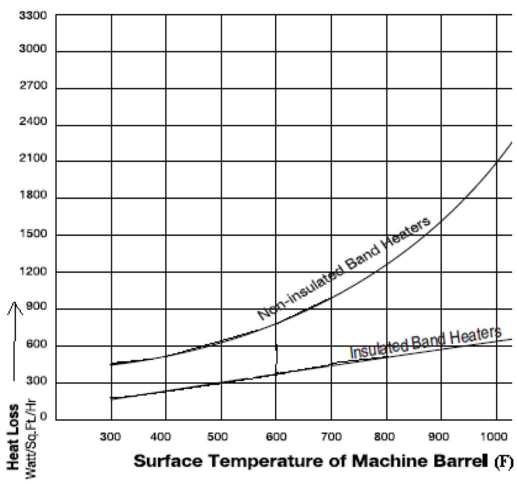

Figure No.7 Temperature vs. Heat Loss Graph

From above graph we can see that, the heat loss goes on increasing with increase in surface temperature of the barrel for non insulated band heaters, as compared with the insulated band heaters [3], [4]

V. MINERAL INSULATED BAND HEATER

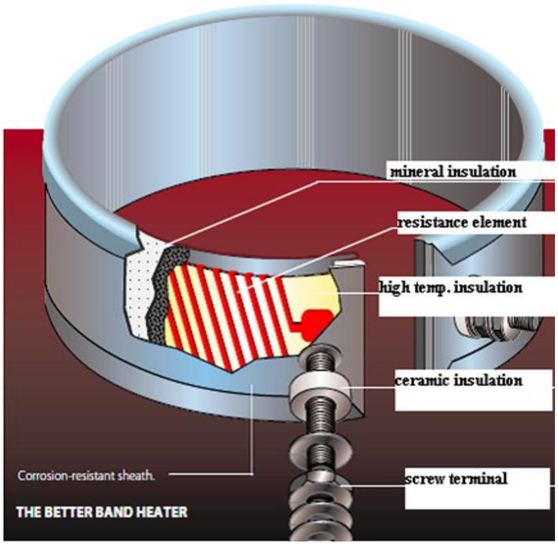

Figure No.8 Construction of MI Band Heater

A. Features and Benefits

- Maximum watt densities; far in excess of any other type of band.
- Highest application temperatures available.
- •Best possible clamping and the resulting improved efficiency.
- Longest life available for any application and reduction of equipment downtime.
- High heat transfer rates and the resulting fast response.
- Rapid heat-up capabilities and no fear of heater failure.
- Reduced number and physical size of heaters required per application.
- Cost-effective performance.
- Choose a Mineral Insulated Band when the temperature of the heater will exceed 650º F (343º C).
- Expandable or two-piece construction.

B. Material and Construction

- Precision engineered with computer selected wound resistor element.
- Efficient low expansion clamping systems or welded-to-the-sheath clamping ears.
- Optional lead and screw termination styles.
- High temperature patented mineral insulation heat transfer media.
- High temperature oxidation-resistant sheath material commensurate with maximum operating temperature.
- Stainless steel screw terminals welded to an internal stainless steel pad effecting a positive and secure electrical connection. The surrounding area is insulated with a high temperature refractory cement and ceramic insert.
- When lead wires are specified, they are also welded to a stainless steel pad. The high temperature mica tape lead wire, 842º F (450º C), is ideally suited for most applications.

C. Specifications

Optional features include a sealed low profile cap and tube termination system for low clearance applications. The tube may be lengthened to accommodate radius bends to clear a nozzle hex or other obstructions. Braid and armor lead wire protection is available. A 10” (25.4 cm) length is standard. Flexible leads are 10” (25.4 cm) standard. Other leads are available upon request. Diameters from 3⁄4” (19 mm) up to36” (91.4 cm) typical widths from 3⁄4”(19 mm) up to6” (152.4 mm) maximum.

D. Applications

The Mineral Insulated Band will consistently out-perform other bands in virtually any application. Its ability to withstand extremely high heat makes it the best choice for the plastics industry, especially when processing engineering-grade resins. Additional uses include heating pipes, chemical processing and drum heating. In addition, Mineral Insulated Band can be modified to meet the demands of virtually any special application. Our engineers can utilize a variety of alternative features and options to customize the heater to our specific needs.[5][6] [7]

VI. BAND HEATER SELECTION

Prior to selecting a band heater style for an application, there are a number of items that must be taken into consideration. These include type of application, operational temperature, controls and heat required to continually satisfy the application. All band heaters have their own physical and operational characteristics and limitations which should be reviewed prior to making a selection. Once the total wattage requirement has been established, the number of heaters needed can be determined as below.

$$numberofheaters$$

$$Wattdensityofheater(W/\ \ ) = \frac{totalWATTAGE}{}$$

• Knowing the maximum watts per square inch of the heater is essential when making your selection and can be calculated by:

$$[(HeaterIDX3.14) - 1 / 2''] XHeaterWidthrs$$

$$W/sq.\in = \frac{WattageofHeater}{}$$

[8]

VII. COMPARISON OF MICA, CERAMIC AND MINERAL INSULATED BAND HEATERS

Table No. 4 Comparison of Mica, Ceramic and Mineral Insulated Band Heaters

	MICA	CERAMIC	MINERAL
Electric Insulation	Mica	Ceramic	Mica
Thermal Insulation	No	Ceramic Fiber	Minerals
Wattage (W/In^2)	10 To 40	20 To 45	45 To 100
Temperature Range (^0c)	150-450	150-650	340-760
Cost	low	high	high
Durability	less	good	better

From the graph given below we can see that, the ceramic insulated band heaters and mica insulated band heaters gives maximum watt density up to 45 to 50 W/in^2, where as the mineral insulated band heaters haves maximum watt density up to 100 W/in^2.

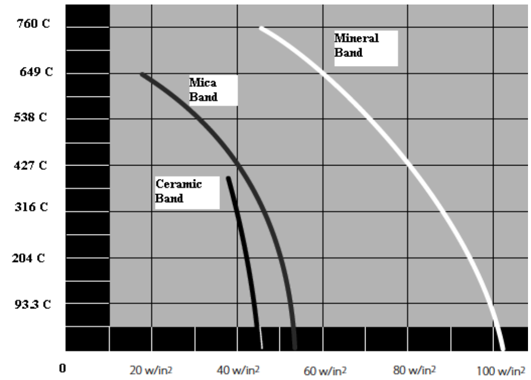

Figure No. 9 Mean Temperature vs. Watt Density Graph

VIII. CONCLUSION

After studying in details about three types of band heaters it is seen that, band heaters without thermal insulation causes heat loss to the atmosphere through convection, which increases the cost of energy. Comparitive results shows that the mineral insulated band heater gives better watt densities (up to 100 W/in^2) and lesser heat loss. Thus mineral insulated band heaters are better band heaters.

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[4] PHP 11/12, Tankiwala Industrial Estate, Steel Made Compound, MarolMaroshi Road, Andheri(E), Mumbai 400 059. INDIA.

[5] IDEAL HEATERS, No. 694/A, GuruwarPeth, Opposite SBI TMPune - 411042, Maharashtra, India

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[8] TEMPCO electric heater corporation

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Mathematical Analysis of Solar Water Distillation System Using Copper Basin

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Abstract: Clean water is the essential for good health and the development of country. Most of water available on the earth is salty i.e. sea water. Hence we need to desalinate the water. Solar still is the simple and low cost method to purify the water. It uses solar energy as input to get pure water from the brackish water as output. In this paper solar still made of copper, basin is studied theoretically. An attempt is made to analyze the performance of solar still with the help of equations to predict the output of solar still.

Keywords: - Mathematical analysis, solar still, Copper basin

1. INTRODUCTION

Water with good quality is the basic need of human being. One can not imagine life without water. We have only few resources of water like river and lakes. Most of the water available for drinking is underground water. The underground water is generally hard due to dissolved salts. And hence it cannot be directly used for drinking. So we need to remove the salts from the water. There are various methods to purify the water like Electro Dialysis, Reverse Osmosis etc. [7] The simplest method used to purify the water is solar water distillation system or simply solar still. It is the thermal method for desalinating the water. The solar still may be single slope or double slope as shown in fig.1 and fig.2 respectively. Here the study is carried out for single slop single basin solar still,[9]

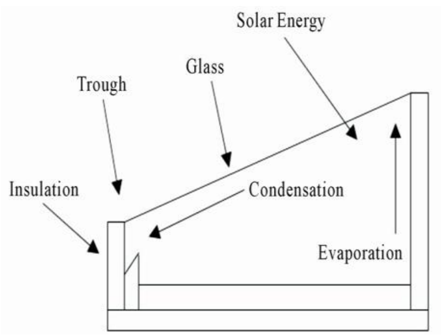

Fig.1- Single slop solar still

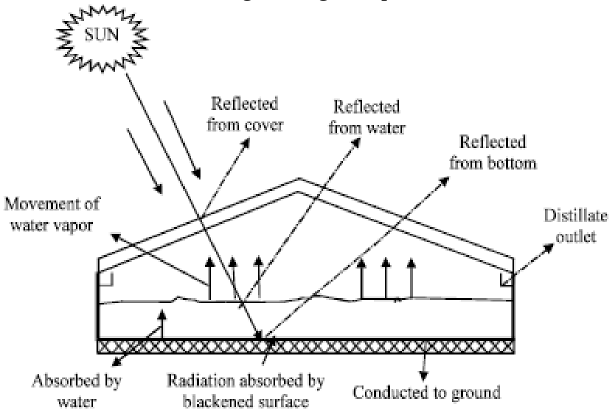

Fig.2- Double slop solar still

The increase in the use of energy and environment effects has focused the attention on non conventional energy sources. Solar energy is available on earth at free of cost. Solar energy can be used as thermal energy. It is also non polluting and easily available. It also reduces the transportation cost of fuel. the simple solar still can produce the pure water required for drinking and cooking for a house. Also those distilled water can be used in many industrial processes. It is the simple technology that uses solar energy to drive the system. Ia has almost zero maintenance cost and can be operated by non-skilled worker.

The problem associated with the conventional solar still is that it has low productivity. Various experiments are carried out to improver the efficiency of solar still such as the inner surface if the basin is painted with black coating [5], use of reflecting material on the inner side of solar still [7], application af vacuum inside the solar still [4].

From the above experiments the output of the solar still is improved.

2. Theoretical Analysis:-

The operation of solar still at any time is determined with the help of energy balance. Fig.3 shows the energy transfer inside and outside the solar still which is related to the output of the solar still

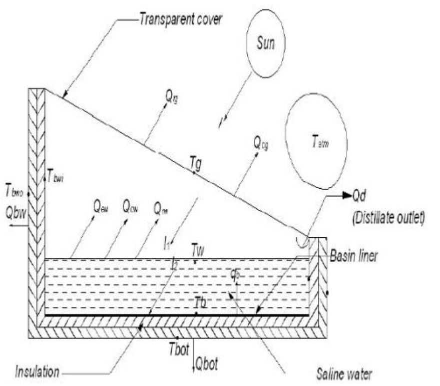

Fig.3- Energy transfer in single slope solar still

The theoretical analysis is done with the following assumptions [1],[2],[3]

1. There is not any vapour leakage.
2. The heat capacity of glass, basin material, and insulation is neglected
3. The physical properties do not change with temperature.
4. The solar radiations are not absorbed by the vapors between the water level and glass.
5. Water in the basin is at uniform temperature.
6. The reflection of solar radiations is neglected.

2.1 Energy balance for water in the basin[2]

$I_1+Q_b+(m_w x Cp) \times dT_w/dt = Q_{cw}+Q_{ew+}Q_{rw}+I_2$ --------(1)

$I_1 = (1-\alpha_g)$
$I_2 = (1-\alpha_g)(1-\alpha_w) I$

Where α_g and α_w are the radiation absorptivity of glass and water respectively.

2.2 Energy balance for glass:-

$Q_{rg}+Q_{cg}+I_1 = Q_{cw}+Q_{ew}+Q_{rw}+I$----- (2)

2.3 Energy balance for basin:-

$I_2 = Q_b + Q_{bot}$----------------- (3)

The Various heat transfers can be calculated by following equations

The radiative heat transfer between water and glass (Q_{rw}) is [2]

$$Q_{rw} = h_{rw} A_w (T_w - T_g)$$

Where,

$h_{rw}= \varepsilon_{eff}\, \sigma\ [(T_w+273)^2+(T_g+273)^2](T_w+T_g+546)$

Where,

$\sigma = 5.669 \times 10^{-8} W/m^2K^4$

$$\varepsilon_{eff} = \left(\frac{1}{\varepsilon_g}+\frac{1}{\varepsilon_w}-1\right)^{-1}$$

$$\varepsilon_g = \varepsilon_w = 0.9$$

The convective heat transfer between water and glass (Q_{cw}) is [2]

$$Q_{cw} = h_{cw} A_w (T_w - T_g)$$

h_{cw}=0.884 $\left[(Tw - Tg) +\right.$
$Pw{-}PgTw{+}273268.9X103{-}Pw13$

where,

$$P_w = exp\left(25.317 - \frac{5144}{Tw+273}\right)$$

$$P_g = exp\left(25.317 - \frac{5144}{Tg+273}\right)$$

Where

P_w-partial vapor pressure at water temperature

P_g- partial vapor pressure at glass temperature

T_w – Water temperature

T_g – Glass Temperature

The Evaporative heat transfer between water and glass (Q_{ew}) is [2]

$$Q_{ew} = h_{ew} A_w (T_w - T_g)$$

$$h_{ew} = 16.27 X 10^{-3} X hcw X \frac{(Pw-Pg)}{(Tw-Tg)}$$

The convective heat transfer coefficient between glass and surrounding is given by,[1]

$$h_{cg} = 2.8 + 3V$$

$$Q_{cg} = h_{cg} A_g (T_g - T_a)$$

Where,

V- Wind velocity

The radiative heat transfer coefficient between glass and surrounding is given by,[3]

$$h_{rg} = \varepsilon\sigma (T_g^4 - T_{sky}^4)/(T_g - T_a)$$

$$Q_{rg} = h_{rg} A_g (T_g - T_{sky})$$

Hourly yield of solar still is given by.

$$m_w = \frac{q_{ew} A_w}{L} x 3600$$

Where,

m_w- mass of water evaporated(kg)

q_{ew}- evaporative heat transfer from water to glass (W/m^2)

A_w- area of water(m^2)

L- Latent heat of evaporation

Using above formulae the theoretical output of the solar still can be calculated.

3. Solar still Specification

The specifications used for theoretical analysis are given in table.1

Table.1- Specifications for solar still

Specification	Dimension
Basin Area ,m^2	1
Glass Area ,m^2	1
Glass Thickness, m	$5x10^{-3}$
Number of glass	1
Slope of glass	20°
Absorptivity of glass,α_g	0.0475
Absorptivity of Water,α_w	0.05
Absorptivity of basin,α_b (Cu)	0.25
Emissivity of Glass,ε_g	0.9
Emissivity of Water,ε_w	0.9

RESULTS : To calculate the theoretical output of solar still the data is taken from various papers to solve the different equations.

Table.2-Solar still with copper basin

Time(hr)	Solar intensity (W/m^2)	Basin Temperature (°C)	Water Temperature (°C)	Glass Temperature (°C)	Hourly Output (ml/m^2)
9	290	32.8	30.8	21	0.1
10	425	45	32.1	23.6	0.248
11	635	50.5	40.6	27.9	0.3
12	785	58.9	50.2	31.2	0.311
13	740	55.7	55.3	27.9	0.302
14	680	53.9	59.87	27.2	0.298
15	598	48.7	46.4	25.3	0.287

16	445	41.9	38.3	22.7	0.276
17	335	34.2	31.6	21.6	0.265
18	210	28.6	28.4	20.4	0.245

1. Variation in temperature due to solar radiation

The variation in basin, water and glass temperature according to solar radiation are shown in fig.

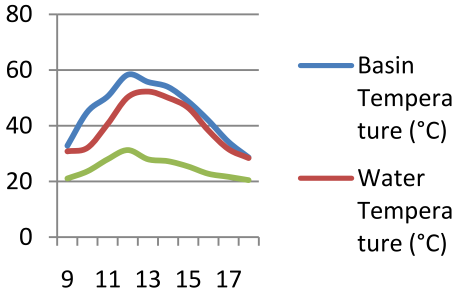

Fig.4 Temperature variation for solar still made up of copper.

From the graph it is clear that with the increase in solar intensity the temperature of basin, water and glass increase up to noon and with the decrease in solar intensity the temperature of basin, water and glass decreases during evening.

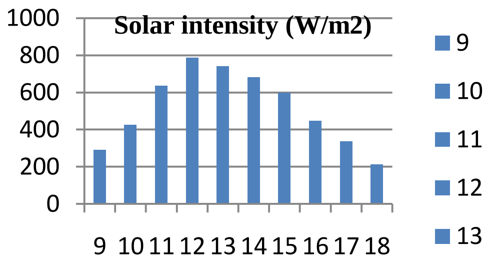

Fig.5 Variation of solar intensity with time

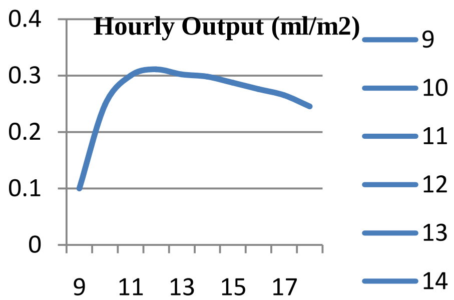

Fig.6 Hourly output of the solar still with time

CONCLUSION

A mathematical model is used to predict the performance of solar still made up of copper basin with different parameters. It is found that the efficiency of the still increases with the increase in solar intensity.

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Effect of Air Induction System Design on Compression Ignition Engine Performance: A Review

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ABSTRACT: In present scenario, engine performance enhancement by reduction in fuel consumption and reduction in emissions are objectives of car manufacturers. Understanding of aspects involved in the combustion chambers of C. I. engines is essential to attend these objectives. Compression ratio, atomization of fuel, fuel injection pressure, and quality of fuel, combustion rate, air fuel ratio, Air intake temperature or pressure in the cylinder and also based on piston design, air induction system, and combustion chamber designs etc. are different factors affecting the performance of engine. Air induction system design is one of the best method to enhance the C.I. engine performance. Air induction system design should be done in such a way that considering the complete system objectives. Efficient air induction system development requires minimum fuel consumption and maximum utilization of air pressure for reduction of the exhaust emissions from C.I. engine and also for effective utilization of fuel energy. In this paper, air induction system, especially low air induction pressure problem is a subject of specific interest for design and development of air induction system with air induction pressure control activities are focused.

Keywords: - fuel consumption, air induction pressure, Compression ratio, engine performance

Introduction

Engine is a main element in automobile. An engine which burns the fuel inside it and generates the energy is called as internal combustion engine. Compression ignition engines are important among all the other engines due to their high thermal efficiency. In both types of vehicle such as light duty and heavy duty, C.I. engines can be used. In an internal combustion engine (ICE), air induction system is made up of a network of interconnecting pipes. The part of an engine that supplies the air mixture to the cylinder is known as an air induction system or air intake manifold. The main role of the air intake manifold is to supply air to inlet port in the cylinder head of a C.I. engine. In C.I. engine, depending upon the motion of the air in the chamber injected fuel gets mixed with air. Combustion process can be controlled with air flow which is one of most important factor as air is directly supplied in to cylinder through air inlet manifold with high velocity. In diesel engine, air flow controls the air-fuel mixing and also burning rates. Owing to high velocity of air, the kinetic energy of the air results in turbulence and causes fast mixing of air and fuel. Heat loss to the surroundings is reduced as better cooling of the cylinder surfaces due to enlarged turbulence. The air supplied in suction absorbs heat from the cylinder walls which is used to reduce delay period and hence increases thermal efficiency of C.I. engine. [1, 2]

Intake Manifold Design:-

The main task of an inlet manifold is to distribute air inside the manifold runner uniformly, which is essential for an optimized inlet manifold design. The inlet manifold design has strong influence on the volumetric efficiency of the engine. An uneven air distribution leads to less volumetric efficiency, power loss and increased fuel consumption. Depending on the amplitude and phase of pressure waves inside the inlet manifold, filling of cylinders by air can be affected positively or negatively. The amplitude and phase of these pressure waves depend on inlet manifold design, engine speed and valve timing. The unsteady nature of the induction means and the effect of the manifold on charging are extremely dependent upon the engine speed. This is because of the entry of air inside the inlet manifold which is a function of varying pulses. Therefore these pulses should be fine-tuned in engine manifolds to give required power [1]

2.1 Types of air motion within the cylinder:-

Air-Motion inside the Engine Cylinder includes air, fuel, and exhaust gas motion that occurs within the cylinders during the compression stroke, combustion, and power stroke of the cycle. To increase air-fuel mixing, to enhance combustion speed and efficiency, to boost evaporation of the fuel air motion inside the cylinder is important. The air motion includes swirl motion, tumble motion, squish motion, and turbulence. An organized rotational motion about the cylinder axis within the cylinder is known as "swirl". An organized rotational motion caused due to geometrical arrangement of the inlet ports and the valves, and their opening plan. Construction of induction system to lateral component to inlet flow entering in to the cylinder generates swirl. An organized rotational motion orthogonal to the cylinder axis within the cylinder is known as "Tumble". The gas mixture occupying the volume at the outer radius of the cylinder is forced radially inward as this outer volume is reduced to near zero, as the piston approaches TDC. Such radial inward motion of the gas mixture is called "Squish". Flows are turbulent in C.I. engine because of the high velocity flow within, into, and out of the cylinder. Thermodynamic transfer rates such as Heat transfer, evaporation, mixing, and combustion rates inside an engine are enhanced by a magnitude order. High turbulence during suction stroke is due to turbulence of inlet jet itself also due to conversion of non-turbulent flow of the inlet jet in to turbulence. However turbulence is decreases as the flow rate slows near Bottom Dead Center. Again near Top Dead Center, turbulence increases during compression as swirl, squish, and tumble increase.

Turbulence becomes more homogeneous all the way through the cylinder because of swirl. For combustion, high turbulence near Top Dead Center as ignition occurs is very advantageous. It breaks up and spreads the flame front many times faster than that of a laminar flame. The air-fuel is consumed in a very short time, and self-ignition and knock are avoided [3].

Effect of manifold inclination on C.I. engine performance:-

Inlet manifold plays an important role in performance of an engine. Air flows into the cylinder through the intake port via intake manifold in the form of a jet with maximum velocity at the exit of the intake valve. In the present work inlet manifolds are manufactured with different angle inclinations using mild steel. The manifolds are manufactured with angles 30^0,60^0,90^0 and normal. Also in most of the cases, it is seen that the jet of air after leaving the intake port impinges onto the cylinder wall and diverts back causing the formation of small and large scale vertices within the cylinder [4].

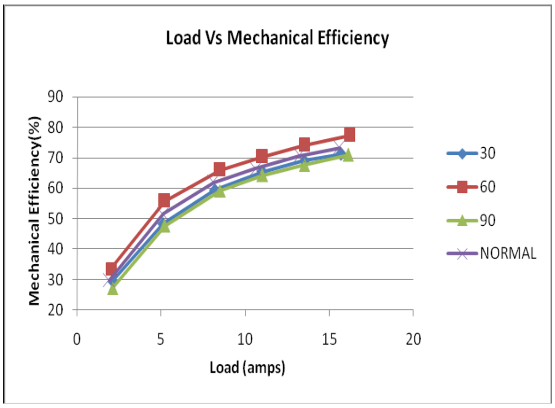

Figure No.1:- Graph of Load Vs Mechanical efficiency at different manifold angles at 160 bar injection pressure [4]

From figure no.1, it is observed that mechanical efficiency is better at 60^0 than other manifold inclinations.

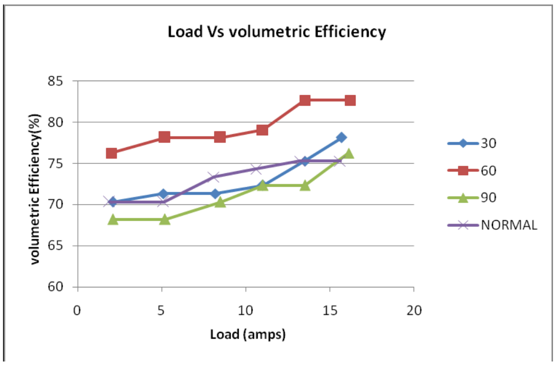

Figure No.2:- Graph of Load Vs Volumetric efficiency at different manifold angles at 160 bar injection pressure [4]

From figure no.2, it is observed that volumetric efficiency is better at 60^0 than other manifold inclinations.

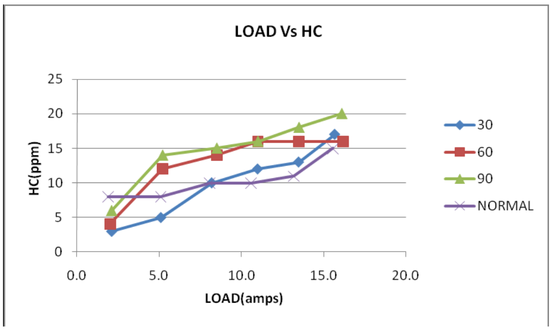

Figure No.3:- Graph of Load Vs HC (ppm) emission at different manifold angles at 160 bar injection pressure [4]

From figure no.3, it is observed that an HC (ppm) emission is less at normal manifold inclination than other manifold inclinations.

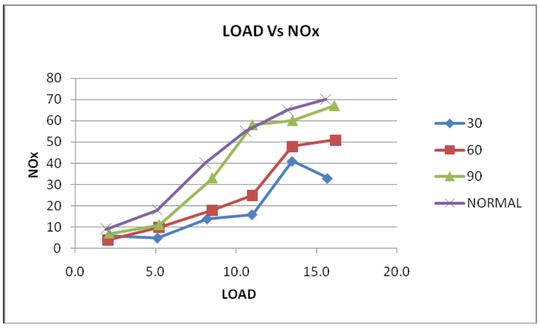

Figure No.4:- Graph of Load VsNO$_x$ emissions at different manifold angles at 160 bar injection pressure [4]

From figure no.4, it is observed that a NOx emission is less at 30^0 than other manifold inclinations.
Intake manifold inclination significantly influence flow arrangement in cylinder. Study of air induction system improves both performance and fuel economy. Better performance is obtained than normal one by varying the manifold inclination. Increasing fuel injection pressure causes complete combustion of fuel which results in reduction in pollution level.

Effect of internally threaded manifold of C.I. engine performance:-

The turbulence is achieved in the inlet manifold with different types of internal threads of constant pitch. The effect of different types of internal threads viz. acme, buttress and knuckle threads of constant pitch is studied.

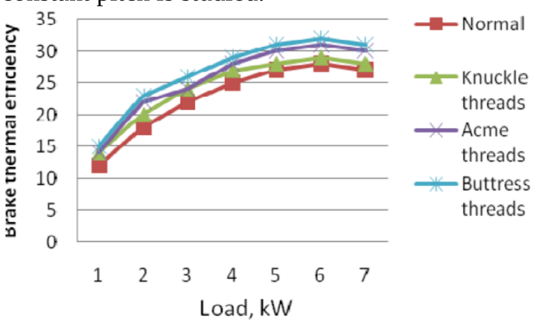

Figure No. 5: Load Vs Brake thermal efficiency at different types of internal threads [5]

The brake thermal efficiency Vs load for diesel engine with inlet manifolds having three different types of internal threads viz. acme, buttress and knuckle threads is compared with the engine with normal inlet manifold and is shown in figure no 5. From above figure it is observed that the brake thermal efficiencies are increasing with an increase in load for configurations that are under consideration [5]. It is also seen that the engine with inlet manifolds having buttress internal threads give highest thermal efficiencies. This is because inlet manifold with buttress threads achieved a higher swirl coefficient and swirl ratio compared with inlet manifold with acme and knuckle threads [6].

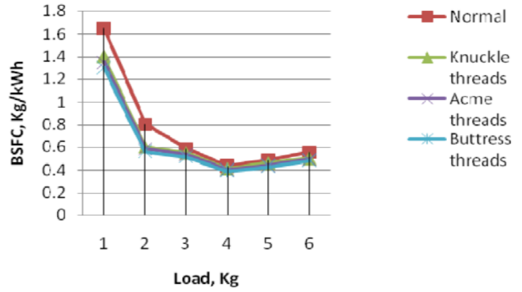

Figure No. 6: Graph of Load Vs Brake Specific Fuel Consumption at different types of internal threads [5]

The BSFC is a measure of engine efficiency. Actually BSFC and engine efficiency are inversely related. Lower the BSFC better is the engine efficiency. A more are less universally accepted definition of thermal efficiency does not exist henceforth Engineers use the BSFC rather than thermal efficiency. Figure no 6 shows The Brake Specific Fuel Consumption Vs load for diesel engine with inlet manifolds having three different types of internal threads viz. acme, buttress and knuckle threads and is compared with the engine with normal inlet manifold. The brake specific fuel consumption is decreasing with an increase in load for all the configurations that are under consideration. From above figure it is observed that the engine with inlet manifold having buttress internal threads give less brake specific fuel consumption than other internal threads [5]. The decrease in BSFC might be due to higher swirl produced in inlet manifold having buttress internal threads compared to engine with normal inlet manifold [6].

Conclusion:-

The air induction system for single cylinder four stroke C.I. engine is studied briefly to understand its effect on C.I. engine performance. The design of inlet manifold configuration is very important in a CI engine. A swirl in the cylinder of a C.I. engine enhances fuel combustion due to improved homogenization of the air - fuel mixture. Proper designing of air induction system should be used to create swirl which is useful to increase combustion efficiency of diesel engine. Swirl motion of air is a function of engine speed. There is an increase in swirl with increase in engine speed. As swirl increases rate of evaporation, mixing of air-fuel increases which leads to complete combustion. Study of air induction system is helpful to improve both performance and fuel economy. Better performance could be obtained than normal one by varying the manifold inclination. The greatest improvement in brake thermal efficiency and reduction in BSFC for engine with inlet manifold having buttress internal threads is observed compared to engine with normal inlet manifold. The inlet manifold with buttress threads is recognized as most favorable configuration depending upon performance characteristics of engine. The design of the air induction system has a major influence on the air flow- field generated within the Diesel Engine Cylinder which in turn helpful to get maximum engine output, minimum fuel consumption, highest thermal efficiency and least exhausts emission.

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Homomorphic Encryption Technique for Storage of data on Cloud

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Abstract: Today like in every field, security is the most challenging aspect in computing technology, computing may be simple computing, cloud computing, grid computing. One of the most untrusted computing is cloud security because user are not aware about the cloud provider, they have provided all computing services from remote location. So there is problem when people keep our data on cloud servers. To avoid this first of all user should encrypt the data after then store these data on cloud. There are many encryption techniques available in market one of them is Homomorphic Encryption. It is a new concept of security which enables to provide results of calculations on encrypted data without knowing the raw entries on which the calculation was carried out respecting the confidentiality of data. This paper analyzes application of different Homomorphic Encryption cryptosystems on a Cloud Computing platform. They are compared based on four characteristics; Homomorphic Encryption type, Privacy of data, Security applied to and keys used. Measurements of this prototype shows that homomorphic algorithm achieves strong security with overhead comparable systems that encrypt all data. In this work, analysis of the behavior of Homomorphic Encryption cryptosystems is compared to the length of the public key and the time of the treatment of the request by the Cloud provider depending on the size of the encrypted messages.

Keywords: Cloud Computing, Cloud Data Security, Homomorphic Encryption Techniques, RSA Encryption Techniques

1. Introduction

Cloud computing came into the foreground as a result of advances in virtualization, distributed manipulating with server clusters and increase in the availability of broadband internet access. Industry leaders describe cloud manipulating simply as the delivery of applications or IT services.

The national institute of standards and technology defines cloud computing as follows:"cloud computing is a model for enabling favorable, on demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model provides availability and is composed of five essential characteristics, with three services models, and four deployment models."

We propose Homomorphic encryption to provide security on cloud. Homomorphic encryption systems are also used to perform operations on encrypted data without knowing the private key (without decryption), the client is the only holder of the private key. This method provides more security on data because provider is not involving in key management. Cloud computing system is divided into two types: The front end and the back end. Front end means through which user can interact with the server. Backend means is the server which provides data to the client. There are many problem related with cloud manipulating traffic, security and resource management.

2. Cloud computing service models

Following are the cloud deployment models, the next security consideration related to the various cloud computing service delivery models. The figure 1 shows there are three main cloud service delivery models are: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS).

Infrastructure as a Service (IaaS)

Infrastructure as a Service is a unique tenant cloud layer where the Cloud computing vendor's dedicated resources are only shared with contracted clients at a pay-per-use fee. This greatly decreases the need for huge initial investment in computing hardware such as servers, resources, networking devices and processing power. They also allow differing degrees of financial and functional flexibility not found in internal data centers or with collocation services, as computing resources can be added or released much more quickly and cost-effectively than in an internal data center or with a collocation service. IaaS and other associated services have enabled startups and other businesses focus on their core competencies without worrying much about the provisioning and management of infrastructure. IaaS fully abstracted the hardware beneath it and allowed users to consume infrastructure as a service without bothering anything about the underlying complexitions. The cloud has a compelling value proposition in terms of cost, but 'out of the box' IaaS only provides basic security (perimeter firewall, load balancing, etc.) and purposes in moving into the cloud will need higher levels of security provided at host.

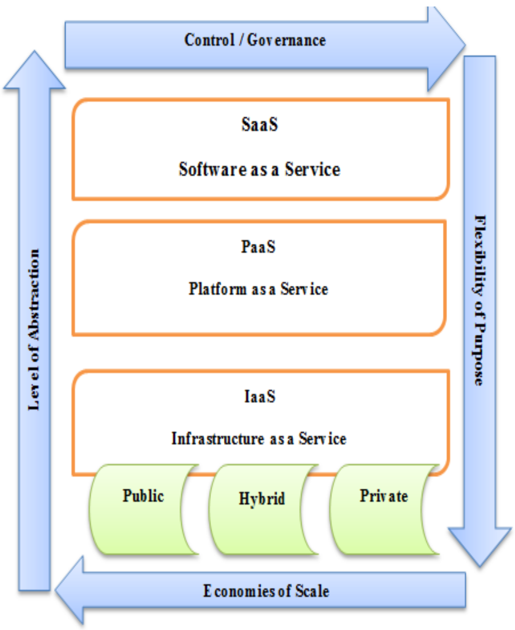

Figure 1: Cloud computing service models
Platform as a service (PaaS)

Platform-as-a-Service (PaaS) is a set of software and development tools hosted on the provider's servers. It is single layer above IaaS on the stack and abstracts away all things up to OS, middleware, etc. This offers an integrated set of developer environment that a developer can tap to build their applications without having any clue about what is going on below the service. It offers developers a service that provides a complete software development life cycle management, from planning to design to the building applications to deployment to testing to maintenance. Everything else is taken away from the "view" of the developers. Platform as service cloud layer works like IaaS but it provides an additional level of 'rented' functionality. Clients using PaaS services relocate even more costs from capital investment to operational expenses but must acknowledge the additional constraints and possibly some degree of lock-in posed by the additional functionality layers. The use of virtual machines act as a catalyst in the PaaS layer in Cloud computing. Virtual machines must be kept protected against malicious attacks such as cloud malware. Thus maintaining the integrity of applications and well enforcing accurate authentication checks during the transfer of data across the entire networking channels is fundamental.

Software as a Service (SaaS)

Software-as-a-Service is a software distribution model in which applications are hosted by vendor or service provider and made available to the customers over the network, typically Internet. SaaS is becoming a highly prevalent delivery model as underlying technologies that support web services and service-oriented architecture (SOA) mature and new developmental approaches become popular. SaaS is often associated with a pay-as-you-go subscription licensing model.Due time, broadband service has become increasingly available to support user access from more areas around the world. SaaS is mostly implemented to provide business software functionality to enterprise customers at a low cost while allowing those customers to obtain the same benefits of commercially licensed, internally operated software with no associated complexity of installation, management, support, licensing, and increased initial cost. The architecture of SaaS-based applications is specifically designed to support many concurrent users (multitenancy) at once. Software as service applications are accessed using web browsers over the Internet therefore web browser security is vitally important. Information security officers will wish to consider various methods of securing SaaS applications. Web Services (WS) security, Extendable Markup Language (XML) encryption, Secure Socket Layer (SSL) and available options which are used in enforcing data protection transmitted over the Internet.

3. Cloud Deployments Models

In cloud deployment model, networking, platform, storage, and software infrastructure are provided as the services that scale up or down depending on the demand as depicted in figure 2. The Cloud Computing model contains three main deployment models which are:

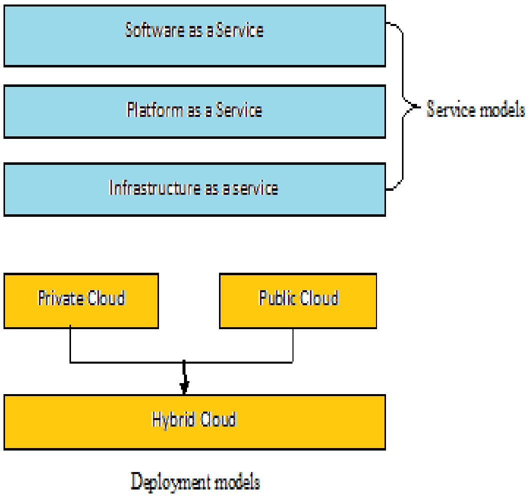

Figure 2: cloud deployment model

Private cloud

Private cloud is new term that some vendors have just now used to describe offerings that emulate cloud manipulating on private networks. It is set up within organization’s internal enterprise data center. In private cloud, scalable resources and virtual uses provided by the cloud vendor are pooled well organized and available for cloud users to share, use. It differs from public cloud in that all cloud resources and applications are managed by the organization itself, same to Intranet functionality. Utilization on private cloud can be much more secure than that of the public cloud because of its specified internal exposure. Only organization and designated stakeholders may have access to operate on a specific Private cloud.

Public cloud

Public cloud explains cloud computing in the traditional mainstream sense, where the resources are dynamically provisioned on fine-grained, self-service basis over the Internet, by web applications or web services, from off-site third party provider who shares resources and also bills on a fine-grained utility computing basis. It is typically based on pay-per-use model, as same to a prepaid electricity metering system which is flexible enough to cater for spikes in demand for cloud optimization. Public clouds are less secure than other cloud models as it places an additional burden of ensuring all applications and data accessed on the public cloud are not subjected to malicious attacks.

Hybrid cloud

Hybrid cloud is secret cloud linked to one or more external cloud services, centrally managed, provisioned as a unique unit, and circumscribed by a secure network. It provides imaginary IT solutions through a mix of both public and private clouds. Hybrid Cloud provides more protected control of the data and applications and allows various parties to access information over the Internet. It also has open architecture that allows interfaces with other management systems. Hybrid cloud can also describe configuration combining a local device, as a Plug computer with cloud services. It also describe configurations combining virtual and physical, collocated assets -as an example, a mostly virtualized environment that requires physical servers, routers, or the other hardware such as a network appliance acting as a firewall or spam filter.

4. RGB color system

RGB color system, constructs all the colors from combining the Red, Green and Blue colors. The red, green and blue make use of 8 bits each, which have integer values from 0 to 255. This makes 256*256*256=16777216 as much possible colors. A color is stored in the computer system in the form of three numbers representing the quantities of Red, Green and Blue respectively. It is used in to store images in BMP, JPEG and PDF formats. Any color can be uniquely represented in which Red, Green and Blue. The RGB color model is an additive model into which Red, Green and Blue are combined in various ways to produce other color. Here we use RGB values for security purpose separately three values are generated. Password may be stealing by the attacker but at the time of user registration RGB values are generated automatically. So in that case the chances of attack are very less.

5. Homomorphic encryption

Homomorphic Encryption systems are used to perform operations on encrypted data without knowing the private key (without decryption), the client is the only holder of the private key. When we decrypt the result of any operation, it is the similar as if we had carried out the calculation on the raw data.

Definition: An encryption is homomorphic, if: from Enc (a) and Enc(b) it is possible to compute Enc(f (a, b)), where f can be: +, ×, ⊕ and without using the private key. Among the Homomorphic encryption we differentiate, according to the operations that allows to assess on raw data, the additive Homomorphic encryption (only additions of the raw data) is the Pailler and Goldwasser-Micalli cryptosystems, and multiplicative Homomorphic encryption (only products on raw data) is the RSA and El Gamal cryptosystems.

Additive Homomorphic Encryption

A Homomorphic encryption is additive, if:

Enc (x⊕y) = Enc(x) ⊗Enc(y)
1 1

Enc (Σmi) = ΠEnc (mi)
i=1 i=1

Table I Paillier Cryptosystem

1. Key generation: Step 1: n = pq, the RSA modulus Step 2: λ = lcm (p − 1, q − 1) Step 3: g ϵ Z /n2 Z s.t. n|or dn 2(g) Step 4: Public-key: (n, g), secret key: λ, μ
2. Encryption of m : Step 1: m ϵ {0, 1... n − 1}, a message Step 2: h ϵR Z/n Z Step 3: c = gm hn mod n2, a cipher text
3. Decryption of c : m = L (c λmod n2) L(g λmod n2)−1 mod n The constant parameter, L (gλ mod n2)-1 mod n or L (gα mod n2)-1 mod n where g=1+ n mod n2 can also be recomputed once for all.

Suppose we have two Ciphers C1 and C2 such that:
C1 = gm1. r1n mod n2
C2 = gm2. r2nmod n2
C1.C2 =gm1. r1n .gm2.r2nmod n2 = gm1+ m2 (r1r2)nmod n2
So, Pailler cryptosystem undergoes with the property of additive Homomorphic encryption.

The use of an additive Homomorphic encryption is electronic voting: Each vote is encrypted but only the "sum" is decrypted.

Multiplicative Homomorphic Encryption

A Homomorphic encryption is multiplicative, if:
Enc (x⊗y) = Enc(x) ⊗Enc(y)
1 1
Enc (∏mi) = ∏ Enc (mi)
i=1 i=1

Table II RSA Algorithm

Key generation	
Select p, q	p and q both prime p ≠ q
Calculate n=p * q	
Calculate ∅ (n)=(p-1)(q-1)	
Select integer e	gcd ($\overset{n}{∅¿}$),e)=1; 1 < e < ∅ (n)
Calculate d	d=e^-1(mod ∅(n))
Public key	PU={e ,n}
Private key	PR={d, n}
Encryption	
Plaintext:	M < n
Cipher text:	C=M ^ e mod n
Decryption	
Cipher text:	C
Plaintext:	M=C^4 mod n

As if we have two ciphers C1 and C2 such that:
C1 = m1e mod n
C2 = m2e mod n
C1.C2 = m1em2emod n = (m1m2)emod n

RSA cryptosystem realize the characteristics of the multiplicative Homomorphic encryption, but it still has a lake of security, because if we assume that two ciphers C1, C2 corresponding respectively to the messages m1, m2, so:

C1 = m1e mod n
C2 = m2e mod n

The client sends the pair (C1, C2) to the Cloud server; the server will perform the calculations requested by the client and sends the encrypted result (C1× C2) to the client.

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If the attacker intercepts two ciphers C1 and C2, which are encrypted with the same secret key, he/she will be able to decrypt all messages exchanged between the server and the client as the Homomorphic encryption is multiplicative, i.e. the product of the ciphers equals the cipher of the product.

Example: The uses of RSA multiplicative Homomorphic encryption on two messages m1 and m2.

Let, for p = 3, q = 5, e = 9 and d = 1 with block size = 1 Two messages m1 and m2 and their ciphers C1 and C2 respectively, obtained using the RSA encryption.

m1= 589625 □ C1 = 00 05 00 08 00 09 00 06 00 02 00 05
m2 = 236491 □ C2 = 00 02 00 03 00 06 00 04 00 09 00 01
We have convert the ciphers into binary system suppose we decrypt the cipher C1 × C2 with the private key, we get:
C1C2 = 00 10 00 02 00 04 00 05 00 04 00 02 00 04 00 01 00 08 00 05

m1m2 = 10 2 4 5 4 2 4 1 8 5
This is exactly the similar raw message obtained by multiplying m1 × m2
m1 = 5 8 9 6 2 5
m2 =2 3 6 4 9 1
m1m2 =10 24 54 24 18 5 (we are multiplying m1× m2 block by block).

6. Existing System

A Homomorphic encryption has distinct Homo-morphic schemes according to its properties as shown in table 1:

Table III Homomorphic Encryption Schemes

Scheme	Homomorphic properties	Algorithm (Symmetric/Asymmetric)
RSA	Multiplicative	Asymmetric
EIGamal	Multiplicative	Asymmetric
GoldwasserMicali	XOR	Asymmetric
Benaloh	Additive	Symmetric and Asymmetric
Paillier	Additive	Asymmetric
Okamoto-Uchiyama	Additive	Asymmetric

Security is biggest problem of cloud computing. Many Research paper discuss about cloud and Its advantage and disadvantage.

Additive Homomorphic Encryption
A Homomorphic technique is additive, if: Enc(a + b) = Enc(a) +Enc(b)

Table IV Paillier Cryptosystem

Key Generation: KeyGen (p,q)	**Encryption: Enc(m, pkey)**	**Decryption: Dec(ci, skey)**
Input: p, q € P	Input: m € Zn	Input: Ci € Zn
Compute: n=p*q, and =lcm(p-q)(q-1) Choose g € Zn such that Gcd(L(g^ mod n2),n)=1 with L(u)=(u-1)/n	Choose r € Zn Compute: ci=gm * rn mod n2	Choose r € Zn Compute: ci=gm * rn mod n2 Compute: m= mod n [L((c^ mod n2)/L((g^ mod n2)]
Output: (pkey, skey) Public Key: pkey=(n, g) Secret Key: skey=(p,q)		Output: m € Zn

Suppose we have two ciphers Ci1 and Ci2 such that:
Ci1=gm1. r1 n mod n2
Ci2=gm2.r2 n mod n2
Ci1. Ci2= gm1.r1 n.gm2.r2 n mod n2= gm1+m2 (r1r2) n mod n2

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So, Paillier cryptography system realizes the property of additiveHomomorphic encryption. An application of an additive Homomorphic encryption is electronic voting: Each vote is encrypted but only the “sum” is decrypted.

Problem in Existing System

Let, we have two ciphers C1 and C2 such that:

$$C1 = m1e \bmod n$$
$$C2 = m2e \bmod n$$
$$C1.C2 = m1em2e \bmod n = (m1m2)e \bmod n$$

RSA cryptosystem is based on the property of multiplicative Homomorphic encryption, but it has a lake of security, because if we have two ciphers C1, C2 corresponding respectively to the messages m1, m2 as shown in figure 5, so:

$$C1 = m1e \bmod n$$
$$C2 = m2e \bmod n$$

The client sends the pair (C1, C2) to the Cloud server and server performs the calculations requested by the client and sends the encrypted result (C1 × C2) to the client. If the attacker intercepts two ciphers C1and C2, which are encrypted with the similar private key, so they are able to decrypt all messages exchanged between the server and the client. Because the Homomorphic encryption is multiplicative, i.e. the product of the ciphers equals the cipher of the product. The basic RSA algorithm and Paillier Cryptosystem is vulnerable to chosen cipher text attack (CCA).CCA is defined as an attack in which adversary chooses a number of cipher text and is given the corresponding plaintext, decrypted with and then be able to get plaintext back by having it decrypted by private key. So attacker will know the entire data in-between client and cloud server.

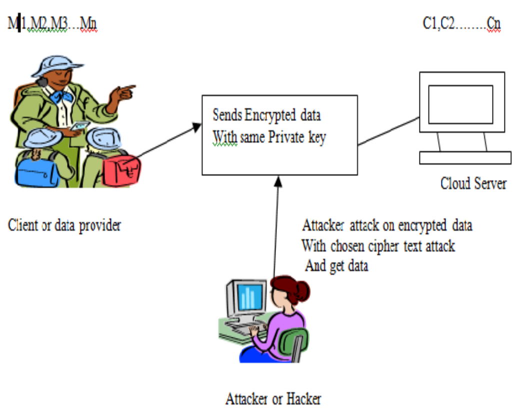

Figure 5: Existing System model

7. Proposed System

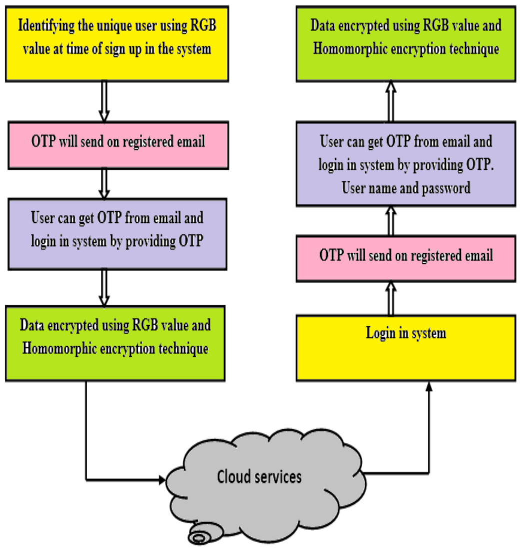

Figure 6: Proposed system

To avoid the chosen cipher text attack in the existing system, we are providing the encryption from our side and the service provider also provides the encryption from its side. So it will be the double security for our information as the encryption is provided by us also. Usually the server side encryption is by default. We are providing the new security using RSA cryptosystem with Paillier algorithm of Homomorphic encryption Technique. Homomorphic encryption scheme has many properties like multiplicative, XOR and additive. Paillier is the additive type of scheme with asymmetric key cryptography. As shown in figure 6,the user identification during the registration is done using the RGB value. RGB value is also additive for the security. While registration of user, he will be provided with a unique RGB value which is in the form of (123, 20, 223). Simultaneously, the user signup will be done. Then the user will able to login to the system. The OTP will be generated every time the user log in to the system. That will be available on its mail then he can login to system. After this the encryption will be done using RGB value and Homomorphic encryption technique and sent on cloud. The user can able to decrypt the data by again log in to the system and providing key further.

Homomorphic Encryption Algorithm:

Key generation – keygen (p, m)

1. Take two prime numbers as p and m.
2. Calculate n such that n=p.m, f(n)=(p-1)(m-1) and choose e such that gcd(e,f(n))=1.

3. Calculate d such that d.e=1 mod f(n).
4. The public key (pk) is generated as (e, n).
5. The secrete key (sk) is generated as (d).

Encryption Process:

1. Let q be a massage to be encrypted.
2. Cipher text (c) can be calculated as c=qe mod n.

Decryption Process:

1. Decryption (dec) will be dec=(c,sk).
2. Calculate the value such that message q=cd mod n.

Conclusion

It is clear that although the use of cloud computing has rapidly increased; cloud computing security is still considered as major issue in the cloud computing environment. Customers do not want to lose their private information as a result of malicious insiders in the cloud. In addition, the loss of service availability has caused many problems for a large number of customers recently. Furthermore, data intrusion leads to many problems for users of cloud computing. The purpose of this work is to survey the recent research on single clouds to address security risks and solutions. So, this system is more secure than existing system because here double security first one is RSA based encryption techniques and one time password is provided.

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Design of Experiment for Performance Analysis of Hot Water Storage Tank in a Solar Water Heating System

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ABSTRACT: There are many methods carried out by research scholar to enhance the performance of hot water storage tank in the recent times. The specific objective of this paper is to design method to measure performance parameter and testing techniques for hot water storage tank in solar water heating system, for performance enhancement of hot water storage tank. There are number of design available in the market for improving performance of hot water storage tank requires some unified approach or testing method that will compare and determine performance of different hot water storage tank models under similar climatic and operating conditions. In this paper more concentration is given on investigation of factors affecting the performance of hot water storage tank such as type of material, storage temperature, storage heat losses, costs of storage medium and container, climatic data such as solar radiation, ambient temperature, wind speed, sky conditions, etc. heating load, collector type, its area and efficiency, fraction of the total heat load to be met by solar energy.

Abbreviations

SWH	Solar Water Heater
TS	Thermal stratification
Q	The energy absorbed by the collector
G	Total solar radiation intensity
η_c	Charging efficiency
η_c	Discharging efficiency
T_a	ambient temperature
TES	Thermal Energy Storage
m	The fluid flow rate
T_i & T_o	The fluid inlet and outlet temperature of collector
V	Wind speed

INTRODUCTION:

Developing efficient and inexpensive energy storage devices is as important a field as developing new sources of energy. Energy storage can reduce the time or rate mismatch between energy supply and energy demand, thereby playing a vital role in energy conservation. It improves' the performance of energy systems by smoothening the output and thus increasing reliability. For example, storage would improve the performance of power generating plant by load leveling. The higher efficiency would lead to energy conservation and improve cost effectiveness. Some of the renewable energy resources can provide only an intermittent energy supply, e.g., solar energy. In most solar energy systems a back-up or auxiliary energy source becomes essential. Provision of a solar thermal energy storage can reduce auxiliary energy consumption to a great extent and increase the so called solar load fraction substantially, thus conserving the valuable fossil fuel reserves, coal, oil, and natural gas.

Nature has been storing wast amouts of solar energy in the form of bio-mass and fossil fuels. However, this process takes a very long time. If the present rate of industrialization is to be maintained, and the amenities from man-made systems are to continue to be available, then storage of energy is essential. The storage of energy in suitable forms, which can conveniently be converted into the required form is a present day challenge to the technologists.

It is clear that if solar energy is to become an important energy source, efficient, economical and reliable solar thermal energy storage devices and methods will have to be developed. Although, several methods have been proposed for storage as will be evident in this chapter yet they have not been around long enough to be fully evaluated.

The optimum size of solar thermal storage for space heating system depends on the type of application, and is a function of several parameters, such as type of material, storage temperature, storage heat losses, costs of the storage medium and container, type of heat exchanger and pumps, cost of auxiliary energy if any, climatic data such as solar radiation, ambient temperature, wind speed, sky conditions, etc. heating, collector type, its area and efficiency, fraction of the total heat load to be met by solar energy, thermo physical properties of the storage materials, etc.

THERMAL ENERGY STORAGE

Thermal energy can be stored in well insulated fluids or solids. It is generally stored either as:

(i) Sensible heat—by virtue of the heat capacity of the storage medium, or as
(ii) Latent heat—by virtue of the latent heat of change of phase of the medium, or both.

There are four main items affecting the cost of a thermal storage:

(i) The thermal heat storage material,
(ii) The insulating packaging,
(iii) The space occupied by the storage device and
(iv) The heat exchanger for charging and discharging the storage.

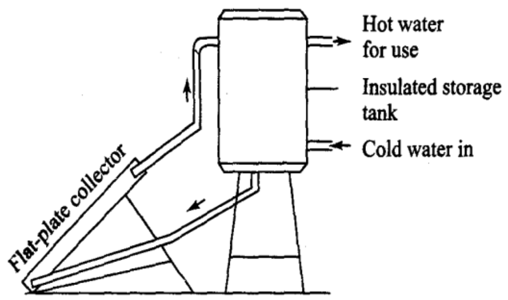
Desired characteristics of a thermal storage

1. Compact, large storage capacity per unit mass and volume.
2. High storage efficiency.
3. Heat storage medium with suitable properties in the operating temperature range.
4. Uniform temperature.
5. Capacity to charge and discharge with the largest heat input/output rates but without temperature gradients.
6. Complete reversibility.
7. Ability to undergo large number of charging/discharging cycles without loss of performance and storage capacity.
8. Small self-discharging rate i.e. negligible heat losses to the surroundings.
9. High speed of charging and discharging.
10. Long life.
11. Inexpensive.
12. Should not be corrosive.
13. No fire and toxicity hazard.

The specific application for which a thermal storage system is to be used determines the method to be adopted. Some of the considerations which determine the selection of the method of storage and its design are as follows.

1. The temperature range over which the storage has to operate.
2. The capacity of the storage has a significant effect on the operation of the rest of the system, especially the collectors. A smaller storage unit operates at a higher mean temperature. This results in a reduced collector output as compared to a system having a larger storage unit.
3. Heat losses from the storage have to be kept to a minimum. Heat losses are of particular importance for 'long-term' storage.
4. Cost of the storage unit. This includes the initial cost of the storage medium, the containers and insulation, and the operating cost.

Other considerations include the suitability of materials used for the container, the means adopted for transferring the heat to and from the storage, and the power requirements for these purposes.



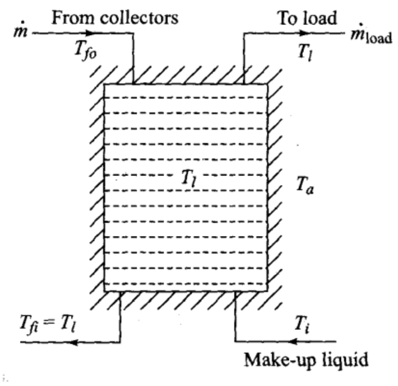


Fig 1 Natural Circulation SWH
Fig 2 Hot Water Storage Tank

THERMAL STRATIFICATION

In a thermally stratified situation, the temperature of the contained liquid varies from the bottom to the top, being less at the bottom and more at the top. This situation is in contrast to that obtained in

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a well-mixed tank in which the liquid temperature is uniform throughout.

Thermal stratification is obviously desirable if the temperature difference (TL-Ti) (Fig. 1), is significant. If the line taking liquid to the load at the required temperature Tl is located appropriately near the top of the storage tank, then only the liquid near this exit port has to be at the temperature TL. The rest of the liquid in the storage tank can be at a lower temperature at all times. As a result, heat losses from the tank are reduced. A second advantage is that the collectors operate at a lower temperature level and deliver higher collection efficiency.

TESTING PROCEDURE

The tests to be performed are the heat loss test and two charge-discharge tests for determining the storage capacity.
In the heat loss test, the transfer fluid is passed through the storage device at a fixed mass flow rate (m) and at an inlet temperature (T_{fi}) 25°C above the ambient air temperature (T_a). After steady state conditions are achieved, the difference between the inlet and outlet fluid temperature is measured. The heat loss factor $(UA)_t$ is calculated from the expression

$$(UA)_t = \frac{mC_p(T_{fi} - T_{fo})}{(T_{fi} - T_a)}$$

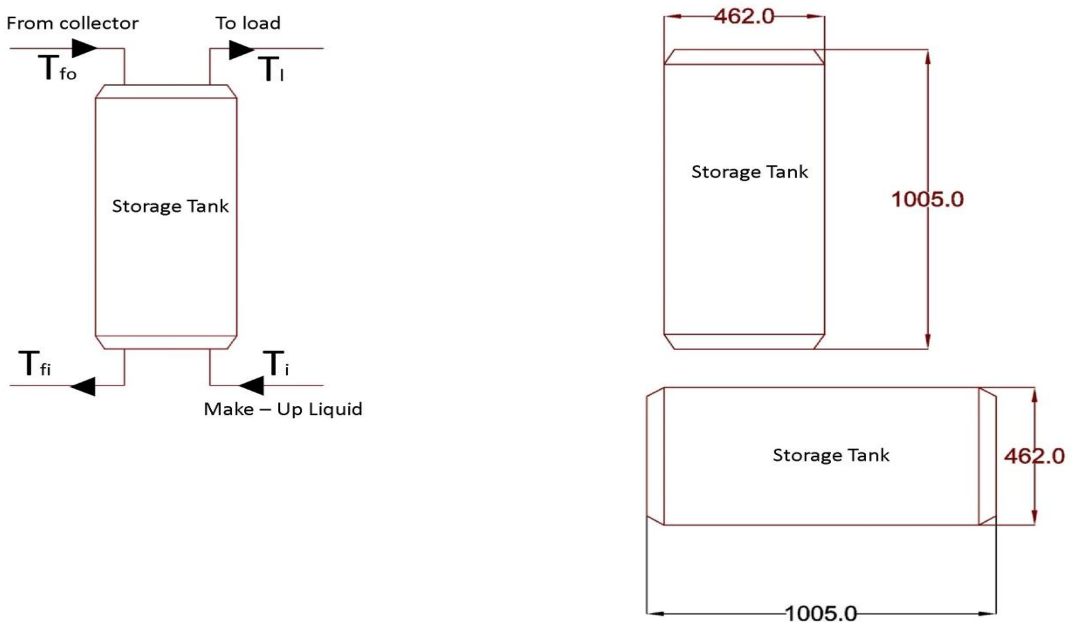

Fig 3 Dimension of storage tank 100 LPD

In the charge-discharge test, the transfer fluid at a constant temperature is first passed through the device and the device brought to a uniform initial temperature T_i .Then the flow is adjusted to the test flow rate (m) and the temperature of the transfer fluid is suddenly increased in a step-wise manner to $T_i + \Delta T_i$ The difference between the temperature of the transfer fluid entering and leaving the device is continuously recorded over a specified time period t_p, as charging takes place. The temperature of the transfer fluid is maintained at ($T_i + \Delta T_i$) until the exit temperature of the transfer fluid reaches a steady value. Thereafter with the same mass flow rate, the temperature of the transfer fluid is suddenly decreased in a step-wise manner back to the initial value T_i .The difference between the temperatures of the transfer fluid entering and leaving

The device is again continuously recorded over the same time period t_p as discharging takes place. The charge-discharge cycle is performed for two test conditions. If the transfer fluid is a liquid, the value of ΔT_i is taken as 15°C for both test conditions, while the values of t_p are taken to be 2 and 4 hours. If the transfer fluid is air, the corresponding values are ΔT_i = 35°C, and t_p = 2 and 4 hours. The variation of the inlet and exit temperature of the transfer fluid during a typical charge-discharge cycle is shown in Fig. 3

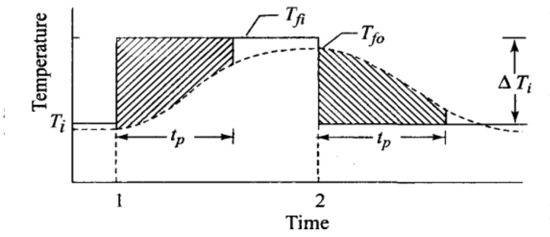

Fig 4 Charge-discharge test cycle

The value of T_i the initial temperature of the storage device, is chosen by considering the intended temperature range of the device during use, while the value of the mass flow rate maintained during charging and discharging is calculated from the expression

$$m = \frac{TSC}{t_p C_p \Delta T_i}$$

Where, TSC = theoretical storage capacity of the device for a temperature change from ΔT_i to ($T_i + \Delta T_i$).

From the data recorded, the charge and discharge capacities of the device are obtained by integration as follows.

$$C_c = m\int_0^{t_p} C_p\left(T_{fi} - T_{fo}\right)dt - (UA)_t t_p\left[\frac{T_{fi} + T_{fo}}{2} - T_a\right]$$

$$C_d = m\int_0^{t_p} C_p\left(T_{fi} - T_{fo}\right)dt$$

The standard recommends that the performance of the thermal storage device should be judged by the values of C_c and C_d calculated from above Equation along with plots of dimensionless temperature $\left(T_{f0} - T_{fi}\right)/\Delta T_i$ vs. time obtained for the two conditions specified.

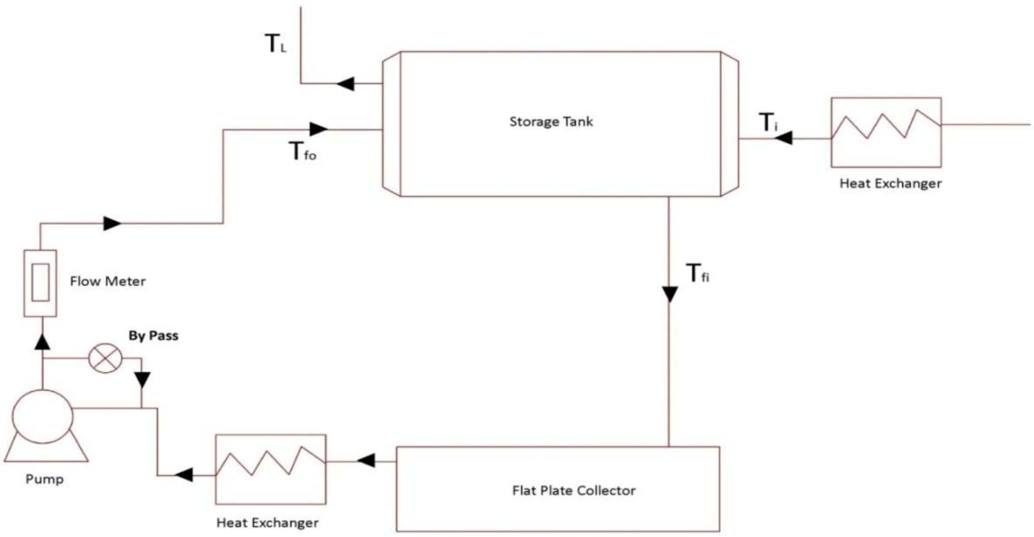

Fig 5 Experimental Setup

CONCLUSION:

Solar hot water storage tank performance is a topic of never-ending discussion in solar as renewable energy field. While the performance of hot water storage tank is at par, still there is scope of performance improvement. In order to assure certain quality for hot water storage tank, it is necessary to design standards, conduct tests to verify compliance of these standards. In this paper hot water storage tank performance parameters are discussed. These would be useful to optimize and compare various hot water storage tanks. It would provide information to designers and users regarding performance of hot water storage tank. There is wide scope in research and development of hot water storage tank to understand behavior of thermal stratification with low conductivity material and composite for hot water storage tank. Also find the effect of storage tank design parameters that is, insulating layer thickness and size on performance of a solar water heating system. Instead of conducting the tests for the whole year, tests could be conducted for about fifteen days and results should be extrapolated to obtain annual performance.

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Design and Development of Experimental Setup for Thermoelectric generator system Performance Analysis

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ABSTRACT: Recently an increasing concern of energy production, global warming issues and shortages of energy resources has resulted in extensive research into novel technologies of generating electrical power. Thermoelectric power generation offers a potential application in the direct conversion of waste heat energy into electrical power. It is unnecessary to consider the cost of the thermal energy input. During this era of shortage of electricity, it is very essential to convert low grade heat energy into electricity. Thermoelectric generators are having great potential for directly converting heat energy into electrical power. In the thermoelectric generators because of absence of linkage or mechanism no mechanical wear, tear of materials and noise problems occurs. In this paper basic theory, design considerations and development of experimental setup for two thermoelectric module TEG 1268-4.3 and TEG-4199-5.3 Module is discussed. This work is focused on system design for maximization of waste heat recovery using thermoelectric generator. Two thermoelectric generators with different specification are used for design and development for further thermoelectric generator performance analysis.

INTRODUCTION:

A large thermal potential is available like at steam condensers of thermal power plants, internal combustion engine jacket cooling water, waste heat from nuclear power plants, solar thermal energy collectors and water heaters storage tanks. A thermoelectric power generator is a solid state device that provides direct energy conversion from thermal energy (heat) due to a temperature gradient into electrical energy based on "Seebeck effect". The thermoelectric power cycle, with charge carriers (electrons) serving as the working fluid. The major drawback of thermoelectric power generator is their relatively low conversion efficiency (typically ~5%). This has been a major cause in restricting their use in electrical power generation to specialized fields with extensive applications where reliability is a major consideration and cost is not. Applications over the past decade included industrial instruments, military, medical and aerospace and applications for portable or remote power generation[1].

BASIC THEORY OF A THERMOELECTRIC POWER GENERATOR

The basic theory and operation of thermoelectric based systems have been developed for many years. Thermoelectric power generation is based on a phenomenon called "Seebeck effect" discovered by Thomas Seebeck in 1821 [1]. When a temperature difference is established between the hot and cold junctions of two Dissimilar materials (metals or semiconductors) a voltage is generated, i.e., Seebeck voltage. In fact, this phenomenon is applied to thermocouples that are extensively used for temperature measurement.

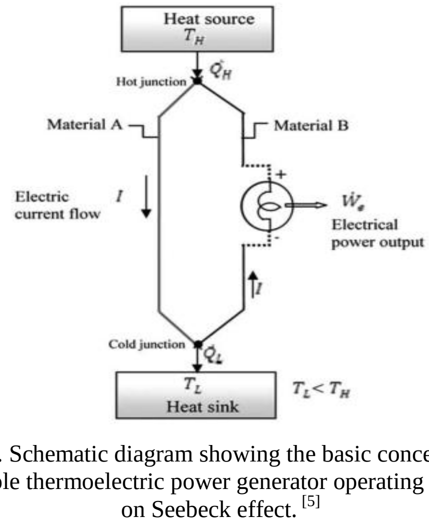

Fig.1. Schematic diagram showing the basic concept of a simple thermoelectric power generator operating based on Seebeck effect. [5]

In above figure heat is transferred at the rate of Q_H from a high temp. heat source maintained at T_H to the hot junction, and rejected heat rate of Q_L to low temp.sink maintained at $T_{L.}$ Due to the heat supplied at hot junction, causes the electric current to flow in the circuit to produced electrical voltage.

COMPONENTS OF THE THERMOELECTRIC GENERATOR:

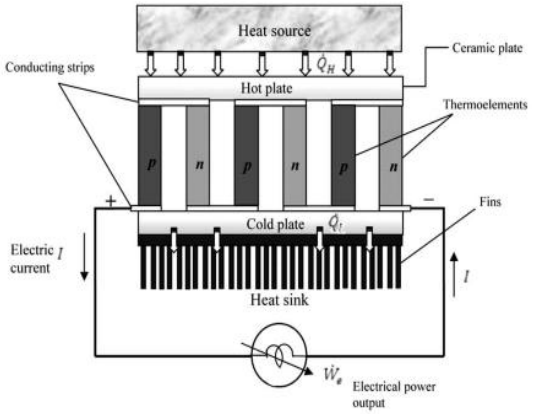

Fig 2: Schematic diagram showing components and arrangement of a typical single stage thermoelectric power generator [3]

Fig.2. shows a illustrating diagram of components & arrangement of a conventional single stage thermoelectric power generator It consist of two ceramics plates, which are used as foundation mechanical integrator & electrical insulator for n-type (to create electron) and p-type (to create excess holes) semiconductors elements. The thermoelectric material operates as the charge carriers & electron carriers.

The sizes of conventional thermoelectric devices vary from 3mm^2 by 4 mm thick to 75 mm^2 by 5 mm thick. Due to mechanical consideration the length of most of the module not exceed more than 50 mm. The height of the module in between 1 to 5 mm [2]. Depending upon the large temp. Requirement Multistage thermoelectric module shown in fig.[3] can be up to 20 mm in height, depending upon the number of stages.

Design Consideration for Thermoelectric Generator system:

Before starting the module selection process, the designer should be prepared to answer the following questions [4] :

- At what temperature your object is maintained.
- How much heat is removed from heat source
- How much cooling effect is obtained from cooling source
- How much space is available for the module and heat sink?
- What power is available?
- Does the temperature of the cooled object have to be controlled? If yes, to what precision?
- What is the expected approximate temperature of the heat sink during operation? Is it possible that the heat sink temperature will change significantly due to ambient fluctuations etc.?
- What is the expected ambient temperature? Will the ambient temperature change significantly during system operation?

Parameters to be considered for Thermoelectric Generator system design [4]:

Temperature of cold surface (TC); temperature of hot surface (TH) and the amount of heat absorbed of removed by the cold surface of the thermoelectric module (QC).
If the object to be cooled is in deep contact with the cold surface of the thermoelectric module, the expected temperature of the object (TC) can be considered the temperature of the module‘s cold surface. There are cases which the object to be cooled is not in deep contact with the cold side of the module, such as an amount of cooling which the heat exchanger in the cold surface of the thermoelectric module. When this kind of system is used, the cold surface required can be several degrees lower than the desired temperature of the object.

The hot surface temperature (TH) is defined by two important parameters:

1. The temperature of the environment which the heat is rejected.
2. The heat exchanger efficiency which is between the hot surface of TE and the environment. Consideration of operating variables for Thermoelectric Generator Temperature difference between hot junction and cold junction, Temperature range at input or thermoelectric material melting point, temperature or sustainable

Development of Thermoelectric Generator System:-

Thermoelectric system consist of following components-

Sr. No.	Components Details	Qty.
1	Thermo Electric Generator,(TEG) Module 12 volt	2
2	Heat Exchanger Aluminum , Max 1Litter Capacity	2
3	Digital Temp. Meter	3
4	Digital Voltage Meter	2
5	Digital Amp Meter	2
6	100 Watt, 230 volt AC Inverter CKT	1
7	7Amp/12 Volt Rechargeable Battery	1
8	Charging Controlled CKT	1

Considering all the design consideration for thermoelectric generator system develop the system for two TEG Module i.e TEG 1268-4.3 and TEG 4199-5.3 are shown in figure. 3 and 4. Each module is built with high temperature graphite sheets on both the hot & cold side, eliminating the need for thermal grease. The leads are connected to the cold side on the module in order to protect them from extreme temperatures.

Hot Side Temperature (0C)	300
Cold Side Temperature (0C)	30
Open circuit Voltage (V)	10.7
Matched Load Resistance (ohms)	5.4
Matched Load Output voltage (V)	5.3
Matched Load Output current (A)	1.0
Matched Load Output Power(W)	5.2
Heat Flow Across the Module (W)	115

TEG-1268-4.3 Module

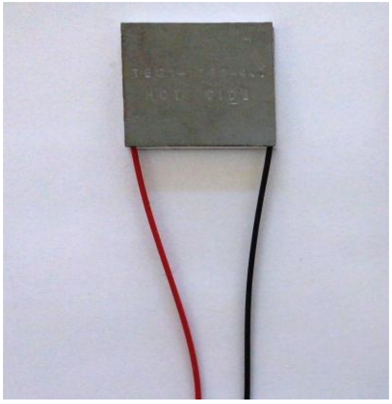

Fig.3: Thermoelectric module 1268.4.3 with Specification

Hot Side Temperature (0C)	300
Cold Side Temperature (0C)	30
Open circuit Voltage (V)	13.4
Matched Load Resistance (ohms)	5.7
Matched Load Output voltage (V)	6.7
Matched Load Output current (A)	1.12
Matched Load Output Power(W)	7.5
Heat Flow Across the Module (W)	152

TEG-4199-5.3 Module

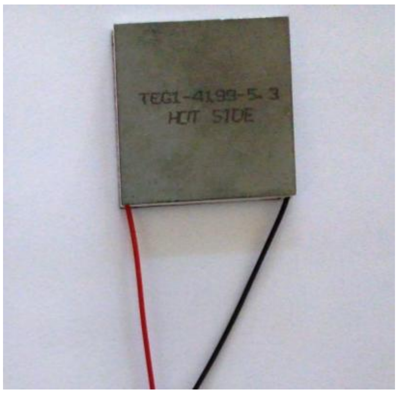

Fig.4: Thermoelectric module 4199.5.3 with Specification

Design of Thermoelectric Generator System:

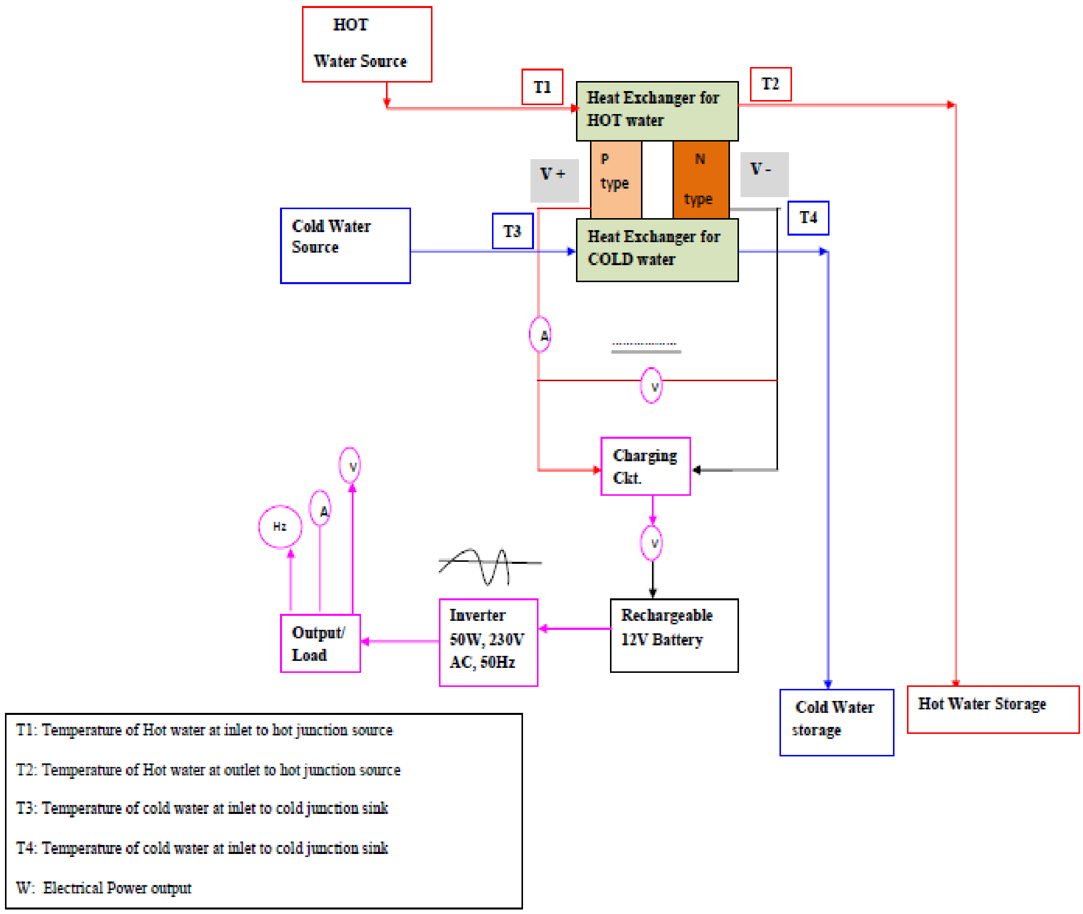

Figure 5:Layout for Thermoelectric Generator System

Seebeck Effect thermoelectric power modules are design with high temperature bonding materials that allow them to withstand temperatures of up to 300°C (608°F). As long as the TEG module is placed into a system, whereby the hot side has a higher temperature than the cold side, DC power will be produced. The greater the DT (difference in temperature across the module the greater the power produced). These modules can be placed in parallel and series to produce a workable larger voltage.

CONCLUSION:

This work would be very useful for performance testing of thermoelectric generators to determine the effect of important parameter considerations and their potential for improvement in design & development of thermoelectric generator system. It is expected that experimental data generated would increase in conversion efficiency & increased in power output capacity. This work would be very useful for direct conversion of waste heat that is. low grade energy into high grade electricity.

Acknowledgement

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Comparative Analysis for Suitability of Fly Ash and Coconut Husk in BOD and COD Removal from Paper Mill Waste Water

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Abstract: Since last 2 decades as the world population is increased. Hence there is increase in requirement of paper mills due to market development. Today's industrial environment is competitive, it is well known fact that paper mill wastes causes so many destruction and produces bad impacts on nations economics. Though it is almost impossible to fully recoup the damage caused by lignin, it is possible to minimize the potential risks. Last couple of year's some difficulties comes in to picture which results in development of country.

The waste by product obtained from thermal power station is residue from combustion of pulverized coal is known as fly ash. To achieve material of cementing properties it is combined with lime. Aim of this paper is to study and find out an adsorbent for the removal of lignin from paper mill wastes using fly ash and coconut husks. Find out best suitable material among these. Use of such technique helps to provide the controlling lignin waste strength and for the improvement of treatment on BOD, COD to provide valuable empirical data and further protect environment with use of unproductive waste like coconut husk and fly ash.

Keywords—Fly ash, coconut husk, BOD, COD, Lignin

I. INTRODUCTION

An increasing global pollution has forced many researchers to find more eco- friendly methods for waste elimination. The highly concentrated, toxic in nature are the causes of industrial waste waters. Also Phosphorus and nitrogen are also released into wastewaters. The raw material such as wood is the main source of nutrients, nitrogen, and phosphorus compounds. The use of ozone, peroxide and other chemicals in bleaching makes it necessary to use a strong agent for heavy metals such as manganese. Lignin can be removed by using Coconut husk and fly ash, which themselves are waste materials.

Paper mills discharge in large quantities of overly colored effluents into receiving streams. Color in natural waterway has been considered undesirable mainly from an esthetics viewpoint. The color discharged from Kraft mills is economically undesirable is released. Removal of color in downstream waters is also detrimental to fishing and tourist industries.

The reduction of the oxygen demand of pulp mill effluents is done by biological treatment, which is not effective for color removal. The compounds related with lignin are the major contributors to color in Kraft pulp and paper mill effluents. These compounds are difficult to degrade biologically. Although lignin related compounds have been found to be toxic to few aquatic species, the colors they add to receiving steams interfere with transmission of sunlight and hinder the growth of oxygen producing algae. Thus, color material indirectly imposes an oxygen demand on downstream reservoirs. If the color is severe enough, the dissolve contentof the oxygen in the reservoir may go down below a level necessary to sustain aquatic life.

A material suitable for removing color from pulp and paper mill effluents would have to be cheap and readily available. Fly and Coconut husk are such a material. Coconut Husk powder is manufactured by various stages by crushing coconut shells in hammer mills. Coconut shells are taken as raw material from coconut processing industries. Husk and shells are separated from the coconut manually. It normally takes 3-4 minutes. The separated coconut shells are put in to the crushing machine which is provided with press rollers, so that through crushing coarse shell are produced.

There is a huge scope of commercial utilization of coir and coir dust, with their own or in combination with different raw materials, to produce the products like mat and matting, brush, twine and rope, rubberized coir, particle board, fertilizer and applications such as upholstery cushioning, pad and carpet underlay. Fly ash is a waste product of the electric power generating industry, and is produced wherever coal is used for thermal generation of electricity. With the high demand of coal consumption, it is important to meet future energy demands; an abundant supply of low cost fly ash is assured. In this study, an effluent from a caustics extraction stage of a Kraft pulp mill was used to determine the color removal effectiveness of a fly ash produced from lignite.

II. LITREATURE REVIEW

Concrete mixes having fly-ash as CRM have lesser cement content, adverse effects related to higher cement content, such as shrinkage, excessive rate of heat development etc., are minimized in the concrete. Use of fly-ash as cement replacement material for low strength concrete beyond 30% level can have enhanced durability and hence long service life. Mixes having fly-ash as found to be more durable and corrosion resistant due to their refined pore size distribution. Reinforced concrete structures and the products of pre-casting made with concrete having fly-ash as CRM would, therefore have long, maintenance-free service life [1].

The replacement of high lime fly ash concrete generally increases the ultimate strength of concrete. It is possible that even higher percentile replacement of cement would still be able to provide the number of fly-ash is added to concrete, a decrease in the rate of strength is gained [2].

The influence of fly-ash of water demand is not same for different fly-ash and the content of different fly-ash. The fly-ash with bigger particle does not increase the surface layer water, and their water demand cannot be reduced because its flying and lubrication roles are very weak. The fly-ash with smaller particle mat reduces flying water and has a stronger lubrication role but it will increase the surface layer too. An increase in the amount of the super plasticizer may reduce the surface layer water [3, 9].

The use of fly-ash in concrete as a partial replacement of cement is achieving so much importance today, due to the improvement of the long term durability of concrete combined with their ecological benefits. The studies have been conducted on concrete mixes for the particle replacement of cement by fly-ash with 300 to 500 kg/cum with cementing material at 20%, 30%, 40% and 50% replacement level. By using rapid chloride permeability test workability, setting time, modules of elasticity shrinkage, air content, permeability, compressive strength and density for the effect of fly-ash are studied [4].

The effect of fly-ash on the properties of concrete for m25 grade of concrete are as w/c ratio of concrete increases the slump loss of concrete increases and the ultimate compressive strength of concrete goes on decreasing and the increasing in the quality of fly-ash increases the slump loss of concrete. 10% to 20% replacement of cement with fly-ash in concrete shows good compressive strength while 30% replacement decreases the ultimate compressive strength of concrete [5].

The use of coconut husk in cement concrete helps in reducing waste and pollution. The use of waste products can be used as a construction material in the low costing house. They can be used in rural areas and places where coconut is available in large amount and may also use in where aggregates are costly. Coconut husk are mostly suitable for low strength giving light weight aggregate as a replacement to common coarse aggregate in concrete production [6].

The addition of coconut husk decreases the workability while the addition of fly-ash as cement replacement or as a aggregate replacement increases the workability of coconut husk concrete. The density of concrete decreases as increase in the amount of coconut husk. The strength properties of coconut husk concrete depend on the aggregate properties of coconut husk and on its strength characteristics. To calculate the strength of coconut husk experiments on impact and crushing value is done [7].

Coconut husk may be used as a full replacement to other conventional aggregate in concrete construction. Coconut husk concrete shows 65% of compressive strength of regular concrete. Coconut husk requires more resistance against impact, crushing and abrasion compared to normal concrete [8, 10].

III. NATURE OF LIGNIN

Lignin is available in all vascular plants, mostly between the cells, and also within the cells and the cell walls. It helps in making the vegetables firm and crunchy, and gives us the "fiber" in our food. It is hold together with strong chemical bonds due to resistant to degradation in nature; and it also appears to have a lot of internal H bonds. It is bonded in complex and number of different ways to carbohydrates (hemicelluloses) in wood.

Lignin is an organic substance binding together the fibers, cells and vessels which forms wood and the lignified elements of plants. It is highly available renewable carbon source on Earth after cellulose. Between 40 and 50 million tons per annum are produced worldwide as a mostly noncommercial.

A. Lignin Compounds

The majority of the color in Kraft pulp and paper mill effluents comes from the caustics extraction stages of the bleaching plant. It has been estimated that effluents from the caustics extraction stages contribute 60 to 80 % of the colored material in the total discharge from Kraft mills. Since color reduction was the major concern in this study, a caustic extract was used.

It has been found that lignin, degradation products of lignin, and products of chemical reaction with lignin are the major contributors to color in bleaching effluents. Only limited information is available about the structure of lignin and lignin related compounds. The National council of the Paper Industry for air and Stream Improvement (NCASI) showed that the solids in caustics extraction stages effluents consist of chlorine-substituted acidic materials.

The organic material in caustic extract and for undecomposed Kraft lignin can be determined by empirical formulae and molecular weight. The result is shown in table 1, from the table it can be seen that the solids in caustic extraction stage effluents have empirical formulae similar to that of Kraft lignin. The average molecular weights of the effluents solids are relatively less than the molecular weight of Kraft lignin, indicating that solids are for the most part degradation products of lignin.

Table 1: Element Analysis of Solids In A Caustic Extract

	Empirical Formula	**Average molecular weight**
Lime perceptible solids	C9H8.2 O6.2 CL0.47 (OCH3)0.10	495
Lime non-perceptible solids	C9H10.05 O10.3 CL0.95 (OCH3)0.92	210
Pipe Kraft lignin	C9h7.7 o2.0 (OCH3)0.92	1600

The NCASI study found that approximately 70% to 80 % of the acidity of the solids in caustic extraction stage effluents is caused by carboxylic acids. The reminder of the acidity is caused by steel weaker acidic groups and phenols.

It has been found that the chromophores in the lignin related compounds in caustic extraction stage effluents are aromatic and nuclei, and carbonyl and ethylic groups, and that the auxocromes present are hydroxyl group. The color of the lignin related compounds is affected by ionization of the acidic groups in the compounds [12]. Ionization of the acidic groups increases the color intensity so that the color of the effluent increases with increases with an increase in PH.

B. FLY ASH

B.1. SOURCES OF FLY ASH

Fly ash is a waste product of the electric power generating industry. It is removing from the flue gases of coal burning power station in order to prevent serious air pollution problems [10]. Fly ash is formed from the incombustible component in the fuel and from material unburdened because of incomplete combustion. The majority of fly ash collected is coal –derived, but fly ash may also be produced by the combustion of wood. According to a recent survey of coal consumption and ash production, the present production rate of fly ash is our 30 million tons / yr. in the united State alone and it is estimated that the production rate will increase to 40 million tons / yr. by 1980 effers to utilize fly ash have been made in many field, from pollution abatement to comment manufacture, but the majority of fly ash produced is stock-pilled. As a solid disposal problem exists [9]. Figure 1 shows the some minor hump particle also in flyash while doing experimental work.

Fig No. 1: Sample of fly ash

C. COCONUT HUSK

C.1. SOURCES OF COCONUT HUSK

Coconut husk are nothing but the exterior shells of the coconut. The liquid found within the exterior shell of the coconut husk can be used in many ways such as in creating enriched potting soil and as chips which are used to provide ground cover for flower beds [11]. The mass produced coconut husk products can be purchased or it can also make at home by using the shells of fresh coconuts. A very straightforward process is used to husk a coconut at home.

The materials required are a fresh coconut and a long stick sharpened at one end. Other end of the stick must be inserting below the ground, with the sharpened end straight upward [13]. This helps in creating the basic framework for the removal of the coconut husk as shown in figure no 2 below.

Fig No.2 Coconut husk particles after screened through IS Sieve-300micron and retained on IS Sieve-150micron

IV. EXPERIMENTAL

A. Treatment of paper mill waste water using fly ash and coconut husk (Column study)

The set up used for the treatment of paper mill waste water (lignin removal) is shown in figure 3. The glass column of the setup had a size of 30 mm diameter and 60 cm height. It was filled with fly ash obtained from Deepnagar thermal power station and other similar glass column of the set up was filled with coconut husk obtained from Ratnakar Nursery which has provided as per requirement.

Initially the fly ash and coconut husk bed height was maintained at 25 mm. The paper mill waste water was passed through this bed from the overhead storage at a flow rate of 0.3 liter/hr for 30 minutes. The treated effluent was collected in a collector. The same procedure was repeated by varying the bed height as 35mm, 45mm, and 55mm and contact times 60minutes, 90 minutes and 120minutes. For each of this treated effluent was collected.

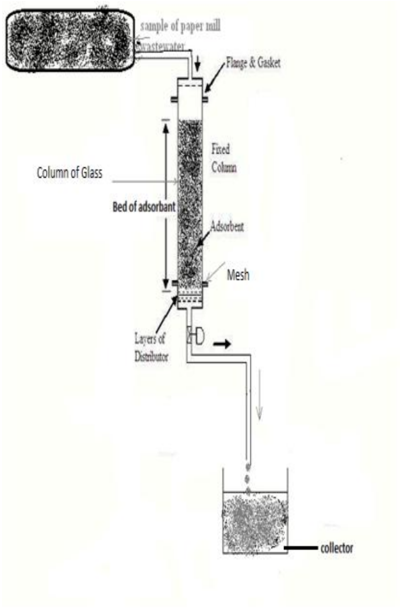

Fig No.3: Experimental set up used for treatment of paper mill waste water

B. Analysis of effluent from fly ash column

Analysis of the various samples collected by passing through fly ash bed of different heights was carried out for the parameters of pH, BOD, COD as per APHA (American public health association) methods.

C. Analysis of effluent from coconut husk column

The paper mill waste water sample was passed through coconut husk column and filtered waste water analyzed for following tests.

i. pH
ii. BOD
iii. COD

V. RESULTS AND DISCUSSION

A. Characteristics of paper mill waste water at Initial Stage

Characterization of paper mill waste water for the parameters pH, BOD, COD was collected as given in table 2.

Table No.2: Characterization of paper mill waste water

Sr.No.	Parameters	Initial Concentration of Effluent used in this study
01	pH	8.5
02	Biological Oxygen Demand (BOD)	300 mg/l
03	Chemical Oxygen Demand (COD)	2475 mg/l

The results observed after the physio-chemical analysis of the wastewater as depicted in table: 2 showed that the paper mill waste water is highly polluted with the organic load. Organic load is depicted in terms of pH and COD values. The BOD concentration is much higher than the permissible limit. The effluents used in this study had very high COD content, turbid. This was due to the high concentration of non-biodegradable lignin related compounds in the effluents. The effluent contained very less suspended settle-able solids. For this reason, no removal of contaminates could be obtained by primary sedimentation.

B. Coconut husk size

Husk size was determined by sieve analysis. It was found that average particle size of coconut husk was between 300 microns to 150 microns. Due to very fine size the particles have a larger surface area with high area/volume ratio. This is desirable from adsorption point of view.

C. Column study of fly ash and coconut husk

The final treated effluent characteristics after various runs as described are given as follows in table (3) to (6). The tables 3 to 6 are for batch study in which the wastewater is filled in the glass tube of experimental set up for a fixed contact period and then effluent is drawn for further analysis. The table (7) to (10) are for continuous flow study in which various flow rates are maintained and effluent collected from bottom outlet is analyzed. The sorbent (fly ash) bed depth is varied:

Table No.3: Effect of bed depth on removal of impurities using fly ash

Sr. No.	Parameter	Time of Contact- 30min.			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.5	8.45	8.4	8.3
2	BOD in mg/l	110	100	95	80
3	COD in mg/l	260	245	235	225

Table No.4: Effect of bed depth on removal of impurities using fly ash

Sr. No.	Parameter	Time of Contact- 60min.			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.4	8.35	8.30	8.2
2	BOD in mg/l	90	80	75	70
3	COD in mg/l	250	245	230	220

Table No.5: Effect of bed depth on removal of impurities using fly ash

Sr. No.	Parameter	Time of Contact- 90min.			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.35	8.25	8.2	8.1
2	BOD in mg/l	80	75	70	65
3	COD in mg/l	240	230	220	215

Table No.6: Effect of bed depth on removal of impurities using fly ash

Sr. no.	Parameter	Time of Contact- 120 min Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.25	9.15	8.0	8.0
2	BOD in mg/l	75	70	65	60
3	COD in mg/l	230	225	220	210

Table No.7: Effect of bed depth on removal of impurities using coconut husk

Sr. no.	Parameter	Time of Contact- 30 min Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.5	8.45	8.45	8.4
2	BOD in mg/l	100	95	80	75
3	COD in mg/l	260	250	240	225

Table No.8: Effect of bed depth on removal of impurities using coconut husk

Sr. no.	Parameter	Time of Contact- 60 min Bed Height			
		25cm	35cm	45cm	55cm
1	PH	8.45	8.4	8.35	8.3
2	BOD in mg/l	95	90	80	70
3	COD in mg/l	245	240	230	225

Table No.9: Effect of bed depth on removal of impurities using coconut husk

Sr. no.	Parameter	Time of Contact- 90 min Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.35	8.25	8.25	8.2
2	BOD in mg/l	90	80	75	70
3	COD in mg/l	240	235	230	220

Table No.10:. Effect of bed depth on removal of impurities using coconut husk

Sr. no.	Parameter	Time of Contact- 120 min Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.25	8.20	8.20	8.0
2	BOD in mg/l	80	75	70	65
3	COD in mg/l	240	230	220	215

It can be seen that:

1. Fly ash is acting as a better absorbent as compared to the coconut husk.
2. With the increase in bed thickness (depth) the removal of impurities is enhanced.
3. After adsorption by fly ash or by coconut husk, the pH which is slightly alkaline initially gets neutralized almost.
4. The BOD gets removed by around 90% with appropriate contact time and depth of bed.
5. COD are also removed up to 90%.

Thus it can be postulated that fly ash as well as coconut husk both are effective low cost adsorbents for treatment of paper mill effluents. They have tremendous potential to remove the Turbidity from the wastewater that is not removed by other biological or physic-chemical methods.

D. Graphical Representation of Removal Rates

In the present study, two adsorbents are used and their performances are compared over various parameters. The removal of various pollution parameters is graphically represented in the following section:

D.1. pH Removal Rates

Fig (4) and (5) represents the removal (neutralization) efficiencies of fly ash and coconut husk respectively for pH.

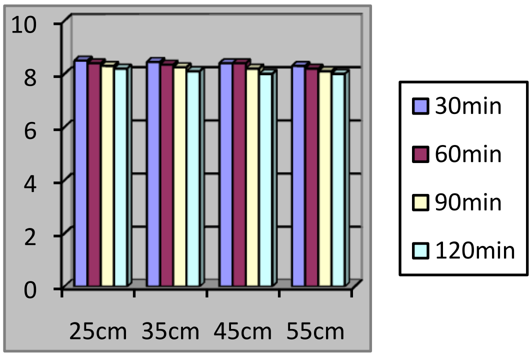

Fig No.4: pH neutralization efficiency of fly ash: effect of bed depth and contact time.

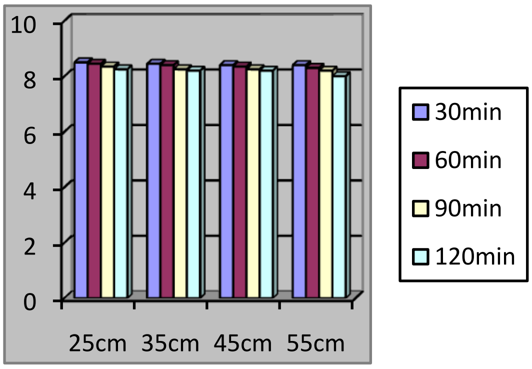

Fig No.5: pH neutralization efficiency of coconut husk: effect of bed depth and contact time

E. BOD removal rates

Fig (6) and (7) represent the removal (neutralization) efficiencies of fly ash and coconut husk respectively for BOD.

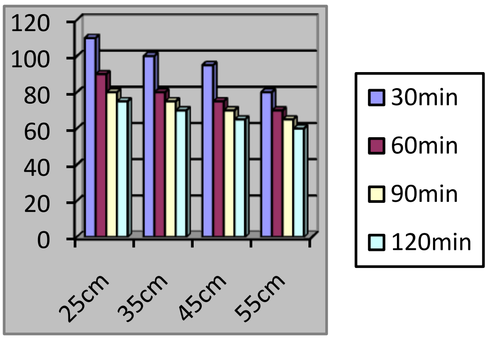

Fig No.6: BOD neutralization efficiency of fly ash: effect of bed depth and contact time.

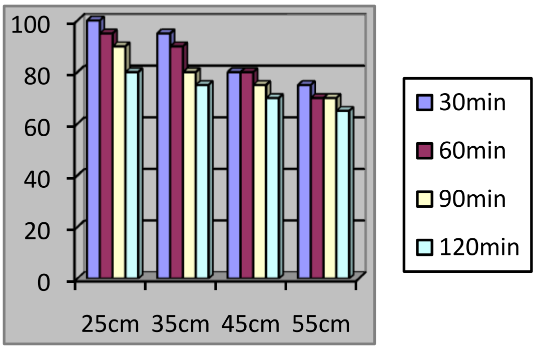

Fig No.7: BOD neutralization efficiency of coconut husk: effect of bed depth and contact time.

F. COD removal rates

Fig (6) and (7) represent the removal (neutralization) efficiencies of fly ash and coconut husk respectively for COD

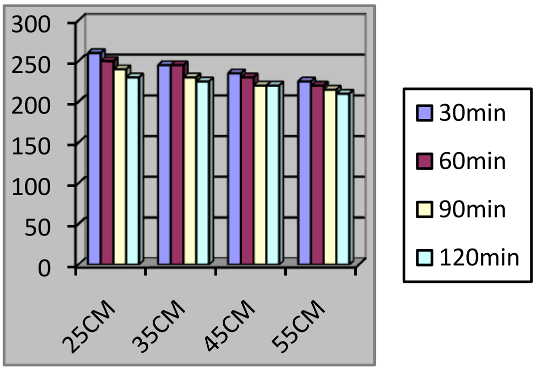

Fig No.8: COD neutralization efficiency of fly ash: effect of bed depth and contact time.

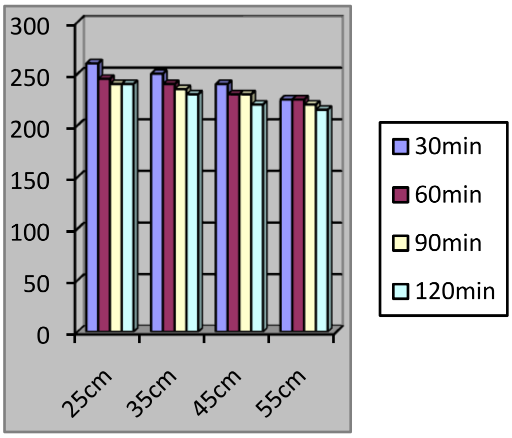

Fig No.9: COD neutralization efficiency of coconut husk: effect of bed depth and contact time.

VI. CONCLUSION

With reference to the result obtained, from experiments conducted in the laboratory concerning to the factors affecting the adsorption of lignin, following points are clear. Fly ash is more suitable as compare to coconut husk. As the bed height of column of adsorption material (fly ash and coconut husk) is increased, the percentage of turbidity removal also increases. Finally it is clear that fly ash has more adsorption capacity as compared to coconut husk for removal of BOD, COD and also to neutralize pH.

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A Review on Ergonomic Considerations in Development of Human Powered Electric Generation System

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Abstract: In this paper attention is focused on the efficient use of human power as an alternative source of energy. Importance of human power as an alternative energy source is investigated, since beginning to present state for increasing effectiveness. Human power credit is more because of health benefit equally important as a source of energy. Main concern in this work is to convert human efforts in to electrical energy that could be achieved through properly designed mechanism. These include the design of human powered machine using ergonomic considerations.

In this paper different devices to transmit human energy into electrical energy are analyzed with proper lubrication to achieve maximum output. This work would be useful for development of human power machine producing electrical energy quickly and easily at remote locations also.

Keywords: Human Power machine, Bicycle Technology, Dinapod, Flywheel.

I. INTRODUCTION

Human power as prime mover used to operate working unit is termed as human powered machine. The content of this paper is built around the phenomenon of 'human-powered energy system s in consumer product'. Although there are various ways of using human power, this work focuses on the conservation of muscular work into electricity. Products discussed in this paper are therefore characterized by the presence of a technical system converting muscular work into electricity. We provides multiple synopsis for the conversion process involved in human powered energy systems, i.e. 'energy scavenging', 'energy harvesting', 'power from the people' and 'self-powering' . Human power is generally defined as a non-conventional power source and seen as battery alternative for electrical products.

A mechanism for the transmission of mechanical power, usually with a transformation of the forces, torques, speeds, and in some cases, the nature of the motion. In machine drives, power transmission makes it possible to match the operating conditions of the motor with those of the machine's working elements. It also allows several mechanisms to be driven from one motor, reverses the direction of motion, alters torques and rotational speeds while maintaining a constant torque and speed for the motor, and converts rotational motion into reciprocating, helical, or other type of motion. The most common power transmissions in machine building have mechanical linkages, although hydraulic, pneumatic, and other types are occasionally used. In order to drive different mechanisms in one machine, different types of power transmissions are sometimes used, or combinations of transmissions, as in hydro mechanical power transmissions. The economic advantage of using high-speed motors in machines (because of their smaller dimensions, weight, and cost) accounts for the preference for power transmissions that reduce the speed of the driven shaft in comparison to that of the driving shaft.

Very high power can be transmitted with gear transmissions; for instance, there are reduction gears for marine turbines that handle powers of over 50 megawatts. The power-handling capacity of worm-gear transmissions is limited (generally to 200 kilowatts) by the poor efficiency of such designs and by the production of heat. Chain-drive power transmissions can transmit as much as 4 megawatts, friction transmissions up to 300 kilowatts, and belt drives up to 1.5 megawatts.

Mechanical power transmissions are compact, suitable for machine layouts, and very reliable. They make it possible to achieve in a relatively simple fashion the required conversion of motion and practically any transmission characteristics. With proper manufacturing, the majority of power transmissions have a high efficiency.

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II. TRANSMISSION MECHANISM

A. Belt Drive

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel. In a two pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts). As a source of motion, a conveyor belt is one application where the belt is adapted to carry a load continuously between two points.

The use of belt reassures us the low cost while designing the human power operated electric generator. This design is simpler type of power transfer from bicycle to the generator. As belt drive faces the problem of slippage this drive does not give 100% efficiency. The use of latest technology belt such as multi-groove belt, ribbed belt, film belt, and timing belt reduces the problem of slippage.

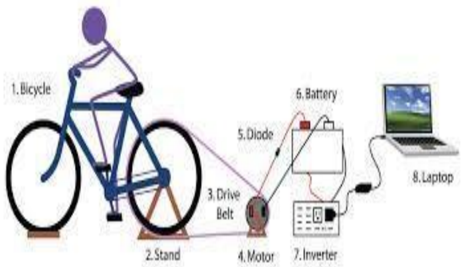

Fig 1: Belt drive in Bicycle Generator

B. Chain Drive

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles.
Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system. Another type of drive chain is the Morse chain, invented by the Morse Chain Company of Ithaca, New York, USA. This has inverted teeth.
The use of chain reassures us the medium cost while designing the human power operated electric generator. This design is simpler type of power transfer from bicycle to the generator. As in chain drive the problem of slippage is reduces it gives 100% efficiency. Use of chain drive mostly increases the maintenance cost.

Fig 2: Chain Drive in Bicycle Generator

C. Gear Drive

A gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called a rack, thereby producing translation instead of rotation.

The gears in a transmission are analogous to the wheels in a crossed belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage.
When two gears mesh, if one gear is bigger than the other, a mechanical advantage is produced, with the rotational speeds, and the torques, of the two gears differing in proportion to their diameters.

In transmissions with multiple gear ratios—such as bicycles, motorcycles, and cars—the term "gear" as in "first gear" refers to a gear ratio rather than an actual physical gear. The term describes similar devices, even when the gear ratio is continuous rather than discrete, or when the device does not actually contain gears, as in a continuously variable transmission.

The main advantage of this drive when used for the design of human powered operated generator is to reduce the size of machine. As it is positive drive maximum efficiency is achieved.

Fig 3: Belt Drive in Bicycle Generator

D. COMPARISON BETWEEN DRIVES

	Belt	Chain	Gear
Required alignment accuracy	Medium	Medium	High
Positive drive	No (except toothed)	Yes	Yes
Efficiency	Medium	High	Variable
Stiffness	LOW	High	High
Strength	Low-medium	High	High
Ability to span large distances	Medium	Medium	Low
Maintenance	Medium	High	Medium
Cost	Low	Low	Medium

III. TRIBOLOGICAL CONSIDERATIONS

The general purpose of this is to discuss the fundamental theory of tribology and to study the behavior of machine elements behavior with tribology. This paper was commissioned by HAMK University of Applied Sciences with the aim to provide additional studying material for this science area. The initial background was based on machine elements theory and the work results are essential knowledge for machinery related design.

This work aims to define theory and results behind friction phenomena. Also, to determine different wear types and reasons for wear failure. This work also focuses on different aspects of lubrication and the influence of viscosity and lubrication regimes on machine elements performance. An additional target of this work was to present tribological behavior of gears and sliding elements.

The starting theory used in this work was based on machine elements and strength of materials studies but it required a further knowledge of other fields such fluid and solids mechanics, thermodynamics, physics and material science. The work focuses only on tribological functions of gears and sliding elements and requires previous knowledge of these elements.

The studies presented in this work allowed analysis of different phenomena causing friction and the definition of different formulas to evaluate friction. The work also provided methods of calculations to predict wear losses under non-lubricated and lubricated conditions. Furthermore lubrication regimes for operating machine elements and viscosity response for different working conditions were presented. Finally, equations quantifying bearing and gears tribological behavior are determined.

If all these concern of friction and lubrication are taken into consideration then we can design electric generator which will give a maximum efficiency. This maximum efficiency is achieved as in terms of reducing human efforts. The properly lubricated system will ensure low loss of energy and thus maximum utilization of human power.

IV. IMPORTANCE OF ERGONOMICS IN BICYCLE DESIGN

When designing bicycle generator, many factors are considered: speed and maximum efficiency; space; ease of maintenance; cost.

Creativity is the key for any design process. A design process, which is usually complex, is best simplified by inculcating creative design ideas. Thus it is of extreme importance that the ergonomic design is highly interdependent on the design factors. Ergonomics are implemented in every form of engineering design. It is of paramount importance that ergonomic factors are taken into consideration while designing a product. Human factors play a crucial role in the productivity of any activity. For example, for a person working on an assembly line in a automobile company needs to have all the available components for assembly at the right distance and the tools should be located at the correct places to avoid tangling of hands, moving from place to another. If these ergonomic considerations are made the worker would be enabled to make the assembly faster and therefore improving the overall efficiency of the company.

This field of ergonomic design has spread to all areas including computer desktops, cell phone software, pens, banking, housing and farming sectors.

Ergonomic design means irrespective of the type of product and its function, evaluating it in terms of maximizing the interaction between product and user to make it more appropriate for use. The principles of ergonomic design are considered in five levels [16] are determined below-

In the first level an equipment/ machinery must be safe while in contact with human beings.

In the second level an equipment/ machinery must not produce harmful effects in human beings over longer periods.

In the third level an equipment/ machinery must be physically comfortable that is, it should not require excessive efforts, both physical and mental or visual.

In the fourth level an equipment/ machinery should provide mental satisfaction i.e. give a feeling of pleasure to the human being using the same. This must also include the cost price of the equipment against the function of the same.

The fifth level is the determining the degree of modernity of an equipment/ machinery ergonomic considerations must constitute an essential factor of the social profitability of the equipment/ machinery. Even at the stage of establishing the design assumptions of an equipment/ machinery it is necessary to introduce both ergonomic requirements and limitations.

V. ERGONOMIC SOLUTIONS

A. LATERAL MOVEMENT OF THE SEAT

In the vast diversity of the human race there are people of different heights and it is not possible that a single non customizable design would satisfy all the ergonomic requirements of everyone. Hence to solve the problem of high trunk inclination and improper hand posture a laterally movable seat has been proposed.

It was identified that that the most comfortable elbow position of the rider is between 1500 and 1650. So in order to maintain this angle for the rider the need of the laterally adjustable seat is shown in Fig. 4. The seat has three modes of adjustment from which the rider can choose according to his/ her height [14].

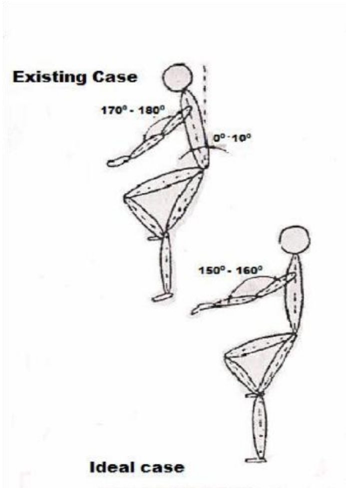

Fig. 4: Optimum position of the hands while riding

The first mode is for the riders between the height ranges of 1.60 to 1.68 meters. From the anthropometric data collected the average arm length ranges from 0.40 – 0.47 meters. Optimum seat to handle distances are computed for the first mode as shown below in Fig 5.

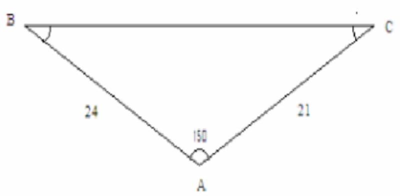

Fig. 5: Hand position in First mode

Applying the cosine rule

Cos A = (b2 + c2 – a2) / 2bc

Here, b = 21; c = 24 A = 1500

cos150 = (212 + 242 - a2) / 2×21×24

a = 0.43m

From the obtained solution the optimum distance between the seat and the handle of the bicycle should be 0.43 meters for riders ranging between the heights 1.60 m – 1.68 m. Similar to the calculation mentioned above, using the average arm lengths of 0.45m – 0.53m and 0.50m – 0.60m obtained from the anthropometric data for the height ranges of 1.65m – 1.75m and 1.75m – 1.85m respectively are used to calculate the optimum distances between the seat and the handle of the bicycle in the second and third modes. The values obtained are presented in Table 1.

Table 1: Optimum Seat to Handle Distance in various modes

Mode Number	Height of the Rider	Optimum distance between the seat and the rider
1	1.60 m – 1.68 m	0.43 m
2	1.68 m - 1.75 m	0.48m
3	1.75m – 1.85 m	0.54m

B. Design of Foot Pedal

The design of the pedal is important as it is the part which the driver has to put the force in order to drive the bicycle. When the force is applied on the pedal there is an equal and opposite force which is acts on the foot. In the standard bicycle the pedal is designed in such a way that the total force is exerted at the toe of the foot. If the bicycle is pedaled for a long time then the stress concentration on the toe would cause pain to the rider.

In order to solve this problem the pedal has to be designed in such a way that the force is evenly distributed on the foot. The proposed design of the pedal is like a foot rest so that it more convenient for the rider to ride the bicycle. The foot rest is also designed using acupuncture data to ensure good blood circulation.

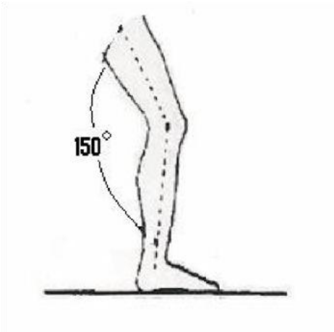

Fig. 6: Angel between Legs

A. The most desired angle between the calf and thigh of the rider for comfortable sitting position is 1500. It was observed that the angle between the thigh and the calf is 1500 of more number of positions than the regular pedal of the normal bicycles [15].

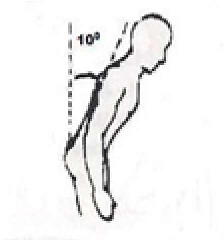

Fig .7: Trunk Posture

VI. CONCLUSION

In conclusion human power there is vast scope in economical use of Bicycle mechanism as an alternative energy Source. This means renewable energy generation as well as exercising for good health cause. Adopting the proper drive system for transmission of human energy into electrical energy through maximum conversion efficiency designed systems. Thus lubrication of machine would make it comfortable to operate this already well designed machine. These machines are also ergonomically designed for trouble free operation both for human operator and electric generation efficiently.

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A Review on Productivity Enhancement Techniques in MSME

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ABSTRACT

In present era of globalization, small and medium scale manufacturing enterprises in India are facing intense competition. Some industries are consistently achieving the growth under competitive conditions while others are not. As a result of this, new opportunities and threats have emerged., small-scale units were given further protection. Small scale units were given the reservation of over 800 products exclusive production in the small-scale sector, reservation of some of the products produced in the sector for purchase preference by government agencies, supply of scarce materials, input price concessions like lower interest rates and numerous fiscal measures such as excise duty exemptions and other tax concessions. Even after 138,000 sick units within the sector in India (Business Today, 2006)[14]. The survey report shows that small sector has been growing rapidly, even in the face of growing competition, internally and globally (http://ssrn.com). There are numerous problems that small scale units face today like maintaining quality standards, access to credit, over regulation etc. To counter competition in the long run and to be economically viable, the small scale sector needs to improve its productivity and quality, reduce cost (given the higher qualities) and innovate. Although Maharashtra is a highly industrialized state of India and is a industrial backbone of the country. State contributes around 21% in country's industrial output. It is a most preferred investment destination in the country and one of the major sources of Indian exports. The industrial growth rate has averaged to around 10% and efforts should be made by the state to increase the growth rate by creating and efficient infrastructure for facilitating sustained industrial production (Economic Survey, 2006). State has announced SEZ policy and having highest number of approved SEZ.

Keywords- MSME, Globalization ,Problems, Productivity, Economic growth

INTRODUCTION

Small scale sector provides nearly 40% of the state's GDP It accounts for nearly 40% of our industrial output, nearly 6% of GDP, 35 % of national exports, while employing nearly 30 million people, the second largest after agriculture. The small scale sector in India is very diverse producing over 8000 products, from traditional handicraft to high end technical instruments. Owing to the feeling that the small scale sector was an important tool in employment generation, value creation and poverty alleviation.

Definition of MSMEs in India
(As Per Micro, Small & Medium Enterprises Development (MSMED) Act, 2006)

Manufacturing Enterprises – Investment in Plant & Machinery		
Description	**INR**	**USD($)**
Micro Enterprises	upto Rs. 25Lakh	upto $ 62,500
Small Enterprises	above Rs. 25 Lakh & upto Rs. 5 Crore	above $ 62,500 & upto $ 1.25 million
Medium Enterprises	above Rs. 5 Crore & upto Rs. 10 Crore	above $ 1.25 million & upto $ 2.5 million

Service Enterprises – Investment in Equipments		
Description	**INR**	**USD($)**
Micro Enterprises	upto Rs. 10Lakh	upto $ 25,000
Small Enterprises	above Rs. 10 Lakh & upto Rs. 2 Crore	above $ 25,000 & upto $ 0.5 million
Medium Enterprises	above Rs. 2 Crore & upto Rs. 5 Crore	above $ 0.5 million & upto $ 1.5 million

Thiripurasundari, K and V. Gurumurthy (2009)[3] The study highlights the challenges of micro, small and medium enterprises of India. One side the globalization is an opportunity as well as another side it is a challenge for the indigenous MSME'S. The Indian MSME'S are facinga great problem due to larger production of foreign manufacturing concern. The financially strong MSME'S will survive strongly at globalized platform.

Bhavani, T.A. (2011),This study reveals that how the all aspects of the MSME'S (Employment, Leading sector of MSME'S, Investment in fixed assets) being change in modern perspective. The technological advancement and protection of MSME'S through various subsidy schemes and liberal availability of credit will be a great help.

Nalabala Kalyan ,Kumar. Sardar, Gugloth. (2011)[4].This study focuses upon the growth pattern of the MSME'S ,employment generation (1992-2009). Further, study reveals the symptoms and steps involved in industrial sickness. The study gives the ample amount of knowledge about the various credit schemes sponsored by thegovernment. Laghu udyami credit card scheme , Credit guarantee fund trust for small industries, Swa rojgar creditcard scheme, Credit linked capital subsidy scheme and credit through commercial banks are the sources and schemes available to fulfill the financial needs as well as financially strengthen to the MSME'S..

Singh et al. (2012)[5] analyzed the performance of Small scale industry in India and focused on policy changes which have opened new opportunities for this sector. Their study concluded that SSI sector has made good progress in terms of number of SSI units, production & employment levels. The study recommended the emergence of technology development and strengthening of financial infrastructure to boost SSI and to achieve growth target.

Venkatesh and Muthiah (2012)[6] found that the role of small & medium enterprises (SMEs) in the industrial sector is growing rapidly and they have become a thrust area for future growth. They emphasized that nurturing SME sector is essential for the economic well-being of the nation. The above literature highlights the various aspects viz. performance, growth & problems of MSMEs in Indian economy and induces for continuous research in this field.

OBJECTIVES OF THE STUDY

The major objectives of this study were as follows:-

1. To know the present status of MSME`S in India
2. To know the problems and solutions related to MSME`S.
3. Performance of MSMEs in India & future prospects .

RESEARCH METHODOLOGY

The present study has based on both primary and secondary data .secondary are mostly collected from the Annual Reports[1] published by the Ministry of Micro, Small and Medium Enterprises. Thestudy covers a period from 2005-06 to 20014-15. The primary data are collected through the personal discussion with entrepreneurs of these industries located in Jalgaon district.

TABLE 1.1: PERFORMANCE OF MSME, EMPLOYMENT AND INVESTMENTS

Sl. No.	**Year**	**Total Working Enterprises** (in Lakh)	**Employment** (in Lakh)	**Market Value of Fixed Assets** (Rs. in Crore)
I	II	III	IV	V
1.	2006-07	361.76	805.23	868,543.79
2.	2007-08#	377.36	842.00	920,459.84
3.	2008-09#	393.70	880.84	977,114.72

4.	2009-10#	410.80	921.79	1,038,546.08
5.	2010-11#	428.73	965.15	1,105,934.09
6.	2011-12#	447.64	1,011.69	1,182,757.64
7.	2012-13#	447.54	1,061.40	1.268,763.67
8.	2013-14#	488.46	1,114.29	1,363,700.54

inculding activities of wholesale/retail trade, legal, education & social services, hotel & restaurants, transports and storage & warehousing (except cold storage) for which data were extracted Economic Census 2005, Central Statistics Office, MOSPI.

- Estimated on the basis of per enterprises value obtained from sample survey of unregistered sector for activities wholesale/retail trade, legal, education & social services, hotel & restaurants, transports and storage & warehousing(except cold storage) which were excluded from Fourth All India Census of MSME, unregistered sector.

\# projected.

TABLE 1.2: CONTRIBUTION OF MANUFACTURING OUTPUT OF MSME IN GDP
(at 2004-05 prices)

Year	Gross Value Output of MSME Manufacturing sector (Rs in crore)	Share of MSME sector in total GDP(%)			Share OF MSME Manufacturing output in total manufacturing output (%)
		Manufacturing Sector MSME	Service Sector MSME	Total	
2006-07	1198818	7.73	27.40	35.13	42.02
2007-08	1322777	7.81	27.60	35.41	41.98
2008-09	1375589	7.52	28.60	36.12	40.79
2009-10	1488352	7.45	28.60	36.05	39.63
2010-11	1653622	7.39	29.30	36.69	38.50
2011-12	1788584	7.27	30.70	37.97	37.47
2012-13	1809976	7.04	37.54	37.54	37.33

Source

1. Fourth All India Cenus of MSME 2006-7
2. NATIONAL ACCOUNTS STATISTICS (2014),CSO,MOSPI and
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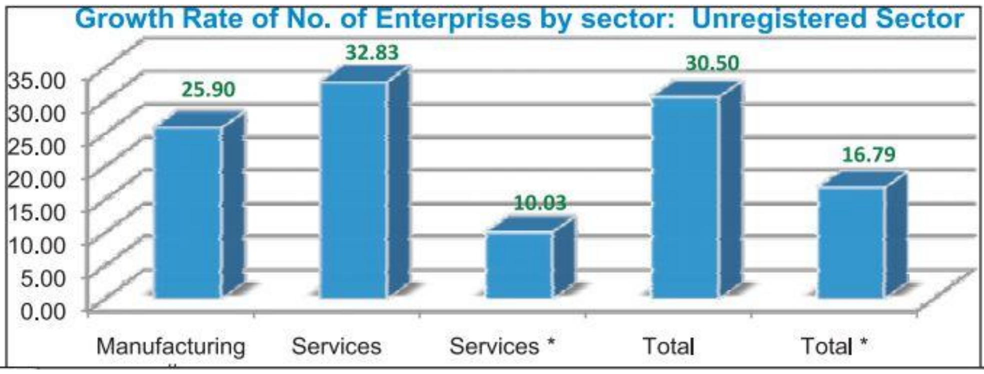

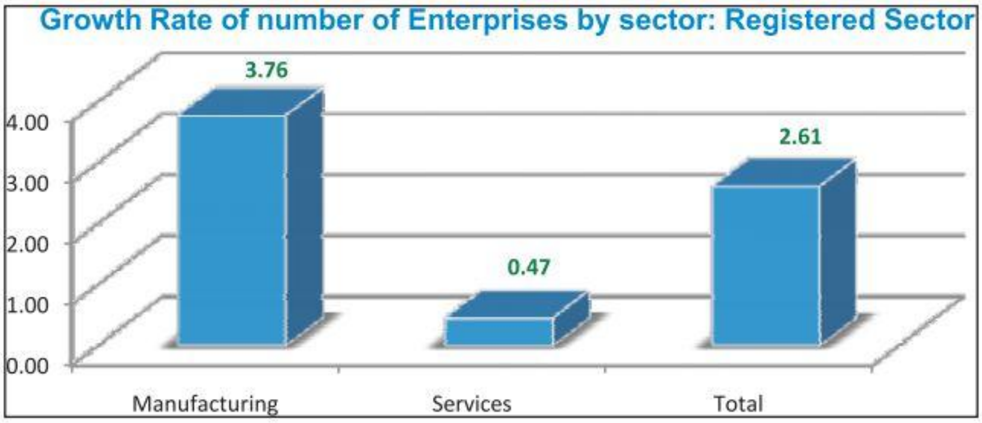

Table 1.3: Performance of Ni-MSME during 2013-14 & 2014-15

Programmes	2013-2014		2014-15 (as on 31-12-2014)	
	Progs	Trainees	Progs	Trainees
Entrepreneurship Development Programmes				
A.Programmes under Assistance to Training Institutions Sponsored by M/o MSME				
ni-msme Apex Institutions	789	23600	193	5790
Programmes by partner institutions	256	7310	411	11790
B.other programmes:				
(1) National :				
Announced	71	3685	49	3673
Sponsored	170	5797	551	21441
(2)International				
Announced	23	429	10	196
Sponsored				
C.National Seminars and Workshops	35	2466	33	2157
D. Consultancy &Research	10	-	6	-
TOTAL	1354	43287	1253	50313

The main problems in MSMEs iare:

1. The banks are not providing the adequate amount of loan to the MSME`S. The loan providing
2. Process of the banks is very long and formalistic.
3. Lack of power, Lack of adequate warehousing, Transportation problems Lack of information, Low quality raw materials, low return.
4. The owners of MSME`S are not aware of advanced technologies of production. Their methodology of production is outdated.
5. Poor infrastructures, their production capacity is very low,
6. The training and development programs in respect of, MSME`S development concern is very low.
7. The MSME`S are not adopting the innovative channels of marketing.,
8. Constraints in modernization and expansions,
9. The MSME`S are facing the great from the international manufacturing companies who are proving quality goods at cheapest price.,
10. Non availability of highly skilled labour at affordable cost.

The following suggestions for the growth and development of the MSMEs in India:

1. For the purpose of technological advancement and guidance a panel of experts and consultants should be prepared, who can help the MSMEs within the region for effectively transfer the available technologies.

2. There should be detailed survey to assess the technical and financial needs of the MSME.

So that, the proper arrangement could be make to fulfill the needs of the MSME's.

3. There must be conduction of training and development programs by the MSME ministry. The currently running programs are not so effective and sufficient.

4. There must be availability of credit according to the requirement at cheaper rate.

5. There should proper research and development in respect of innovative method of production and service .

6. Total Quality Management 's Tools and Technique apply in MSME' s.

CONCLUSION

Small and Medium Enterprises (SMEs) contribute to economic development in various ways such as creating employment opportunities for rural and urban population, providing goods & services at affordable costs by offering innovative solutions and sustainable development to the economy as a whole. SMEs in India face a number of problems - absence of adequate and timely banking finance, non-availability of suitable technology, ineffective marketing due to limited resources and non availability of skilled manpower. The Micro, Small and Medium Enterprises (MSME) sector contributes significantly to manufacturing output, employment and exports of the country. It is estimated that in terms of value, the sector accounts for about 45 % of the manufacturing output and 40% of total exports of the country. To make this sector to become more vibrant and significant player in development of the Indian economy the Government of India has taken various initiatives. The MSMEs need to be educated and informed of the latest developments taking place globally and helped to acquire skills necessary to keep pace with the global developments. It also aims at motivating the companies to follow TQM principles in future.

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A Review on Collector Designs for Solar Water Heating System Performance Enhancement

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Abstract— A solar collector is heat exchanger device which transforms solar radiant energy into heat energy. Solar collector is important component of solar water heating system. In this paper two major types of solar collectors non-concentrating or stationary and concentrating are studied for performance enhancement. Further sub types of non-concentrating or stationary and concentrating collector with their applications details are discussed. A chronological research and development of solar water heating system using various collectors like flat-plate, compound parabolic, evacuated tube, parabolic trough, Fresnel lens, parabolic dish and heliostat field collectors is revealed. Selection criteria for specific application of collector are presented. It is found that flat plate collector is economical and most suitable for water heating system. More stress is given on study of performance parameters of flat plate collector.

Keywords— Flate plate collector, solar collectors, Solar water heating system.

I. Introduction

A solar collector is the heat exchanger device which transforms the absorbing sunlight i.e. solar radiant energy into heat. The major component of any solar system is the solar collector. This is a device which absorbs the incoming solar radiation, converts it into heat, and transfers this heat to a fluid (usually air, water, or oil) flowing through the collector. The solar energy thus collected is carried from the circulating fluid either directly to the hot water or space conditioning equipment or to a thermal energy storage tank from which can be drawn for use at night and/or cloudy days [3]. The solar collector is the most important part. This is device which converts solar radiation in the form of electromagnetic radiation from the infrared (long) to the ultraviolet (short) wavelengths that can be used for heating swimming pools, hot water preparation, space heating and even as heat for industrial processes.

The solar collectors are mainly distinguished as follows
•Stationary collectors
•Non Stationary collectors

II. Stationary Collector

As the name suggests these collectors are permanently fixed in position and do not track the sun. Three types of collectors fall in this category:

- Flat plate collectors (FPC)
- Stationary compound parabolic collectors (CPC)
- Evacuated tube collectors (ETC)

A. Flat Plate Collector

A schematic figure of flat-plate solar collector is shown in Fig.1.The flat-plate collector consists essentially of the collector box, the absorber, heat insulation and transparent cover. Solar radiation enters the collector through the transparent cover and reaches the absorber. Here the absorbed radiation is converted to thermal energy. A good thermal conductivity is needed to transfer the collected heat from the absorber sheet to the absorber pipes where heat is finally transferred to the fluid [1]. Underside of the absorber plate and the side of casing are well insulated to reduce conduction losses. The liquid tubes can be welded to the absorbing plate, or they can be an integral part of the plate. The liquid tubes are connected at both ends by large diameter header tubes [2,3].

The absorber plate is usually made of copper, aluminium or stainless steel, which is connected to flow tubes (risers) and the headers (manifold). The absorber plate is selective coated or in case of a simple collector just painted with a black paint. The transparent cover is used to reduce convection losses from the absorber plate through the restraint of the stagnant air layer between the absorber plate and the glass. It also reduces radiation losses from the collector as the glass is transparent to the short wave radiation received by the sun but it is nearly opaque to long-wave thermal radiation emitted by the absorber plate (greenhouse effect) [3].

The most commonly used collector is the Flat plate collectors (FPC). It can be used for low temperature (for simple FPC) as well for high temperature (For Advance FPC). It is fixed and one placed and can't e moved and that's the reasons needed proper orientation i.e. directly towards the equator, facing south in the northern hemisphere and north in the southern. Flat-plate collectors have been built in a wide variety of designs and from many different materials. They have been used to heat fluids such as water, water plus antifreeze additive, or air [3].

The main use of this expertise is in residential buildings where the demand for hot water has a large impact on energy bills, especially for large family. Commercial applications include Laundromats, car washes, military laundry facilities and eating establishments. The technology can also be used for space heating if the building is located off-grid or if utility power is subject to frequent outages. Solar water heating systems are most likely to be cost effective for facilities with water heating systems that are expensive to operate, or with operations such as laundries or kitchens that require large quantities of hot water. Unglazed liquid collectors are commonly used to heat water for swimming pools. They also do not require freeze-proofing because swimming pools are generally used only in warm weather or can be drained easily during cold weather. While solar collectors are most cost-effective in sunny, temperate areas, they can be cost effective virtually anywhere in the country so should be considered.

B. Compound Parabolic Collectors

Compound parabolic collectors (CPC) are a collector with benefits of parabolic trough and flat plate collector.By making use of both principles the CPC can function without continuous tracking and still achieve some concentration. The necessity of moving the concentrator to accommodate the changing solar orientation can be reduced by using a trough with two sections of a parabola facing each other, as shown in Fig. (2).Compound parabolic concentrators can accept incoming radiation over a relatively wide range of angles. By using multiple internal reflections, any radiation that is entering the aperture, within the collector acceptance angle, finds its way to the absorber surface located at the bottom of the collector. The absorber can be cylindrical as shown in Fig. (2) Or flat. In the CPC shown in Fig. (2) the lower portion of the reflector (BC and CD) is circular while the upper portions(AB and DE) are parabolic. As the upper part of a CPC contribute little to the radiation reaching the absorber, they are usually truncated thus forming a shorter version of the CPC, which is also cheaper. CPC's are usually covered with glass to avoid dust and other materials from entering the collector and thus reducing the reflectivity of its walls [1].These collectors are more useful as linear or trough-type concentrators. The orientation of a CPC collector is related to its acceptance angle [2].

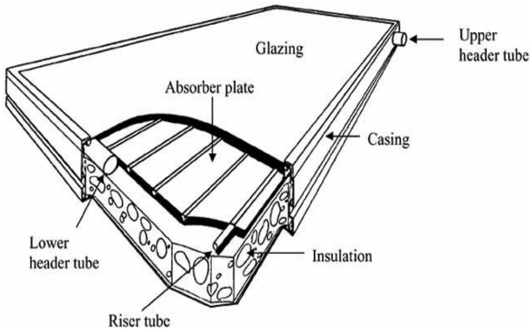

Fig.1. Flat Plate Collector[3]

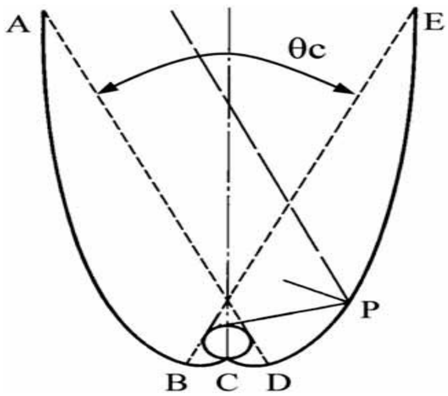

Fig. (2). Schematic diagram of a CPC collector. [3]

C. Evacuated Tube Collectors

The evacuated tube solar thermal system is one of the most popular solar thermal systems in operation. An evacuated solar system is the most efficient and a common means of solar thermal energy generation with a rate of efficiency of 70 per cent. Evacuated (or Vacuum) Tubes are solar panel built to reduce convective and heat conduction loss (vacuum is a heat insulator).It consists of a heat pipe inside a vacuum-sealed tube, as shown in Fig. (3). Evacuated tube collectors have demonstrated that the combination of a selective surface and an effective convection suppressor can result in good performance at high temperatures [2,3]. These collectors feature a heat pipe (a highly efficient thermal conductor) placed inside a vacuum-sealed tube. The pipe, which is a sealed copper pipe, is then attached to a black copper fin that fills the tube (absorber plate). Protruding from the top of the tube

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is a metal tip attached to the sealed pipe (condenser).

The cylindrical shape of evacuated tubes means that they are able to collect sunlight throughout the day and at all times in the year. Evacuated tube collectors are also easier to install as they are light, compact and can be carried onto the roof individually. What's more, the tubes can be replaced individually if one becomes faulty, avoiding the need to replace the whole collector. The system is an efficient and durable system with the vacuum inside the collector tubes having been proven to last for over twenty years. The reflective coating on the inside of the tube will also not degrade unless the vacuum is lost.Because no evaporation or condensation above the phase change temperature is possible, the heat pipe offers inherent protection from freezing and overheating. This self-limiting temperature control is a unique feature of the evacuated heat pipe collector.

III.CONCENTRATING COLLECTORS

Concentrating collectors are the collectors with sun tracking system or the collector with more absorbing surface. In concentrating collectors solar energy is optically concentrated before being transferred into heat. Concentration can be obtained by reflection or refraction of solar radiation by the use of mirrors or lenses. The reflected or refracted light is concentrated in a focal zone, thus increasing the energy flux in the receiving target [4].

The collectors falling in this category are:

1. Parabolic trough collector (PTC)
2. Linear Fresnel reflector (LFR)
3. Parabolic dish reflector (PDR) and
4. Heliostat field collector (HFC) or central receiver system

Parabolic Trough Collectors

It is a solar thermal collector i.e. curved as a parabola with a polished metal mirror. The parabola helps to enter the sunlight energy towards the mirror parallel to its plane of symmetry and is focused along the focal lines, where objects are positioned that are intended to be heated. It concentrates the sunlight before it strikes the absorber. When the parabola is pointed towards the sun, parallel rays incident on the reflector are reflected onto the receiver tube. It is sufficient to use a single axis tracking of the sun and thus long collector modules are produced [4]. Parabolic trough collectors (PTC) can effectively produce heat at temperatures between 50°C and 400°C for solar thermal electricity generation or process heat applications. Parabolic trough technology is the most advanced of the solar thermal technologies because of considerable experience with the systems and the development of a small commercial industry to produce and market these systems. Parabolic trough collectors are built in modules that are supported from the ground by simple pedestals at either end [3].

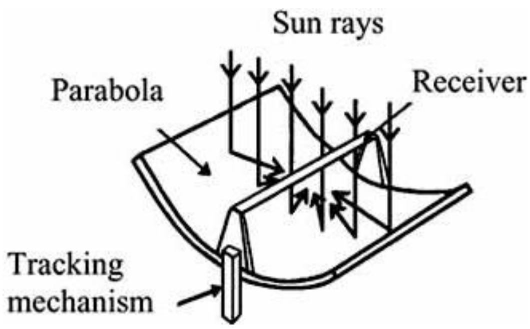

Fig 3. Parabolic Trough Collector

Linear Fresnel Reflector

The major aim of the reflector to increase the intensity of light so that the absorbing light will be more and time taken to absorb the sunlight will be less. In LFR a long and thin segments of mirrors focus sunlight onto a fixed absorber located at a common focal point of the reflectors. These mirrors are capable of concentrating the sun's energy to approximately 30 times its normal intensity.The greatest advantage of this type of system is that it uses flat or elastically curved reflectors which are cheaper compared to parabolic glass reflectors. Additionally these are mounted close to the ground, thus minimizing structural requirements [1].

One difficulty with the LFR technology is that avoidance of shading and blocking between adjacent reflectors leads to increased spacing between reflectors. Blocking can be reduced by increasing the height of the absorber towers, but this increases cost.

Parabolic Dish Reflector

The parabolic shape has its own importance as it covers the maximum area also and help in concentrating at one point also. A PDR is a reflective surface used to collect or project energy such as light, sound, or radio waves. The parabolic reflector transforms an incoming plane wave travelling along the axis into a spherical wave converging toward the focus. Conversely, a spherical wave generated by a point source placed in the focus is reflected into a plane wave propagating as a collimated beam along the axis. The main function of the parabolic reflector is to

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concentrate the energy at focal point. The receiver absorbs the radiant solar energy, converting it into thermal energy in a circulating fluid. The thermal energy can then either be converted into electricity using an engine-generator coupled directly to the receiver, or it can be transported through pipes to a central power-conversion system [1].

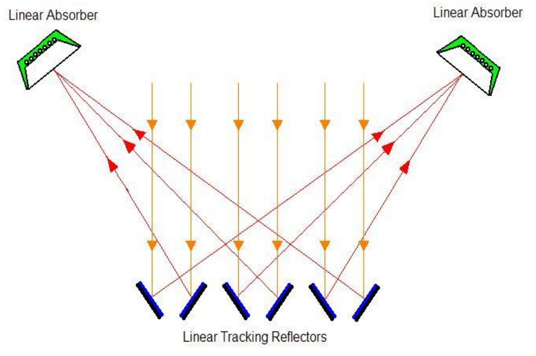

Fig. (4). Schematic diagram of a Fresnel type parabolic trough collector.

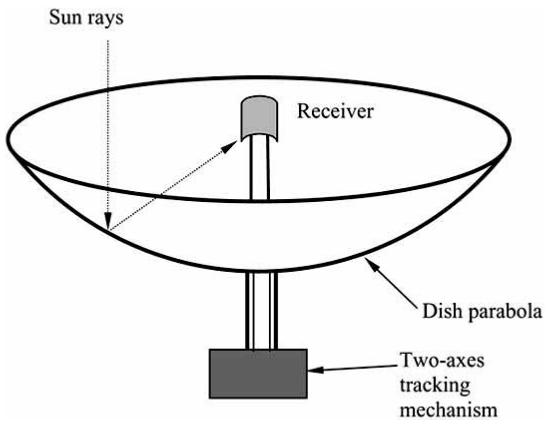

Fig. (5). Schematic diagram of a parabolic dish collector. [4]

Heliostat Field Collector

A heliostat (from helios, the Greek word for sun, and stat, as in stationary) is a device that includes a mirror, usually a plane mirror, which turns so as to keep reflecting sunlight toward a predetermined target, compensating for the sun's apparent motions in the sky. For very high energy this system is used the whole rays are concentrated on one region i.e. called as heliostat field or central receiver collector. By using slightly concave mirror segments on the heliostats, large amounts of thermal energy can be directed into the cavity of a steam generator to produce steam at high temperature and pressure. The concentrated heat energy absorbed by the receiver is transferred to a circulating fluid that can be stored and later used to produce power [3,4].

IV. Application Of the Collectors

Solar collectors are the important part of solar thermal system. Above types of solar collectors are used in variety of applications. The solar collectors are used as per their needs; in stationary solar collector the collectors are used to heat the liquid or fluid in the range of 60^0Cto 140^0C. Collectors are used as a heat exchanger which convert the sunlight in photovoltaic or in heat energy. The solar thermal system is applied to so many systems now that in future we don't need any fossil fuel for energy generation. With the help of different solar collector, the water, air space can be heated, not only this solar refrigeration, solar drying, solar heat pump, solar engine, solar desalination, solar furnace, solar invertors and many more the most advantages is

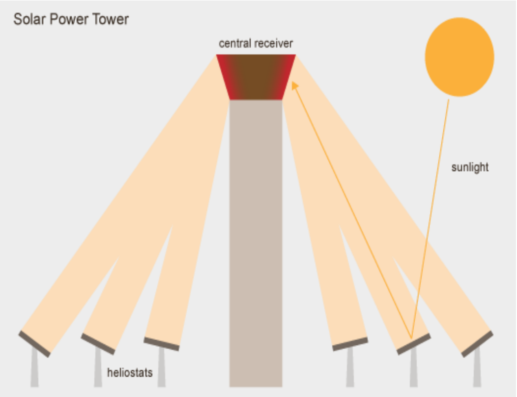

Fig. (6). Schematic diagram of heliostat field collector.

solar thermal power plant can be formed with the help of this collectors. According to the need and availability of space the collectors are invented and used. Stationary collectors are mainly used for fluid heating for small middle and large section region, they are good in power generation also but have less efficiency. The concentrating collectors are the collectors with high efficiency and high temperature rate. The concentrating collectors are more suitable for solar thermal power plant, as the collector increase the intensity of sunlight and due that the heating of fluid is fast and generation of electricity is fast and pure green.

V. Performance and Status of Flat Plate Collector

The paper reaches the point where it needed to explain the performance of Flat-plate collectors. Firstly there is a need to determine the useful energy collected with the interaction of the various constructional parameters on the performance of a collector. The following formula explain the amount of energy obtained from the collector.

$$q_u = A_c F_R [G_t(\tau\alpha) - U_L(T_i - T_a)] \quad (1)$$

where FR is the correction factor, or collector heat removal factor.

$$F_R = \frac{mc_p}{A_c U_L}\left(1 - \exp\left[\frac{U_L F' A_c}{mc_p}\right]\right) \quad (2)$$

where F_0 is the collector efficiency factor. It represents the ratio of the actual useful energy gain that would result if the collector-absorbing surface had been at the local fluid temperature. The collector efficiency factor can be calculated by considering the temperature distribution between two pipes of the collector absorber and by assuming that the temperature gradient in the flow direction is
negligible [2].

$$S\,\Delta x - U_L\,\Delta x(T - T_a) + \left(-k\delta\frac{dT}{dx}\right)\bigg|_x - \left(-k\delta\frac{dT}{dx}\right)\bigg|_{x+\Delta x}$$

$$= 0 \quad (3)$$

$$\frac{d^2T}{dx^2} = \frac{U_L}{k\delta}\left(T - T_a - \frac{S}{U_L}\right) \quad (4)$$

By applying the boundary conditions

$$\left.\frac{dT}{dx}\right|_{x=0} = 0, \quad \text{and} \quad T|_{x=L} = T_b \quad (5)$$

To find the variance

$$m = \sqrt{\frac{U_L}{k\delta}} \quad (6)$$

$$\Psi = T - T_a - \frac{S}{U_L} \quad (7)$$

Therefore equation 4 becomes

$$\frac{d^2\Psi}{dx} - m^2\Psi = 0 \quad (8)$$

$$\frac{T - T_a - S/U_L}{T_b - T_a - S/U_L} = \frac{\cosh(mx)}{\cosh(mL)} \quad (9)$$

This equation gives the temperature distribution in the x-direction at any given y:

$$n = F_R\left[\tau\alpha - \frac{U_L(T_i - T_a)}{G_t}\right]$$

This gives the efficiency of the collector. For incident angles below about 358, the product t times is essentially constant.

The above section shows the application of collectors for domestic water heating we need the temperature of range 60 to 80degree Celsius. This temperature can be easily achieved by flat plate and evacuated type collectors.

Many researchers has studied the flat plate and evacuated tube collector for their performance and efficiency and found that the flat plate are less efficient than the evacuated tube collector. But if these two technologies are used in Solar water heating system than the flat plate gives less cost and better result and in comparison to flat plate evacuated gives high cost with good performance and efficiency. If the storage tank is enough design to store the water with fewer drops in temperature than the Flat Plate Solar water heater gives more economical and better performance. Evacuated tubes need thermal shock test i.e. if they are exposed to full sun for too long prior to being filled with cold water the tubes may shatter due to the rapid temperature shift. There is also the question of vacuum leakage. Flat panels have been around much longer and are less expensive. They may be easier to clean. Other properties, such as appearance and ease of installation are more subjective. The above discussion clears the idea that the any engineer who wants to use the collector for solar water heater will select the collector on the criteria based on expenditures, easy manufacturing, space or size required Efficiency, easy installation and less maintenance. Approximate solar radiation range, climatic condition. Over these selection criteria flat plate criteria offers the best possible advantages i.e. High thermal efficiency; Sheet metal structural formula; Maintenance-free; High cost performance.

VI. CONCLUSION

It is evident from the above discussion that there are varieties of collectors in use for solar water heating system so far from low temperature to high temperature applications. Research and development in collector design needs more attention since vast potential exists due to use of renewable energy source is concerned.

Various types of collectors that are flat-plate, compound parabolic, evacuated tube, parabolic trough, Fresnel lens, parabolic dish and Heliostat field collector (HFC) performance parameters are discussed related to water heating application. It is found that flat Plate collector is most suitable collector because of higher efficiency and economy in the solar water heater system application.

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A Review on Pre-treatment of Damaged Sorghum and Corn Grains for Ethanol Production

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Abstract: Sorghum and corn grains are damaged due to many reasons like mechanical damages during harvesting, handling and storing grains size reduces due to breakage. This causes reduction in grain size and protective shield of grains becomes weak and moisture content with insecticides deterioration of grain occurs heavily. So these grains are wasted every year all over the world that needs to be better utilised quickly and easily, these inedible grains should be pre-treated. Review of literature is done for pre-treatment method analysis from damaged sorghum and corn grains in ethanol production. These damaged or inedible sorghum and corn grains are harmful if consumed. Such grains are utilized as a feedstock for Ethanol Production with proper separation of damaged portion of grains as a pre-treatment processing. In this paper stress is given on possible pre-treatment techniques specifically for damaged corn and sorghum grains of different quality. It is observed that separation of damaged or inedible sorghum and corn grains as feedstock could be better utilized for ethanol production.

Keywords : Damaged Grains, Storage, Ethanol, Harvesting, Handling, Pre-treatment

1. INTRODUCTION

The storage of food grains is normally done in order to maintain a uniform supply of food for consumption, for the domestic and export market and to provide a buffer stock for contingencies such as drought floods and war. As well as Millers, traders and other private entrepreneurs adopt it to speculate on good price. Losses in storage are considered significant and these are attributed mainly to spillage, attacks by insects, mites, rodents, moulds and dry matter loss due to respiration. In Southeast Asia, for instance, it is reported that grain losses in storage ranges from 5% to 15% (Champ and Highly, 1981). Insect infestation accounts for the single largest component of these losses. The storability of grains is affected by their temperature and moisture content. Either or both factors must be reduced to ensure a conducive environment for storage. This could be done through aeration. Aeration involves moving a relatively low volume of air through the grain bulk to control grain temperature. The process was found to reduce the risk of damage or spoilage of grains. Aeration is normally done using ambient air.

The primary concern in storage is the safety of the product. For perishable crops, the product quality and quantity have to be maintained or deterioration has to be minimized. To be able to achieve this purpose the five aspects of storage has to be considered, attended to and understood, namely - stored product, storage structure, environmental factors, storage pests and personnel involved. The interrelationship of these five components or factors may well be stated as follows. The personnel involved in storage operation have the primary responsibility of keeping the stored product safe and secure inside the structure against storage pests and environmental factors.

Factors affecting losses in storage are -i) Mechanical and Environmental i.e. Handling damage, Handling spillage and Moisture stresses and movements, ii) Infestation i.e. Bacteria, molds, and fungi, Insects, Rodents, Birds, iii) Biochemical Processes i.e. Vitamin loss, Fat acidity, Natural respiration

$$C_6H_{12}O_6 + 6O_2 \text{--} 6CO_2 + 6H_2 + 677 \text{ Kcal}$$

Measures for preventing or minimizing losses in storage can be minimized or prevented by adopting any or combination of the following:

i) Chemical Control i.e. Insect control, Mold, fungi and bacterial control, ii) Biological Control i.e. Predators and parasites, Entomogenous fungi, Entomopathogenic diseases and Varietal resistance, iii) Physical Control i.e. Air conditioning (temperature & R.H. control), Drying (moisture control), Controlled atmosphere (gas concentration control), Aeration, Heat disinfestations and Irradiation, iv) Proper Design of Structure i.e.

Weather tight, Rodent and bird proof and Gastight, v) Sanitation i.e. Cleaning of storage facilities before and after storage and Regular inspection of storage condition.

After the control measures also damaged or inedible sorghum and corn grains are available every year all over the world due to many causes and more focus is required for its use in ethanol production as a valuable product.

2. REVIEW OF LITERATURE ON PRE-TREATMENT OF DAMAGED CORN AND SORGHUM:

In this paper exhaustive review of literature is carried out for determination of main causes and type of sorghum and corn grains damages. Major causes of sorghum and corn grains damages are briefly discussed in this paper. It is revealed that grain gets damaged during harvesting, handling, and storage due to breakage. This cause reduction in grain size and protective shield of grains becomes weak. On these weak grains an insect infestation is able to reduce its chemical or nutritional value which is very important for its further utilization. The intensity of grain damage is difficult to quantify accurately but it can be measured with the help of physical and chemical tests [1].

All damaged grains lose some of the starch and increased soluble sugars, ash and crude fiber. It is observed that sprout-damaged grains contained the highest amounts of reducing sugars. Ethanol yields based on the already damaged grains indicated that sprout-damaged grains yielded similar amounts compared to undamaged grains. The insect-damaged and mold-damaged corn and sorghum have reduced ethanol yields. As per exhaustive study it is observed that already damaged insect, mold or sprouted, corn and sorghum grains are having vast potential for ethanol production and could be good alternative for fossil fuel [2].

The most important issues in industrial ethanol production are yield, efficiency, and energy consumption. Laboratory results in terms of ethanol yield and ethanol fermentation efficiency from artificially germinated high-tannin sorghum suggest that huge potential energy savings exist in production of ethanol from germinated sorghum grain. Using germination-damaged sorghum for industrial ethanol production might benefit the producer and end user by expanding market uses of what has been historically considered a low-value commodity. Germination not only causes compositional changes in the sorghum grain but also initiates a series of biochemical and physiological changes. Intrinsic enzymes such as amylases, proteases, lipases, fiber-degrading enzymes, and phytases are activated [3].

Ethanol production from starchy raw materials specifically damaged corn and sorghum grains by direct bioconversion are potential source for non-edible option. Ethanol production from damaged corn and sorghum starch requires the use of amylase and amyloglucosidase for the pre-treatment starch before fermentation. Preparation of damaged corn and sorghum grains for ethanol production is concentrated by study of separation for damaged grains to removing waste part and constituents reducing bio-ethanol conversion. It is observed that Process of Ethanol production from damaged Sorghum and Corn grains is having vast potential and it would be very useful source of renewable energy [4].

In this paper, fermentation of damaged sorghum grains for bio-ethanol production is revealed by co-cultures of A. Niger (NCIM 1248) and S. Cerevisiae (MTCC 170). It is observed that at 2% substrate concentration ethanol yield was 0.40 g/100ml, while ethanol concentration increased to a maximum of 1.81 g/100ml at 10% substrate concentration. When culture conditions were optimized, ethanol yield further increased to 1.91 g/100ml at a temperature of 35 0 C, pH 5.0, 300 rpm agitation rate and reduced fermentation period of 5 days. In the present analysis of a simultaneous single step system for production of ethanol from damaged sorghum grains using symbiotic co-cultures of A. Niger and S. Cervisiae is carried out for determination of optimal culture conditions [5].

Purpose of this work is to optimize ethanol production process from damaged sorghum grains with specific objective to study process parameters of ethanol production by fermentation. To determine the optimum response, surface plots for desirability and overlay plots are generated. Flour from damaged sorghum grains yielded 2.30 (g/100ml) ethanol by fermentation with co-culture of A. Niger (NCIM 1248) and S. Cerevisiae (MTCC 170) under optimized conditions of pH 5.5, temperature (30^0 C), and inoculum level (7.5 % v/v).Thereby damaged sorghum grains those are non-edible could be utilized optimally for ethanol production [6].

In this study a number of different process flowsheets were generated and their feasibility evaluated using simulations of dynamic models. A dynamic modeling framework was used for the assessment of operational scenarios such as, fed-batch, continuous and continuous with recycle configurations. Each configuration was evaluated against the following benchmark criteria, yield (kg ethanol/kg dry-biomass), final product concentration and number of unit operations required in the different process configurations. The results show that simultaneous saccharification and co-fermentation (SSCF) operating in continuous mode with a recycle of the SSCF reactor effluent, results in the best productivity of bioethanol among the proposed process configurations, with a yield of 0.18 kg ethanol/kg dry-biomass [7].

Life cycle assessment (LCA) techniques allow detailed analysis of material and energy fluxes on regional and global scales. This includes indirect inputs to the production process and associated wastes and emissions, and the downstream fate of products in the future. At the same time if not used properly, LCA can lead to incorrect and inappropriate actions on the part of industry and/or policy makers. This paper aims to list key issues for quantifying the use of resources and releases to the environment associated with the entire life cycle of lignocellulosic bioethanol production [8].
Corredor et al. (2006) investigated decorticating sorghum prior to starch hydrolysis and ethanol fermentation. In general, decortication decreased the protein content of the samples up to 12% and increased starch content by 5–16%. Fibre content was decreased by 49–89%. These changes allowed for a higher starch loading for ethanol fermentation and resulted in increased ethanol production. Ethanol yields increased 3–11% for 10% decorticated sorghum and 8–18% for 20% decorticated sorghum. Using decorticated grain also increased the protein content of the distillers dried grains with solubles (DDGS) by 11–39% and lowered their fibre content accordingly. Using decorticated sorghum may be beneficial for ethanol plants as ethanol yield increases and animal feed quality of the DDGS is improved. The bran removed before fermentation could be used as a source of phytochemicals (Awika et al., 2005) or as a source of kafirin and wax. There is one report on the potential of pearl millet for ethanol production (Wu et al., 2006). On a starch basis, ethanol yield was similar to that of sorghum and maize with an efficiency of 94.2%. On account of pearl millet being rich in protein and lipid, the protein and energy contents of the pearl millet DDGS were higher than those from sorghum and maize, indicating that pearl millet DDGS could be a good animal feedstuff. 5.2. Starch wet milling Ethanol can also be produced from sorghum by first wet milling the grain to isolate the starch, the so-called wet-grind process. Isolated sorghum starch could also be used in other industrial applications in a similar fashion to corn starch. In fact, sorghum starch was commercially produced in the US from 1948 until the 1970s (Munck, 1995). In general the wet milling of sorghum is similar to that of maize. A thorough review of early research on wet milling of sorghum can be found in Munck (1995). However, a problem particular to sorghum is that where polyphenolic pigments are present in the pericarp and/or glumes, they stain the starch (Beta et al., 2000a–c). In recent years several new developments in sorghum wet milling have been reported. Perez-Sora and Lares-Amaiz (2004) investigated alkaline reagents for bleaching the starch and found a mixture of sodium hypochlorite and potassium hydroxide to be the most effective. To help improve the economics of sorghum wet-milling Yang and Seib (1995) developed an abbreviated wet-milling process for sorghum that required only 1.2 parts fresh water per part of grain and that produced no waste water. The products of this abbreviated process were isolated starch and a high moisture fraction that was diverted to animal feed. Buffo et al. (1997b) investigated the impact of sulphur dioxide and lactic acid steeping on the wet-milling properties of sorghum and reported that the amount of lactic acid used during steeping had the most impacted wet-milling quality characteristics such as starch yield and recovery. These authors also investigated the relationships between sorghum grain quality characteristics and wet-milling performance in 24 commercial sorghum hybrids (Buffo et al., 1998). Perhaps not surprisingly, they found that grain factors related to the endosperm protein matrix and its breakdown and subsequent release of starch granules important factors in wet-milling of sorghum. Related to this, Mezo-Villanueva and Serna-Saldivar (2004) found that treatment of steeped sorghum and maize with proteinase increased starch yield, with the effect being greater with sorghum than maize. Wang et al. (2000) optimised the steeping process for wet-milling sorghum and reported the optimum steeping process to utilise 0.2% sulphur dioxide, 0.5% lactic acid at a temperature of 501C for 36 h. Using this steeping process, wet-milling of sorghum produced starch with an L lightness value of 92.7, starch yield of 60.2% (db), and protein in starch of only 0.49% (db). Beta et al. (2000a–c) found that both polyphenol content and sorghum grain properties influence sorghum starch properties. Using sorghum grits as the starting material for wet-milling rather than whole sorghum produced lower yields, but the isolated starch was higher in quality. Sorghum starch matching the quality of a commercial corn starch was successfully produced by wet-milling sorghum grits (Higiro et al., 2003). Xie and Seib (2002) developed a limited wet-milling procedure for sorghum that involved grinding sorghum with in the presence of 0.3% sodium bisulphite. This

procedure was produced starch with an L value of 93.7 and a starch recovery of 78%. Large grain sorghum hybrids wet-milled by this ‘‘no steep’’ procedure were reported to produce high-quality starches with L values from 93.1 to 93.7 (compared to 95.2 for a commercial corn starch) [9].

The bioconversion into ethanol of insect (Sitophilus zeamais), mold (Aspergillus flavus) and sprout-damaged maize and sorghum was investigated. Kernel test weight losses due to insect damage in maize were almost twice compared to sorghum (18.6 vs. 10.7%). All damaged kernels lost some of the starch and increased soluble sugars, ash and crude fiber. The mold-damaged sorghum contained approximately five times more FAN compared to the control. The sprout-damaged kernels contained the highest amounts of reducing sugars prior (11 g/L) to and at the end (146.5 g/L) of liquefaction with a - amylase. Ethanol yields based on the already damaged grain indicated that sprout-damaged kernels yielded similar amounts compared to sound kernels (381.1 vs. 382.6 L/ton and 376.6 vs. 374.8 L/ton of sorghum or maize respectively). The insect-damaged maize and sorghum have reduced ethanol yields compared with the controls (29 and 23% respectively), and this negative result was mainly due to dry matter losses during the inadequate storage. Despite differences in ethanol yield, all treatments have similar conversion efficiencies (76.1e89.9%) indicating the robustness of yeast facing biotic-damaged feedstocks. This research demonstrates that the use of already damaged insect, mold or sprouted kernels is feasible and a good alternative for biorefineries.

This research demonstrated that there was a clear negative impact of insect, molds and intrinsic enzymes in the physical and chemical composition of maize and sorghum. Insect and mold-damaged kernels were mainly affected at the endosperm level. These kernels had reduced amounts of starch and NFE and higher levels of reducing sugars and FAN. There was no evidence of germ attack because the crude fat remained at the same concentration. Sprouted grains with high enzymatic activity had clear evidence of degradation of both starch and proteins. The use of sprouted kernels reduced hydrolysis time needed to achieve optimum reducing sugar concentration and enhanced ethanol yields. Conversions into bioethanol of insect, mold and sprout-damaged maize and sorghum were lower calculated in relation to the orig-inal grain weight, indicating that the dry matter loss incurred during storage was the main reason for the observed detrimental effect. Nevertheless, all already damaged kernels had similar fermentation efficiencies, indicating that these feedstocks are suitable for fuel ethanol production [10].

Bioethanol accounts for the majority of biofuel use worldwide, either as a fuel or a gasoline enhancer. In Serbia, the industrial production of bioethanol still relies on conventional feedstocks containing starch and sugar such as corn, wheat and molasses. In order to improve the economy of bioethanol production and to avoid the competition of the feedstock utilization for food and energy, several production approaches based on crop selection, process integration and waste utilization were considered in this paper. Particular attention was put on utilization of non conventional crops such as triticale and damaged crops not appropriate for food consumption. Potential of lignocellulosic biomass for the production of second generation ethanol in Serbia was also considered as well as the utilization of stillage as a main by-product. The investigated approaches can significantly improve the economy of bioethanol production and contribute to solve serious environmental problems.

Utilization of waste crops or by-products from other industries such as starch processing, could also be a very rational approach. The efforts and investments in promoting the second generation of bioethanol on lignocellulosic biomass in Serbia should be intensified, especially due to the fact that this biomass is vastly available in the country and it doesn’t compete with food production. In addition, a proper utilization of by-products from bioethanol production for the production of animal feed and lactic acid can significantly improve the economy of bioethanol production [11].

Current fuel ethanol research and development deals with process engineering trends for improving biotechnological production of ethanol. In this work, the key role that process design plays during the development of cost-effective technologies is recognized through the analysis of major trends in process synthesis, modeling, simulation and optimization related to ethanol production. Main directions in techno-economical evaluation of fuel ethanol processes are described as well as some prospecting configurations. The most promising alternatives for compensating ethanol production costs by the generation of valuable co-products are analyzed. Opportunities for integration of fuel ethanol production processes and their implications are underlined. Main ways of process intensification through reaction–reaction, reaction–separation and separation–separation processes are analyzed in the case of bioethanol production. Some examples of energy integration during ethanol production are also highlighted. Finally, some concluding considerations on current and future research tendencies in fuel ethanol production regarding process design and integration are presented [12].

Field sprouting damaged starch granules, protein matrices, and cell walls in sorghum kernels, consequently decreasing kernel hardness, kernel weight, and kernel size. Field sprouting also changed the chemical composition and pasting properties of field-sprouted grain sorghum, which could shorten fermentation time without decreasing ethanol yield. Field-sprouted grain sorghum had relatively high FAN content. The FAN provided efficient buffering capacity and optimal yeast performance, and field- sprouted sorghum had a more rapid fermentation rate than non- sprouted sorghum. FAN played a key role in increasing conversion efficiency for ethanol production. Using weathered and/or sprouted sorghum from regions affected by unusually high moisture events during grain fill and harvest may provide an opportunity for ethanol producers to maintain ethanol production efficiency, while shortening processing time. This could offer sorghum producers an opportunity to receive a premium, or at least a fair market value, for sorghum when such environmental events occur [13].

Steam-flaked sorghum was more susceptible to alpha-amylase hydrolysis compared to whole sorghum. The moist thermal process improved performance during the subsequent steps of saccharification and yeast fermentation. The end result was a substrate that yielded higher amounts of ethanol in approximately 30 h fermentation. Steam-flaking of sorghum allowed the production of similar amounts of ethanol compared to maize in similar liquefaction and fermentation times. Compared to the whole sorghum conventionally processed, the steam-flaked sorghum yielded 44% more ethanol. Steam-flaking might be used as a preliminary process to pregelatinize and disrupt the kernel structure, improving the rate of starch conversion into fermentable carbohydrates and ethanol yields [14].

A process and cost model for a conventional corn dry-grind processing facility producing 119 million kg/year (40 million gal/year) of ethanol was developed as a research tool for use in evaluating new processing technologies and products from starch-based commodities. The models were developed using Super Pro Designer ® software and they handle the composition of raw materials and products, sizing of unit operations, utility consumptions, estimation of capital and operating costs, and the revenues from products and coproducts. The model is based on data gathered from ethanol producers, technology suppliers, equipment manufacturers, and engineers working in the industry. Intended applications of this model include: evaluating existing and new grain conversion technologies, determining the impact of alternate feedstocks, and sensitivity analysis of key economic factors. In one sensitivity analysis, the cost of producing ethanol increased from US$ 0.235 l^{-1} to US$ 0.365 l^{-1} (US$ 0.89 gal^{-1} to US$ 1.38 gal^{-1}) as the price of corn increased from US$ 0.071 kg^{-1} to US$ 0.125 kg^{-1} (US$ 1.80 bu^{-1} to US$ 3.20 bu^{-1}). Another example gave a reduction from 151 to 140 million l/year as the amount of starch in the feed was lowered from 59.5% to 55% (w/w) [15].

The PV for the dilute-acid pretreatment scenario is $1.36/LGE, which is the lowest among all pretreatments and process variations. This is due primarily to the higher sugar yields – and, therefore, ethanol yields – from dilute-acid pretreatment and enzymatic hydrolysis than for the other process scenarios. The exception to this is the scenario with separate C5 and C6 sugar fermentation, which has higher ethanol yields. However, the PV is higher because of the high capital cost of extra fermentation vessels needed to ferment the sugars separately.

To estimate the potential risk associated with process scale-up, a pioneer plant risk analysis was conducted. Under the most probable assumptions for pioneer plant operation for the dilute-acid pretreatment scenario, the PV is $2.30/LGE. Additionally, the TCI for the most probable case is estimated to double from the cost of an nth plant. Because of the large capital cost and the PV being well above ethanol market prices for a pioneer plant, it may prove difficult for the cellulosic ethanol industry to finance growth until a number of biotechnology barriers are broken. Significant opportunities exist to reduce the PV through biochemical technology breakthroughs. Enzyme cost in this study is assumed to be $0.27/LGE, representing a potential ethanol cost reduction by reducing enzyme production cost and increasing specific activity. In the dilute-acid pretreatment model in this study, 75.6% of xylose is converted to ethanol during fermentation and none of the other hemicelluloses sugars are converted to ethanol. The development of organisms that can ferment xylose at conversions similar to those of glucose to ethanol– as well as other hemicelluloses sugars – also offers potential for reducing ethanol cost [16].

For the first time, a single source of cellulosic biomass was pretreated by leading technologies using identical analytical methods to provide comparative performance data. In particular, ammonia explosion, aqueous ammonia recycle, controlled pH, dilute acid, flow through, and lime approaches were applied to prepare corn Stover for subsequent biological conversion to sugars through a Biomass Refining Consortium for Applied Fundamentals and Innovation (CAFI) among Auburn University, Dartmouth College, Michigan State University, the National Renewable Energy Laboratory, Purdue University, and Texas A&M University. An Agricultural and Industrial Advisory Board provided guidance to the project. Pretreatment conditions were selected based on the extensive experience of the team with each of the technologies, and the resulting fluid and solid streams were characterized using standard methods. The data were used to close material balances, and energy balances were estimated for all processes. The digestibilities of the solids by a controlled supply of cellulase enzyme and the fermentability of the liquids were also assessed and used to guide selection of optimum pretreatment conditions. Economic assessments were applied based on the performance data to estimate each pretreatment cost on a consistent basis. Through this approach, comparative data were developed on sugar recovery from hemicelluloses and cellulose by the combined pretreatment and enzymatic hydrolysis operations when applied to corn stover. This paper introduces the project and summarizes the shared methods for papers reporting results of this research in this special edition of Bio-resource Technology [17].

Lignocelluloses biomass can be utilized to produce ethanol, a promising alternative energy source for the limited crude oil. There are mainly two processes involved in the conversion: hydrolysis of cellulose in the lignocelluloses biomass to produce reducing sugars, and fermentation of the sugars to ethanol. The cost of ethanol production from lignocelluloses materials is relatively high based on current technologies, and the main challenges are the low yield and high cost of the hydrolysis process. Considerable research efforts have been made to improve the hydrolysis of lignocellulosic materials. Pretreatment of lignocellulosic materials to remove lignin and hemicelluloses can significantly enhance the hydrolysis of cellulose. Optimization of the cellulase enzymes and the enzyme loading can also improve the hydrolysis. Simultaneous saccharification and fermentation effectively removes glucose, which is an inhibitor to cellulase activity, thus increasing the yield and rate of cellulose hydrolysis [18].

Results indicate that rice straw is potentially the most favorable feedstock, and the next most favorable raw materials are wheat straw, corn stover, and sugar cane bagasse in terms of the quantity of biomass available. These four feedstocks can produce 418 GL of bio-ethanol. The most favorable area is Asia, which can produce 291 GL of bio-ethanol because of biomass availability.

I) Biomass availability issue: Biomass availability is a primary factor. A favorable region for bio-based industrial products should have surplus biomass and no problems with food security. Societal response to the utilization of biomass for bio-based industrial products is also a factor. Some societies may be reluctant to use even waste crops for industrial products if they believe that somehow food resources are diminished. The biomass availability issue is a global matter because food security is a top global priority. However, when only the crop residues are considered, biomass availability tends to become a local matter.

ii) Economic issue: Bio-based products, including ethanol, must be made at competitive costs. Otherwise, there will be no market for the bio-based products even though they are made from renewable resources. Economic factors, for example land availability, labor, taxation, utilities, crop processing costs, and transportation, especially the delivered cost of the biomass feedstock, are important. Hence, the economic issues are primarily local matters.

iii) Environmental issue: One of the potential merits of bio-based products is the utilization of renewable resources instead of non-renewable resources. However, specific crop production practices may reduce or even overwhelm this potential benefit. For example, a proper balance between the crop yield and the application rate of agrochemicals is needed. Other environmental issues in the agricultural operation, such as soil erosion, soil organic matter trends, water and groundwater use, should also be fully reviewed. These environmental issues tend to be local matters.

This study investigated the potential for utilization of wasted biomass and lignocellulosic feedstocks for bio-ethanol. The lignocellulosic feedstocks have much more favorable utilization potential for biobased industrial products because of their quantity and competitive price. Furthermore, lignocelluloses can generate electricity and steam, which can be used in a biorefinery and also exported into the power grid. Importantly, lignocellulosic feedstocks do not interfere with food security. However, facilitating the utilization of lignocellulosic materials requires tremendous efforts in achieving a high ethanol yield, establishing infrastructure for the collection system, increasing the thermal efficiency of generating electricity and steam, and so on. Regarding the data quality of FAOSTAT, some nations may have a large gap between values in their national database and the data in FAOSTAT, as shown in Table 1. Technology for utilizing wasted crop, defined as crop lost in the distribution, as a raw material for bio-based product will depend strongly on regional conditions, e.g., climate, storage facility, efficiency of transportation [19].

Cellulosic plant material represents an as-of-yet untapped source of fermentable sugars for significant industrial use. Many physio-chemical structural and compositional factors hinder the enzymatic digestibility of cellulose present in lignocellulosic biomass. The goal of any pre-treatment technology is to alter or remove structural and compositional impediments to hydrolysis in order to improve the rate of enzyme hydrolysis and increase yields of fermentable sugars from cellulose or hemicelluloses. These methods cause physical and/or chemical changes in the plant biomass in order to achieve this result. Experimental investigation of physical changes and chemical reactions that occur during pre-treatment is required for the development of effective and mechanistic models that can be used for the rational design of pre-treatment processes. Furthermore, pre-treatment processing conditions must be tailored to the specific chemical and structural composition of the various, and variable, sources of lignocellulosic biomass. This paper reviews process parameters and their fundamental modes of action for promising pre-treatment methods [20].

The state of the art of hydrolysis-fermentation technologies to produce ethanol from lignocellulosic biomass, as well as developing technologies, is evaluated. Promising conversion concepts for the short-, middle- and long-term are defined. Their technical performance was analyzed, and results were used for economic evaluations. The current available technology, which is based on dilute acid hydrolysis, has about 35% efficiency (HHV) from biomass to ethanol. The overall efficiency, with electricity co-produced from the not fermentable lignin, is about 60%. Improvements in pre-treatment and advances in biotechnology, especially through process combinations can bring the ethanol efficiency to 48% and the overall process efficiency to 68%. We estimate current investment costs at 2.1 kh/ kW HHV (at 400 MW HHV inputs, i.e. a nominal 2000 tonne dry/day input). A future technology in a 5 times larger plant (2 GW HHV) could have investments of 900 kh/kW HHV. A combined effect of higher hydrolysis-fermentation efficiency, lower specific capital investments, increase of scale and cheaper biomass feedstock costs (from 3 to 2 h/GJ HHV), could bring the ethanol production costs from 22 h/GJ HHV in the next 5 years, to 13 h/GJ over the 10–15 year time scale, and down to 8.7 h/GJ in 20 or more years [21].

The most common renewable fuel today is ethanol produced from sugar or grain (starch); however, this raw material base will not be sufficient. Consequently, future large-scale use of ethanol will most certainly have to be based on production from lignocellulosic materials. This review gives an overview of the new technologies required and the advances achieved in recent years to bring lignocellulosic ethanol towards industrial production. One of the major challenges is to optimize the integration of process engineering, fermentation technology, enzyme engineering and metabolic engineering.

Major research challenges- I) Improving the enzymatic hydrolysis with efficient enzymes, reduced enzyme production cost and novel technology for high solids handling. ii) Developing robust fermenting organisms, which are more tolerant to inhibitors and ferment all sugars in the raw material in concentrated hydrolysates at high productivity and with high ethanol concentration and iii) Extending process integration to reduce the number of process steps and the energy demand and to re-use process streams to eliminate the use of fresh water and to reduce the amount of waste streams [22].

3. BIOETHANOL PRODUCTION PROCESSES FROM DAMAGED CORN AND SORGHUM GRAINS:

Damaged corn and Sorghum grains separation process is suggested here, for maximum conversion of damaged grains into bio-ethanol. Density difference in water as well as in vibrators damaged grains can be separated from edible or good quality grains. Separated damaged or inedible grains can be sun dried or can be heat dried for further dry milling process. Germ or insects damaged grains can be directly sun or heat dried or submerged in water pool for separating germs or any micro- organisms from damaged grains instantly. Mechanically damaged grains can be separated using filtering with the help of nets of different grid size for separation of damaged or broken grains.

Today, most fuel ethanol is produced from corn by either the dry grind (67%) or the wet mill (33%) process. The key distinction between wet mill and dry grind facilities is the focus of the resourcing. In the case of a dry grind plant, the focus is maximizing the capital return per gallon of ethanol. In the case of a wet mill plant, capital investments allow for the separation of other valuable components in the grain before fermentation to ethanol. The wet milling process is more capital- and energy intensive, as the grain must first be separated into its components, including starch, fiber, gluten, and germ. The germ is removed from the kernel and corn oil is extracted from the germ. The remaining germ meal is added to fiber and the hull to form corn gluten feed. Gluten is also separated to become corn gluten meal, a high-protein animal feed. In the wet milling process, a starch solution is separated from the solids and fermentable sugars are produced from the starch. These sugars are fermented to ethanol. Wet mill facilities are true "bio-refineries", producing a number of high-value products. In the dry grind process, the clean corn is ground and mixed with water to form a mash. The mash is cooked and enzymes are added to convert starch to sugar. Then yeast is added to ferment the sugars, producing a mixture containing ethanol and solids. This mixture is then distilled and dehydrated to create fuel-grade ethanol. The solids remaining after distillation are dried to produce distillers' dried grains with protein and are sold as an animal feed supplement. A schematic of both processes is illustrated in Fig. 1.

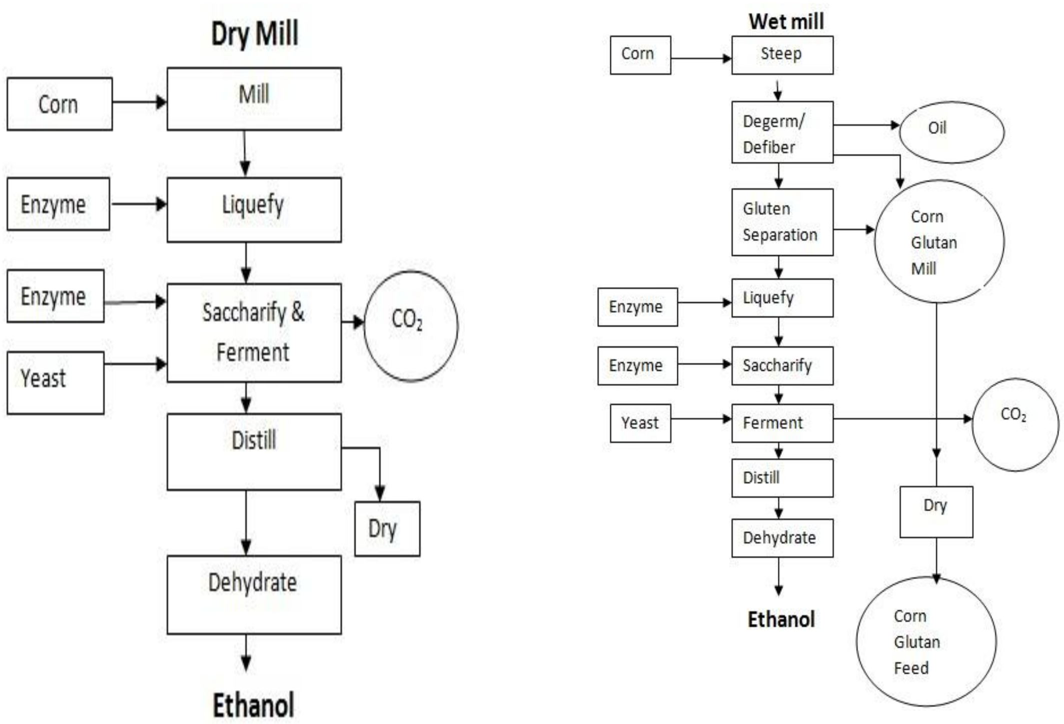

Fig 1-: Ethanol production processes

CONCLUSION:-

Every year damaged sorghum and corn grains are wasted, since these grains are inedible. Pre-treatment on damaged sorghum and corn grains is proposed in this paper for different quality of these grains for effective and quick removal of non-productive or harmful constituents. This would maximize further conversion process of sorghum and corn grains into ethanol production. As per the need of pre-treatment for grain qualities available as feedstock the separation method is reviewed here for efficient ethanol production. It is revealed that damaged or inedible sorghum and corn grains could be easily converted into ethanol right from damaged or poor quality grains available.

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Smart Grid Devices for Performance Management of High Voltage Transmission Lines in India

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ABSTRACT: Owing to increasing demand for bulk power transmission, and huge electric power requirement in urban areas, there is need for implementing Smart Grid technologies for power Transmission and Distribution. This paper presents smart grid devices for on-line condition monitoring of electrical equipments, technical evaluation in extra high voltage transmission lines and in substations. Smart Grid Technology is used to achieve Advanced Asset Management (AAM), to enhance asset utilization, efficiency and improve system reliability. Electrical equipment maintenance is one of the most important tasks in asset management. Using computers, sensors and other advanced monitoring technologies, conditions of overhead lines can be consistently monitored and Condition-Based Maintenance (CBM) can be implemented. Power systems cannot be tested at full power rating in the laboratories, and simulation is an extremely valuable tool for designing, operating and understanding complex systems. Real-time simulation can avoid inadvertent outages caused by human error, equipment overload, etc. Thus in this paper use of smart grid technologies for various maintenance techniques for improving performance of power system is illustrated.

1.

***KEYWORDS:** Smart Grid Technology, On-Line Condition Monitoring, Technical Evaluation, Advanced Asset Management, System Reliability, Equipment Maintenance, Condition-Based Maintenance, Real-Time Simulation*

I. INTRODUCTION:

In the current scenario of energy consumption in India, the power which is feeded always deficit to its demand. It is found that by transmitting power up to high KVs the power handling capacity increases with more power to be transmitted over large distance. Efficient utilization of available infrastructure & reduction of losses in a transmission System can improve the performance of existing lines. The economic advantage is also linked with reduction in losses. Renovation, Modernization and up gradation of existing projects is one of the cost effective alternatives to increase the power transmission capabilities. [1]. Indian power system is facing high AT&C Losses, poor distribution network, wide demand supply gap of energy, poor asset management etc. Smart grid technology will bring solutions to all of the mentioned problems and sustainability by way of demand side management, demand response, outage management, reduction in AT&C losses and improved customer satisfaction. This can be achieved with distribution system improvement through smart grid technologies.[2].

Smart Grid enables real time monitoring and control of power system as well as helps in power quality management, outage management, smart home energy system etc. Smart Grid will act as a backbone infrastructure to enable new business models like smart city, electric vehicles, smart communities apart from more resilient and efficient energy system and tariff structures. In this way Smart Grid technology shall bring efficiency and sustainability in meeting the growing electricity demand with reliability and best of the quality.[3]

2.

3. The transmission lines are operated in accordance with Regulations/standards of Central Electricity Authority (CEA) / Central Electricity Regulatory Commission (CERC) / State Electricity Regulatory Commissions (SERC) [6]. Loading on transmission lines may have to be restricted keeping in view the voltage stability, angular

stability, loop flows, load flow pattern and grids.[4]. National Missions is Restructured Accelerated Power Development and Reforms Programme (R-APDRP), AT&C loss reduction, Adoption of information technology in the areas of energy accounting, consumer care and strengthening of Distribution network of State Power Utilities.[5].Establishment of supervisory control & data acquisition system.

II INDIAN POWER SCENERIO

Present Power Scenario & Transmission Network in India. All India Installed Capacity (in MW) of Power station is 2,88,664.97 MW[6].The vision statement of the Ministry of Power as per the RFD document follows: "Reliable, adequate and quality power for all at reasonable prices".[3]. Power System Operation Corporation Limited (POSOCO), is managing the National and Regional grid from National Load Despatch Centre (NLDC) and its five Regional Load Despatch Centres (RLDC) through state-of-the-art unified load dispatch & communication facilities.[4].

Integration of Renewable Energy Resources with conventional sources is a top priority worldwide and special attention is being given in our country to harness the Green Energy. CERC has provided a framework for trading in Green Certificates (Renewable Energy Certificates or RECs) and National Load Despatch Centre (NDLC) of POSOCO has been designated as the Central agency for this purpose.[2].

- **Transmission Scenario in India.**

4.

5. The nominal Extra High Voltage lines in vogue are ± 800 kV HVDC & 765kV, 400 kV, 230/220 kV, 110 kV and 66kV AC lines. The capacity of transmission system of 220 kV and above voltage levels, in the country as on 29th February' 2016 was 3,39,158 ckm of transmission lines and 6,40,056 MVA of transformation capacity of Substations. As on 29th February' 2016, the total transmission capacity of the inter-regional links is 57,450 MW, which is expected to be increased to 68,050 MW by the end of 12th plan i.e. 31st March, 2017.[2].

Power Grid operates and maintains more than 95,000 circuit km transmission line and 155 substations mainly at 400kV and 765kV level and plan to add about 50,000 circuit km lines in next 4-5 years. All the State-of-the-Art Load Despatch Centres in the country having SCADA / EMS have been established by POWERGRID1,28,200 ckt kms of transmission lines at 800/765kV, 400kV, 220kV & 132kV EHVAC & +500kV HVDC levels and 206 sub-stations.Also the transformation capacity of about 2,49,578 MVA as on 29th February 2016.[8]

Table no.1 Executive summary of Power Supply Position (Energy & Peak) in Feb 2016.

8. Power Supply Position (Energy & Peak) in February 2016

Region	Energy (MU)				Deficit (%)	
	Requirement		Availability			
	Feb '15	Feb '16	Feb '15	Feb '16	Jan '14	Jan '15
Northern	23549	25115	22371	23926	-5.0	-4.7
Western	23457	28603	23269	28579	-0.8	-0.1
Southern	23035	24443	22567	24232	-2.0	-0.9
Eastern	8417	9515	8310	9493	-1.3	-0.2
North Eastern	1044	1111	982	1087	-5.9	-2.2
All India	79502	88787	77499	87317	-2.5	-1.7

Region	Power (MW)				Deficit (%)	
	Peak Demand		Peak Met			
	Feb '15	Feb '16	Feb '15	Feb '16	Jan '14	Jan '15
Northern	40474	41547	38586	39842	-4.7	-4.1
Western	42966	45110	42750	45070	-0.5	-0.1
Southern	37602	37053	35818	37053	-4.7	0.0
Eastern	16020	17456	15892	17456	-0.8	0.0
North Eastern	2318	2401	2155	2328	-7.0	-3.0
All India	139380	142146	135201	140346	-3.0	-1.3

7

Table no.2 T & D and AT & C Losses .

11. T& D and AT&C Losses (%)

	2010-11	2011-12	2012-13	2013-14
T&D Losses	23.97	23.65	23.04	21.46(P)
AT&C Losses	26.35	26.63	25.38	22.70(P)

Note: As per PFC for utilities selling directly to consumers P: Provisional

- **Issues & Challenges in Transmission Network.[1]**

1. **Right Of Way**
The most notable and challenging issue of the transmission sector is the need of the hour to develop high intensity transmission corridor (MW per meter ROW) in an environmental friendly manner including protection of flora and fauna.
2. **Regulation of Power**
Another important aspect is the need towards regulation of power flow due to wide variation in demand on day as well as seasonal basis and change in the drawl pattern/shares of the utilities from time to time.
3. **Flexibility in Line Loading**
To handle more power as well as to optimize the use of transmission corridor it is important to load the different lines in Controlled Series Capacitors (TCSC) and similar other means is an effective method.
4. **Improvement of Operational Efficiency**
Power system is required to be operated at the rated capacity with security, reliability and high availability.This can only be achieved through reliability based on-line condition monitoring, repair and maintenance in advance and making forced outage as zero.
5. **High Density Transmission Corridors**
In view of the above, key technological requirements for development of future power system are upgrading/up-rating of existing transmission system, technology suitable for bulk power transfer over long distances like high capacity EHV/UHV AC system, HVDC system, compact tower/substation, mitigating devices to address high short circuit level, intelligent grid etc. POWERGRID.

- **Methods to minimise issues & challenges [7]**

In order to optimize right-of-way high density transmission corridors (MW per metre ROW) either by increasing voltage level, current order or both i.e. increase in voltage and current are need to be developed.

1. **Increase in transmission voltage:** Power density of transmission corridors (MW per meter ROW) is being enhanced by increasing the voltage level. Increasing the AC voltage level at 1200kV level has been planned. Research work for 1000kV HVDC system has also been commenced.
2. **Upgradation of transmission line:** Upgradation of 220kV D/C Kishenpur-Kishtwar line in J&K to 400 kV S/c, which was first time in India.
3. **Upgradation of HVDC Terminal: Upgradation of Talcher (ER)** – Kolar(SR) 500kV HVDC terminal from 2000MW to 2500MW has been achieved seamlessly withoutchanging of any equipment. That has been achieved with enhanced cooling oftransformer and smoothing reactor with meagre cost.
4. **High capacity 400kV multi-circuit/bundle conductor lines:** POWERGRID has designed & developed multi circuit towers (4 Circuits on one tower with twin conductors) in-house and the same are implemented in many transmission systems, which are passing through forest and RoW congested areas e.g. Kudankulam and RAPP-C transmission system.
5. **High Surge Impedance Loading (HSIL) Line:** In order to increase the loadability oflines development of HSIL technology is gaining momentum.
6. **Compact towers:** Compact towers like delta configuration, narrow based toweretc. reduce the space occupied by the tower base are being used.
7. **Increase in current: High Temperature Low Sag (HTLS) conductor line:** High temperature endurance conductor to increase the current rating is in use for select transmission corridors and urban/metro areas.
8. **Reduction in land for substation:** With scarce land availability there is a growing

need for reduction of land use for setting up of transmission systems, particularly in Metros, hilly and other urban areas. Gas Insulated Substations (GIS), requires less space (about 70% reduction) i.e. 8-10 acres as compared to conventional substation which generally requires 30-40 acres area.

- **Blackouts – Major Reasons in India [11]**

1. Depleted transmission network - Power swing - inadequate transmission lines - congested network
2. Overdrawals attributable to frequency control through commercial signals - Low frequency - Generation loss, inadequate defense mechanism
3. Non-compliance of directions of LDCs and Regulatory Commissions
4. Low Voltage - Inadequate Reactive Power
5. Protection System Issues
6. Lack of Visualization of power system
7. Inability to control flow on 400 kV Bina-Gwalior-Agra line

- **Techniques to overcome Blackouts**

1. Primary response from generators
2. Improvement in operational efficiency - Optimum utilization of available assets
3. Operation of defense mechanism
4. Regulation in Power Flow - Autonomy to Load Despatch Centres
5. Intra-State transmission Planning and its implementation
6. Dynamic security assessment and proper state estimation
7. FACTS devices:

With electricity market opening up further, more and more need has been felt to utilize the existing assets to the fullest extent as well as regulate the power. This could be possible through use of power electronics in electricity network.

8. Condition Based Monitoring:
POWERGRID has adopted many state of the art condition monitoring & diagnostic techniques such as DGA, FRA, PDC, RVM etc. for transformers, DCRM for CBs, Third Harmonic Resistive current measurement for Surge Arrestors etc. to improve Reliability, Availability & Life Extension.
9. On-line monitoring systems :- for transformers have been implemented to detect faults at incipient stage and provide alarms in advance in case of fault in the transformers.
10. Preventive Maintenance: Preventive State-of-the-art maintenance techniques for various equipment applied in our system include. on line monitoring of various components of transformers and reactors, Circuit Breakers, Instrument transformers, Lightening arrester etc
11. Establishing national grid in the country:- which is one of the largest synchronously operating electrical grids in the world with all its five electrical regions interconnected synchronously.
12. Smart Transmission Grid Implementation
In Smart transmission, POWERGRID has been implementing Synchrophasor Technology in its Wide Area Measurement System (WAMS), Project through installation of PMUs (Phasor Measurement Units) at different locations in all regions across the country, which facilitates better visualization and situational awareness[2].

- **Smart Grid is expected to provide benefits to Utilities, Consumers & society in the following areas**

1. Benefits to Utilities :- [7]

A. Improved Efficiency:- Reduction in transmission and distribution lines losses, Improved load forecasting. Reduction in frequency of transformer fires and oil spills through the use of advanced equipment failure / prevention technologies

B. Improved Economics:- Reduced operational cost, capital cost transmission congestion costs and maintenance (O&M) costs. Increased revenues as theft of service is reduced. Improved cash flow from more efficient management of billing and revenue management processes.

C. Improved Reliability:-Increase asset utilization, improved employee productivity through the use of smart grid information that improves O&M processes. extended life of system assets through improved asset “health” management. Increased employee safety.

D. Improved Environment:- Increased capability to integrate intermittent renewable resources. Opportunity to improve environmental leadership image in the area of improving air quality and reducing its carbon footprint.

Benefits to Consumer :- .

A. Improved Efficiency:- Higher customer satisfaction Increased asset data and intelligence enabling advanced control and improved operator understanding . Increased

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capability, opportunity, and motivation to be more efficient on the consumption end of the value chain.

B. Improved Reliability:- Improved level of service with fewer inconveniences, Reduced out-of-pocket costs resulting from loss of power. Opportunity to interact with the electricity markets through home area network and smart meter connectivity.
C. Improved Economics:- Downward pressure on energy prices and total customer bills. Opportunity to reduce transportation costs by using electric vehicles in lieu of conventional vehicles. Opportunity to sell consumer produced electricity back to the grid.
D. Improved Environment:-Increased opportunity to purchase energy from clean resources, further creating a demand for the shift from a carbon-based to a "green economy".

- **Smart Transmission Grid Equipment Implementation in India**

1. Phasor Measurement Unit &Wide Area Technology in Power System Operation

1.1 WAMS (Wide Area Measurement System) WAMS technology requires installation of hundreds of PMUs in each region and reliable communication network with very high band width and with least latency. Phasor data concentrators (PDC) are to be installed at National, Regional and major State Load Despatch Centre (in states having 400 kV transmissions system)[7].Availability of PMU at strategically located 400 kV/ 765kV sub-stations / power stations and a robust fiber optic communication network will facilitate situational awareness (especially dynamic state of the grid in terms of angular stability and voltage stability), control and regulation of power flow to maintain grid parameters. Remedial action scheme (RAS), system integrated protection scheme (SIPS) and identifying corrective actions to be taken in the event of severe contingency to prevent grid disturbances. The process for installation of PMUs has already been started. Eight (8) PMUs (at Moga, Kanpur, Dadri and Vindhyachal in first phase and Agra, Bassi, Hisar and Kishenpur in second phase) have already been Commissioned in the Northern Region and proposal for installation of PMUs in other regions is also in the pipeline[2].

1.2 Advantages of PMU &WAMS technology

- Optimize Network Capabilities
- Accelerate the operators decision
- Avoid possible cascading effect
- Provide detailed Knowledge of system Behavior
- Improved assessment of the state of the system
- System can be operated closer to its limits (Increased transmission capabilities)

1.3 Implementation of Technology.
For Validation of the dynamic model of the system following technology are used

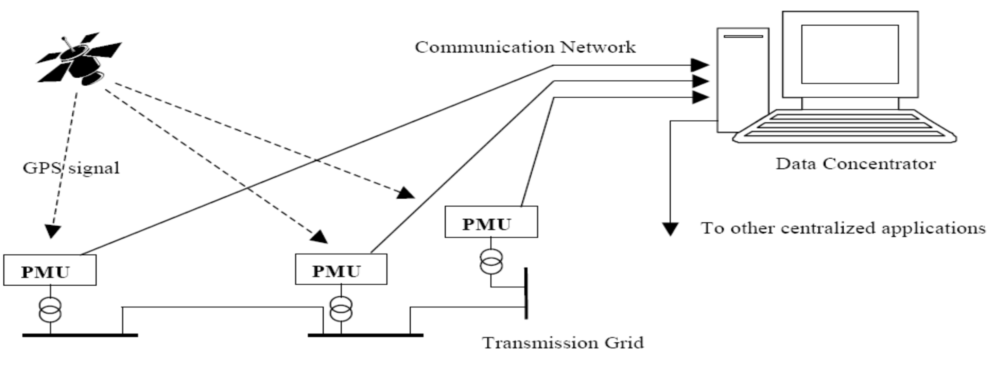

Figure 1: WAMS System Architecture

Fig.1 WAMS Systems Architecture

a. Post event analysis,
b. On-line system monitoring and enhancement to state estimation,
c. Wide area control,
d. Wide area protection.

1.3.1 Post Event Analysis

- Recording of PMU used to make a post analysis of the system after a major incident.
- This analysis gives a wide area view of the system behavior thus helps in under standing
  - the sequence of events that led to the grid incidents
  - the inter area oscillations
  - Analyzing the performance of the oscillation damping equipments

Used by Italy ,NCG, Russia, Korea, France

1.3.2 On Line System Monitoring and Enhancement to State Estimation

- PMU technology improves real time system monitoring, helps in better assessment of the state of the system
- System monitoring covers

A. Monitoring of basic data such as voltage, power flow and frequency for each of the nodes.

B. Monitoring of voltage angle differences between the ends of major lines likely to be heavily loaded (to ensure that they can be easily re closed when a fault occurs).

C. Voltage stability monitoring, i.e. supplying the dispatcher with an estimate of the margins available to the system before a voltage collapse; in such situations PMU measurements can be extremely useful for assessing the dynamic behavior of loads.

D. Transient stability monitoring, i.e. monitoring of possible loss of synchronism between certain system areas.

E. inter-area oscillation monitoring, i.e. detecting the occurrence of any inter-area frequency oscillations, calculating the different modes and their damping.

Used by Italy , Korea. Planed to be used by NCG, Russia, REE,

Gaps in On line system Monitoring

- – WAM's used so far only for off line applications.
- – Methods and algorithms for monitoring and evaluating transient stability, voltage stability etc are not yet available.
- – Architectural dependency
  - Architecture for increased data volume both in terms of performance and storage criteria
  - As the WAMS technology continue to develop the architecture should be capable of dynamically change with the development.

Gaps in enhancement to state estimation

- – High cost due to high percentage of buses to be covered by PMU's (PMU cost is low but the communication cost high)
- – More investigation required about PMU accuracy and requirements of redundancy.

1.3.3 Wide area control

- Can control automatically Power system equipments like PSS, FACTS, SVC, and HVDC controllers.
- Controls can be made based on the wide view of the power system instead of local phenomena.
- Such operation will Increase reliability ,increase transfer capability, require a fast and reliable and secure communication signal should be transmitted in 20 to 50 milliseconds.
- Gaps
  - – High cost in maintaining reliable two way communication
  - – PMU technology should mature enough and trust to use this technology for automatic critical corrective action

1.3.4 Wide area protection

- PMU technology can be used for initiating System Protection Schemes.
- Wide area measurements give better understanding of the situation.
- Require a fast and reliable and secure communication signal should be transmitted in 20 to 50 mili seconds
- Gaps
  - – High cost in maintaining reliable two way communication
  - – PMU technology should mature enough and trust to use this technology for automatic critical corrective action

1.4 Wide Area Communications Systems

I. It comprises of t he Neighbourhood Area Network (NAN) and the Wide Area Network (WAN). NA N is a localized or regional network of several smart meters in an area aggregating data at a concentrator.

II. The concentrators end data collected from the smart meters to the Meter Data Management Systems (MDMS).

III. Components are AMI Smart Meters, Home Area Networks (HANs) , Wide Area Communications Systems ,Meter Data Management Systems (MDMS) & Operational Gateway.

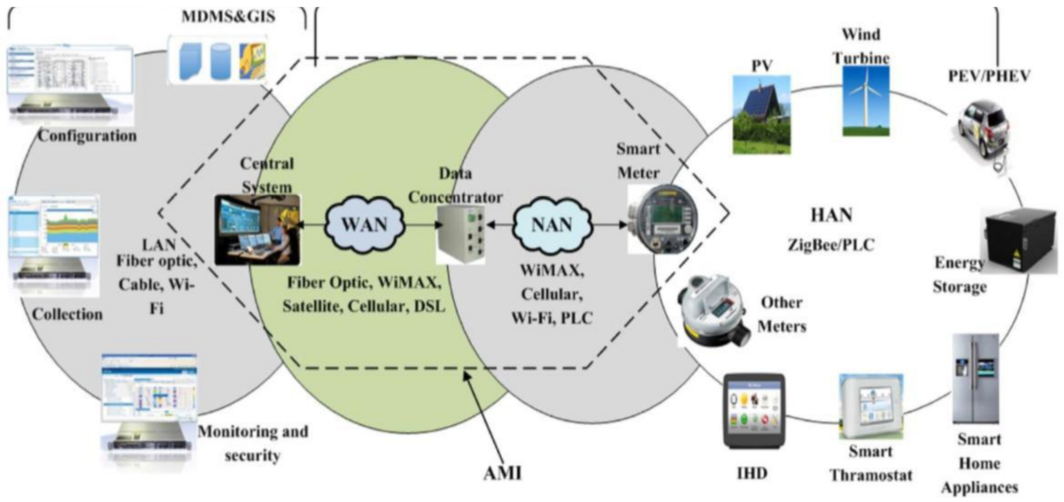

FIG.2 WAMS COMMUNICATION SYSTEMS

1.4.1 Home Area Network (HAN) is a kind of Local Area Network (LAN) that facilitates a two-way communication between smart home devices or appliances (such as heaters, refrigerators, air-conditioners etc.) and the Smart Meter or an in-home display for t he benefit of both the consumer and utility.

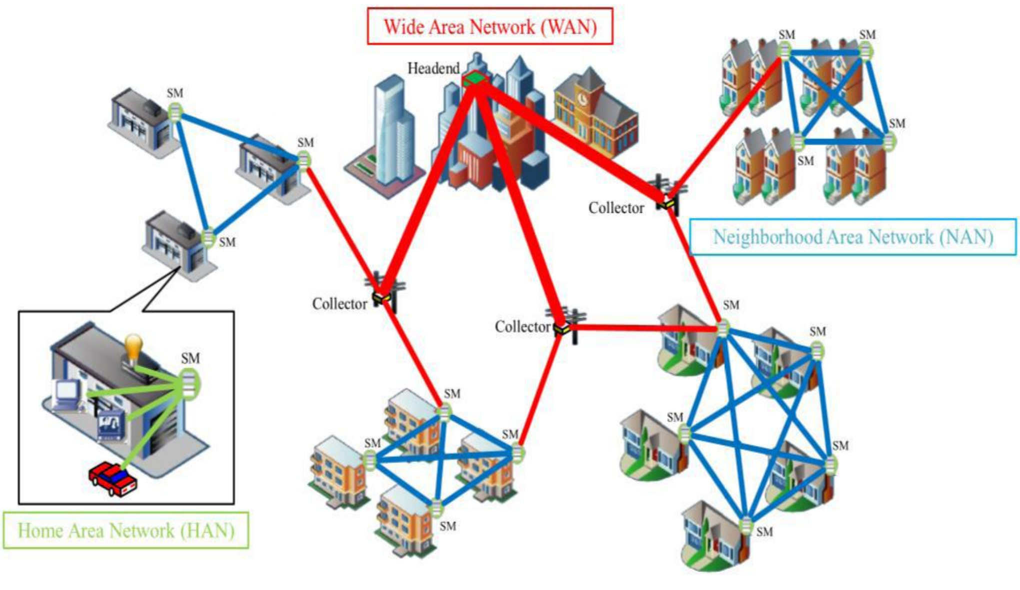

Fig.3. HAN Communication Network

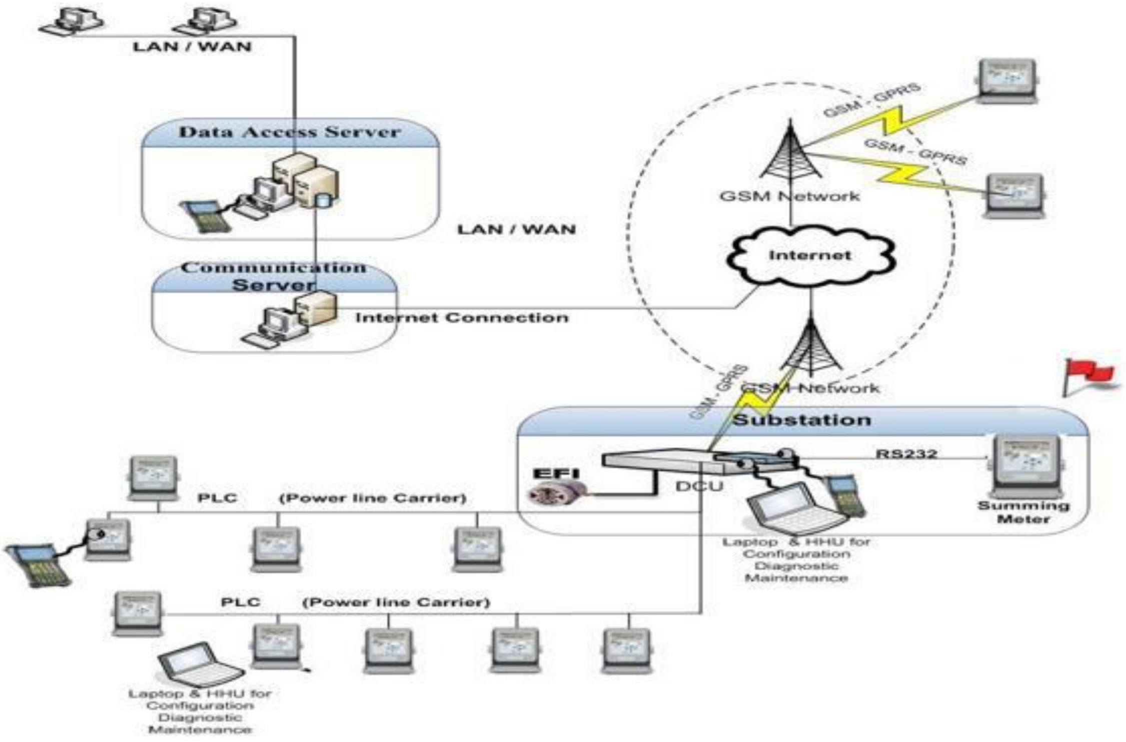

Fig.4 LAN Communication Network

1.4.2. AutomaticMeterReading

The system utilizes several different types of commendations media such as, PLC, RS458, LAN/ WAN, GSM/GPR Setc 26-11-2015 10

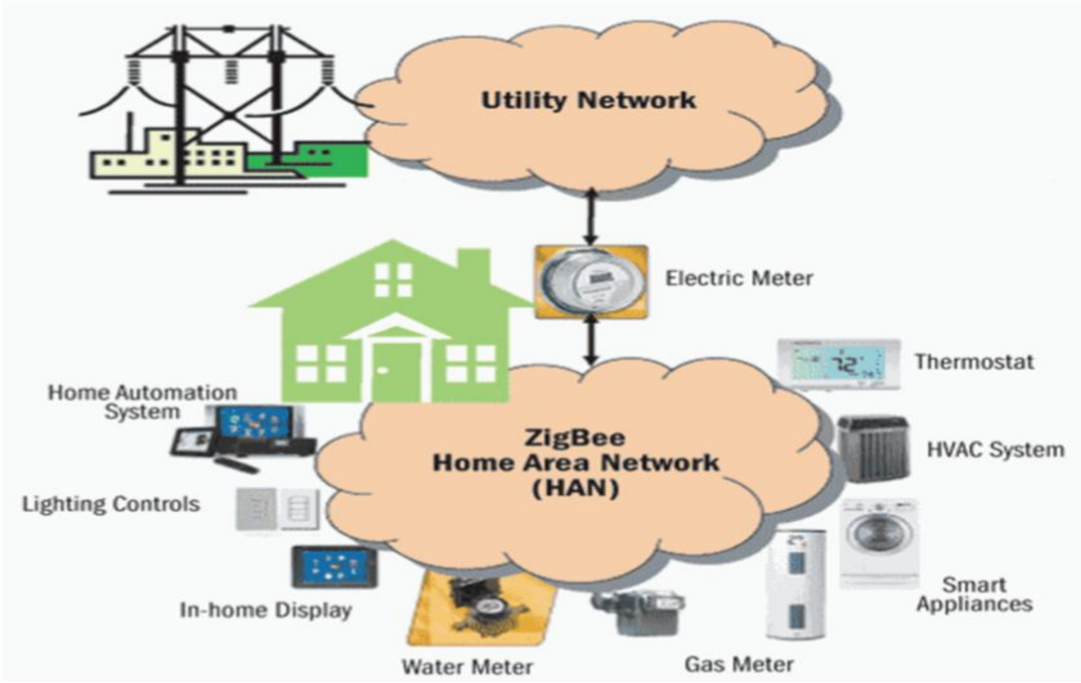

Fig.5 HAN Communication Network

1.4.2 Advanced Metering Infrastructure

Mobile:Mobile or "drive- by" meter reading is where are adding device is installed in a vehicle. The meter reader drives the vehicle while the reading device automatically collects the meter readings. Reading equipment includes navigational and mapping features provided by GPS and mappings of tware .AMI is seen as an important part of any smart grid initiative.

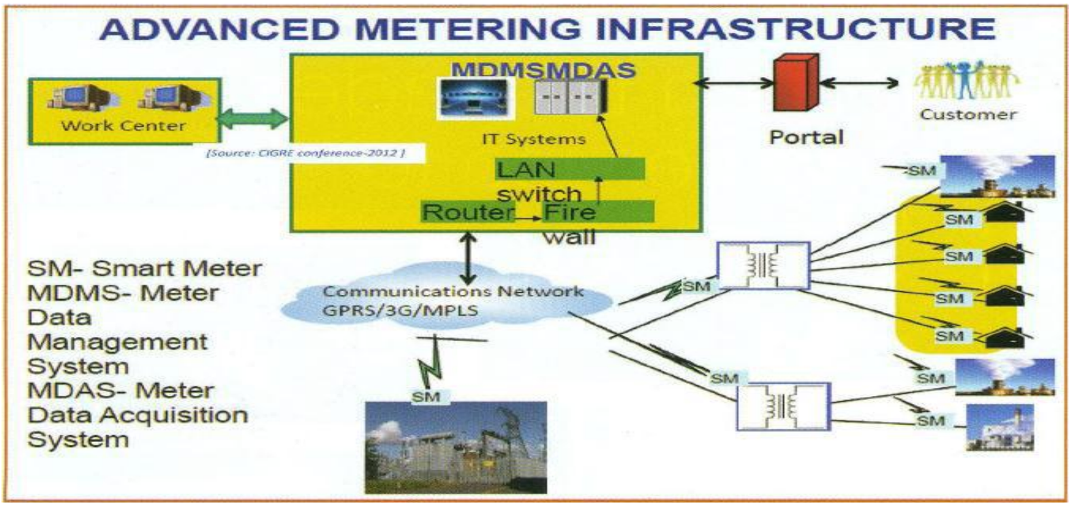

Fig.6 Advance Metering Infrastructure

1.4.3 Smart Power Management System[14]

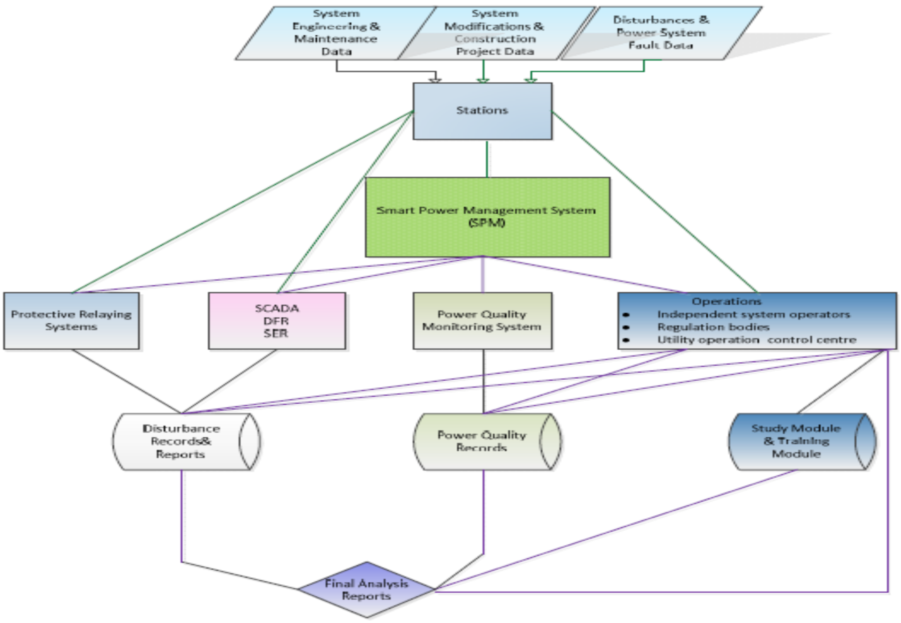

Fig.7 Smart Power Management System Communication Network

1. SCADA (supervisory control and data acquisition system)
2. EMS (energy management system)
3. DMS (distribution management system)
4. GIS (geographic information system)
5. SER (sequence event record system)
6. DFR (digital fault recorder system)
7. Smart metering data
8. Operation event data
9. Power quality (voltage, Frequency)
10. Protection system fault data (fault currents, voltages,
11. phase angles…etc.)
12. Asset management data
13. Demand response
14. Power system operation
15. Operator training
16. Station maintenance data

17. Engineering data

2. Need for fibre optic based communication system:

For planning, implementation and maintenance of dedicated high band width, fiber optic communication network is used. For connecting the existing and new substations and power plants under central sector, the mandate should address the communication requirements in power sector in all associated areas such as Smart Transmission Grid, Protection, data, speech, audio/video etc. [8]

3. Automation

(i) To address the natural calamity, fire in substation, for quick restoration Emergency Restoration System (ERS) for substations is necessary. Design and deployment of mobile substation is considered necessary for implementation.

(ii) Process bus technology over the conventional station bus technology is used. Process bus technology has the advantage of reduction in huge copper wiring, integration of any number of IEDs at bay level etc.

(iii) Demonstration project of IEC 61850 substation automation comprising of both process bus and station bus, along with interoperability.

4. System performance improvements by [9]

- The condition based maintenance on-line diagnostics techniques will be developed.
- Condition monitoring of polymer insulators :
- Robotic inspection of transmission system:-
- NIFPES:
- Development of controllers for FACTS devices
- Development of FACTS devices and its controls

5. Advanced Technologies in Transmission[5]

Gas Insulated Transmission Lines, EHV Cables and Submarine cables (34, 35, 36). These technologies would help power sector in meeting the projected load demand.

(i) Gas Insulated Transmission Lines are means for bulk power transfer at EHV/UHV levels. The application of GIL is viable option in densely populated areas or in environmentally sensitive regions, and where application of cables is not possible or reaches technical limits. This uses SF6 tubular conductor technology, which has been around for several decades.

(ii) Application of EHV class cables advantages, such as reduced emission into the surrounding area, of electromagnetic fields and reduced space

(iii) Application of submarine cable: For power transmission becomes unavoidable where there is no feasibility of overhead lines. The application of submarine technology in the proposed India – Sri Lanka interconnection as an exploratory project would give big boost to transmission planners.

CONCLUSIONS

Issues and challenges in transmission systems also different methods to overcome these issues in Indian Power Strategy is discussed in this paper. An overview on reasons of blackouts and possible techniques to overcome these problems are also stated. Benefits of smart grid technology and its associated equipments with its characteristics are discussed. Some other advance techniques to improve the transmission system parameters are also discussed. Thus in this paper overall methodology to improve the performance of transmission system is given.

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Experimental Analysis of Helical Coil Induction and Electric Immersion Type Water Heater

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Abstract: This work presents a comparative experimental analysis for energy consumption of Helical Coil Induction and Electric Immersion type water heater. The experimental setup is developed using Induction cooker with different helical coil and Electric Immersion heater of 1200 Watt power. The Energy consumption for Helical coil induction water heater with different configurations and immersion water heater is taken at constant values of water outlet temperature of 54^{0}C for 5 Liters of water. It is observed from results energy consumptions for helical coil induction water heater shows less energy requirement as compared to Electric Immersion water heater. The energy consumption for experimental setup with Helical Coil with number of turns equals to four shows least energy consumptions.

Keywords: Helical Coil, Electric Immersion Type Heater, Energy Consumption

I. INTRODUCTION

A green and renewable energy, high cost and clean environmental are important issues that influenced the technology in home appliances recently such as in stove and water heating. Induction heating is one of the new technologies in home appliance. [1]

Helical coils are used for transferring heat in chemical reactors and agitated vessels because heat transfer coefficients are higher in helical coils. chemical reactions have high heats of reaction and the heat generated (or consumed) has to be transferred rapidly to maintain the temperature of the reaction. helical coils have a compact configuration with provision of more heat transfer surface per unit of space than by the use of straight tubes. [2]

To fulfill the demand of water at specific temperature 80^0-90^0 in industry required lot of electricity or fuel for different techniques including Electric Heater, Gas Water Heater, Storage Heat Pump water heater, Heat Exchanger using burning of fuel etc. Due to degradation of resources in environment, alternative energy resources needed or available resources effectively utilized; so for water heating process it should aimed at having effective use over the supplied electricity, the new technique of induction heating process for water heating is being developed. [3]

The work presented by Ordoñez Flores Rafael, Reyes Castillo Fabiola and Carreño Hernández Carlos (2013) is an attempt made to heat shower water wasted at the beginning due to water is not hot immediately in case of gas geyser and solar heater. Magnetic induction is applied at pipe carrying water for shower which assumed as conductor. Water heater consists of solenoid coil and pipe as its core is inducts a big current on the pipe in which its dissipated power follows the relation $P(t) = I^2R(t)$; so the water gets warm immediately when getting in touch with the hot pipe. This is experimentally tested and concludes water heater by magnetic induction contributes to environment preserving and water saving into reliable and proficient device, it can be used in houses or hotels, generating comfort and benefits for the user. [4]

This work concentrates on length of the helical coil which is specific interest for design of helical coil. These change in length of helical with change in tube diameter had been increase in experimentation briefly explained. In this presented work the length of the coil tube varied and results shows that it was affected on the outlet and bulk temperature of the test fluid used. The smaller length of helical coil shows an increasing trend in temperature distribution of fluid inside the coil as compared to larger length of helical coil for same flow rate and heat input. This investigation also concluded with experimentation work of helical coil, change in diameter of tube the heat transfer coefficient is also changes. Also temperature difference of each flow rate shown increasing trend for lesser length of the coil tube compare to the larger length of the coil tube. [5]

J.S. Jayakumar, S.M. Mahajani, J.C. Mandal, P.K. Vijayan and Rohidas Bhoi have Utilize a constant value for the thermal and transport properties of the heat transport medium which results in prediction of inaccurate heat transfer coefficients. Experimentation is carried out with different flow rates and different inlet temperature of water at the inlet of helical coil and heat transfer characteristics heat exchanger with helical coil. [6]

Induction Heating Process induction coil design for particular application because it governs other factor of induction heating system and for the different type of induction coils used in industry especially based on geometry like Helical, Round, Pancake coil etc. [7]

The efficiency of the induction cooking may be up to 80-90%. The thermal performance of an induction cooker system is correlated to the distribution of eddy currents which are directly associated with the quantity and position of the heating generation on the induction top. [8] Induction cooker used a pancake coil, with which the flux from only one surface intersects the work piece or utensils placed on it. [9] Simulations were carried out to find out heating efficiency of induction cooker which states thickness of pan which is placed on induction cooker increases the heat energy supplied to water present in pan from induction cooker decreases. [10] The experimental work done by author shows condensation heat transfer coefficient increases with the decrease in pipe diameter as well as helical coil diameter and also increases with increase in the coil pitch up to certain value then it decreases. [11] The work presented by author shows heat transfer in helical coil with circular cross section varied by altering basic geometry of the coil and different fluid types with different flow rates. [12]

The working of helical coil with induction cooker shows flow rates of water and different helical coil configurations plays vital role in heat transfer analysis from induction heating process and validated with CFD software. [13] Coil pitch has significant effect on shell-side heat transfer coefficient, with increasing coil pitch in medium range, the heat transfer coefficient decreases while with increasing pitch to tube diameter, heat transfer coefficient is increased. [14]

With the advantages of induction heating process combine with helical coil is utilized for experimentation to reduce the energy consumption for water heating Process.

II. EXPERIMENTAL SETUP AND PROCEDURE: -

2.1 Experimental setup: -

Design of Experiments consider various aspects of its components. The Experimental setup consists of two different setups. The first test setup consists of helical coil, Induction cooker, Rotameter and thermocouple arrangement as shown in figure 1, This Experimental setup consists of Induction cooker model Bajaj Majesty ICX with rating 1600 w. Induction cooker is works at 1200 Watt as constant heat source for heat transfer to water flow through helical coil. Helical coil is placed at center surface of induction cooker; water is flowing from top to bottom of helical coil after that is return to outlet pipe. During flow of water from top to bottom coil is subjected to induction heating and at last water temperature is increases. These helical coil shown in figure is replaced with other coil has differs in number of turns. Water is supplied to helical coil from the tap through Rotameter so that we can adjust the flow rate so we will get water outlet temperature 54^0 C. Inlet water temperature is measure by thermocouple is fixed at insulated pipe which shows temperature on display unit provided with it. Heating of water during flow through helical coil increase temperature of outlet water which is by thermocouple is attached to insulated pipe shown in figure 1. This water is collected in bucket for different application in house hold. Also portable thermometer is also used to measure temperature of water outlet temperature is shown in figure 1.

The First experimental set up is designed with the following instrumentation.

- Induction cooker arrangement
- Helical coil arrangement
- Rotameter and thermocouple arrangement

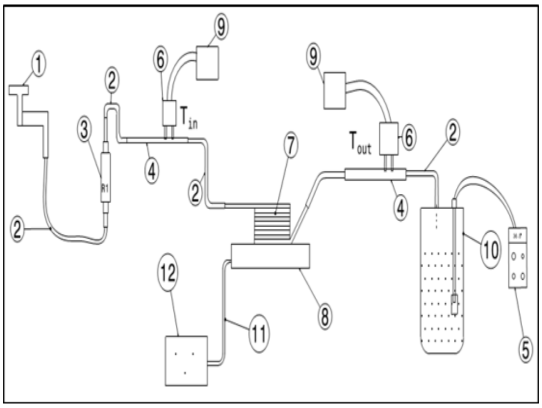

Fig No. 1 Schematic View of Experimental Setup of Helical Coil Induction Water Heater. [3]

1. Water Tap
2. Flexible Pipe to continue water flow
3. Rotameter
4. Insulated Pipe for thermocouple
5. Portable thermometer
6. Thermocouple fixed at insulated pipe
7. Helical coil 8. Induction Cooker
9. Temperature Display unit
10. Plastic Bucket
11. Supply cable of induction cooker

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12. Switch Board

Second test setup consists of Electric immersion heater of rating 1200 w inserted in the bucket with water quantity of 5 litres with for heating and Portable Thermometer for measurement of water temperature as shown in figure 2.

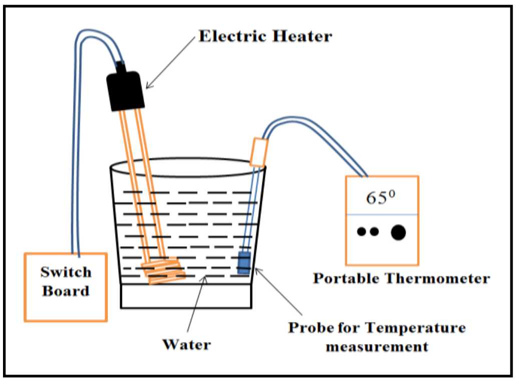

Fig No.2 Schematic View of Experimental Setup of Electric Immersion Type Water Heater with 5 liters' water in Bucket.

2.2 Procedure for Test Run: -

Test is carried out in two sections one is on Helical Coil Induction Water Heater Setup to analyse performance of each configuration of coil and second with Electric Immersion Type Heater separately to achieve 5 litres quantity of water at 54^0C.

For Test run of Helical Coil Induction water heater as shown in figure 1, adjust flowrate of water such that water outlet temperature from test setup is 54^0C. Measurements are taken only after the temperatures attain steady values. The readings for water outlet temperature, Voltage, Current using Clamp meter and time using Stopwatch required to complete 5 litres quantity of water for energy consumption analysis of helical coils are noted down. During the course of each set of experiments, the heat supply from induction cooker at 1200 w is kept constant, which ensures a constant heat transfer in induction heating process. again same procedure is applied to different configurations of helical Coil.

In Second section of Electric Immersion Heater test run initially 5 litres of water at 30^0C is subjected to resistive heating and parameters such as voltage, current using Clamp meter and time taken by water to reach up to 54^0C from initial temperature for Energy consumption is measured.

2.3 Measurement of Energy consumption by Induction Cooker and Electric Immersion Heater: -

It is measured from clamp meter separately using voltage and current measurement with power factor consideration, because power is the product of voltage, current and power factor for selected time using stopwatch. From these we can calculate the energy requirement of induction cooker and electric heater.

$$P = (V * I * \cos \emptyset)/1000 \text{ Kw}$$

Where

P = Power consumed by electric devices in Kw
V = Voltage in Volt
I = Current in ampere
Cos Ø = Power Factor

$$E = (P * t)/3600 \text{ Kw-Hr}$$

Where E = Total Energy consumption by devices for fixed time t in Kw-hr
t = time required for process to carried out in sec

III. RESULTS AND DISCUSSION

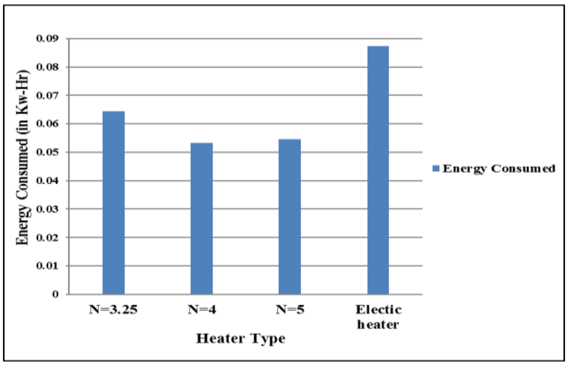

Fig No. 3 Variation in energy consumption of Helical coil induction heater with different helical coil N=3.25, N=4, N=5 and Electric immersion heater utilized to heat fixed quantity of water = 5 liters up to 54^0C.

It is observed from the above graph variation in energy consumption of Helical coil induction heater with different helical coil N=3.25, N=4, N=5 and Electric immersion heater utilized to heat fixed quantity of water = 5 liters up to 54^0C that energy consumption is least in experimental setup with helical coil N=4 among different helical coil configurations selected for experimentation. Energy consumptions by electric immersion heater is found to be maximum as compared to helical coil experimental setup with number of turns N=3.25 which has more energy consumption among different configurations of helical coil. It also shows helical coil induction test setup with helical coil N=4 have least energy consumption.

IV. CONCLUSIONS

It is observed from experimental analysis energy consumption for helical coil induction water heater is less as compared to immersion type water heater. The Experimental Setup of Induction Water Heater with helical Coil using number of turns equals to four requires minimum energy for heating fixed quantity water at particular temperature with contact less, pollution free and safety for water heating process. Finally, Induction Water Heater are more efficient that is 39 percentage saving is evaluated using four number of turns system.

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Problems and Management Techniques in Distribution of Perishable Goods:A Critical Review

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ABSTRACT: This paper describes traditional management of supply chain for fruits and vegetables at mandi level and its problems associated. New practices adopted by the private firms and regulators in order to make the supply chain efficient providing benefits to farmers and final consumers. Degradation patterns and different temperature requirements of perishable items are also discussed for efficient management of goods. Important aspects related to the challenges in managing distribution by companies, such as those dealing in airline catering services and milk based products are illustrated.

Keywords: Perishable items, Distribution management, shelf life.

1. INTRODUCTION

In a typical supply chain the time taken for materials to move from one end to the other can be quite long, depending upon the type of industry. This is usually understood and accepted when the item is not perishable. Perishable items, however, become decayed, damaged, expired or deteriorate through time. Hence, the length of supply chain becomes critical for such items. Examples of perishable goods include fast food, meat, vegetable, fruit, medicine, flower or ready mix concrete. Perishable items can be can he broadly divided into two classes: (1) items with a fixed shelf life such as medicine, blood or ready-mix concrete; (2) items with continuous decay, such as food, vegetable, flower, milk, meat and so on (Nahmias, 1982; Raafat, 1991).Depending on the perishability characteristics of the item, the length of supply chain can vary. For example, items like blood, radioactive medicines; or ready mix concrete require much faster delivery than fruits and vegetables.

OBJECTIVE OF THE STUDY

Fruits & Vegetables are one of the most significant and thrust sector of the economy of India. The entire supply chain of F&V in India is laden with the major issue of post-harvest losses and wastages due to various factors. Since the identification of the issues and challenges may pave a path for planning and implementation of effective mitigation strategies.

1. To identify the factors affecting supply chain of Fruits & Vegetables sector in India.
2. To suggest mitigation strategies for the identified challenges in Supply Chain of Fruits & Vegetables sector in India

Grapes

Apple

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Banana
Figure No: 1 Perishable Fruits

As in any other supply chain, the supply chain for perishable items like fruits and vegetable (F & V) also begins with the production of fruits and vegetables at the farm followed by transportation to procurement facilities, finally to retailers for consumer purchase passing through distribution channels and centres along the way. In addition to control of cost and prompt customer service, F & V supply chain is more concerned with ensuring quality of items and continuity of supply. Table I represents the degradation pattern of some F&V items.

Table 1 Segmentation of deteriorating goods- Shelf Life of Food

Perishable goods	Life span without Cold Storage	Life in Cold Storage
Potatoes	1 week	One year
Onions	4-5 week	One year
Tomatoes	4-5 days	8-10 days
Green leafy vegetable	1 day	3-4 days in air tight container
Meat	2-3hrs	2-3 days at -20 C
Milk	5-8 hrs	4-5 days refrigerated
Apple	2 weeks	3 months
Grapes	3-4 days	1 week

Source:
http://whatscookingamerica.net/Information/FreezerChart.htrn

2. REVIEW OF LITERATURE

Feame and Hughes (1999) point out that initially the supply chain was more concentrated on logistics and the reduction of lead time and inventory levels, reducing uncertainty to make better use of production capacity and underutilized resources. The objective of the supply chain is to ensure that highest and appropriate quality of product is available for customers and to simultaneously ensuring remunerative price to formers and to serve the population with value added food. Gupta et al. (2001) point out some items experience age dependent perishability, leading to physical decay. These include flowers, plants, green vegetables, dairy products, poultry products, medicines, vaccine, and chemicals etc. Some medicines and vaccines can be safe only at the 2-8 degree Celsius temperature. These types of perishables need a cold chain system. The term cold chain refers to keeping the products at their proper temperature and maintaining that temperature through all the stages in the supply chain until it reaches the consumer.

Ferguson and Ketzenberg (2006) addressed the benefits of information sharing on retailers profit in a supply chain in case of perishable items. Hobbs and Young (2000) point out that the quality and price of the perishable products vary with time. The price uncertainty results, largely because of deteriorating quality of the product as the prices are tied to quality. Some chemicals and medicines can be protected for a long time but they require particular temperature, humidity arid pressure. Zhang and Chen (2014) addressed the vehicle routing problem of cold chain logistic system. Bryant (2005) points out that the cold chain makes a lot of difference in the quality of the product. A_hya (2006) in their study explains that restructuring the fresh produce sector will improve productivity and a better deal for the customers. Sengupta (2008) discussed the emergence of organized food retail sector in India and the drivers of evaluation. Negi and Anand (2015a) discuss the current status of infrastructure for F&V sector in India and opportunities for cold chain. Further, Negi and Anand (2015b) reviewed the challenges and issues in F&V supply chain and suggested strategies to overcome the identified issues.

Distribution of ready-mix concrete as a perishable item has also drawn the interest of some researchers (Feng et al., 2004; Naso et al., 2007; Durbin and Hoffman, 2008; Schmid et al., 2009).Naso et al. (2007) addressed the supply chain for the justin-time production and transportation of ready-mixed concrete and considered the coordination between the two activities to guarantee timely delivery.

3. CASE STUDIES IN COLD CHAIN LOGISTICS:-

Cold chain logistics plays a very important role in managing perishable items. According to Ray (2010), the perishable food market is estimated as Rs. 3,50,000 Crore and 20 % of this gets wasted due to lack of storage and transportation facility. Cold chain logistics helps to reduce wastage by providing the suitable storage and transportation facility for perishable food items. It offers several temperature levels for maintaining food safety such as frozen, cold chill and medium chill etc.

3.1 Case 1: Airline Catering Services

Consider the case of a company providing catering services to airlines. Being in a catering service industry, the company needs to deal with perishable items on daily (or, hourly) basis. Since some of these items have a very short life span, they need proper care in terms of time and temperature management. The main issue faced by the company is transportation of these perishable items along with adhering to food safety regulations. The most sensitive perishable item that is used in the company's kitchen is Chicken. Suppose our catering company "A" buys chicken from another company "B". Chicken is produced in Mumbai and then distributed to various locations eg. Delhi. Kolkata, Chennai etc. Besides supply to airline kitchens, company B also supplies chicken to various hotels. Chicken is a perishable item which is very sensitive to bacterial growth. Hence it requires a high level of temperature management. Chicken is frozen at -18° to -20% which is considered a safe temperature and transported to various locations at the same temperature. If this temperature increases to -10° due to various handing issues, bacterial population increases 10 times with every consecutive issue (increase in temperature). This is because, once the population of bacteria increases, this will not decrease even when the temperature is brought back to -20°. With this poor manannment of temperature, chicken become unsafe for consumption.

Often, a third party logistics company is hired for transporting chicken to various locations. Company A can resolve the problem of temperature abuse and food safety in two ways:

i) Spoilage during Transport:

1. Tracks being used to deliver the perishable items are required to possess a tamper-proof recorder which helps the company A to track the temperature changes throughout transit.
2. Loading and unloading of items in temperature-proof room, as it takes 4-5 hours.

ii) Quarantine Procedure:

Company 'A' does not mix their inventory stock with new received orders. When a new order is received, they are quarantined and a sample is first taken for testing. The sample is sent to the pathology for testing the bacterial growth. If the food passes the quality check, then it is mixed with the stock in the inventory. A batching certificate is also received from the vendor which prcvides the batch no. with manufacturing date, which helps the company in making decision about the life of the item.

Kitchen to Flight

Managing transportation from kitchen to flights is not an easy task. There are many challenges and conflicts of requirement faced by the company on a daily basis. These challenges can be delay in flight arrival or additional passengers. For supplying food from the airline kitchen to the flights.a cold chain is maintained using 40 trucks. Trucks .are the most expensive component of the chain and then the manpower. Trucks cannot stand on the bay for longer duration as traffic congestion is another big problem at the airport.In order to manage the kitchen to flight transportation, a detailed chart is prepared with flight arrival times and which vehicle is assigned to which flight. This chart contains all the information with complete flight details (arrival, departure, number of meals, loading unloading time, and travel time for truck, waiting time at bay, etc). Variation in number of passengers due to additional passengers is another big challenge. To overcome this problem if vendor produces extra meal as safety stock for every flight, then a huge cost will be incurred. To overcome this situation, service providers keep their menu simple /common. They also have additional crew sandwiches as a safety stock, which is cost effective. Also, for the last minute delivery changes in flights, they also have manage the logistics. Seventy percent of the company trucks are utilized on a regular basis. The company also keeps small vans as stand by for urgent deliveries for last minute changes in meal requirements.

3.2 Case 2: Milk and milk product distribution problem

We now consider the case of milk distribution in India. India is one of the largest producers of milk and milk products. Milk supply chain is very crucial to manage and it affects a large proportion of the population. It requires continuous monitoring of time and temperature before it is consumed. A careful monitoring of cold chain logistics for milk and dairy products is important to maintain the quality and freshness of these items for longer duration. Cold chain of milk is required to maintain a temperature of 0-4°C to keep milk at its optimal freshness level and preserve its taste. Every increase of2°C in the temperature of cold chain may reduce the life by 50% (BT9. Milk Supply Chain)

Product	Temperature Requirement	Life span
Butter	0°C or Below	1 week
Cheese	-3°C	6 month
Ice cream	18°C	6 month
Paneer	Vacuumed Packed 4-6°C	10-15 days
Butter Milk 8°C or below		1-2 days

(Source: Ray(2010). page 294)

Here we discuss the supply chain of a very large milk and milk manufacturer in India and the challenges faced by them. The company has developed a huge distribution network in India with over half of the millions of retail outlets. Milk is procured from various states: Gujarat, Rajasthan, Punjab, Haryana, Uttar Pradesh, West Bengal, Maharashtra and Madhya Pradesh. The company also has the largest cold chain network in India. Milk is their highest revenue generating product. The company also offers a variety of milk products ghee, butter, cheese, baby milk food, and cold beverages.

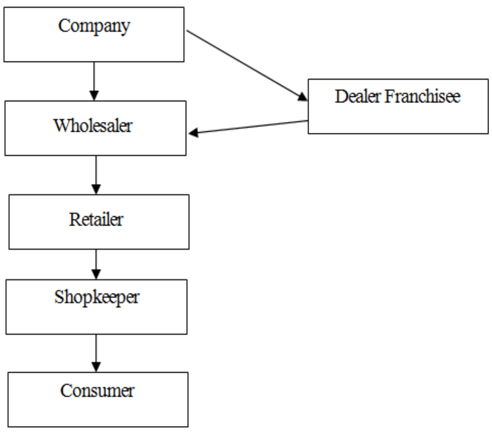

Figure : 2 Distribution Process

District level cooperative societies are formed to collect the milk from fanners or dairy. This is done without any cooling facility. From the cooperative societies, milk is then taken to the processing plant in a temperature controlled environment in tankers. In the plant, milk is processed into various products according to the demand. Since the company has to buy all milk coming to them, surplus of the milk is converted into milk powder and in other commodities, which can later be combined to manufacture other products. Processed products are sent to the wholesale distributors in temperature controlled trucks of different capacities to be cost effective and from there it is distributed to retailers.

Frozen goods are kept at a temperature of -18°C and dairy wet at -4°C. Transportation from wholesale distributor to retailer is managed by distributors. Company also provide the cooling infrastructure to the distributors and retailers. They put an emphasis to ensure that distributors and retailers should he well equipped with cold storage or refrigeration facility to keep the perishable items in good condition.

The company incurs a huge cost in transportation. It is exploring other options in order to reduce their transportation cost. Currently they transport products in their own trucks but they are planning to collaborate with railways with cooling systems to transport their products to other states. They are also planning to have dedicated trains to transport milk with huge capacity, which can result in reducing the transportation cost significantly.

4. DISCUSSIONS

As is seen from the case studies, there are many challenges when it comes to handing perishable items which are sensitive to time and temperature. Firms are now able to resolve the issue of temperature by creating a temperature controlled environment for perishable items. However, such temperature controlled facility come with a huge addition cost. A major cost component of supply chain is transportation.

Each perishable item discussed above is different in nature and can have a specific deterioration pattern. Chicken has a continuous deterioration rate if it is kept under controlled environment. If temperature increases from the required level, the growth of bacteria is exponential, followed by the exponential deterioration in quality.

Milk is also a temperature and time sensitive product. Milk and milk products also have a tendency of bacterial growth but the speed of bacterial growth in milk is much slower than chicken. Unprocessed milk can be used for up to 6-7 hrs if it is kept at a normal temperature. When refrigeratedat life of milk is much longer than that of meat. Unlike food items, it has a fixed shelf life of 2 hrs. Also, unloading of ready mix concrete is restricted by time windows due to site pouring constraints.

5. CONCLUSION

Travel times from production place to utility has an important effect on quality and freshness of perishable items. The choice of routes are dependent on the shelf life of the products in order to prevent losses. In order to make transportations activities of such type of network effective and efficient, it is required to decide the optimal routes, schedules of delivery and number vehicles to be used for delivery. To make a strong presence and be competitive in the global market with higher customer service and to reduce the operating cost, it is necessary to integrate their supply chain operations management. To support this, management of supply chain must have to deal with material and information flow within and between supplier, manufacturer and distributors. In this paper four different deterioration patterns of perishable items are discussed. While developing distribution models one must consider appropriate deterioration rate or maximum delivery time depending on product characteristics.

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Investigation of Ball Valve Design for Performance Enhancement

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Abstract- Flow is controlled using ball valve is most common process in hydraulic system. As Chlorinated Polyvinyl Chloride (CPVC) ball valve is considered in this paper for study of each coponents. Owing to relliability factor and operating conditions, that is quick opening and closing at high temperature and pressure conditions ball valves are mostly used as flow controlling device . Also generally CPVC ball valves are in use when operating pressure is relatively low. Further scope is observed in designing the valve for leak proof and trouble free performance in hydraulic systems. Fast progress of the flow visualization and numerical technique should be incorporated for further flow visualization through the valve and to evaluate the performance of valve. In this experimental work flow evaluation through Ball valve is accomplished using Computational Fluid Dynamics (CFD) software. CATIA V5 R20 software is used for Modelling of valve and ANSYS FLUENT 14.5 is used for analysis. Amount of water leakage is calculated from numerical analysis and it is compared with experimental data. Difference between experimental results and computational results obtained for two cases shows good agreement with each other.

Keywords-CPVC Ball valve, optimum performance, ICEM CFD14.5, ANSYS FLUENT 14.5, CATIA V5 R20

I. INTRODUCTION

A ball valve is a form of quarter-turn valve which uses a hollow, perforated and pivoting ball (called a "floating ball") to control flow through it. It is open when the ball hole is in line with flow and closed when it is pivoted 90⁰ by the valve handle. The handle lies at in alignment with the flow when open and is perpendicular to it when closed which makes easy for visual confirmation of the valve's status. It has simple mechanical meeting and small flow resistance in a totally open function. It provides a surprisingly excessive flow capacity. Usually, the fluid friction coefficient is low and additionally the increase is normally minimal because the Ball valve is operated with a quarter turn. Manual operation may be through lever or tools provided with it. They're most suited for exceptionally low pressure with the flow.

Ball valves are required to have excessive performance characteristics and higher precision as they are used as close off valves. The characteristics of a valve i.e. head loss characteristic, torque traits and force characteristics of Ball valve is decided conventionally through tests. If take a look at valve is of large size, scale version of valve is examined to decide its traits. Evaluation of flow feature experimentally is a hectic and is not very precise work. Exact theoretical evaluation of flow through complex geometry may be very hard with using high velocity computers, and the numerical techniques, the flow evaluation can be made the use of CFD. So flow analysis is to be performed using simulation software. Goal of this research work is to find amount of water leakage from ball valve at closed condition. At present nearly each enterprise is using software for evaluation. Ball valves are used in various power plants and it has extensive scope. So this study will be beneficial for all fields where Ball valves are used. Computational fluid dynamics is a tool to perform numerical solution with the flow simulation for predicting the float behaviour within a particular domain via numerical answer of governing equations to ideal accuracy. Computational fluid dynamics is becoming very beneficial approach for engineering layout and analysis due to improved numerical method and at the same time, it saves time and power of experimental setups. The ball has a hole or port through the middle, so that when the port is in line with both ends of the valve, the flow will occur. When the valve is closed, the hole is perpendicular to the ends of the valve and flow is blocked.

Features of CPVC Ball Valve are:

- Durable &Performing well after many cycles.
- Reliable and closing securely even after long periods of disuse.
- Light weight and quick assembly.
- Smaller in size than most other valves.
- Tight sealing with low torque
- Fire resistance.
- Low Fluid friction coefficient.

II. LITERATURE REVIEW

[1] **A** series of numerical CFD simulations of the flow through ball check valve of an ABS control valves are performed, with and without inclusion of a cavitation model, under similar conditions of pressure difference between inlet and outlet ports by Jose R. Valdes. [1] And concludes that the correlation between measurements and CFD predictions is excellent in both cases, thus validating the accuracy of simulations and cavitation model for valve flow prediction. The significant difference between cavitation and non-cavitations conditions shows importance by taken into account cavitation effects in prediction of the flow rate.

Billy D. Black, David F. Menicucci, and John Harrison [2] studied Analysis of Chlorinated Polyvinyl Chloride Pipe Burst Problems This report documents the investigation regarding the failure of CPVC piping that was used to connect a solar hot water system to standard plumbing in a home. Details of the failure are described along with numerous pictures and diagrams. A potential failure mechanism is described and recommendations are outlined to prevent such a failure. They concluded that The CPVC pipe failure occurred on the cold water inlet pipe leading to the standard domestic hot water heater. The solar heating loop was connected directly to the inlet and outlet connections of the standard hot water heater using Tee fittings. The thermal expansion of the hot water caused it to expand and back up into the inlet pipe since the house side of the plumbing is a closed system and there was no expansion tank. The hot water exceeded the temperature and pressure limits of the CPVC pipe and the pipe bulged and burst.

Arun Azad studied [3] Flow Analysis of Buttery Valve Using CFD. In this research work flow analysis through buttery valve with aspect ratio 1/3 has been performed using computational software. For modeling the valve ICEM CFD 12 has been used. Valve characteristics such as flow coefficient and head loss coefficient has been determined using CFX 12 for different valve opening angle as 30⁰,60⁰,75⁰, and 90⁰ (taking 90⁰as full opening of the valve) for incompressible fluid. Value of head loss coefficient obtained from numerical analysis has been compared with the experimental results.

G. Tamizharasi and S.Kathiresan[4] worked on CFD Analysis of a buttery valve in a compressible fluid. In this paper, three-dimensional numerical simulations by commercial code CFX were conducted to observe the flow patterns around buttery valves with various opening degrees and uniform incoming velocity were used in a piping system. Performance of valves under various operating conditions is generally obtained through an experimental testing of prototype or scaled valves. The availability of performance parameters for compressible flow is limited, and experimental testing can be cost prohibitive. In this case the computational fluid Dynamics analysis provides better results. The capability of using computational fluid dynamics is a test to determine its viability for determining its performance parameters. The objective of the project is to analyze the flow characteristics and performance of buttery valve with the disc shape namely a) Symmetric disc. The analysis would be carried at various valve opening positions (20 deg, 40 deg, and 60 deg) by using CFX tool. A comparative study would be made with the parameters such as static and total pressure, intensity of turbulence, force.

A methodology for the parametric modelling of flow indifferent types of hydraulic valves are developed by Jose M. Rodriguez.[5] This methodologies based on derivation of a generalized parametric function for modeling of the discharge coefficient of valve restrictions. This function has a square root form and two parameters that are characteristic of the restriction geometry and that can be derived from numerical CFD simulations. Once the flow coefficient functions are characterized, the calculation of flow rate is done by means of either a second order equation or a simple iterative procedure, in which input data are fluid properties and main geometrical dimensions. The methodology is demonstrated by applying it into two completely different hydraulic valve systems i.e. a brake master cylinder and HCU valves. The results of flow rate calculated with parametric model. And it’s compared with those obtained from CFD simulations on initial design and on designs with same topology but different dimensions obtaining in every case. The coefficients of critical restrictions of particular valve are used to determine the flow for other valves of similar topology but different dimensions. If the geometry is severely changed, critical restrictions must be identified and the parameters must be calculated again. The flow rate can be calculated using iterative or non-iterative methods.

In order to examine the performance characteristics of the parts of high-pressure, cryogenic ball valves, numerical analyses of the strength and thermal shock were conducted and the seat structure was investigated and tested by Dong-Soo Kim[6]. The conclusions are obtained as the design of the constituent parts of the ball valve, including the body, seat, bonnet, ball and spring, were optimized. In this study, a high-pressure, cryogenic ball valve that can achieve zero leakage was designed.

José R. Valdés [7] developed A methodology for the parametric modelling of the flow coefficients and flow rate in hydraulic valves. It is based on the derivation, from CFD simulations, of the flow coefficient of the critical restrictions as a function of the Reynolds number, using a generalized square root function with two parameters. The methodology is then demonstrated by applying it to two completely different hydraulic systems: a brake master cylinder and an ABS valve. This type of parametric valve models facilitates their implementation in dynamic simulation models of complex hydraulic systems.

Thus CFD analysis of symmetric disc valve has been carried out by G. Tamizharasi [8] and conclusions was drawn are at smaller opening angle the pressure loss is comparatively less. The total pressure variation and intensity of turbulence increase at downstream when opening angle increases. Force concentration is observed for 40°valve opening position. Increased wall shear are observed for40° and 60° opening positions.

V. J. Sonawane [9] designed and analyzed the Globe Valve as Control Valve Using CFD Software. This paper presents the modeling and simulation of the globe valves. The flow system with globe valves is complex structure and has non-linear characteristics, because the construction and the hydraulic phenomena are associated of globe valves. In this paper, three-dimensional CFD simulations were conducted to observe the flow patterns and to measure valve flow coefficient when globe valve with different flow rate and constant pressure drop across the valve were used in a valve system. Furthermore, the results of the three-dimensional analysis can be used in the design of low noise and high efficiency valve for industry.

H. Kursat Celik [10] studied Determination of flow parameters through CFD analysis for Agricultural Irrigation Equipment. In this study, a sample plastic mini valve has been utilized for CFD analysis. Flow behavior of the fluid in the valve was simulated three dimensionally using a commercial CFD code. Pressure loss, head loss, flow coefficient, resistance coefficient and cavitation index parameters were calculated for different flow rates with different valve opening positions with the aid of simulation results.

According to results of CFD, the pressure loss changes with inlet flow volume rate and valve opening positions. If valve opening angle and inlet flow volume rates re increased, pressure loss, head loss and resistance coefficient are increased but flow coefficient is decreased. Also leakage due to high value sudden pressures, manufacturing or material errors is another problem for this type of plastic mini valve. It may therefore be necessary to evaluate structural deformation cases for optimum part thickness of valves to avoid leakage during its operation.

The paper of Ana Pereira [11] shows utility of the CFD numerical simulations as a tool for design and optimization of hydropower performance and flow behaviour through hydro mechanical devices or hydraulic structures of intake and outlet types. Experimental tests not always are viable because they are very expensive and it is much more difficult to analyse different scenarios and boundaries. The flow of a real fluid in contact with a boundary implies velocity variations, pressures gradients and shear stress development, from which energy losses result, as important factors to take into account in the concept, design, construction, operation and maintenance of hydropower plants or any other type of hydraulic conveyance system.

Results of CFX simulation generated by Xue guan Song [12] agreed with the experimental data very well. However, at some peculiar position, especially at the valve opening degree smaller than 20°, it didn’t agree well. This may be due to disadvantage of the k-ε turbulent model of its own. It’s suggested to use another turbulent model which is good at treatment of near-wall such as k-ω model and SST turbulent model. The simulation by CFX was very sensitive to the degree of valve opening near to fully closed condition, where the flow near the valve is highly turbulent. So small subdivision is recommended near this region, and results are used with the comparison of the test values.

[2] In general, the result obtained by using commercial code ANSYS CFX 10.0 agrees with the experimental result very well. However, it is recognized that all CFD based predictions are never possible to be 100% reliable. Hence further investigation must be performed before the computational simulations are used directly in the industry.

Vishal Andhale & Dr. D. S. Deshmukh [13] worked on Flow Evaluation of Ball Valve for Performance Enhancement Using CFD Software. In this study the flow evaluation through 1 ½" CPVC Ball valve is carried out using computational Fluid Dynamics (CFD) software. Modeling of the valve is done using CATIA V5 R20 software and for analysis ICEM CFD 12 is used. Valve parameters including flow coefficient and head loss coefficient have been considered using CFX 12. The fluid is taken as incompressible fluid for design and analysis of valve. Magnitude of head loss coefficient calculated from numerical analysis is compared with the experimental data and the results are found satisfactory.

III. EXPERIMENTATION

Hydro Pressure testing machine is used for the experimentation. Visual inspection method is most preferred performance analysis technique for Ball valve. The valve material is CPVC and as per the ASTM D:2846 for valve material sustainable pressure ratings are passing water at 82^o C with 26 kg/cm^2 pressure for four hours and water at 82^o C with pressure of 36 kg/cm^2 for six minute. Water is taken as a fluid and it is assumed that it is incompressible.

The performance of valve is inspected visually. It shows that the valve meets the standard criteria with large amplitude. That is the valve passes water of temperature 82^{o}C at pressure of 26 kg/cm^2 for four hours and 36 kg/cm^2 for 6 minute satisfactorily.

Figure Error! No sequence specified. Test setup for testing of ball valve

During the testing; leaked water from spindle of ball valve is collected in flask to measure the amount of discharge. From the sample of ball valve taken for experiment, the following results are obtained which as shown in table 1;

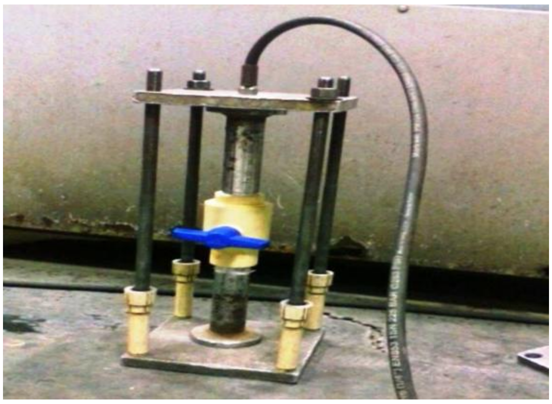

Figure 2 Fixture arrangement for testing of valve.

During the testing; leaked water from spindle of ball valve is collected in flask to measure the amount of discharge. From the sample of ball valve taken for experiment, the following results are obtained which as shown in table 1;

Table No 1. Experimental Results

	Inlet Pressure (Kg/cm$^{2)}$	Time (Min)	Outlet Discharge (m^3/sec)
Case I	36	6	6.75 x 10^{-7}
Case II	26	240	5.27 x 10^{-7}

IV. CFD ANALYSIS AND THEORETICAL APPROACH

I. Computational Fluid Dynamics (CFD) has been used extensively to successfully model fluid flow in number of fields, such as aerospace and pump design. It has not been used as much to model the very complex flow through valves. In this study, however, a high end CFD tool was used to numerically predict the point of incipient cavitation in several complex valve configurations. CFD provides numerical approximation to the equations that govern fluid motion. Application of the CFD to analyse a fluid problem requires certain steps. First, the mathematical equations describing fluid flow are written. CFX is a commercial Computational Fluid Dynamics (CFD) program, used to simulate fluid flow in a variety of applications. The ANSYS CFX product allows engineers to test systems in a virtual environment. The scalable program is applied to simulation of water flowing past ship hulls, gas turbine engines (including

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compressors, combustion chamber, turbines and afterburners), aircraft aerodynamics, pumps, fans, HVAC systems, mixing vessels, hydro cyclones, vacuum cleaners etc.

This is initial step in analysis process. The primary purpose of geometry creation is to generate a solid that defines region for fluid flow. This section describes creation of geometry. Dimensions and geometry details of existing model are collected. Model is created using CATIA V5 R20 software and exported in IGES format. The model of valve shape in shown in the following figures the step defines creation of regions and geometry.2D region is created for defining inlet and outlet. Creation of regions facilitates to assign boundary condition for inlet, outlet and other defined regions. The model of Ball valve is shown in fig. 3

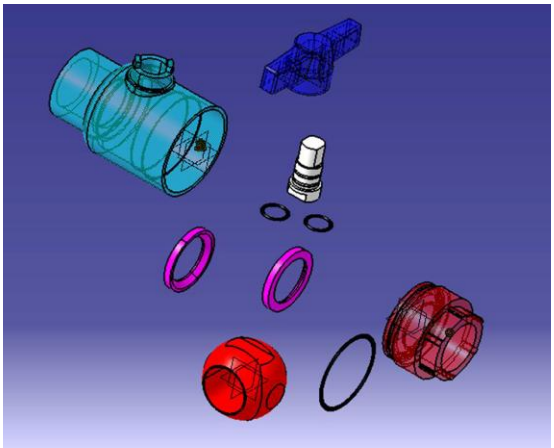

Figure 3 Exploded view of ball valve in Catia V5

A. *Boundary conditions*

A. In this analysis inlet and outlet boundary conditions are defined and subjected to two different conditions that are;

Case I:

- Inlet pressure is taken as 36Kg/cm²
- Temperature of 82°C
- Flow direction is normal to boundary.
- Other end of ball valve is set as wall.

Case II:

- Inlet pressure is taken as 26Kg/cm²
- Temperature of 82°C
- Flow direction is normal to boundary.
- Other end of ball valve is set as wall.

The domain for the analysis is taken as fluid domain and the fluid is taken as water. Material taken as CPVC

B. *Mesh generation and analysis*

The 3-D geometry is generated in the following way. Initially a solid model has been created in CATIA V5 R20 environment. CATIA is a parametric solid/surface feature-based modeller which uses Para solid geometric modelling. The model is then imported to FLOWIZARD for mesh generation using the FLUENT engine in a user friendly environment. The fig. 4 shows the meshing of ball valve assembly.

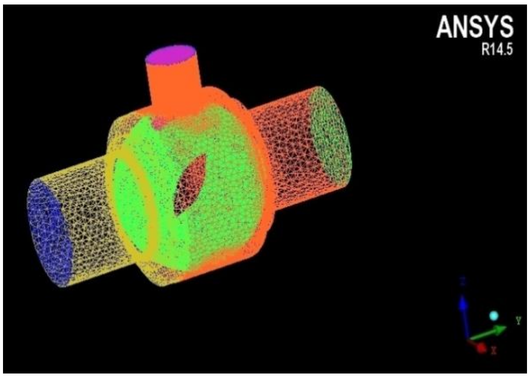

Figure 4 Fine meshing of ball valve

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A typical 3-D mesh has about 2.6–3.0 million elements. The mesh quality has been rigorously checked for parameters such as skewers and aspect ratio and a reasonable balance between mesh size and quality has been attempted. Mesh independence for 3-D simulation was ensured by using three different mesh levels comprising of about 2.0 million, 3.0 million and 4.0 million cells. The numerical values obtained for the accepted mesh were found to agree within 3% to the extrapolated value and accordingly the present mesh was deemed to be adequate. Grids in the mid-plane of valve have shown with the cross-sectional mesh. Unstructured volume mesh is created for this assembly. Grid size of the order of 0.674476 million cells was deployed in this case.

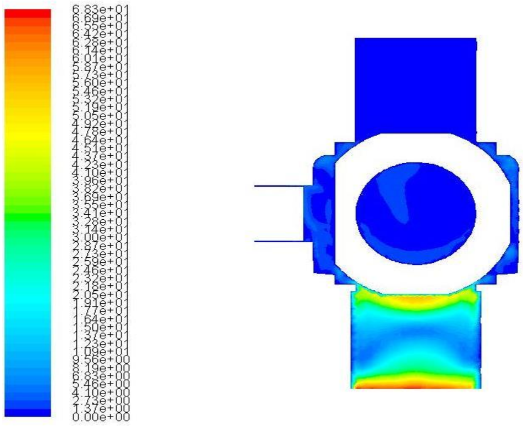

Figure 5 Velocity contour (m/s) for Case I

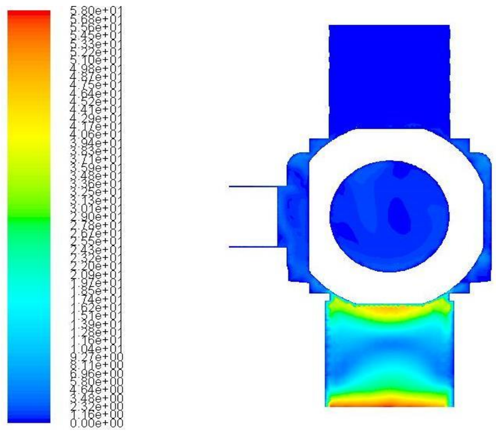

Figure 6 Velocity contour (m/s) for Case II

Fig. 5 and fig. 6 illustrates the velocity contours for Case I and Case II respectively. In which it shows the behaviour of water flow in the ball valve.

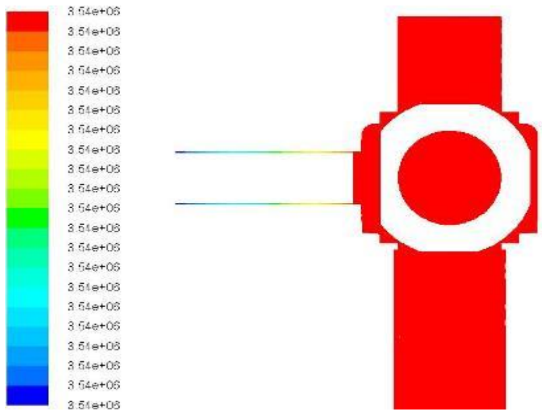

Figure 7 Static pressure contour (Pa) for case I

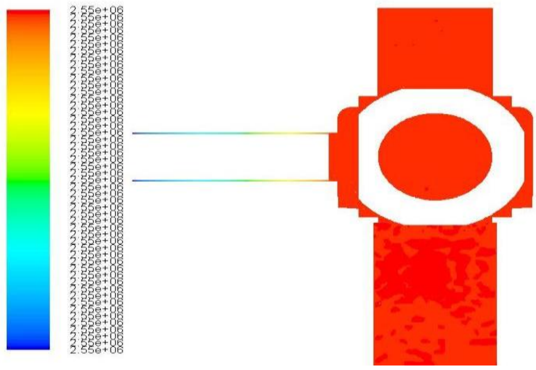

Figure 8 Static pressure contour (Pa) for case II

CFD is attractive to industry since it is more cost-effective than physical testing. However, one must note that complex flow simulations are challenging and error-prone and it takes a lot of engineering expertise to obtain validated solutions. Figure7 and figure 8 shows the static pressure Contours for Case I & Case II respectively. These all figures demonstrate the capability of CFX to simulate the complicated flow in 3-D space. They do not show the flow feature, but also provide obvious evidence of prediction's validity.

V. Results and Discussions

In following figure 9 and figure 10, an experimental and software results are obtained respectively. In which Case I is taken for the input pressure of 26 Kg/cm^2 and Case II is for input pressure of 36 Kg/cm^2.

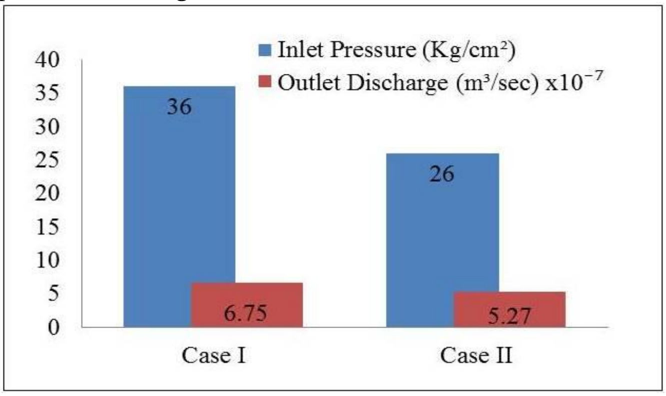

Figure 9 Experimental Result

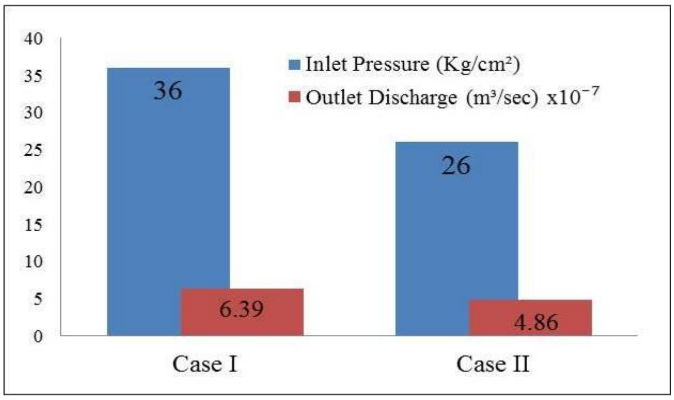

Figure 10 Software Result

From figure 9, it is seen that the discharge in experimental analysis for Case I is 5.27 x 10^{-7} m^3/sec and for Case II is 6.75 x 10^{-7} m^3/sec. Fig. 10 shows discharge from CFD simulation i.e. for case I is 4.86 x 10^{-7} m^3/sec and for Case II is 6.39 x 10^{-7} m^3/sec.

The Validation of the CFD model is done using the experimental data represented in. Fig.11. It compares the discharge evolution in the experimentation and discharge evolution in the CFD simulation for both cases (i.e. Case I & Case II).

The values determined by CFD model is close to experimental results. This shows agreement of results that is observed value and CFD software values for performance testing of ball valve.

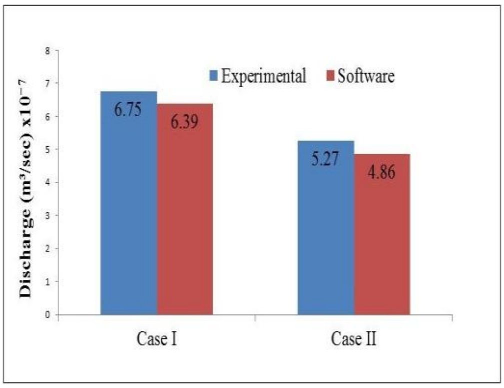

Figure Error! No sequence specified. Relative error on Discharge between CFD and experimental results

Table No 2 Comparison between Experimental and Numerical results

	Output Parameter (Discharge)		Difference	Difference between Experimen-tal and software results in %
	Experimental (m^3/sec)	Software (m^3/sec)		
Case I	6.75 $x10^{-7}$	6.39 $x10^{-7}$	3.6 x10-8	5.34
Case II	5.27 $x10^{-7}$	4.86 $x10^{-7}$	4.1x10-8	7.78

VI. CONCLUSIONS

Experimental observations and software analysis of ball valve is done. Visual inspection shows the valve meets standard criteria set as per ASTM D2846. As per the experimental observations, following are main reasons of trouble in ball valve operating performance.

- It may be due to shrinkage in material of spindle, ball or main body of ball valve during moulding process
- It may be due to improper size and dimensions of small 'O' rings which are placed on spindle of ball valve as a packing
- There may be small bending in spindle during manufacturing
- If the complete assembly is improper or if fitting of ball valve nut is not tighten properly; it may increase clearance in ball valve assembly which also cause leakage problem.

Therefore for reducing water leakage problems as remedial measures, following points must be considered:

- Shrinkage allowance should be considered while designing.
- Proper or accurate size of 'O' rings should be used that is with less tolerance limit.
- Straightness checking of spindle should be carefully done.
- While assembling, proper fitting of each part should be done or checked.

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