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Review on Analysis of Steam Turbine Blade

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***Abstract*— Steam turbine blades are one of the most critical components in power plants Blade is a major component of the turbine, which receives the impulse directly from the steam jet and converts this force into the driving force. Statistics has shown that LP blades are usually more predisposed to failure compared to blades in HP or IP turbines. The present research work analyses the effects of thermal and structural load on a steam turbine blade under the operating conditions. Stresses due to thermal and dynamic loads of low Pressure Steam Turbine blade of 210 MW power stations analyzed in two stages. In first stage a three dimensional model of turbine blade was prepared in CREO 2.0.**

This model will import in ANSYS-14.5 for Finite Element Analysis. Maximum stress and stress distribution is compute using Finite Element Analysis (FEA) at the corresponding section.

***Keywords*— *Low pressure Blade, Steam Turbine, Stress Distribution, and Finite Element Analysis by ANSYS software*.**

I. INTRODUCTION

Steam turbines are major prime movers in thermal power stations. The main parts of simple impulse steam turbine are rotor, blades and nozzles. Turbine blade is exposed to various loads such as thermal, inertia, and bending and may fail due to different factors like Stress-Corrosion Cracking, High-Cycle Fatigue, Corrosion-Fatigue Cracking, Temperature Creep Rupture, Low-Cycle Fatigue, corrosion, etc.

The software offers a comprehensive range of stress analysis and other capabilities in an integrated package for such large-scale, complex problems. An integrated infrastructure, ANSYS Parametric Design Language customization capabilities and nonlinear simulation with contact plasticity work together to provide powerful simulation capabilities for this type of application. Key dimensions of the blade root were modified using ANSYS Parametric Design Language (APDL) capabilities, with ANSYS Mechanical software analyzing the various combinations of parameters.

Ever since the evolution of FEA, there has been a continuous and growing need for a powerful design analysis tool in the power generation industry. In general, turbines represent a class of challenging mechanical prime movers where steady and transient stresses (mechanical and thermal), turbine blade vibrations, and the start/stop cycling of the machines present interesting design challenges to produce a highly reliable machine with long design lives. Particular interest is the analysis of turbine blades, as these rotating components, if the separated from their attachment to the rotor, have the potential for causing a tremendous amount of consequential damage, both in the form of human life and property damage.

*A. **Problem definition***

All mordern steam power plants use impluse-reaction turbines as their blading efficiency is higher than that of impluse turbines. Last stage of steam turbine impluse-reaction blade are very much directly affect efficiency of plant.With the information that an understanding of the forces and stresses acting on the turbine blades is vital importance, in this work we will compute such a force acting on a last stage Low Pressure (LP) blade of a large steam turbine rotating at 3000 rpm in order to estimate the material stresses at the blade root. One such LP steam turbine blade is show in Figure 1. We studied structural and thermal analysis of blade using FEA for this work and by use of the operational data have performed by using FEA (ANSYS) and This study work involved the analyze bldde and check FEA data of std. blade with various material

*B. **Objective***

The main objectives of the study were

1) To study effect of stress distribution on steam turbine blade

2) Structural and thermal analysis of steam turbine blade

3) Calculating stresses through advanced computer modelling techniques and simulation

4) To study effect of pressure and get the response of the blade

II. RESEARCH METHODOLOGY

The following methodology used for carrying out Finite Element Analysis of 210 MW low-pressure blade of Steam turbine.

1) Formulation of the problem – the success of any experiment is dependent on a full understanding of the nature of the problem.

2) Validation of FEM method for finding maximum stress.

3) Modeling of the steam turbine blade will done using CAD software CREO 2.0.

4) Stress distribution on turbine blade and root.

5) Software ANSYS 14.5 using for Finite Element Modeling.

Validation of fem method for finding stress A.

Steps of validation of fem method for finding Stress:

1) Prepare a three dimensional model in CREO 2.0.

2) Import the CREO2.0 model in ANSYS software.

3) Mesh the ANSYS model.

4) Apply boundary conditions and find out stress distribution in the component.

5) Validate that maximum stress in component with operating condition.

III. LITERATURE REVIEW

Many investigators have suggested various methods to explain the effect of stress and loading on turbine blade, roter and analysis the various parameters:

John. V, T. Ramakrishna was investigated on design and analysis of Gas turbine blade, CATIA is used for design of solid model and ANSYS software for analysis for F.E. model generated, by applying boundary condition, this paper also includes specific post processing and life assessment of blade. How the program makes effective use of the ANSYS pre-processor to mesh complex geometries of turbine blade and apply boundary conditions. The principal aim of this paper is to get the natural frequencies and mode shape of the turbine blade. In this paper we have analyzed previous designs and generals of turbine blade to do further optimization, Finite element results for free standing blades give a complete picture of structural characteristics, which can utilized for the improvement in the design and optimization of the operating conditions.

Subramanyam Pavuluri, Dr. A. Siva Kumar was investigated on design of high pressure steam turbine blade addresses the issue of steam turbine efficiency. A specific focus on airfoil profile for high-pressure turbine blade, and it evaluates the effectiveness of certain Chromium and Nickel in resisting creep and fracture in turbine blades. The efficiency of the steam turbine is a key factor in both the environmental and economic impact of any coal-fired power station. Based on the research presented modifications to high-pressure steam turbine blades can made to increase turbine efficiency of the turbine. The results and conclusions are presented for a concerning the durability problems experienced with steam turbine blades. The maximum operational Von Mises Stresses are within the yield strength of the material but the deformation is comparatively better for material CA-6 NM (Chromium Nickel). Modified solutions for Steam turbine blade values to machines to maximize their reduce life cycle costs, efficiency, and improve reliability

Sanjay Kumar was investgated on creep life of turbine blade. Inertia load is the constant load that will cause creep failure. Creep is a rate dependent material nonlinearity in which material continues to deform in nonlinear fashion even under constant load. This phenomenon is predominant in components, which exposed to high temperatures. By studying the creep phenomenon and predicting the creep life of the component, we can estimate its design life. The main objective is to predict the creep life of the simple impulse steam turbine blade, and to give the FEM approach for creep analysis. The analysis of turbine blade for different loads, which shows that the maximum stresses, induced in each case. These stresses are within yield limit of the material and will not undergo plastic deformation during operationresult is found that, creep life decreases as the stress value increases. Hence, by decreasing the stress value in the component we can increase its creep life. This was be achieved by modifying the blade design.

Avinash V. Sarlashkar, MARK L. Redding investigated on the architecture and capabilities of Blade Pro. An ANSYS based turbine blade analysis system with extensive automation for solid model and F.E. model generation, boundary condition application, file handling and job submission tasks for a variety of complex analyses; the program also includes turbo machinery specific post-processing and life assessment modules. Blade Pro is a cutting-edge example for vertical applications built on the core ANSYS engine using ANSYS APDL. Examples of how the program makes effective use of the ANSYS preprocessor to mesh complex geometries of turbine blade and apply boundary conditions are presented using specific examples. A real world application is used to demonstrate the pre-processing capabilities, static and dynamic stress analyses results, generation of Campbell and

Interference diagrams and life assessment. The principal advantage of Blade Pro is its ability to generate accurate results in a short amount of time, thus reducing the design cycle time. The good correlation achieved is a testament to the accuracy of the ANSYS solvers and validity of the modeling techniques adopted in Blade Pro**.**

DR.SHANTHARAJA.M, DR. Kumar. K**.**, was work on the large variety of turbo-machinery blade root geometries used in industry prompted the question if an optimum geometry could be found. An optimum blade root was defined, as a root with practical geometry which, when loaded returns the minimum fillet stress concentration factor. The present paper outlines the design modification for fillet stresses and a special attention made on SCF of the blade root (T-root) which fails and to guarantee for safe and reliable operation under all possible service conditions. Finite Element Analysis is used to determine the fillet stresses and Peterson's Stress Concentration Factor chart is effectively utilized to modify the blade root. The root modified due to the difficulty in manufacturing the butting surface of the tang that grips the blade to the disk crowns.

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having small contact area. Verify the same using Finite Element Analysis for two cases with and without the tang in the blade. Firstly, to study the fillet stresses with tang and then Petersons chart is used to reduce the peak stresses with the modification to the butting area and reducing the fillet radius. To conduct the sensitivity analysis for the fillet stresses in blade and disk using FEA.

In the work, the first stage rotor blade off the gas turbine has analyzed using ANSYS 9.0 for the mechanical and radial elongations resulting from the tangential, axial and centrifugal forces. The gas forces namely tangential, axial were determined by constructing velocity triangles at inlet and exist of rotor blades. The material of the blade was specified as N155. This material is an iron based super alloy and structural and thermal properties at gas room and room temperatures the turbine blade along with the groove blade is modeled with the 3D-Solid Brick element. The geometric model of the blade profile is generated with splines and extruded to get a solid model in CATIA. The first stage rotor blade of a two-stage gas turbine has been analyzed for structural, thermal and modal analysis using ANSYS 9.0 Finite Element Analysis software. The gas turbine rotor blade model meshed in HYPERMESH 7.0, meshing software. The thermal boundary condition is such as convection and operating temperatures on the rotor blade obtained by theoretical modeling. Analytical approach used to estimate the tangential, radial and centrifugal forces.

In this work the failure of a second stage blade in a gas turbine was investigated by metallurgical and mechanical examinations of the failed blade. The blade was made of a nickel-base alloy Inconel 738LC. The turbine engine has been in service for about 73,500 hrs. Before blade has failure. Due to the blade failure, the turbine engine was damaged severely. The investigation started with a thorough visual inspection of the turbine and the blades surfaces, followed by the fractography of the fracture surfaces, micro structural investigations, chemical analysis and hardness measurement. The observation showed that a serious pitting occurred on the blade surfaces and there were evidences of fatigue marks in the fracture surface. The micro structural changes were not critical changes due to blade operation at high temperature. It found that the crack initiated by the hot corrosion from the leading edge and propagated by fatigue and finally, because of the reduction in cross-section area, fracture was completed. An analytical calculation parallel to the finite element method utilized to determine the static stresses due to huge centrifugal force. The dynamic characteristics of the turbine blade evaluated by the finite element mode and harmonic analysis. Finally according to the log sheet records and by using a Campbell diagram there was a good agreement between the failure signs and FEM results which showed the broken blade

has been resonated by the third vibration mode occasionally before the failure occurred

. Conclusion

From above literature, review it is indicated that

1) There are many researches done on turbine blade in high-pressure stage or rotor section and work also done in steam and gas based power plant. But I found that are very few researches done work on last stage tangent-twisted blade of LP stage of turbine so we want to do research on this section. We like to use FEA for analysis.

2) Turbine blade tupe,flow of steam through impluse or rection blade,geomeatry of blade,helix angle,force on the blade,material properties of the blade,speed of the turbine and etc. are various parameter important for the turbine blade condition.

3) They affect the blade life and efficiency of the plant in terms of mechanical properties and working codition.

4) The complex Design of blade will done in CREO 2.0 parametric software with coordinate point of tip and root section of blade

5) To perform analysis with appropriate set of parameters is done in ANSYS14.5 software (FEA).

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TECH-CHRONICLE
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Design of Single Fork of Folding Bicycle

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***Abstract*—In today's life the bicycle can play the very important role for daily transportation purpose in human life. The reason behind increase in the importance is because of increased pollution due to automobiles and cost of fuel which is continuously increasing now a day. Also the transport has been one of the most important issues to be deal with in the present day situation as commuting from place to place within the city has become a tedious and an expensive task. It is very difficult to reach the nearest public transport facility and in many cases the destination will be very far from the main roads where the public transport might not be able to commute or it might be very expensive. To overcome a common problem faced by the society, an idea is conceptualized to design a single fork foldable bicycle. The aim of our paper is to design and analysis of single fork of foldable bicycle which fold in compact form which facilitating easy transport and easily park. We already have seen many foldable bicycles in the global market but the main idea of this paper is to provide only one side fork to a foldable bicycle which is light & safe, easy to handle, easy to fold and easy to maintain. Unlike the conventional cycles, this bicycle will occupy very less space and also is very easy to be carried around.**

Keywords—conventional, conventional bicycles, fork, foldable bicycle, transport

I. INTRODUCTION

The Currently available bicycles are made up of heavy materials which make them difficult to carry. The prices of the bicycles are also not affordable to the common man. Many of them are not foldable in a configurable geometrical order, because of which their transportation becomes very difficult. It also leads to a lot of difficulty, when it is to be stored for future use. To propose a compact foldable bicycle this is weightless and overcomes all the limitations in the currently available bicycles. The proposed bicycle is designed in such a way that it is foldable by providing fasteners at the joints. The design structure imparts stable bicycle geometry.

Transport has been one of the major issues in developing cities such as Bangalore since commuting from one place to another has become tedious and expensive. With the petrol and diesel prices increasing day by day, almost all the modes of transport are becoming expensive. It is difficult to reach the nearest public transport facility and in many cases the destination will be far from the main roads where the public transport might not be able to reach due to the small roads, to avoid which most people use vehicles of their own, which in turn leads to issues with parking, traffic, etc. But not all can opt for having own vehicles as it is expensive. With such issues in health, transport, space for parking, etc. one solution that comes to mind is bicycle. Bicycles are being promoted in the corporate and educational sectors. But how convenient is it to use a conventional bicycle? In many cases there is no special facility provided for locking the bicycles and even if one is present, it is probable to theft, which is one of the fears that obstruct use of bicycle. Conventional bicycles occupy sufficient space and hence providing one at work place or at home are quite difficult. They are probable to be exposed to the weather outside and do require frequent maintenance. With all such issues in the conventional bicycles, the next possible solution is the usage of foldable bicycle. With foldable bicycles, there is no issue since the bicycle can be folded and carried around to the work place or even it can be used to reach the nearest public transport facility and then folded and carried along. Since the bicycle is being folded, it occupies very less space and doesn't require any special parking space. They are not exposed to the weather since they can be carried inside buildings with ease and hence prone to less maintenance. The usage of foldable bicycle helps combine the different modes of transport as mentioned above, which helps in cutting down some cost involved in travelling.

II. COMPONENT OF FOLDING BICYCLE

A. Folding Body Frame

It is a main supporting part of the bicycle. On which wheels and other components are fitted. The modern and most common frame design for an upright bicycle is based on the safety bicycle, and consists of two triangles, a main triangle and a paired rear triangle. This is known as the diamond frame. Frames are required to be strong, stiff and light, which they do by combining different materials and shapes. At the time of folding the folding bicycle the main frame or folding body of

the folding bicycle is folded in such manner that the horizontal axis of the front wheel and the horizontal axis of the back wheel are come in a same axis As the folding of the main frame or folding body of the folding bicycle is completed. The front wheel holder and back wheel holder are fixed with each other with the help of Velcro.

B. Compact joint

It is a joint which provides on the frame so that front and rear portion can be overlap.

C. Handle

It is the front portion of bicycle which uses to control the direction of bicycle. Bicycle handlebar or often bicycle handlebars refer to the steering mechanism for bicycles; the equivalent of a steering wheel. Besides steering, handlebars also often support a portion of the rider's weight, depending on their riding position, and provide a convenient mounting place for brake levers, shift levers, cycle computers, bells, etc. Handlebars are attached to a bike's stem which in turn attaches to the fork.

D. Transmission mechanism

It is the mechanism which transmits the power from pedal to rear wheel. A bicycle chain is a roller chain that transfers power from the pedals to the drive-wheel of a bicycle, thus propelling it. Most bicycle chains are made from plain carbon or alloy steel, but some are nickel-plated to prevent rust, or simply for aesthetic. Before the safety bicycle, bicycles did not have chains and the pedals were typically attached directly to the drive-wheel, thus limiting top speed by the diameter of the wheel and resulting in designs with front wheels as large as possible. Various linkage mechanisms were invented to raise the effective gear ratio, but with limited success. Using chain drive allowed the mechanical advantage between the drive and driven sprockets to determine the maximum speed.

E. Adjustable Seat

It is the setting arrangement in the bicycle. The Saddle, Undo the lever, push the saddle right down, and re-clamp the lever. During this action, it is because of this that the rear frame remains folded, in turn retaining the front wheel in its folded position. So if you do not push the saddle fully down, it is possible for the folded package to come apart when you pick the bike up. Folding pedal, it is best to fold this with the left hand crank as high as possible i.e. with the cranks turned so that the right hand pedal touches the front wheel also, the ridged side of the nylon latch plate on the pedal should face upwards. This is the arrangement used in the bicycle which is use for the carrying the bags or any kind of things on carriage we have to fixed it first on the carriage.

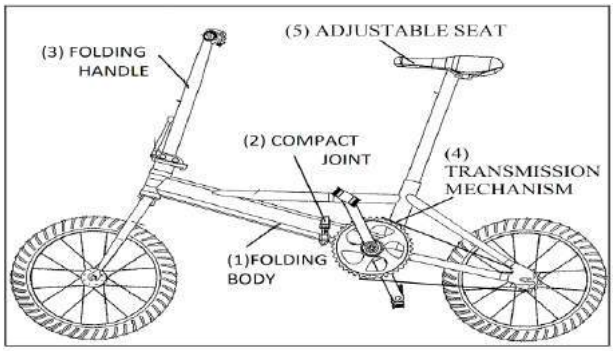

Fig 1: Component of folding bicycle

III. MATERIAL SELECTION FOR FRAME

The selection of suitable material for the frame was most important to make the frame study, yet light. After long sessions of discussion it was finalized to use the standard material used in conventional bicycles i.e. Mild steel.

Mild steel is easily available in the required diameter and length and is also not expensive. One main advantage of using mild steel is that it is easy to fabricate with it as welding of mild steel is by arc welding process which is cheap compared to other welding methods. Use of other materials like alloys of aluminum was not selected as the availability is less and also the fabrication cost is high.

Mild steel tubes of 1”, 1.5”, and 0.5” are easily available in the market and are the ones used for conventional bicycle manufacturing. The hinge found in the market is also made of mild steel which eases the process of joining the frame to the hinges.

The following are the chemical composition and mechanical properties of mild steel.

Chemical composition

Carbon	0.16-0.18%
Silicon	0.40% max
Manganese	0.70-0.90%
Sulphur	0.040% Max
Phosphours	0.040% Max

IV. TESTING FOR BENDING AND COMPRESSION LOADS

A. BENDING TEST:

The tube used to fabricate the bicycle was subjected to bending test. A tube of outer diameter 1 inch, 16 gauge and length 10 inches was used as the test specimen. The specimen was mounted on the UTM with necessary arrangements to perform bending test. The specimen was supported by two v-blocks and then the bending test was done. It was observed that the tube does not show much deflection till a load of 4 KN, but the since the tube is hollow first the outer surface of the tube was bent then the whole tube started bending. The bending test

was carried out till a deflection of 8.5 mm was observed. The variation of the deflection with respect to the load is as shown in the graph below.

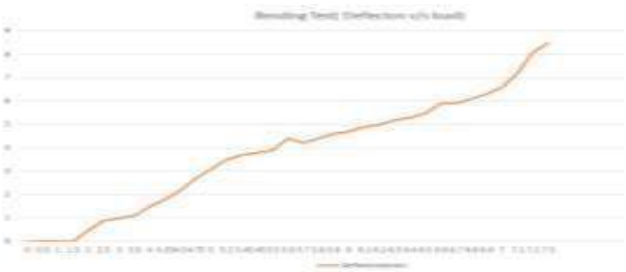

Fig 2: Graph of Deflection v/s Load for bending test

B. COMPRESSION TEST:

The mild steel tube was cut and welded to the angle as in the frame design and tested on the UTM till fracture. The mild steel tube of outer diameter 1 inch and 16 gauges was used to build the specimen as per the required dimensions. Compressive load was applied on the specimen. It is observed that there is very less deflection up to a load of 4 KN and then the joint shows plastic deformation at 5KN and then fractures at a load of 6.5 KN. The result of the test is plotted as a graph of deflection versus load and is as shown in the below figure.

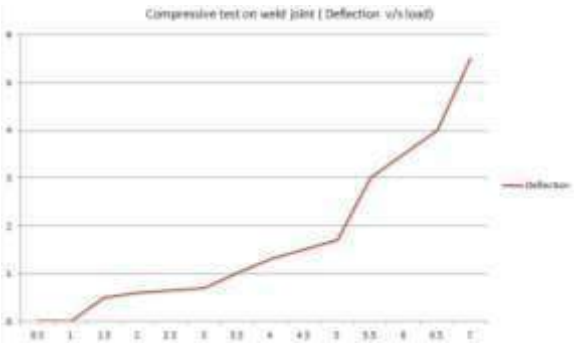

Fig 3: Graph of Deflection v/s Load for compression test

V. DESIGN OF SINGLE FORK

Fork is the portion of bicycle that holds the front wheel allows the rider to steer and balance the bicycle. Forks have several key dimensions which include: offset length, width, steerer tube length, and steerer tube diameter.

We use the simple design of fork for our bicycle; we selected the size 25 mm diameters of tube and 300 mm length as shown in the figure. A normal mild steel fork was to be converted into a member that can lock after the bicycle was unfolded. This was a challenging task. Once the required data was gathered regarding the dimensions of the fork and frame, the fork was modeled using 3D tools.

We analyze the mechanical properties on the single side fork by FEA using various materials and investigate optimum and effective material based on results obtained by proposed analysis.

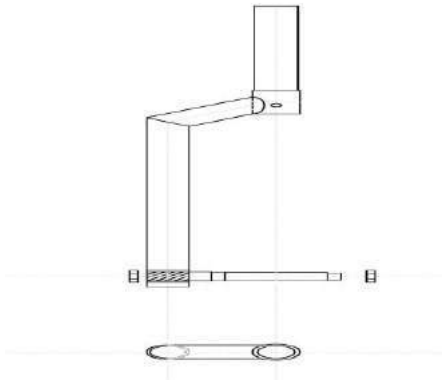

Fig 4: Single fork design

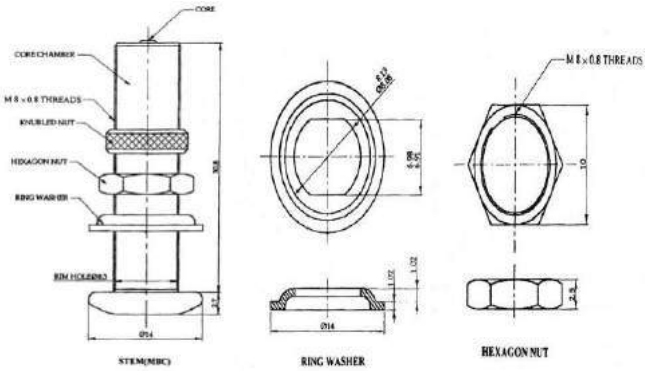

Fig 5: Design of various components

VI. 3D MODELLING OF SINGLE FORK

For modeling and analysis of our proposed folding bicycle we use the softwares Pro-E and Ansys.

A. Pro/ENGINEER

It is basically the 3D modeling tool software in which modeling and drawing and drafting is taking place also it gives the tutorial-based introduction to creating parts, assemblies and drawings in Pro/ENGINEER. If you follow the complete series of procedures, you will learn how Pro/ENGINEER passes 3D design information to and from every design

B. ANSYS

ANSYS is a Workbench application that can be use to perform a variety of engineering simulations, including stress, thermal, vibration, thermo-electric, and magneto static simulations. A typical simulation consists of setting up the model and the loads applied to it, solving for the model's response to the loads, examining the details of the response with a variety of tools.

Analysis is used to evaluate the fatigue failure of the proposed bicycle design. The failure locations and the cycles to failure are determined by analysis. The foldable bicycle frame is

modeled and simulated in the CAD/CAE environment. The developed 3D cad model of foldable bicycle frame is show in fig. The tetrahedral element type has been used in this study for the bicycle analysis.

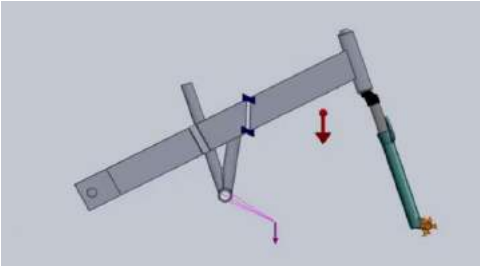

Fig 6: 3D modeling of frame with single fork

CONCLUSION

From the proposed concept we can conclude that single fork used in folding bicycle can be effectively employed in new upcoming bicycle for optimum design, flexibility in maintenance, good aesthetics and best design for improved structure of folding bicycle.

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Review of disc brake squeal analysis

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***Abstract*— It has been observed that brake squeal noise is faced as a major issue by automotive manufactures for many years due to consistent customer complaints, high warranty costs and accidents caused by misbalancing due to crash braking. An automobile survey has revealed that the brake noise is being one of the most critical vehicle quality measurements. From early of the last century and till date disc brake squeal is being a complex problem in the automobiles. Many researchers have investigated the problem by means of experimental, analytical and computational methods. This paper provides review of investigations carried out in context with disc brake squeal analysis. It also includes review on characteristic of brake squeal. A reviews of the analytical, experimental and numerical methods used for the investigation of brake squeal is given.**

Keywords*— *Disc Brake Squeal, Brake squeal noise, Brake squeal analysis, automotive, analytical, experimental.

I. INTRODUCTION

Brake squeal is the unusual sound which occurs in the frequency range between 1 and 12 kHz, has been one of the most difficult concerns associated with vehicle brake systems. In most cases, this type of noise has little or no effect on the performance of brake system. However, most customers perceive this noise as a problem and demand that their dealers fix it. Thus automotive industry is thus looking for new ways to solve this problem.

In general, brake noise has been divided into three categories, in relation to the frequency of noise occurrence. The three categories presented are low frequency noise, low-frequency squeal and high-frequency squeal. Low-frequency disc brake noise typically occurs in the frequency range between 100 and 1 kHz. Typical noises that reside in this category are grunt, groan, grind and moan. This type of noise is caused by friction material excitation at the rotor and lining interface. The energy is transmitted as a vibratory response through the brake corner and couples with other chassis components. The failure mode for this category of squeal can be associated with frictional excitation coupled with a phenomenon referred to as modal locking of brake corner components. Modal locking is the coupling of two or more modes of various structures producing optimum conditions for brake squeal. High-frequency brake squeal is defined as a noise which is produced by friction induced excitation imparted by coupled resonances (closed spaced modes) of the rotor itself as well as other brake components. It is typically classified as squeal noise occurring at frequency range 3-12 kHz. Since it is a range of frequency which affects a region of high sensitivity in the human ear, high-frequency brake squeal is considered the most annoying type of noise.

Brake squeal is a concern in the automotive industry that has challenged many researchers and engineers for years. Considerable analytical, numerical and experimental efforts have been spent on this subject, and much physical insight has been gained on how disc brakes may generate squeal, although all the mechanisms have not been completely understood. No precise definition of brake squeal has gained complete acceptance, but it is generally agreed that squeal is a sustained, high frequency greater than 1 kHz vibration of brake system components during a braking action resulting in noise audible to vehicle occupants or passers-by. There exists no general means for completely eliminating brake squeal. Brakes that squeal do not, in general, squeal during every braking action. Rather, the occurrence of squeal is intermittent or perhaps even random. Many different factors on both the micro- and macroscopic levels appear to affect squeal, and some of these factors (especially on the microscopic level) are not well understood. As different brake squeal experiments produce widely different and even conflicting results. Generally, a central difficulty in modeling brake squeal is one of scales. Effects on very small scales in length and time (i.e., microscopic contact phenomena and high-frequency vibrations) interact in important ways with effects on large scales (such as wear over the life of the brake and dynamics of large vehicle substructures). A number of theories have been formulated to explain the mechanisms of brake squeal, and

numerous studies have tried with varied success to apply them to the dynamics of disc brakes.

II. CHARACTERISTICS AND MECHANISM OF DISC BRAKE SQUEAL

A. Brake noise squeal mechanisms

The Disc brake squeal occurs when a system experiences vibrations with very large mechanical amplitude. There are two theories that attempt to explain why this phenomenon occurs. The first theory states that brake squeal is a result of a stick–slip mechanism. Second theory is mode coupling theory. It states that high levels of vibration result from geometric instabilities of the brake system assembly. Both theories, however, attribute the brake system vibration and the accompanying audible noise to variable friction forces at the pad–rotor interface. According to the first hypothesis, the stick–slip theory, a variable friction coefficient with respect to sliding velocity between pads and rotor, provides the energy source for the brake squeal. Several studies based on this theory were conducted when disc brakes were first used on automobiles. Squeal noise was found to be more likely when the decreasing relationship between the friction coefficient and the sliding velocity become pronounced. An increase in the negative slope did not always increase the occurrence of squeal, however, the need for an alternative or accompanying theory was revealed. In the case of geometric instability, the second theory, the variable friction forces are caused by variable normal forces. Even if the coefficient of friction is constant, variable friction forces are still possible. Investigations based on this hypothesis began with Spurr and were advanced by Earles and Soar. In this case, two system modes that are geometrically matched move closer in frequency as the friction coefficient increases. These two modes eventually couple at the same frequency and become unstable

B. Characteristics of brake squeal

One of the biggest contributors to a brake squeal is the friction material, since Squeal excitation occurs at the friction interface, and it normally takes approximately 12 months to finalize a friction material selection. This certainly makes it very difficult to predict a priori the propensity of a brake system to squeal. Also, often in the design of a brake system, priority is given to requirements such as braking performance, cost and ease of manufacture. The common practice for the different components of a brake system to be manufactured by different suppliers further complicates matters. The large number of vehicles produced means that even a low squeal propensity found during initial testing of a brake system can become a major concern once a vehicle is in production due to a much larger population size. Modifications towards the end of development phase will have two potential risks: [1] leading to production delays and increased costs to both the brake and vehicle manufacturers and [2] leading to products not fully validated with potential field warranty concern. The most significant complication in brake research is the fugitive nature of brake squeal; that is, brake squeal can sometimes be non-repeatable. There are many potential squeal frequencies (unstable modes) for a brake system. Each individual component has its own natural modes. The modal frequencies and modal shapes of the rotor, caliper, anchor and pad will change once these parts are installed. During a brake application, these parts are dynamically coupled together resulting in a series of coupled vibration modes, which are different from the component free vibration modes. The addition of the friction coupling forces at the friction interface results in the stiffness matrix for the system containing un-symmetric off-diagonal coupling terms. From the stability point of view, this coupling is considered to be the root cause of the brake squeal. A brake system may not always squeal given the „„same"" conditions. Alternatively, small variations in operating temperature, brake pressure, rotor velocity or coefficient of friction may result in differing squeal propensities or frequencies. Figs.1and 2 show the percentage occurrence of brake squeal obtained at PBR Automotive Pty Ltdusing a Rubore drag type noise dynamometer and an AK noise matrix for various brake pressures and the temperatures respectively. It can be seen from Fig.1that there is no simple relationship between the percentage occurrence and frequency of the brake squeal and the brake pad pressure. Similarly, the influence of temperature on both the occurrence and frequency of the brake squeal is quite complex (Fig. 2). Due to the above-mentioned difficulties in designing a noise free brake system, efforts to eliminate brake squeal have largely been empirical, with problematic brake systems treated in a case by case manner. The success of these empirical fixes depends on the mechanism that is responsible for causing the squeal problem. The most fundamental method of eliminating brake squeal is to reduce the coefficient of friction of the pad material. However, this obviously reduces braking performance and is not a preferable method to employ. The use of viscoelastic material (damping material) on the back of back plate can be effective when there is significant pad bending vibration. Changing the coupling between the pad and rotor by modifying the shape of the brake pad has also been found effective. Other geometrical modifications that have been successful include modifying caliper stiffness, the caliper mounting bracket, pad attachment method and rotor geometry.

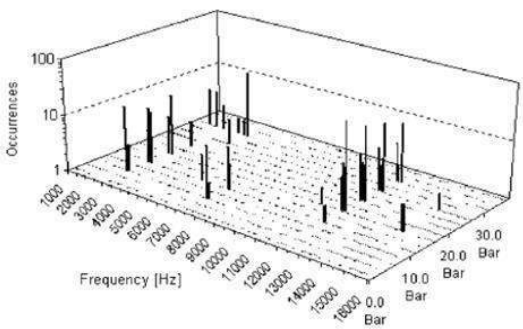

Fig.1 Variation of occurrence of brake squeal with frequency and brake pad pressure

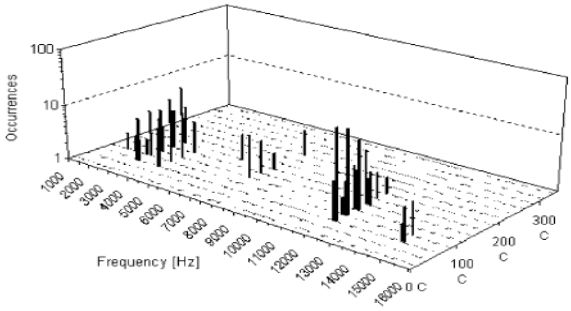

Fig.2 Variation of occurrence of squeal with frequency and temperature

III. ANALYSIS OF BRAKE SQUEAL

A. Analytical Methods

The earliest research into brake squeal suggested that the variation in the friction coefficient with sliding velocity was the cause. Not only is there a difference between the static and dynamic coefficient of friction, but it was thought the drop in kinetic friction with increased sliding velocity could lead to a stick-slip condition and produce self-excited vibration. However, squeal has been shown to occur in brake systems where the coefficient of kinetic friction is constant and has led to analysis of the geometrical aspects of a brake system. Spurr proposed an early sprag-slip model that describes a geometric coupling hypothesis in 1961. Consider a strut inclined at an angle θ to a sliding surface as shown in Fig.3 (a). The magnitude of the friction force is given by

$$F = (\mu L) / (1 - \tan \theta)$$

Where, μ is the coefficient of friction and L is the load. It can be seen that the friction force will approach infinity as μ approaches cot θ. When μ=cot θ the strut „sprags‟ or locks and the surface can move no further. Spurr‟s sprag-slip model consisted of a double cantilever as shown in Fig. 3(b). Here, the arm O'P is inclined at an angle θ' to a moving surface. The arm will rotate about an elastic pivot O' as P moves under the influence of the friction force F once the spragging angle has been reached. Eventually the moment opposing the rotation about O' becomes so large that O"P replaces O'P, and the inclination angle is reduced to θ". The elastic energy stored in O' can now be released and the O'Pswings in the opposite direction to the moving surface. The cycle can now recommence resulting in oscillatory behaviour. Others extended this idea in an attempt to model a brake system more completely. Jarvis and Mills used a cantilever rubbing against a rotating disc in 1963, Earles and Soar used a pin-disc model in 1971, and North introduced his eight-degree of freedom model in 1972. The culmination of these efforts was a model published by Millner in 1978. Millner modelled the disc, pad and caliper as a 6 degree of freedom, lumped parameter model and found good agreement between predicted and observed squeal. Complex eigenvalue analysis was used to determine which configurations would be unstable. Parameters investigated included the coefficient of pad friction, Young‟s modulus of pad material, and the mass and stiffness of caliper. Squeal propensity was found to increase steeply with the coefficient of friction, but squeal would not occur below a cut off value of 0.28. He found that for a constant friction value, the occurrence of squeal and squeal frequency depends on the stiffness of pad material (Young‟s modulus). Caliper mass and stiffness also displayed distinct narrow regions where squeal propensity was high. The common conclusions of these models are that brake squeal can be caused by geometrically induced instabilities that do not require variations in the coefficient of friction. Since these closed form theoretical approaches cannot adequately model the complex interactions between components found in practical brake systems, their applicability has been limited. However, they do provide some good insight into the mechanism of brake squeal by highlighting the physical phenomena that occur when a brake system squeals.

Experimental methods are expensive mainly due to hardware cost and long turnaround time for design iterations. Frequently discoveries made on a particular type of brakes or on a particular type of vehicles are not transferable to other types of brakes or vehicles. Product development is frequently carried out on a trial-and-error basis. There is also a limitation on the feasibility of the hardware implementation of ideas. A stability margin is usually not found experimentally. Unfortunately, this produces designs that could be only marginally stable.

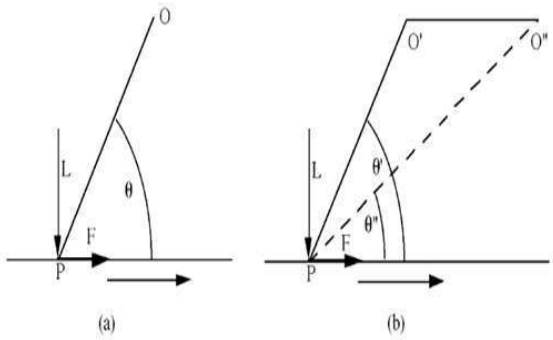

Fig 3 (a) Single strut rubbing against moving surface; (b) Sprag slip system

B. Experimental Methods

The frequencies of a squealing brake are highly dependent on the natural frequencies of the brake rotor. Consequently it is of fundamental importance to be able to determine the vibration modes of the rotor. Not only will an understanding of the vibration modes of the rotor help predict how a brake system may vibrate, but it is also necessary in developing countermeasures to eliminate the problem. The existence of in-plane modes in addition to the bending modes is a further complication, and there is evidence that the in-plane modes can be the cause of some type of brake squeals as well as the bending modes. Accelerometers provide an effective tool for determining the vibration mode shapes and the forced

response of a system. Fig. 4(a) shows a bending mode shape of a typical brake rotor that has been determined experimentally. A model was created using STAR MODAL software that consisted of 384 grid points over the surface of a brake rotor. Frequency response measurements were made with a B&K 2032 FFT analyser using a B&K 4374 uni-axial accelerometer and a B&K 8001 impedance head. The excitation was introduced with a B&K 4810 shaker driven by a random noise signal. Unfortunately, the contact mounting required for accelerometers limits their usage on rotating brake components. They can only be used for analysis of stationary brake components making it almost impossible to determine the mode shapes of a squealing brake rotor. Optical techniques have been used more recently. In particular, double pulsed laser holographic interferometry has been successfully applied to squealing brake systems. This has allowed the coupled mode shapes of a complete brake system to be determined while it is squealing. A holographic image is produced by triggering a laser at the maximum and minimum amplitude of a vibrating object. The difference in optical path length, caused by the deformed shape of the vibrating object, creates an interference fringe pattern on a holographic plate. The mode shape can then be determined by interpreting the fringe pattern. The advantage of holographic interferometry is that the mode shapes of a brake rotor can be determined while it is squealing. Included in the holographic image can be the rotor as well as the pads, anchor bracket and caliper. The technique can be applied to a brake system mounted on a brake dynamometer. Suspension components, such as the spindle, spring and damper, can also be included to simulate the on car performance of the brake system. An example of the value of double pulsed holography in investigating a squealing brake was work done by Nishiwaki et al. in 1989. In the brake system that was being investigated it was apparent that the mode shape of the vibrating brake rotor was stationary with respect to the brake caliper. Hence, the mode shape is also stationary with respect to the area of excitation. The rotor was modified by changing the symmetry of the rotor about its axis of rotation. The mode shapes of the modified rotor must now rotate with respect to the area of excitation, preventing the rotor from vibrating in the original vibration mode.

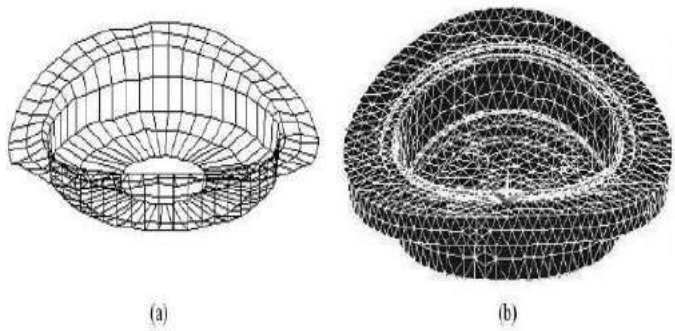

Fig. 4 (a) Experimental bending mode shape (b) FEA bending mode shape

C. Numerical Methods

Finite element analysis (FEA) has been used in the analysis of brake squeal. CAE simulation and analysis methods play an important role in understanding brake squeal mechanism. Numerical modeling, on the other hand, can simulate different structures, material compositions and operating conditions of a disc brake or of different brakes or of even different vehicles, when used rightly. With these methods, noise improvement measures can be examined conceptually before a prototype is made and tested. Theoretical results can also provide guidance to an experimental set-up and help interpret experimental findings. It can also be used to interpret test results, prepare for upfront DoE (design of experiment), simulate structural modifications and explore innovative ideas.

Ansys 14.5 solves the brake squeal problems effectively. To predict the onset of instability a modal analysis is performed on the prestressed structure. An unsymmetric stiffness matrix is a result of the friction coupling between the brake pad and disc; this may lead to complex eigenfrequencies. If the real part of the complex frequency is positive, then the system is unstable as the vibrations grow exponentially over time. Three different methods to perform a brake squeal analysis are present in Ansys 14.5.

1) Full Nonlinear Perturbed Modal Analysis.

2) Partial Nonlinear Perturbed Modal Analysis.

3) Linear Non-prestressed Modal Analysis.

A full nonlinear perturbed modal analysis is the most accurate method for modeling the brake squeal problem. This method uses nonlinear static solutions to both establish the initial contact and compute the sliding contact. A partial nonlinear perturbed modal analysis is used when a nonlinear solution is required to establish contact but a linear analysis can be used to compute the sliding contact.

A linear non-prestressed modal analysis is effective when the stress-stiffening effects are not critical. This method requires less run time than the other two methods, as no nonlinear base solution is required. The contact-stiffness matrix is based on the initial contact status.

IV. CONCLUSION

Presently, research into brake squeal is focused on specific brake systems. The challenge for the future is to be able to develop general techniques and guidelines to eliminate brake squeal during the design stage. Given the complexity of the mechanisms that generate brake squeal, it appears that general guidelines are some way off in the future. For the present, the reduction of squeal noise for specific brake systems is achievable, with the additional knowledge acquired in each case adding to the overall understanding of brake squeal.

Theoretical analysis of brake systems is difficult given the complexity of the mechanisms and the lack of an adequate model for the friction interface that causes brake squeal. However, this should not limit the development of simplified models as valuable insight can be gained. Understanding obtained by studying simplified models can assist in the interpretation of experimental results and the development of improved computational tools

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Boiler Performance Optimization

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Abstract- Survival market is not only based on the quality of the product but also the cost of the product. Today we are in era of competition where performance of products, its production time and production cost are considered as integral parts of quality. Any enterprise ignoring to optimize cost will eventually be perished by others who strive to achieve cost reduction by maintaining or enhancing the quality of the product. So, we begin this paper by quoting the definition of the energy efficiency in context to the above discussion. Energy efficiency is "using less energy to provide the same service". Here we have chosen the most common utility i.e. Boiler and discussed about various parameters that impact boiler efficiency and possible energy conservation measures. The main purpose served by boilers is to convey heat for process applications. Boilers are therefore essentially operated to generate the required quantity and quality of steam with least possible fuel consumption and thus at minimum cost.

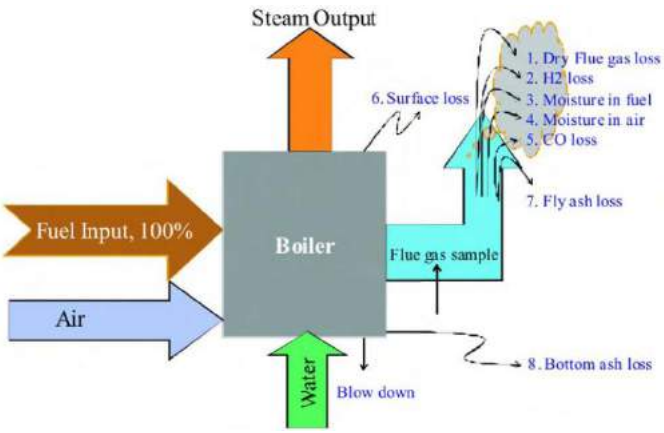
INTRODUCTION

Performance of the boilers, like efficiency and evaporation ratio reduces with time, due to various reasons which include poor combustion, heat transfer fouling, deterioration of fuel quality, water quality, poor operation and maintenance, high flue gas temperature, excess air supply to boilers etc. The boiler efficiency test helps to indentify the existing performance level of the boiler and identify the necessary corrective actions to bring the boiler performance to the optimized leading to conservation of energy. The British Standard BS845: 1987 describes the methods and conditions for the boiler testing. In India we are utilizing IS 8753: Indian Standard for Boiler Efficiency Testing. The boiler performance are tested based on

i. *The Direct Method:* This is also known as input-output method due to the fact that it need only the useful output (steam) and the heat input (i.e. fuel) for evaluating the efficiency.

ii. *The Indirect Method:* The indirect method is also called as heat loss method. The efficiency is arrived at by subtracting the heat loss fractions from 100. The standard does not include the blowdown loss in the efficiency determination process.

PARAMETERS AFFECTING THE BOILER PERFORMANCE:



1. *Loss due to dry flue gas (Sensible heat):* It represents the % heat carried out by the flue gases. The stack temperature should be as low as possible. However, it should not be so low that water vapor in the exhaust condenses on the stack walls. This is important in fuels containing significant sulphur as low temperature can lead to sulphur dew point corrosion. Stack temperatures greater than 200°C indicates potential for recovery of waste heat. It also indicates the scaling of heat transfer/recovery equipment and hence the urgency of taking an early shut down for water / flue side cleaning. ***Controlling excess air to an optimum level always results in reduction in flue gas losses; for every 1% reduction in excess air there is approximately 0.6% rise in efficiency.***

THEORETICAL COMBUSTION DATA – COMMON BOILER FUELS		
Fuel	*kg of air req./kg of fuel*	*CO 2% in flue gas achieved in practice*

Solid Fuels		
Bagasse	3.3	10-12
Coal (bituminous)	10.7	10-13
Lignite	8.5	9 -13
Paddy Husk	4.5	14-15
Wood	5.7	11.13
Liquid Fuels		
Furnace Oil	13.8	9-14
LSHS	14.1	

TYPICAL VALUES OF EXCESS AIR LEVELS FOR DIFFERENT FUELS

Fuel	*Type of Furnace or Burners*	*Excess Air(% by wt)*
Pulverized coal	Completely water-cooled furnace for slag-tap or dry-ash removal	15-20
	Partially water-cooled furnace for dry-ash removal	15-40
Coal	Spreader stoker	30-60
	Water-cooler vibrating-grate stokers	30-60
	Chain-grate and traveling-grate stokers	15-50
	Underfeed stoker	20-50
Fuel oil	Oil burners, register type	15-20
	Multi-fuel burners and flat-flame	20-30
Natural gas	High pressure burner	5-7
Wood	Dutch over (10-23% through grates) and Hofft type	20-25
Bagasse	All furnaces	25-35
Black liquor	Recovery furnaces for draft and soda-pulping processes	30-40

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2. *Heat loss due to evaporation of water formed due toH2 in fuel (%):* The combustion of hydrogen causes a heat loss because the product of combustion is water. This water is converted to steam and this carries away heat in the form of its latent heat. This loss thus varies as per the % H_2 is the fuel.
3. *Heat loss due to moisture present in fuel:*

   Moisture entering the boiler with the fuel leaves as a superheated vapour. This moisture loss is made up of the sensible heat to bring the moisture to boiling point, the latent heat of evaporation of the moisture, and the superheat required to bring this steam to the temperature of the exhaust gas
4. *Heat loss due to moisture present in air:*

   Vapour in the form of humidity in the incoming air, is superheated as it passes through the boiler. Since this heat passes up the stack, it must be included as a boiler loss.

   To relate this loss to the mass of coal burnt, the moisture content of the combustion air and the amount of air supplied per unit mass of coal burnt must be known.
5. *Heat loss due to incomplete combustion:*

   Products formed by incomplete combustion could be mixed with oxygen and burned again with a further release of energy. Such products include CO, H_2, and various hydrocarbons and are generally found in the flue gas of the boilers. CO is the only gas whose concentration can be determined conveniently in a boiler plant test.
6. *Heat loss due to radiation and convection:*

   The other heat losses from a boiler consist of the loss of heat by radiation and convection from the boiler casting into the surrounding boiler house. Normally surface loss and other unaccounted losses is assumed based on the type and size of the boiler as given below:
   - For industrial fire tube / packaged boiler = 1.5 to 2.5%
   - For industrial water tube boiler = 2 to 3%
   - For power station boiler = 0.4 to 1%
7. *Heat loss due to unburnt carbon in fly ash and bottom ash:*

   Small amounts of carbon will be left in the ash and this constitutes a loss of potential heat in the fuel. To assess these heat losses, samples of ash must be analyzed for carbon content. The quantity of ash produced per unit of fuel must also be known.

Case Study: Onsite Observation for Multifuel travelling grate boiler

Particular	Onsite Observed Data
Ambient air Temperature (^oC)	31
Gross calorific value (GCV) adjusted based on moisture present in as on received coal sample (kCal/kg)	4489
Gross calorific value (GCV) as on received ash sample (kCal/kg)	1055
Average Steam Pressure (kg/cm^2)	15.5
Average Steam Temperature (^oC)	60.5
Steam Temperature (^oC)	520

Steam extraction no 1	7 TPH (P = 5 kg/cm^2)
Steam extraction no 2	9.4 TPH (P = 21 kg/cm^2)
Percentage of boiler loading (%)	91.11
Feed water Temperature (^{o}C) – inlet to economizer	85
Feed water Temperature (^{o}C) – outlet from economizer	213
Power generation (kW)	400
Air flow rate at FD fan– inlet to air preheater (m^3/sec)	35
BOILER SURFACE Temperature (^{o}C) • Boiler front side near coal feeder • Boiler bagasse side • Below travelling grate (bagasse side) • Boiler rare side, below travelling gate • Boiler road side • Below travelling gate road side	142.6 37.6 and 39.9 92.5 97.5 38.1 and 41.2 89.2
CO_2 in exhaust gas (%)	7.5
O_2 in exhaust gas (%)	9.5
Air Temperature (^{o}C)– inlet to air preheater	26
Air Temperature (^{o}C)– outlet fromair preheater	103.5
Furnace Temperature (^{o}C)	677.3
Flue gasTemperature (^{o}C) – inlet of economizer	383.3
Flue gas Temperature (^{o}C) – outlet of economizer	167.6
Flue gas Temperature (^{o}C) – outlet of air preheater	131
Flue gas Temperature (^{o}C)– ESP outlet i.e. supply to chimney via ID fan	109.8
Feed water tank Temperature (^{o}C)	64.6
Deaerator tank Temperature (^{o}C)	81.9
Feed water line Temperature (^{o}C)	70.6
Water Temperature (^{o}C) - Inlet of economizer	84.7
Water Temperature (^{o}C) – outlet of eco	213.3
Outlet of pre-super heater header Temperature (^{o}C)	328
Outlet of super heater header Temperature (^{o}C)	388
De super heater 1 Temperature (^{o}C)	210
De super heater 2 Temperature (^{o}C)	208
De-super heater 3 Temperature (^{o}C)	253.5
Average Wind Velocity (m/s)	3
Fuel Analysis (%)	
Moisture	39.89
Ash	11.89
Carbon	41.80
Hydrogen	1.38
Nitrogen	1.15
Oxygen	3.89

Results and Recommendations for Efficiency Improvement:

Input/ Output Parameter	**kCal / kg of fuel**	**%**
Heat Input in fuel	4489	100
Various Heat losses in boiler		
1. Dry flue gas loss	6.43%	
2. Loss due to hydrogen in fuel	1.74%	
3. Loss due to moisture in fuel	5.57%	
4. Loss due to moisture in air	0.24%	
5. Partial combustion of C to CO	0.00%	
6. Surface heat losses and blow down loss	5.00%	
7. Loss due to Unburnt in fly ash and	2.81 %	
8. Loss due to Unburnt in bottom ash		
Total Losses	**= 21.78 %**	
Boiler efficiency = 100 – (1+2+3+4+5+6+7+8) **= 78.2%**		

RECOMMENDATION:

AREAS OF IMPROVEMENT

Combustion of coal: -

Efficient combustion of fuel requires availability of oxygen at reactive condition of fuel. Spreader stoker is suitable for 30% Oversize, 30% Size, 40% undersize.

It is essential that at operating firing rate of around 4 tons per hour, 1.3 tons per hour should fall on last 30% length, 1.3 tons per hour in the middle zone and rest in last 30% or in

suspension. Such distribution can be verified only in cold condition.

Effect of the above on Air to fuel ratio: -

Air follows least resistance path. Zone where coal bed height is less, air tends to flow more in that zone. Therefore unless height of coal bed is uniform, air flow cannot be adjusted.

At present to maintain the desired unburnt Carbon, air to fuel ratio is 11.66 kg/kg. Theoretical requirement of air is 5.16 Kg/Kg. Thus, about 126% excess air is being used.

Normally 50% excess air is recommended, provided distribution of coal is uniform on grate.
Reduction of air can result into savings of

Savings potential:

Increase in efficiency- reduction in heat losses by stack

= (126%- 50%) x 5.16 kg/kg x0.24kcal/kg-^{o}C x (130-30)^{o}C/4489 kcal/kg

= 2.01%

Fuel savings

= 2.01% x (2.16 x 1000) kg/hr x 24hrs/day x 300 days per year

=313 tonnes of coal

Savings in INR

= 313 tones X INR 3700/ton

= 11.58 lakh per year

Energy Conservation/ Monitoring Parameters for Boilers:

- Remove soot deposits when flue gas temperature raises 40°C above the normal. A coating of 3mm thick soot on the heat transfer surface can cause an increase in fuel consumption of as much as 2.5%.
- Recover heat from steam condense. For every 6°C rise in boiler feed water temperature through condense return, there is 1% saving in fuel.
- Improve boiler efficiency. Boilers should be monitored for flue gas losses, radiation losses, incomplete combustion, blow down losses, excess air etc. Proper control can decrease the consumption upto 20%.
- Use only treated water in boilers. A scale formation of 1mm thickness on the waterside would increase fuel consumption by 5-8%.
- Stop steam leakage. Steam leakage from a 3 mm-diameter hole on a pipeline carrying steam at 7kg/cm^2 would waste 32 kl of fuel oil per year.
- Maintain steam pipe insulation. It has been estimated that a bare steam pipe, 150 mm in diameter and 100m in length, carrying saturated steam at 8kg/cm^2 would waste 25 kl of furnace oil in a year.

CONCLUSION:

The reduction of heat losses due to dry flue gases, moisture present in fuel and air, incomplete combustion force the major impact on the performance of boiler. In the case study to improve the efficiency of the boiler the requirements for air combustion of coal is recommended. Also some energy conservation methods also discussed.

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TECH-CHRONICLE
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DESIGN OF AN ALTERNATIVE ARRANGEMENT FOR STACKING OF BARE WELDING RODS

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Abstract: Automation in production is need of today's industry. Automation enhances the production, increases accuracy, improves quality and reduces the chances of accidents. Keeping this in mind we have taken problem from 'Weld Well Industries Pvt. Ltd', the manufacturers of welding rods. In industry, the wire rods are being cut by the cutting machine and are collected in a pot. Then the cut rods are collected in a rack manually. The company needs a system which will enable them to stack the rods directly in the rack without any human intervention. This paper focuses on the basic steps involved in the welding rod manufacting and the design of new system for stacking of rods.

Keywords: Stacking of rods, welding electrode process, automation for collection of bare electrodes

1.0 INTRODUCTION

In fabrication of various equipments and constructions works generally we need welding electrodes made up of Mild steel & its alloys. M.S. Welding Electrode is the most widely used core wire.

Welding electrodes consists of steel core wire and flux Besides mild steel, nickel, Nickel-copper, Nickel irons are also used in MIG & TIG welding.

To improve the product Quality Company frequently does third party inspection, R & D on the existing and for new components. Company has marked its presence in business, and proved themselves as an example for their peers. In these years, they have gained immense trust from their customers and consumers.

Weldwell Electrodes Pvt. Ltd was established in the year 1985, the company got reputation in the field of electrode making from last 30 years, and hence are one of the trustworthy manufacturers and suppliers of a gigantic compilation of Welding Electrodes & Mig Wire. Main product of the company consists of Mild Steel Electrodes, Low Hydrogen Electrodes and Creep Resistant Electrode that are manufactured as per the preset IS, AWS, LRS, DNV, BV, IRS, ABS, BIS and DIN standards.

3.0 STEPS INVOLVED IN ELECTRODE MANUFACTURING

3.1 Step I: Wire Drawing

A 5 mm diameter wire is drawn through the rollers by two step reduction process. In Each step 0.5mm dia. is reduced.

Figure 3.1: Wire Drawing Process

Figure 3.2: Dry Drawing Lubricant used by Weld well company

3.2 Step II: Wire Cutting

The wire drawn from the Step-I is then cut into the required lengths by cutting machine as is collected in the container as shown.

Figure 3.3: Cut wire collected in container

3.3 Step III: Flux Coat Preparation

Figure 3.4: Powder formed for flux coat preparation

3.4 Step IV: Flux Coating

When a flux-coated electrode is heated up, part of the flux burns and forms a gaseous shield which keeps the oxygen away from the weld. This prevents the formation of a poor weld which occurs when iron burns in oxygen. Another part of the flux melts and mixes with the weld pool, the impurities of which float and are easily removed when the weld joint cools down.

Flux coating on the electrodes ensures a weld with good mechanical properties, chemical composition and weld metal cleanliness

Figure 3.5: Flux coating by extrusion

3.5 Step V: Flux Drying (De-moisturizing)

Electrodes must be kept dry. Moisture destroys the desirable characteristics of the coating

and may cause excessive spattering and lead to porosity and cracks in the formation of the welded area. Electrodes exposed to damp air for more than two or three hours should be dried by heating in a suitable oven for two hours at 500°F (260°C).

Figure 3.6: Flux de-moisturizing in oven

3.6 Step VI: Finishing [1]

The flux at end of the welding rod is removed by brush and other end is chamfered by means of grinder. It is done so that one end must be properly gripped to the welding holder and proper arc formation at other end. Both these process are done at a time.

Figure 3.7: Finishing of electrodes

3.7 Step VII: Quality Checking & inspection

Weight of electrodes is measured and checked. Also core wire diameter, length and flux coating thickness, moisture is inspected. [1]

Figure 3.8: Inspection of electrode

4.0 SPRING DESIGN

Let **Dm/d = c** (Spring Index)

The spring will be subjected to direct shear load and a torque T.

The resultant shear stress on the section will be

$\tau max = T/Zp + F/A$…….(1)

For Round Wire

$Zp = \pi/16 \times d^3$

$A = \pi/4 \times d^2$

$T = F.Dm/2$

$\tau max = 8FDm/\pi d^3 + 4F/\pi d^2$

$= 8FDm/\pi d^3 [1+ 0.5d/Dm]$

$= 8FDm/\pi d^3 [1+ 0.5/c]$

$= K1\ 8FDm/\pi d^3$

The quantity [1+ 0.5/c] is called shear stress multiplication factor and is denoted by K_1.

The deflection of the helical spring having n, effective turns is given by

$\delta = 8FDm3n/ Gd4$

The equation for the spring stiffness (Ks) is given by,

$Ks = F/\delta$

$= Gd / 8c^3n$

As per our design consideration, we need the spring which will get compressed by 5mm under the action of 50 N Force.

It means the spring should have a stiffness of Ks= 10N/mm.

i.e Fmax = 50N

Ks = 10N/mm

Free Length =40mm

Material Cr- Vanadium Steel (Cr-V Steel)

From Table VIII-9

Sys = 770MPa,

G = 85 GPa

Di =Dm-d+d(c-1)

=10 (assumed)

d = 10/(c-1)

No. of effective turns,

$$n = Gd/ 8c^3Ks$$

$$= \frac{85x\ 10^3\ x\ 10}{80\ c^3(c-1)}$$

$$= 10625/ c^3(c-1)$$

Total no. of turns

$$n1 = n+1.75$$

Minimum free length

$$= n1 X d + \delta max$$

$$40 = [10625/ c^3(c-1) +1.75]\ 10/(c-1) + 50/10$$

After solving this equation we get

C = 4.5 (Spring index)

d =2.85mm

= 3mm (Wire Diameter)

Dm = 12.5mm (Mean Diameter)

Ball Bearing of size 6205 (i.e. Dia =25mm bore) is used for the wheels of the trolley

5.0 ALTERNATIVE ARRANGEMENT FOR COLLECTION OF BARE RODS

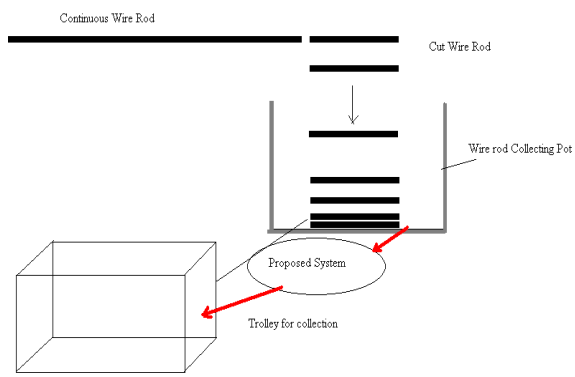

Figure 5.1: Conceptual model of system

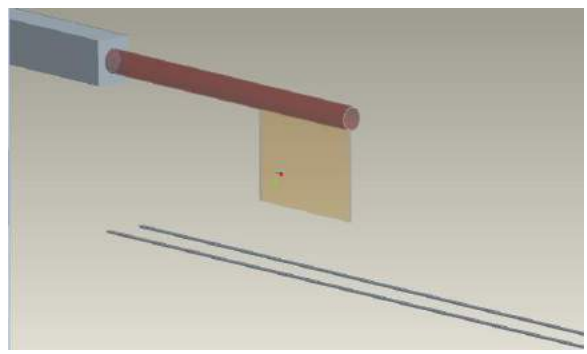

Figure 5.2: Electrode exit arrangement

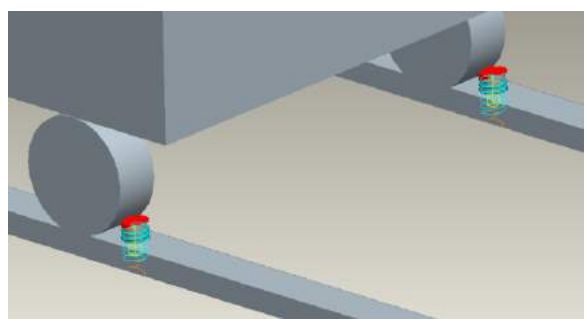

Figure 5.3: Spring stopper having weight sensor

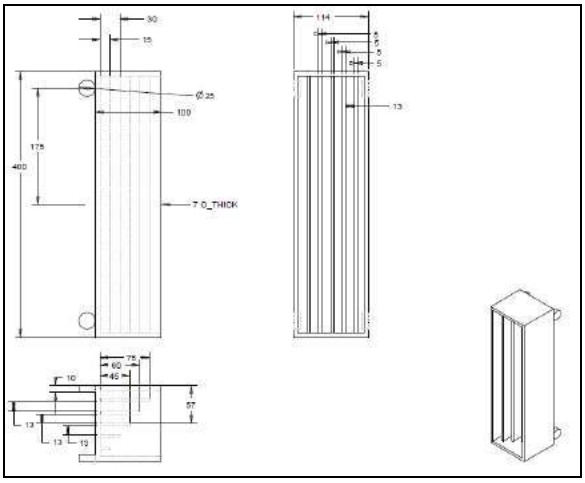

Figure 5.4: Drafting of the trolley prepared

6.0 CONCLUSION

After the cutting of wire, the bare rods are collected in container which is further stacked in a trolley manually. Two operators were engaged for the collection and stacking of wire rods in the trolley.

The time needed for collection and stacking of 100 bare rods was around 4.5 to 5 mins with existing system.

The proposed system eliminates the one of the operators. Also the time required for the collection of 100 bare rods is reduced to around 2.5 to 3 mins. Hence adopted by the company for the future work.

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TECH-CHRONICLE
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Experimental Investigation of Solar Air Heater

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Abstract: In the current scenario the whole world is looking for solar energy because of its abundant availability, The solar energy has found good response in heating applications and thus air heater is most commonly used solar application. It is advantageous and its main features are its cost-effectiveness. In this paper we are focused on how to improve the performance of glass covered solar air heater with help of experimental investigation of interrelationship of various parameters to understand its behavior and further opportunities to optimize and predict its performance under variable environmental as well as working conditions. Our main motive is to improve the Air outlet temperature, which is the function of inlet air, plate and glass temperature. To optimize productivity we are segregating the performance efficiency of air heater in 3 factors as follows, to proper utilize the solar flux and to raise the air outlet temperature.

The efficiencies are categorized as follows:

1) **Efficiency when solar radiations are absorbed by air as well as oil and there is no fall in oil temperature.**
2) **Efficiency when heat to the air is supplied by solar radiation as well as oil.**
3) **Efficiency when air is being heated only due to the heat released by oil. This term will not exist because the calculated efficiency in this case will always come as infinity since S=0 W/m^2.**

INTRODUCTION

Burned engine oil is filled in the inner bed as shown in the figure 1. In this case the incident solar radiations are utilized for raising the temperature of air as well as the temperature of oil. Hence the useful heat gain will be the addition of heat gained by air as well as heat gained by oil. Useful heat gain is calculated by both the cases, viz. by theoretical and experimental approach, and on the basis of it their efficiencies are calculated and compared.

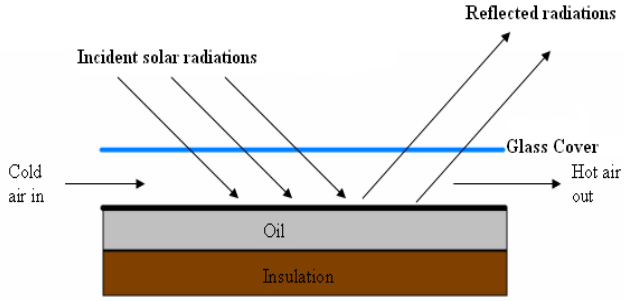


Figure No.1

$U_b=k_i/\delta_b=0.05/0.075=0.67 W/m^2K$

$U_s= (L_1+L_2)\ L_3\ k_i/L_1L_2\delta_s=0.163 W/m^2K$

Experimental approach

Velocity measured with Anemometer of air through duct of diameter 6cm = 6.5m/s

Density of air at average intake air temperature 430C=1.08kg/m3

Mass flow rate m'= ρ A v

= 0.0198 kg/s

Measure mV with the help of pyranometer

Convert it into incident solar flux (W/m2)

S = mV*1000/13.27

Useful heat gain for air $q_{uair}= m_{air}C_{pair}(T_{oair}-T_{iair})$

Useful heat gain for oil $q_{uoil} = m_{oil}\ C_{poil}\ (T_{final}-T_{initial})/3600$

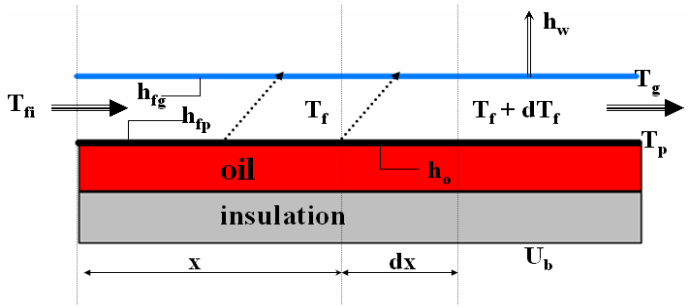
Useful heat gain for oil $q_{uoil} = m_{oil}\ C_{poil}\ (T_{final}-T_{initial})/3600$

Net Total useful heat gain $q_u = q_{uair} + q_{uoil}$

Solar air heater efficiency = $q_u/S*A$

Thus efficiency of solar air heater is calculated for the day and Graph of solar air heater efficiency vs. time is plotted.

Analysis:



$$S\,dA = h_{fp}(T_p-T_f)dA + h_o(T_p-T_o)dA + \frac{\sigma dA(T_p^4-T_g^4)}{(1/\varepsilon_p+1/\varepsilon_g-1)}$$

$$\sigma dA(T_p^4-T_g^4) = \frac{h_r(T_p-T_g)dA}{(1/\varepsilon_p+1/\varepsilon_g-1)}$$

$$S\,dA = h_{fp}(T_p-T_f)dA + h_o(T_p-T_o)dA + h_r(T_p-T_g)dA$$

For Fluid

$$m'C_{pf}dT_f = h_{fp}(T_p-T_f)dA + h_{fg}(T_g-T_f)dA$$

For Glass

$$h_r(T_p-T_g)dA = h_w(T_g-T_a)dA + h_{fg}(T_g-T_f)dA$$

For Oil

$$h_o(T_p-T_o)\,A = C_{po}\rho_o v_o(dT_o/dt) + U_b(T_o-T_a)\,A$$

$$m'C_{pf}dT_f = h_{fp}(T_p-T_f)\,dA + h_{fg}(T_g-T_f)\,dA$$

$$m'C_{pf}dT_f / dA = h_{fp}(T_p-T_f) + h_{fg}(T_g-T_f)$$
$$= h_{fp}\,T_p - h_{fp}\,T_f + h_{fg}\,T_g - h_{fg}\,T_f$$

$$m'C_{pf}dT_f / dA = h_{fp}\,T_p + h_{fg}\,T_g - T_f(h_{fp} + h_{fg})$$

put $(h_{fp}\,T_p + h_{fg}\,T_g) = a$

$(h_{fp} + h_{fg}) = b$

$$m'C_{pf}dT_f / dA = a - Tf*b$$

$$\frac{1}{a-T_f*b}\,dT_f = \frac{dA}{m'C_{pf}}$$

$$\frac{A}{m'C_{pf}} = -\frac{1}{b}\ \ln\ 1-\frac{(T_{fo}-T_{fi})\,b}{a-T_{fi}\,b}$$

$$(T_{fo}-T_{fi}) = \frac{a-T_{fi}b}{b}\quad 1 - \exp\ -\frac{b\,A}{m'C_{pf}}$$

Substituting $(h_{fp}\,T_p + h_{fg}\,T_g) = a$

$(h_{fp} + h_{fg}) = b$

for simplicity let us assume $h_{fp} = h_{fg}$

now $a=h_{fp}(T_p+T_g)$

and $b=2\,h_{fp}$

$T_{fo}-T_{fi} = (T_g+T_p-2T_{fi})/2 * (1-\exp\{-2h_{fp}A /m'C_{pf}\})$

$T_{fo} = T_{fi} + ((T_g+T_p-2T_{fi})/2 * (1-\exp\{-2h_{fp}A /m'C_{pf}\}))$ ----------(a)

If T_{fi} , T_g , T_p are known at any instant then T_{fo} can be calculated for that particular instant.

Sample calculation

Time: 9 a .m.

Plate temperature T_p = 80°C

Glass Temperature T_g = 76°C

Air inlet temperature T_{fi} = 49°C

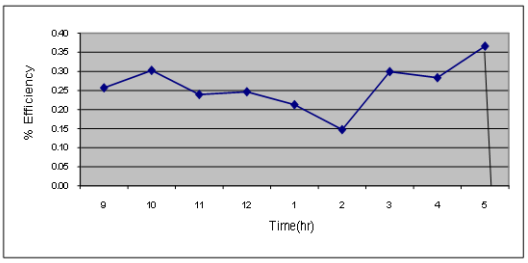
Air outlet temperature T_{fo} = 58°C

Mean film temperature = $(T_p+T_g)/2$ = 351 K

Properties at 351 K

ρ = 0.995 Kg/m^3 , C_p = 1010J/KgK , μ = 20.80 *10^{-6} Ns/m^2 , k = 0.03 W/mK

Equivalent diameter = 4*0.9*0.08/2(0.9+0.08) =0.1469m
Average velocity = 0.0198/(0.995*0.9*0.08) =0.2763 m/s
Re = 0.995 *0.2763* 0.1469/(20.80*10^{-6})
Re = 1941.61



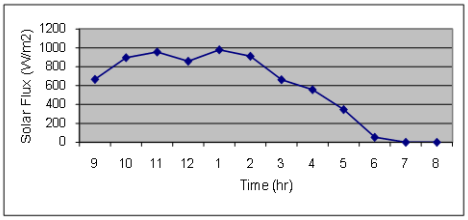
Nu = 0.0158 * (1941.61)$^{0.8}$
Nu = 6.74
h_{fp} = 6.74 * 0.03/0.1469 =1.378W/m^{2}K
substituting this value in equation(a)
we get T_{fo} = 54.0°C
% error =(58-54)/58 =0.0689 =6.89%

Inlet air temperature(°C) T_{fi}	*Plate Temperature (°C) T_p*	*Glass Temperatu-re (°C)T_g*	*Measured Outlet Air Temperatu-re(°C)*	*Outlet Air Temperature By $T_{fo} = T_{fi} + ((T_g+T_p-2T_{fi})/2 * (1-\exp\{-2h_{fp}A /m'C_{pf}\}))$*	*% Error*
49	80.0	65.0	58.0	54.0	7%
51	100.0	85.0	63.8	59.8	6%
50	105.0	88.0	63.8	59.8	6%
52	95.0	78.0	63.3	59.3	6%
52	104.0	87.0	65.2	61.2	6%
53	103.0	86.0	65.8	61.8	6%
52	94.0	77.0	63.1	59.1	6%
54	90.0	73.0	63.8	59.8	6%
52	72.0	55.0	58.4	54.4	7%
45	54.0	37.0	49.1	45.1	8%
45	49.0	32.0	48.0	44.0	8%
44	46.0	29.0	46.6	42.6	9%

TABLE NO. 1

This table shows that the outlet air temperatures obtained by the derived formula are nearly equal to the measured outlet air temperatures.

Conclusion:



Graph No.1 Solar Flux Vs Time

Let us divide the performance efficiency of this air heater in following 3 zones

efficiency when solar radiation are absorbed by air as well as oil and there is no fall in oil temperature.

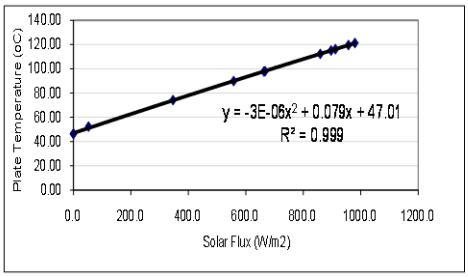
efficiency when heat to the air is supplied by solar radiation as well as oil.

Efficiency when air is being heated only due to the heat released by oil. This term will not exist because the calculated efficiency in this case will always come as infinity since S=0 W/m^2

Graph No.2 % Efficiency Vs Time

Mathematical Modeling for glass covered oil based flow over absorber plate solar air heater

1) Incident Solar Flux Vs Plate Temperature



GRAPH NO. 3 INCIDENT SOLAR FLUX VS OIL TEMPERATURE

Solar Flux (w/m^2)	Plate Temperature oC	Plate temperature measured by $y = -3E-06x^2 + 0.0792x + 47.01\ 8$ $R^2 = 0.9998$	% Error
666.9	98.08	99.84	-2%
896.8	115.18	118.04	-2%
957.0	119.67	122.82	-3%
859.1	112.38	115.06	-2%
979.7	121.35	124.61	-3%
911.8	116.30	119.24	-3%
663.1	97.80	99.54	-2%
557.6	89.95	91.18	-1%
346.6	74.25	74.47	0%
52.8	52.39	51.20	2%

Table No. 2

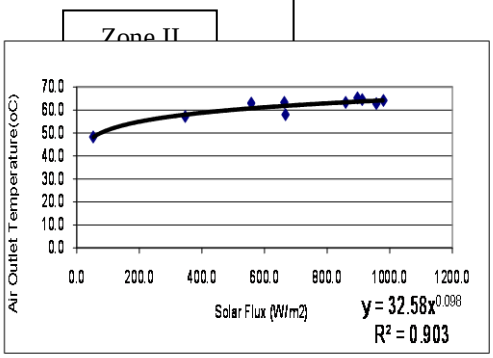
The governing equation for the relation between incident solar flux and plate temperature for oil based glass covered solar air heater is found out to be exponential. The relation is $y = -3E-06x^2 + 0.0792x + 47.018$ with regression value $R^2 = 0.9998$. Here in this equation y= Plate temperature in ^oC and x= Incident Solar flux in W/m^2. This equation is quite satisfactory over a large span of incident solar flux ,because the maximum % error in the plate temperature found by using this equation could be not more than 3% and It is obtained only in single case.

2) Incident Solar Flux Vs Oil Temperature

GRAPH NO. 4 SOLAR FLUX VS. OIL TEMPRATURE

Incident Solar Flux(W/m^2)	Oil temperature (^oC)	oil temperature (^oC) $y = 60.073e0.0003x$ $R^2 = 0.9047$	%Error
666.9	70	73.38	-5%
896.8	73	78.62	-8%
957.0	75	80.05	-7%
859.1	76	77.73	-2%
979.7	79	80.60	-2%
911.8	79	78.97	0%
663.1	74	73.30	1%
557.6	70	71.01	-1%
346.6	65	66.66	-3%
52.8	61	61.03	0%

TABLE NO. 3



The governing equation for the relation between incident solar flux and oil temperature for oil based glass covered solar air heater is found out to be exponential. The relation is $y = 60.073e0.0003x$ with regression value $R^2 = 0.9047$. Here in this equation y= oil temperature in ^oC and x= Incident Solar flux in W/m^2. This equation is quite satisfactory over a large span of incident solar flux ,because the maximum % error in the plate temperature found by using this equation could be not more than 8% and It is obtained only in single case.

Solar Flux Vs air outlet Temperature

Graph No. 4 Solar Flux Vs Air Outlet Temperature

Solar Flux (W/m^2)	Measured Air Outlet Temperature(oC)	Air Outlet Temperature by $y = 32.586x^{0.0985}$ $R^2 = 0.9032$	% Error
666.9	58.0	61.830	-7%
896.8	65.3	63.660	2%
957.0	62.8	64.070	-2%
859.1	63.3	63.392	0%
979.7	64.1	64.217	0%
911.8	64.5	63.765	1%
663.1	63.3	61.796	2%
557.6	63.0	60.750	4%
346.6	57.2	57.971	-1%
52.8	48.3	48.158	0%

Table No. 4

The governing equation for the relation between incident solar flux and air outlet temperature for oil based glass covered solar air heater is found out to be power. The relation is $y = 32.586x^{0.0985}$ with regression value R^2 =0.9032. Here in this equation y= air outlet temperature in ^oC and x= Incident Solar flux in W/m^2. This equation is quite satisfactory over a large span of incident solar flux, because the maximum % error in the plate temperature found by using this equation could be not more than 7% and It is obtained only in single case.

Glass Covered Solar Air Heater with Flow over Absorber Plate

(Without Oil Bed)

Equation (a) for finding out air outlet temperatures which is the function of inlet air, plate and glass temperature can be used for finding out outlet air temperature for the same solar ir heater. Here we will use the relation derived in chapter 7for finding out plate temperature and glass temperature.

Time	*Solar Flux (W/m2)*	*Inlet air temperature(oC)*	*Plate Temperature(oC) by y=48.738 e0.001x*	*Glass Temperature (oC)*	*Outlet air temperature by Tfo = Tfi + ((Tg+Tp-2Tfi)/2 * (1-exp{-2hfpA /m'Cpf}))*	*Useful Heat Gain (W)*	*% Efficie-ncy*
9	715.9	49	99.719	82.7	57.9	178.2121	14.6%
10	896.8	50	119.488	102.5	63.7	273.1654	17.8%
11	957.0	50	126.913	109.9	64.5	288.78	17.6%
12	859.1	52	115.070	98.1	63.5	230.3451	15.7%
1	979.7	52	129.815	112.8	66.7	292.5868	17.5%
2	911.8	53	121.303	104.3	65.7	252.4339	16.2%
3	663.1	52	94.595	77.6	59.2	143.9202	12.7%
4	557.6	54	85.124	68.1	58.8	95.4978	10.0%
5	346.6	52	68.931	51.9	53.8	35.58799	6.0%
6	52.8	44	51.378	34.4	44.6	10.99121	12.2%

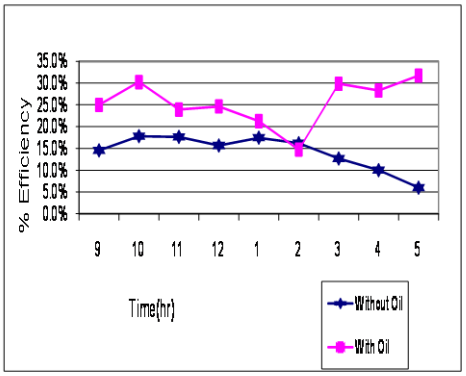
Table No. 5

Graph No.5 Comparison of Efficiencies for Solar Air Heater With And Without Inclusion Of Oil.

CONCLUSION

Solar air heaters are significantly saves the household emission; reducing the amount of air pollution and greenhouse gases that created from the use of fossil fuels. The cost of installing a solar air heater can be rather expensive, however there are many local utility companies or state agencies offering rebates for solar systems. To make the solar air heaters more effective we enhance the efficiency of the solar air heater by dividing ino the following ways.

1. Efficiency when solar radiation are absorbed by air as well as oil and there is no fall in oil temperature.
2. Efficiency when heat to the air is supplied by solar radiation as well as oil.
3. Efficiency when air is being heated only due to the heat released by oil. This term will not exist because the calculated efficiency in this case will always



come as infinity since S=0 W/m^2

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Parametric Optimization of GMAW Welding Process

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***Abstract*— The study aimed at the investigation of the effect of preheating, shielding gas flow rate and heat input on the hardness of weldment. In this study, 304 stainless steel was bonded by MIG welding with Argon as a shielding gas and hardness properties of the welded samples at different points from the weld center line was investigated. For that purpose welding was done with different level of preheat, shielding gas flow rate and heat input. Welding samples were characterized by means of hardness test on optical Brinell hardness tester. Hardness test revealed that for all welding parameters hardness in HAZ and weld metal was higher than parent metal.**

With application of design of experiment (DOE) mathematical relationship between the welding process input parameters and output variable like hardness of welded joint in order to determine the welding input parameters that lead to desired weld hardness. Preheat, shielding gas flow rate, and heat input are selected as input parameter and hardness as output parameter. By application of response surface methodology and Tanguchi method of DOE, relationship between these parameters and Hardness was developed.

The experiment result show that the heat input has greatest effect. Gas flow rate has second largest effect on hardness and preheat has very little effect on hardness of weldment.

Keywords*— *MIG, SS 304, Preheat Gas flow rate, Heat input; Hardness.

I. Introduction

The GMAW welding process is easily found in any industry whose products require metal joining in a large scale. It establishes an electric arc between a continuous filler metal electrode and the weld pool, with shielding from an externally supplied gas, which may be an inert gas, an active gas or a mixture. The heat of the arc melts the surface of the base metal and the end of the electrode. The electrode molten metal is transferred through the arc to the work where it becomes the deposited weld metal (weld bead).

The quality of the welded material can be evaluated by many characteristics, such as bead geometric parameters (penetration, width and height), hardness, residual stresses and deposition efficiency (ratio of weight of metal deposited to the weight of electrode consumed). These characteristics are controlled by a number of welding parameters, and, therefore, to attain good quality, is important to set up the proper welding process parameters. Out of these properties hardness is important property because hardness determines the impact strength, toughness and crack susceptibility of welded joint.

Unfortunately, an underlying mechanism connecting welding parameters and quality characteristics is usually not known. Traditionally, it has been necessary to determine the weld input parameters for every new welded product to obtain a welded joint with the required specifications. To do so, requires a time-consuming trial and error development effort, with weld input parameters chosen by the skill of the engineer or machine operator. Then welds are examined to determine whether they meet the specification or not. Finally the weld parameters can be chosen to produce a welded joint that closely meets the joint requirements. Also, what is not achieved or often considered is an optimized welding parameters combination, since welds can often be produced with very different parameters. In other words, there is often a more ideal welding parameters combination, which can be used if it can only determined.

In order to overcome this problem, various optimization methods can be applied to define the desired output variables through developing mathematical models to specify the relationship between the input parameters and output variables. In the last two decades, design of experiment (DoE) techniques has been used to carry out such optimization.

The Taguchi method is a systematic application of design and analysis of experiments for the purpose of designing and improving product quality. In recent years, the Taguchi method has become a powerful tool for improving productivity during research and development so that high quality products can be produced quickly and at low cost.

One of the most widely used methods to solve this problem is the response surface methodology (RSM), in which

the experimenter tries to approximate the unknown mechanism with an appropriate empirical model, being the function that represents it called a response surface model Identifying and fitting from experimental data a good response surface model requires some knowledge of statistical experimental design fundamentals, regression modeling techniques and elementary optimization methods

II. GAS METAL ARC WELDING (GMAW) OF AISI 304

Gas Metal Arc Welding (GMAW) is a welding process which joins metals by heating the metals to their melting point with an electric arc. The arc is between a continuous, consumable electrode wire and the metal being welded. The arc is shielded from contaminants in the atmosphere by a shielding gas.

A. Objective solution to be used

There remains a continuing requirement in the art of TIG welding to achieve even greater penetration levels of welding involving penetration activating fluxes without affecting the quality of the weld to end use and applications and also to improve upon the productivity for welding by greater penetration of weld without degrading the microstructure and mechanical properties. Hence need of optimization rises.

1. Comparative study of coated uncoated sample.
2. Find out the most effective parameter by Taguchi Method.
3 .Enhancement of weld Penetration.
4. Study the effect on tensile strength on welded sample.

B. Different Phase of Experimentation

Phase-I

1. Development of experimental setup providing varying range of input parameters in ATIG Welding and measuring the various responses.
2. Investigation of the working range and the level of ATIG Welding parameter (pilot run) affecting the selected quality characteristics, by using one factor at a time approach.

Phase-II

1 .Investigation of the effect of the ATIG process parameter on quality characteristics that is welding penetration.
2. Optimization of quality characteristics of ATIG Welding.

a) Prediction of optimal sets of ATIG Welding process parameter

b)Prediction of optimal value of quality characteristics welding penetration.

c)Determination of confidence interval (95%).

3. Experimental verification of optimized quality characteristics.

The Taguchi's parameter design approach has been used to obtain the above objective.

III.SYSTEM DEVELOPMENT

To study the effect of Welding Process parameter on weld Penetration in TIG Welding a heat source is required. Heat source produce an electric arc to generate heat to melt the metal and form a weld for this purpose continuous supply of either direct or alternating electric current. The experiments were carried out on INARC400-i series IGBT Inverter based arc welding power source with soft switching technology

This TIG welding machine has fallowing technical specifications

Input power	18.4 KVA
Current range	20A-400 A
Duty cycle	60%
Weight	43 Kg
Input supply	380-440 V
Efficiency at full load	89%
Power factor	0.95
Ambient Temperature	40 degree C

A. Details of Test Specimens

AISI304 Steel material plate is used, as it has a very large scale application in the process industry. Sample of 100mm×70mm×5mm size has been used as a work piece material and bead on welding is done for present experiments.

The SS304 sheet is converted in the desired work pieces size by using shearing operation. After shearing the work pieces are straighten by holding them in a press. The burr from the cut edges of the work pieces is removed by manual filing.

Table I- Chemical Composition of Test specimens

Chemical Analysis	**C**	**Si**	**Mn**	**P**	**S**	**Cr**	**Ni**
%	**0.036**	**0.066**	**1.57**	**0.017**	**<0.03**	**18.05**	**8.57**

C. Activated Flux Powder

Activated flux can increase the joint penetration, mainly because the surfactant (surface-active element) in the molten pool switches the surface tension gradient, and consequently reverses the Marangoni convection pattern, resulting in a deep-penetration weld. To clarify this uncertainty, this study used following flux powder.

Table II- Activated Flux Powder Used

Sr. No	1	2	3	4	5
Activated Flux Powder	Cr2o3	Tio2	Al2o3	Cao	Sio2

c. Preparation of Specimens

The SS304 sheet is converted in to the desired 100mm×70mm×5mm size by using shearing operation. After shearing the work pieces are straighten by holding them in a press. The burr from the cut edges of the work pieces is removed by manual filing the plate surface was ground using 400 grit (silicon carbide) flexible abrasive paper to remove impurities, and then cleaned with acetone .The Thirty number of SS304 plate of are prepared. The various flux powders were mixed with acetone to make a paint-like consistency. A brush was used to apply the mixture on the joint surface to be welded. The mean coating density of flux powder was 4.3 mg/cm2.The four set of plates are made from thirty plates.

Table III- Chemical Composition of Test specimens

Sr.No	1	2	3	4	5	6
Sample	TiO2 Coated	Cr2O3 Coated	Al2O3 Coated	Uncoated	CaO Coated	SiO2 Coated

D. Effect of current on weld penetration

Welding current is the most influential parameter because it affects bead shape, controls the rate at which electrode is melted and therefore also controls the deposition rate, heat affected zone, the depth of penetration, and the amount of base metal melted. For studying the effect of current on weld penetration with following parameter constant.

Gas flow rate 10 LPM, Welding speed 1.6 mm/s and torch angle 60 degree. Following result are observed for various current.

Table IV: Effect of Welding Current on Weld Penetration

Sr.No	***Welding current A***	***Weld penetration in mm***
1	150	2.5
2	200	3.1
3	250	4.1
4	300	5.0

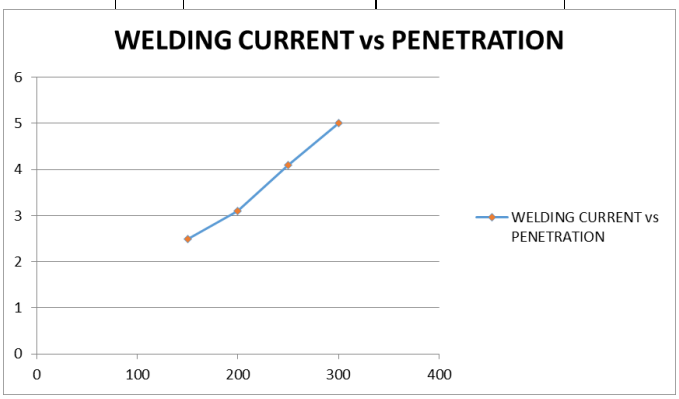


FIG-I Graph Effect of Welding Current on Weld Penetration

E. Effect of gas flow rate on weld penetration

In the second case Shielding gases are used in GTAW in order to prevent atmospheric contamination of the weld metal. This contamination can produce porosity, weld cracking, scaling and even change in the chemical composition of melted material. Besides shielding

Gas also has a large influence on the stability of the electric arc. Gases with low ionization potential facilitate the ignition of the electric arc and those with low thermal conductivity tend to increase the arc stability. Argon is the most used GTAW shielding gas. It has low ionization potential and is heavier than air, providing an excellent shielding of the molten weld pool.

To study the effect of gas flow rate on weld penetration with following parameter constant Current 200 A, Welding speed 1.6 mm/s and torch angle 60 degree. Following result are observed for various Gas flow rate.

Table V: Effect of Welding Current on Weld Penetration

Sr.No	***Gas flow rate(LPM)***	***Weld penetration in mm***
1	5	3
2	10	3.5
3	15	5.0

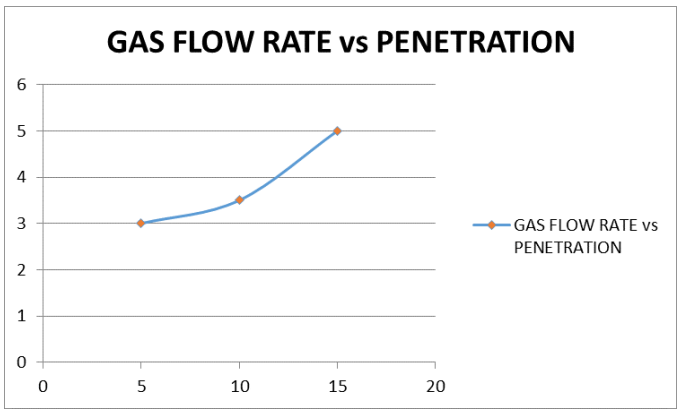


Fig II: Graph Effect of Welding Gas Flow Rate on Weld Penetration

F. Effect of welding speed on weld penetration

In the third case, the effect of time on undercut Welding speed is the linear rate at which an arc is moved along the weld joint. With any combination of welding voltage and welding current, the effect of changing 106 the welding speed confirms to a general pattern. To study the effect of Welding speed on weld penetration with following parameter constant Current 200 A, Gas flow rate 10 LPM and torch angle 60 degree. Following result are observed for various Welding speed.

Table VI: Effect of Welding Speed on Weld Penetration

Sr.No	*Welding speed*	*Weld penetration in mm*
1	6.66	3
2	3.33	3.5
3	1.66	5.0

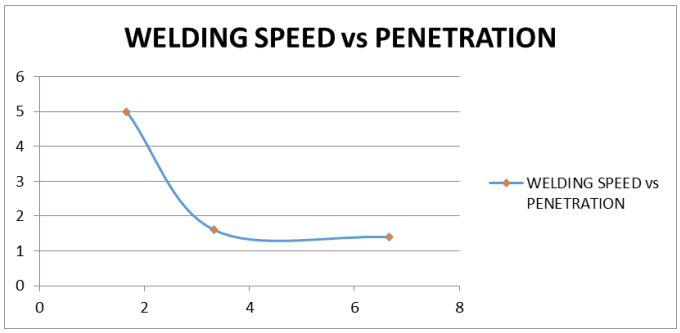


FIG III. Graph Effect of Welding speed on Weld Penetration

G. Effect of torch angle on weld penetration

In the third case, the effect of the torch may be held perpendicular to the work piece or, tilted forward or backward with respect to the weld pool. As the arc stream tends to align itself along the axis of the electrode, the weld pool shape is different in each case, and so is the shape of the weld bead. To study the effect of torch angle on weld penetration with following parameter constant Current 200 A, Gas flow rate 10 LPM, 1.6 mm/s and torch angle 60 degree. Following result are observed for various torch angles on weld penetration.

Table VI: Effect of Torch Angle on Weld Penetration

Sr.No	*Torch Angle in degree*	*Weld penetration in mm*
1	60	5
2	75	3
3	90	1.6

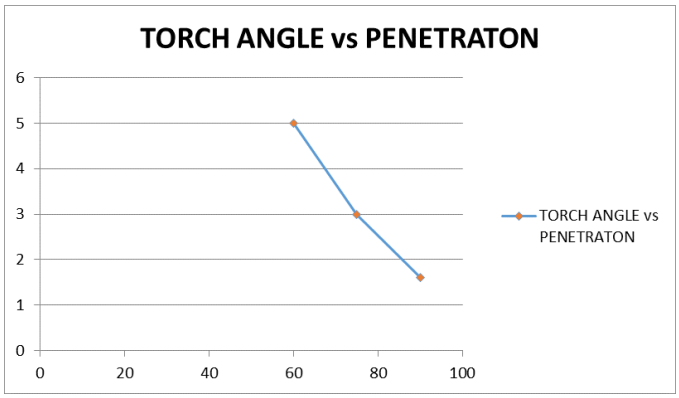


FIG IV: Graph Effect of Torch angle on Weld Penetration

III. Taguchi's Experimental Design and Analysis

Taguchi's comprehensive system of quality engineering is one of the greatest engineering achievements of the 20th century. His methods focus on the effective application of engineering strategies rather than advanced statistical techniques. It includes both upstream and shop-floor quality engineering. Upstream methods efficiently use small-scale experiments to reduce variability and remain cost-effective, and robust design for large –scale production and market place. Shop-floor techniques provide cost based real time methods for monitoring and maintaining quality in production. The farther upstream a quality method is applied, the greater leverage it produces on the improvement, and the more it reduces the cost and time. Taguchi's philosophy is founded on the following three very simple and fundamental concepts (Ross, 1988; Roy 1990):

1. Quality should be design into the product and not inspected into it.

2. Quality is best achieved by minimizing the deviations from the target. The product or process should be so designed that it is immune to uncontrollable environmental variables.

3. The cost of quality should be measured as a function of deviation from the standard and the losses should be measured system-wide.

Taguchi proposes an "off-line" strategy for quality improvement as an alternative to an attempt to inspect quality into a product on the production line. He observed that poor quality cannot be improved by the process of inspection, screening and salvaging. No amount of inspection can put quality back into the product. Taguchi's recommends a three stage process: system design, parameter design and tolerance design. In the present work Taguchi's parameter design approach is used to study the effect of process parameters on the depth of penetration of the Metal Inert Gas Welding process.

A. Loss function

The Taguchi loss function recognizes the customer's desire to have products that are more consistent, part to part, and a producer's desire to make a low-cost product. The loss to society is composed of the costs incurred in the production process as well as the costs encountered during use by the customer (repair, lost business, etc.). To minimize the loss to society is the strategy that will encourage uniform products and reduce cost at the point of production and at the point of consumption.

The heart of Taguchi method is his definition of the nebulous and elusive term 'quality' as the characteristic that avoid loss to the society from the time the product is shipped (Braker, 1986). Loss is measured in terms of monetary units and is related to quantifiable product characteristic.

Taguchi defines quality loss via his 'loss function'. He unites the financial loss with the function specification through a quadratic relationship that comes from a Taylor series expansion. The quadratic function takes the form of a parabola. Taguchi defines the loss function as a quality proportional to the deviation from the nominal quality characteristic (Roy, 1990). He has found the following quadratic form to a useful workable function (Roy, 1990):

$$L(y) = k(y-m)^2 \quad (1)$$

Where,

L = Loss in monetary units

M = value at which the characteristics should be set

Y = actual value of the characteristic

K =constant depending on the magnitude of the characteristics and the monitory unit involved

The characteristics of loss function represented as below:

1. The farther the product's characteristic varies from the target value, the greater is the loss. The loss must be zero when the quality characteristic of a product meets its target value.

2. The loss is a continuous function and not a sudden step as in the case of traditional (goal post) approach. This consequence of the continuous loss function illustrates the point that merely makes a product within the specification limits does not necessary mean that product is of good quality.

A. Average loss-function for product population

In a mass production process, the average loss per unit is expressed as (Roy, 1990):

$$L(y) = (1/n)*\{k (y_1-m)^2 + k (y_2-m)^2 + \ldots\ldots + k (yn-m)^2\} \quad (2)$$

Where,

y_1, y_2, y_n = Actual value of the characteristic for unit 1, 2, 3…….n respectively.

n = Number of units in a given sample

k = Constant depending on the magnitude of the characteristic and the monetary units involved.

m = Target value at which the characteristic should be set.

The eq^n can be simplified as,

$$L(y) = k\,(MSDNB) \quad (3)$$

Where,

MSDNB =Mean squared deviation or the average of squares of all deviation from the target or nominal value

NB = "Nominal is Best"

B. Signal to noise ratio

The loss function discussed above is an effective figure of merit for making engineering design decision. However, to establish an appropriate loss-function with its k value to use as a figure of merit is not always cost-effective and easy. Recognizing the dilemma, Taguchi created a transform function for the loss-function which is named as signal-to-noise ratio(S/N ratio) (Barker, 1990).

The S/N ratio, as stated earlier, is a concurrent statistic. A concurrent statistics is able to look at two characteristics of a distribution and roll these characteristics into a single number or figure of merits. The S/N ratio combines both the parameters (the mean level of the quality characteristics and variance around this mean) into a single metric (Barker, 1990).

The S/N ratio consolidate several repetition (at least two data point are required) into one value. The equation for calculating S/N ratios for 'smaller is better' (LB), 'large is better' (HB) and 'nominal is best' (NB) type of characteristics are as follows (Ross, 1998):

1) Larger the Better: $(S/N)\ HB = -10 \log (MSDHB)$ (4)

Where, $MSDHB = (1/R)\ \Sigma\ (1/y^2_j)$

2) Smaller the Better: $(S/N)\ LB = -10 \log (MSDLB)$ (5)

Where, $MSDLB = (1/R)\ \Sigma\ (y^2_j)$

3) Nominal the Best: $(S/N)\ NB = -10 \log (MSDNB)$ (6)

Where, $MSDNB = (1/R)\ \Sigma\ (y_j-y_0)^2$

R= Number of repetitions. The mean square deviation (MSD) is a statistical quality that reflects the deviation from the target value. The expressions for MSD are different for different quality characteristics. For the 'nominal is best' characteristics, the standard definition of MSD is used. For the other two characteristics the definition is slightly modified. For 'smaller is better', the unstated target value is zero. For

'larger is better' the inverse of each large value becomes a small value and again, the unstated target value is zero. Thus for all three expression, the smallest magnitude of MSD is being sought.

C. Steps in experimental design and analysis

I) Selection of orthogonal array (OA)

In the selecting an appropriate OA, the pre-requisites are (Roy1990, Ross, 1988):

a) Selection of process parameters and/or interactions to be evaluated

B)Selection of number of levels for the selected parameters

The determination of which parameter to investigate is depend upon the product or process performance characteristics or response of interest (Ross, 1988). Several methods are suggested by Taguchi for determining which parameters to include in an experiment. These are (Ross, 1988):

1. Brainstorming
2. Flow charting
3. Cause effect diagrams

The total Degree of Freedom (DOF) of an experiment is a direct function of total number of trial. If the number of levels of a parameter increases, the DOF of the parameter also increases because the DOF of a parameter is the number of level minus one. Thus, increase the number of levels for a parameter increases the total degree of freedom in the experiment which in turn increases the total number of trials. Thus, two levels for each parameter are recommended to minimize the size of the experiment (Ross, 1988). If curved or higher order polynomial relationship between the parameter under study and the response is expected, at least three level of each parameter should be considered (Barker, 1990).

The standard two levels and three level arrays (Taguchi and Wu, 1979) are:

1. Two level array: L4, L8, L12, L16, and L32.
2. Three level array: L9, L18, and L27.

The number as subscript in the array designation indicates the number of trial in that array. The total degrees of freedom (DOF) available in an OA are equal to the number of trial minus one (Ross, 1988):

$$fLN = N-1 \quad (7)$$

Where,

fLN = Total degree of freedom of an OA

LN = OA designation

N = Number of trial

When a particular OA is selected for an experiment, the following inequality must be satisfied (Ross, 1988):

fLN ≥Total degree of freedom required for parameters and interaction

Depending on the number of level of the parameters and total DOF required for the experiment, a suitable OA is selected.

D) Assignment of Parameters and interaction to the OA

The OA's have several columns available for assignment of parameters and some columns subsequently can estimate the effect of interaction of these parameters.

Taguchi has provided two tools to aid in the assignment of parameters and interactions to arrays (Ross, 1988; Roy, 1990):

1. Linear graphs
2. Triangular tables

Each OA has a particular set of linear graphs and a triangular table associated with it. The linear graph indicates various columns to which parameters may be assigned and the columns subsequently evaluate the interaction of these parameters. The triangular table contains all the possible interaction between parameters (columns). Using the linear graphs and or the triangular table of the selected OA, the parameters and interactions are assigned to the columns of the OA. The linear graph of L09 OA is given in Table.

E. Selection of outer array

Taguchi separates factors (parameters) into two main group: controllable factors and uncontrollable factor (noise factors). Controllable factors are factors that can easily be controlled. Noise factors, on the other hand, are nuisance variable that are difficult, impossible, or expensive to control (Byrne and Taguchi, 1987). The noise factors are responsible for the performance variation of a process. Taguchi recommends the use of outer array for the noise factor and inner array for controllable factors. If an outer array is used, the noise variation is forced into the experiment. However, experiments against the trial condition of the inner array (The OA used for the controllable factors) may be repeated and in this case the noise variation is unforced into the experiment (Byrne and Taguchi, 1987). The outer array, if used, will have same assignment considerations. However, the outer array should not be complex as the inner array because the outer array is noise only which is controlled only in the experiment (Ross, 1988).

*E.*Selection of orthogonal array

Taguchi orthogonal design uses a special set of predefined arrays called orthogonal arrays (OAs) to design the plan of experiment. These standard arrays stipulate the way of full information of all the factors that affects the process performance. The corresponding OA is selected from the set of predefined OAs according to the number of factors and their levels that will be used in the experiment. For the present experimental work, three factors with their three levels are used for which the corresponding orthogonal array is L9 which is shown in Table.

Table 4.2: L-9 Orthogonal Array

Exp No	*Process Parameter*		
	Welding Current	*Gas flow rate*	*Welding Speed*
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

F.. Conduction of experiments

By putting the values of three levels of three parameters in L9 Orthogonal array , the nine set of experiments with different values of parameters are obtained as fallows

Experiment No.1 Current=150Amp.

Gas flow rate=10.0 LPM. Welding speed = 6.66 mm/s.

Experiment No.2 Current=150Amp.

Gas flow rate =12.5 LPM. Welding speed = 3.33 mm/s.

Experiment No.3 Current=150Amp.

Gas flow rate =15.0 LPM. Welding speed = 1.66 mm/s.

Experiment No.4 Current=175Amp.

Gas flow rate=10.0 LPM. Welding speed = 3.33 mm/s.

Experiment No.5 Current=175Amp.

Gas flow rate =12.5 LPM. Welding speed = 1.66 mm/s.

Experiment No.6 Current=175Amp.

Gas flow rate =15.0 LPM. Welding speed = 6.66 mm/s.

Experiment No.7 Current=200Amp.

Gas flow rate=10.0 LPM. Welding speed = 1.66 mm/s.

Experiment No.8 Current=200Amp.

Gas flow rate =12.5 LPM. Welding speed = 6.66 mm/s.

Experiment No.9 Current=200Amp.

Gas flow rate =15.0 LPM. Welding speed = 3.33 mm/s.

Table 4.3: Experimental Results

Sr No	*Welding Current(Amp)*	*Gasflow rate(LPM)*	*Welding speed(mm/s)*	*Weld Penetration(mm)*
1	150	10	6.66	1.6
2	150	12.5	3.33	2.5
3	150	15	1.66	2.7
4	175	10	3.33	3.0
5	175	12.5	1.66	5.0
6	175	15	6.66	3.0
7	200	10	1.66	2.5
8	200	12.5	6.66	2.5
9	200	15	3.33	2.0

G. Analysis of S/N ratio

In the Taguchi Method the term Signal represents the desirable value (mean) for the output characteristic and the term Noise represents the undesirable value (standard deviation) for the output characteristic. Therefore, the S/N ratio to the mean to S.D.S/N ratio used to measure the quality characteristic deviating from the desired value.

The S/N ratio is defined as n=10log (M.S.D.) Where, M.S.D is the mean square deviation for the output characteristic. To obtain optimal welding performance, higher the better quality characteristic can be taken and S/N ratio is calculated for each experiment.

Table 4.4: Analysis of S/N Ratio

Sr No	*Welding Current(Amp)*	*Gas flow rate(LPM)*	*Welding speed{mm/s)*	*Weld Penetration(mm)*	*S/N Ratio*
1	150	10.0	6.66	1.6	4.08
2	150	12.5	3.33	2.5	7.95
3	150	15.0	1.66	2.7	8.62
4	175	10.0	3.33	3.0	9.54
5	175	12.5	1.66	5.0	13.97
6	175	15.0	6.66	3.0	9.54
7	200	10.0	1.66	2.5	7.95
8	200	12.5	6.66	2.5	7.95
9	200	15.0	3.33	2.0	6.02

H. S/N Response analysis

The S/N Response is calculated for each level of each parameter as fallows

[1]Welding Current

Level 1=[4.08240+7.95880+8.62728]/3=6.8894

Level 2=[9.54243+13.9794+9.54243]/3=11.0214

Level 3=[7.95880+7.95880+6.02060]/3=7.3127

[2] Gas flow rate

Level 1=[4.08240+9.54243+7.95880]/3=7.1945

Level 2 =[7.95880+13.9794+7.95880]/3=9.9656

Level 3=[8.62728+9.54243+6.02060]/3=8.0634

[3] Welding speed

Level1=[4.08240+9.54243+7.95880]/3=7.1954

Level 2 =[7.95880+9.54243+6.02060]/3=7.84601

Level 3 =[8.62728+13.9794+7.95880]/3=10.1884

Table 4.5: S/N Response Table for Weld Penetration

Symbol	*Input Parameter*	*Mean S/N Ratio*		
		Level 1	*Level 2*	*Level 3*
A	Welding Current	6.889	11.021	7.313
B	Gas flow rate	7.195	9.966	8.063
C	Welding speed	7.195	7.841	10.188

J. Finding the optimal process parameters

Regardless of the category of the quality characteristic, a greater S/N ratio corresponds to better quality characteristics. Therefore, the optimal level with the greatest S/N ratio. The optimal levels of process are

Current =A 2 = 175Amp

Gas flow rate =B 2 = 12.5 LPM

Welding speed =C3 = 1.6 mm/s.

Maximum Penetration = T + (A2-T) + (B2-T) + (C3-T)

=A2+B2+C3-2T (8)

A2=Average value of penetration at the second level of current=[3.0+5.0+3.0]/3=3.66

B2=Average value of penetration at the second level of gas flow rate=[2.5+5.0+2.5]/3=3.33

C3=Average value of penetration at the third level of welding speed=[2.7+5.0+2.5]/3=3.4

T=Overall mean of penetration

=[1.6+2.5+2.7+3.0+5.0+3.0+2.5+2.5+2.0]/9=2.75

By putting the respective values, we get

Maximum penetration = 3.66+3.33+3.4-2x2.75

= 10.39 – 5.5

= 4.89 mm

I. Confirmation experiment

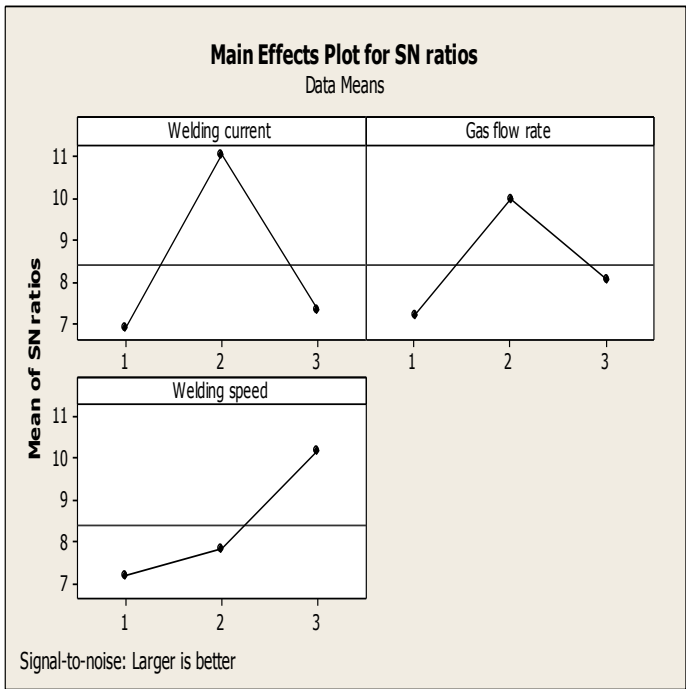
Once the optimal level of process parameters has been selected, the final step is to carry out the confirmation experiment by taking the optimal values of process parameter which are as fallows

Current =A 2 = 175Amp

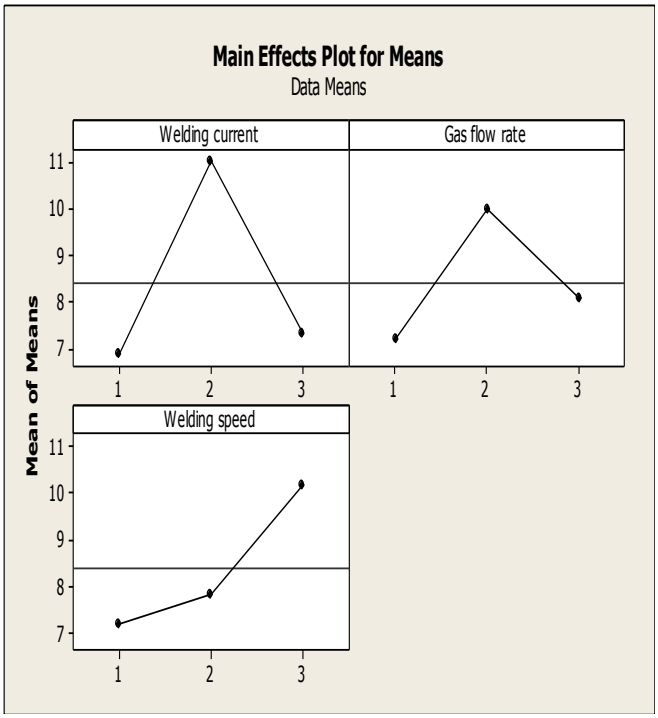
Gas flow rate =B 2 = 12.5 LPM

Welding speed =C3 = 1.6 mm/s.

The above set of optimal process parameters are not found in orthogonal array so we have to carry out confirmation experiment. After carrying out confirmation experiment the actual penetration obtained is 5.00 mm.



Graph 4.1: Main Effects Plot for S/N Ratio



Graph 4.2: Main Effect plot for Means

K. Analysis of Variance

Analysis of variance (ANOVA) is the statistical treatment most commonly applied to the results of the experiments to determine the percentage contribution of each parameter against a stated level of confidence. Analysis of Variance (ANOVA) is a statistically based objective decision making tool for detecting any difference in average performance of groups of items tested. The decision rather than pure judgments, take variation in to account. The experimental design and subsequent analysis like ANOVA are intrinsically tied to each other. Analysis of Variance (ANOVA) breaks total variation down into accountable source and total variations is decomposed into its appropriate components.

The P-value approach is widely adopted in practice risks implied by specific value or level of significance. The P- value is probability that the tests statistics will take on a value that is at least extreme as the observed value of the statistic when the null hypothesis Ho is true. Thus, the P- values convey much information about the weight of evidence against the Ho and so a decision maker can draw a conclusion at any specified level of significance. The P- value is therefore the smallest level of significance that would lead to rejection of the null hypothesis Ho. Detail step for ANOVA are given below for weld penetration in (mm). Calculation of correction factor:

1. Correction Factor (C.F.) = (Total) ^{2}/ T.C. (9)

2. Total Sum of Square (SS_T) = $\sum y^2$ - C.F. (10)

3. Sum of Squares due to Current (SS cur) = $\sum y_{cur}^2$ - C.F. (11)

4.Sum of Squares due to gas flow rate = $\sum y_{gas\ flow\ tate}^2$ - C.F. (12)

5) Sum of Squares due to speed (SS_{speed}) = $\sum y_{speed}^2$ - C.F. (13)

6) Sum of Squares due to Error (SS_E) = SS_T - (SS_{cur} + $SS_{gas\ flow\ rate}$ + SS_{speed}) (14)

In order to statistically analyze the result, ANOVA was performed. Process variables having p-value<0.05 are considered significant terms for the requisite response characteristics. The insignificant parameters were having p value larger than 0.05.

The ANOVA.

Table 4.6 Analysis of Variance for SNRA1, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS
Welding current	2	3.7422	3.7422	1.8711
Gas flow rate	2	1.5622	1.5622	0.7811
Welding speed	2	1.8956	1.8956	0.9478
Error	2	0.0622	0.0622	0.0311
Total	8	7.2622		

S = 0.176383 R-Sq = 99.14% R-Sq (adj) = 96.57%

IV. CONCLUSION

The optimum response for welding penetration by Taguchi Method is given as below

1. According to Taguchi methods, an attempt is made to determine set of values of process variable at their selected levels

2. To have predicted optimum value of welding penetration 4.89 mm but actual value of welding penetration is 5.00 mm at conditions of confidence interval as in table Conclusion according to Taguchi method.

Table 5.1: Predicted Vs Actual Value of Welding Penetration

Response	*Predicted Value*	*Actual Value*
Welding Penetration Set of optimum value of process parameter are as follows • Welding Current 175 Amp • Gas flow rate 12.5 LPM • Welding Speed 1.66 mm/sec	4.89 mm	5.0 mm

In addition to welding Penetration one additional test is performed to analyze what happened to tensile strength. The standard value of tensile strength for 5mm AISI304 Plate is in the range of 540 to 750 N/mm2 and when the Specimen is welded with Cr2O3 Coating and at the level of optimum Parameter in addition to full Weld Penetration the tensile strength found to be 707 N/mm2 which is within Standard range of Tensile strength.

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TECH-CHRONICLE
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Performance and Evaluation of Solar Powered Bicycle: A Review

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ABSTRACT: **This paper gives the details about the research papers related to the solar power bicycle project and includes the methods and considerations regarding the proper working of the bicycle. The main components of this project is Solar PV panel, Brushless motor, Charge controller and battery. This paper will deals with the main idea of the component and here we compare the different component of solar bicycle.**

Solar energy is one of the renewable energy which can be a feasible and can be used as alternative fossil fuels. In this work, a solar powered bicycle is fabricated by modifying allcomponents of existing geared bicycle. This paper deals with the design, assembly and performance evaluation of the bicycle. This paper highlights the advantages of dual mode of charging and economic feasibility of the bicycle.

Keywords:Solar PV panel, Brushless motor, Charge controller.

LITERATURE REVIEW

A. M. REDDI SANKAR, T. PUSHPAVENI, V. BHANU PRAKASH REDDY, present a paper on "DESIGN AND DEVELOPMENT OF SOLAR ASSISTED BICYCLE" Process.

The solar assisted bicycle developed is driven by DC motor fitted in front or rear axle housing & operated by solar energy. The solar panels mounted on the carriage will charge the battery & which in turn drive the hub motor. When the bicycle is idle, the solar panel will charge the battery. This arrangement will replace the petrol engine, the gear box & the fuel tank in case of a two wheeler or a chain sprocket, chain & gear shifting arrangement of a conventional bicycle being used by most common man. As a part of dissertation work, the solar assisted bicycle is fitted with a dc hub motor on front axle of a bicycle with power rating of 250W and with a travelling speed of around 25-30 kmph. It is provided with a pair of lead acid batteries of 35 Ah each, a photovoltaic solar panel with capacity of 20 watt, a voltage regulator of 24v 10 Amp, accelerator and motor controller of 24v 25Amp. There is also a provision for charging of the battery with 220-240V, AC wall outlet supply, in case of poor solar supply due to cloudy weather.

B. ABDULKADIR BABA HASSAN, present a paper on „„,DESIGN AND FABRICATION OF A MOTORIZED D.PROTOTYPE TRICYCLE FOR THE DISABLE PERSONS"""":

This project design is embodied on a motorized tricycle for disabled Persons. The tricycle was specifically designed to suit wheelchair occupants of healthy Upper torso with pelvic to foot restraint. It is also designed to suit a commonly available Wheel chair. The level of relationship between the disabled people in the society has highly being jeopardized; therefore this project was designed to correct the difficulties in mobility of the wheelchair users. The main aim of the project design is to ease mobility for the physically challenged and also provide adequate comfort they desire. Existing tricycles for the disables requires the disabled person to dismount from the wheelchair onto the tricycle.

The motorized tricycle in this project is designed to overcome this problem by allowing the disabled person to wheel up or down his wheelchair onto or down the tricycle. This is achieved using a specially designed platform that allows the wheel chair to be wheeled up or down. The prototype of this tricycle has been fabricated. The anthropometrics data that need to be considered in the design of the platform and frame of the tricycle have been taken into consideration at the design stage of the tricycle.

C. N.SASIKUMAR, DR.P.JAYASUBRAMANIAM, present a paper on "SOLAR ENERGY SYSTEM IN INDIA".

Conventional energy sources like coal, oil, natural gas, etc., are limited in quantity, and if these continue to be depleted at the present rate, these will be exhausted in the coming decades. Energy demand is resulting in the creation of fossil fuel based power plants leading to substantial greenhouse gas emissions having an adverse impact on global warming and climate change Solar energy offers a clean, climate-friendly, abundant and inexhaustible generation in tropical countries Solar photovoltaic (SPV) cells convert solar radiation (sunlight) into electricity. A solar cell is a semiconducting device made of Silicon materials, which, when exposed to sunlight, generates electricity. Solar cells are connected in series and parallel combinations to form modules that provide the required power.

D.RAJENDRA BEEDU, presents a paper on "DESIGN, DEVELOPMENT AND PERFORMANCE EVALUATION OF SOLAR POWER ASSISTED BICYCLE''.

The fast depletion of fossil fuels due to exponential increase in demand and global warming due to the emission of CO2 made engineers and scientists to look for an alternative source of energy which is renewable, eco-friendly, affordable and available. Among the renewable sources like wind, tidal , geothermal and solar energy, solar power is promising in nations like India which is in the tropical region. India spends large amount of foreign exchange to import crude oil,with the use of solar power assisted vehicles, the dependency on the import of crude oil can be reduced and reasonable amount of foreign exchange can be saved.

E. ARUN MANOHAR GURRAM, P.S.V RAMANA RAO, RAGHUVEER DONTIKURTI, presents a paper on "SOLAR G. POWERED WHEEL CHAIR: MOBILITY FOR PHYSICALLY CHALLENGED".

Personal mobility means freedom for the physically challenged. One of the best inventions in the medical field that helped both the elderly and the handicapped is the mobility vehicle. The fact that they are no longer depending on someone else to perform daily duties is a big step forward. On the journey to mobility and freedom, motorized scooters and wheelchairs are the tools to finish that journey. With scooters and wheelchairs, there is a small inconvenience to mobility independence. The addition of some devices enables persons with physical disabilities a comfortable travel beyond their own homes. The present work involves in design and fabrication of solar powered wheel chair. A motorized wheelchair, power chair, electric wheelchair or electric powered wheelchair (EPW) is propelled by means of an electric motor rather than manual power.

F. TILAKISWARAN A/L SAMURGAM, Present a paper on "DEVELOPMENT OF BATTERY POWERED TRICYCLE".

The main purpose of this project is to develop a battery powered electric motor tricycle which can be used as a simple transportation and for economy reasons, to develop a battery powered electric motor tricycle which can be used as a simple transportation and for economy reasons. A motorized tricycle is a three wheeled bicycle with an attached motor used to assist with pedaling. Generally considered as a vehicle, tricycles are usually powered by electric motors or small internal combustion engines and have function as electric bicycles. Some can be propelled by the motor alone if the rider chooses not to pedal; while in others the motor will only run if the rider pedals. Electric bicycles are generally powered by rechargeable batteries. These are normally charged from the utility supply (mains), with perhaps the option of using the motor to effect regenerative braking or charging while being pedaled or rolling downhill. Electric motorized bicycles are either power-on-demand, where the motor is activated by a handlebar mounted throttle, or pedelec (from pedal electric), where the electric motor is regulated by pedaling.

G. YOGESH SUNIL WAMBORIKAR, ABHAY SINHA, Presents a paper on “SOLAR POWERED VEHICLE”.

The renewable energy is vital for today‟s world as in near future the nonrenewable sources that we are using are going to get exhausted. The solar vehicle is a step in saving these nonrenewable sources of energy. The basic principle of solar car is to use energy that is stored in a battery during and after charging it from a solar panel. The charged batteries are used to drive the motor which serves here as an engine and moves the vehicle in reverse or forward direction. The electrical tapping rheostat is provided so as to control the motor speed. This avoids excess flow of current when the vehicle is supposed to be stopped suddenly as it is in normal cars with regards to fuel. This idea, in future, may help protect our fuels from getting extinguished.

H. CHETAN MAHADIK, SUMIT MAHINDRAKAR, PROF. JAYASHREE DEKA, presents a paper on “AN IMPROVED & EFFICIENT ELECTRIC BICYCLE SYSTEM WITH THE POWER OF REAL-TIME INFORMATION SHARING”.

This paper presents the development of an associate degree "Electric Bicycle System‟ with an innovative approach. The aim of this paper is to show that the normal bi-cycle can be upgraded to electric one by some means– that including the development of a regenerative braking system and innovative BLDC motor control. The main components of the electric bicycle are brushless DC motor, motor controller, photo-voltaic, dry cell battery and solar panel. Also throttle and extra features such as horn, speedometer, and LED signal etc. The power source for this system is given by dry cell battery. The output of dry cell battery is 48V. There are multiple forms of charging source is used such as AC voltage through an outlet, solar energy and mechanical pedal charging system. The source of battery charging is photovoltaic solar panel and it is light weight. The solar panel output is 12V and 20 watt. Also they use mechanical pedal charging system, so dynamo is use for this charging system.

I. T. PUSHPAVENI, V. BHANU PRAKASH REDDY,presents a paper on “DESIGN AND DEVELOPMENT OF SOLAR ASSISTED BICYCLE’’.

As we all know the fuel prices especially the petrol is rising steadily day by day. Again the pollution due to vehicles in metro cities & urban areas is increasing continuously. To overcome these problems, an effort is being made to search some other alternative sources of energy for the vehicles. Again, it is also not affordable to purchase vehicles (mopeds, scooters or motorcycles) for all the class of society. Keeping this in mind, a search for some way to cater these economically poor people as well as to provide a solution for the environmental pollution was in progress. The solar assisted bicycle developed is driven by DC motor fitted in front or rear axle housing & operated by solar energy. The solar panels mounted on the carriage will charge the battery & which in turn drive the hub motor. When the bicycle is idle, the solar panel will charge the battery. This arrangement will replace the petrol engine, the gear box & the fuel tank in case of a two wheeler or a chain sprocket, chain & gear shifting arrangement of a conventional bicycle being used by most common man.

CONCLUSION

It can be concluded from paper that the overall efficiency of the bike will definitely be improved by working on the parameters discussed earlier. Also, a completely new dimension of the bike will be designed with enhanced features. If the venture proves to be successful then an enhanced solar bike can be available at a much cheaper price. The design of the solar bike can also be improved further in terms of its appearance in view of the 21st century people. The bike can prove to be an ideal for promoting the concept of “GO GREEN AND CLEAN”.

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TECH-CHRONICLE
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DESIGN AND FEBRICATION OF MULTI-PORPOSE AGRICULTURAL MACHINE

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***Abstract*- The farming sector in India primarily consists of small scale farmers. These small scale farmers cannot afford equipment like tractors, paddy processing machine s, thereby restricting their output .The present work involves designing and fabricating simple and economical farming equipment to perform multiple farming operations like crop cutting, cultivating, towing loads, seed sowing etc. This vehicle was built keeping in mind the need of small scale farmer.**
Initially various concept were explored and calculated .The final design was selected with these calculations and specifications. This equipment can be used for cutting crop, cultivator and also for sowing seed. It is easily operated by unskilled person. It can reduce labor cost due to the only one person can be handle. Crop cutter machine does not required high maintenance.

Keywords— Farmer, Crop, Cultivator, Sowing etc

I.INTROSUCTION

Agriculture forms the backbone of our country economy; about 55% of citizen is depending on agriculture. Thus developing our country means providing our farmers with more "Sophisticated" and "Advanced Tool" which would decreases overall time required for the task and the task will become more easy and convenient. In agriculture have done more process

Developed agriculture needs to find new ways to improve efficiency. One approach is to utilize available information technologies in the form of more intelligent machines to reduce and target energy inputs in more effective ways than in the past. Precision farming has shown benefits of this approach but we can now move towards a new generation of equipment. The advent of autonomous system architectures gives us the opportunity to develop a complete new range of agricultural equipment based on small smart machines that can do the right thing, in the right place, at the right time in the right way.

The final design was selected with these calculations and specifications. This equipment can be used for cutting crop, cultivator and also for sowing seed. It is easily operated by unskilled person. It can reduce labour cost due to the only one person can be handle. Machine does not required high maintenance. On the basis of this large number of farming equipment are in use at today's date, which are available at different shape and size and on different power supply. Since they are costlier keeping in to consideration the economic ability of our farmer it is required that is should be simple and should fulfil the same intention which are achieved by "DESIGN AND FEBRICATION OF MULTI-PORPOSE AGRICULTURAL MACHINE".

II.LITERATURE REVIEW

Agro-Technology is the process of applying the technology innovation occurring in daily life and applying that to the agriculture sector which improves the efficiency of the crop produced and also to develop a better mechanical machine to help the agriculture field which reduces the amount and time of work spent on one crop. Hence in this work of project we decided to design a better mechanical machine which is available to the farmers at a cheaper rate and also which can sow and seed the crop at the same time. This project consists of the better design of the machine which can be used specifically for rice, wheat crops etc.Sectional Committee as detailed below:

1. Adarsh J Jain, Shashank Karne1, Srinivas Ratod , Vinay Thotad and Kiran et al "Design and Fabrication of small scale Sugarcane harvesting machine" IJMERS, Vol. 3, No 3, APRIL 2013

In today's competitive world there is a need for faster rate of production of agricultural products. Agriculture is the backbone of India. In India almost all farmers facing problems of labour shortage. Day by day labour wages are increasing and in the same way demand of agriculture products are also increasing and today's world need faster rate of production of agriculture products. This project aims to design and fabricate small scale sugarcane harvesting machine for sugarcane harvesting to reduce farmer's effort and to increase production of agricultural products. Machine consists of petrol engine and different mechanisms are used in this machine. When compare to manual harvesting by using this machine has a capacity to cut canes in faster rate and it is economical. The machine is helpful for both whom having small or big farms.

2 P.Vijay, K.V.N.Rakesh, B.Varun, et al "Design of a Multi-Purpose Seed Sower Cum Plougher", IJETAE, Volume 3, Issue 4, April 2013

This paper deal with Agro-Technology is the process of applying the technology innovation occurring in daily life and applying that to the agriculture sector which improves the efficiency of the crop produced and also to develop a better mechanical machine to help the agriculture field which reduces the amount and time of work spent on one crop. Hence in this work of project we decided to design a better mechanical machine which is available to the farmers at a cheaper rate and also which can sow and seed the crop at the same time. This project consists of the better design of the machine which can be used specifically for rice, wheat crops etc. Developed agriculture needs to find new ways to improve efficiency. One approach is to utilize available information technologies in the form of more intelligent machines to reduce and target energy inputs in more effective ways than in the past. Precision farming has shown benefits of this approach but we can now move towards a new generation of equipment. The advent of autonomous system architectures gives us the opportunity to develop a complete new range of agricultural equipment based on small smart machines that can do the right thing, in the right place, at the right time in the right way**.**

3 A.Kannan , K. Esakkiraja, S. Thimmarayan et al "Design Modifications in Multipurpose Sowing Machine" IJRAME. Volume 2, Issue 1, 2014

A multipurpose sowing machine is designed for small farmers to improve their productivity. In this machine a common seed storage place is introduced to reduce the cost of the machine. The existing sowing machine had the individual storage place and separate seed metering mechanism which leads to more cost. The drawbacks in the existing sowing machine are rectified successfully in our machine. It will be more useful for small farmers and the agricultural society. The cost of the machine comes around Rs 6000/-.

4 Anant J. Ghadi and Arunkumar et al "Design, development and fabrication of a low cost corn deseeding machine", IJRET. Volume: 03 Issue: 08 | Aug-2014

This paper present work is carried out on the de-seeding machine has been designed, developed and fabricated keeping in mind the constraints and requirements of the Indian farmers. The deseeding machine was tested in the machine shop and later taken to the field. It worked well in the field conditions and gave an output of 45 Kg/hour. The maneuverability of the device is quite good and the handling is quite simple. The seed discharging mechanism is effective and corn seeds can be discharged off very easily. For commercial purpose one can improve the efficiency of the device effectively by increasing the size of the device and providing it with multiple heads. Additionally, the de-seeder is a multifunctional machine that can de-seed various types of food item such as rice, chilly powering, potato past, corn de-husking etc. This can be done by changing the drum and teeth.

III PROBLEM DEFINITION

The research project aims to accumulate all possible design & fabrication of multipurpose agriculture machine. When a farmer doing work in the farm they required more equipment or machinery, and this machines are available in more cost sometime it's not affordable to the farmer. There for these machine is design and fabricate for small scale farmer and it is available in low cost in future.

IV.CONCLUSION

The multipurpose agriculture machine has been designed, developed and fabricated keeping in mind the constraints and requirements of the Indian small scale farmers and to improve their productivity. In this machine try to reducing the cost and affordable to farmer.

We are reduce time in farming and also reduce cost of labour. This machine fuel consumption is covered. The manoeuvrability of the machine is quite good and the handling is quite simple the mode of operation is very simple even to the lay man. It is more efficient than the present existing machines of this category and range. The maintenance cost of this equipment is very less as there is no delicate part involved.

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TECH-CHRONICLE
AN INTERNATIONAL E-JOURNAL ON
EMERGING TRENDS IN SCIENCE, TECHNOLOGY AND MANAGEMENT

DESIGN AND DEVELOPMENT OF HYBRID MOPED USING ELCTRICAL AND PETROL OPERATING ARRANGEMENT

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ABSTRACT

Rapid depletion of fossil fuels has forced the necessity of an alternate energy vehicle. Electric vehicles serve as promising technology for the future world transportation arena Due to minor drawbacks the electric vehicles cannot match up with the fossil fuel powered vehicle which made the invention of hybrid technology. Concentrated efforts are mainly towards implementing a concept called as hybrid system by which one system will be charged while the other system provides propulsive power to the vehicle. When the s runs on the electric motor it is almost nonpolluting.

This project is deal with the development of the as the only petrol vehicle or electrical vehicle is not as sufficient as hybrid vehicle. This hybrid technology can compensated the disadvantages of both type of vehicle. There is various type of base on the type of charging as it becomes plug-in type or other.

I. INTRODUCTION

Hybrid electric moped (HEM) have a great potential in lowering emissions and reducing fuel demand as the ever growing problems of air pollution and global warming reached its critical stage. Although various researches are carried out to reduce emissions and fuel dependencies for four-wheeled vehicles, not much research is focused on two wheeled vehicles for example, motorcycles in Jakarta, Indonesia contributed to more than 20% in both PM10 and CO and 40% of HC emissions during 1998. Whereas in Hanoi, Vietnam, motorcycles contributes to about 54% of CO,HC and Pb and 43% of dust Finally, in Taiwan where emissions reports indicate that 38% of CO, 3% of NOx, 64% of NMHC and 30% of PM were emitted from motorcycles and scooters alone.

Internal combustion engines are relatively less efficient in converting the on-board fuel energy to propulsion as most of the energy is wasted as heat. On the other hand, electric motors are efficient in converting the stored energy in driving a vehicle, and electric drive vehicles do not consume power while coasting. Some of the energy loss in braking is captured and reused by regenerative braking. With the help of regenerative braking one fifth of the energy loss can be regenerated. Typically, petrol engines effectively use only 15% of its fuel content to move the vehicle. Whereas an electric drive vehicle has an on-board efficiency of about 80%. But due to reasons such as cost, inability to reach higher speeds electric drive vehicles failed to capture markets. Contrary to this petrol vehicle can cover longer distances with higher speed but it cannot cover shorter distance with slow speed (say in traffic) in an efficient way. Two-wheeled vehicles, especially motorcycles and scooters contribute to a major part of air pollution, especially in the Asia region.

Thus a hybrid approach, which is to utilize an internal combustion engine (ICE) and a battery, is more feasible as a much higher range could be achieved compare to pure electric scooters. The only trade-off is that emissions are not reduced to zero. Thus two-wheeled hybrid research is as equally as important

II. CONCEPT OF HYBRID VEHICLE

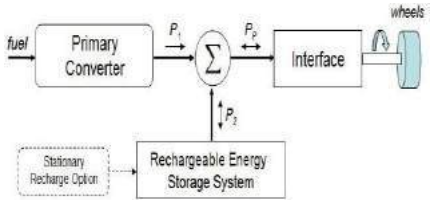


Fig No. 1 Basic Concept diagram

It is basically a two-way source one of which is rechargeable energy storage system. As shown in diagram that the wheels are get power by the two sources P1 and P2 this are the two way sources.

Hybrid vehicle is an automobile which combine more than one method of Propulsion system. It cans anything from petrol with combine's more than one method of propulsion system. It can be anything from petrol with a hydraulic motor, diesel with electric or even solar power. In fact, we already see around us so many hybrid cars and motorcycles running on CNG with petrol with electric motor, petrol with a hydraulic motor diesel with electric or even solar power, In fact, we already see around us so many hybrid cars and motorcycles with LPG. They are nothing but form of a parallel Hybrid system. Hybrid technology is nothing but the solution to the problem of pollution by fuel and limited availability of the storage. In future we have to think out any alternative source so why not from now? That's why we are dealing with this concept.

TYPES OF HYBEID VEHICLE

Hybrid vehicle is mainly classified in two main types on the basis of power supplied to the vehicle. The types are as below,

- Parallel hybrid vehicle
- Plug-in hybrid vehicle

A. Parallel hybrid vehicle

In parallel hybrid vehicle, the internal combustion engine and the electric motor are connected to mechanical transmission and can transmit power simultaneously to drive the vehicle. The commercialized parallel hybrid vehicles use a single small electric motor and a small battery pack. Parallel hybrid vehicles are capable of regenerative braking and the internal combustion engine present in it is capable of supplemental charging of the battery.

B. Plug-in hybrid vehicle

A Plug-in hybrid electric vehicle(PHEV), also called as Plug-in hybrid, is a hybrid electric vehicle withrechargeable batteries that can be restored to full charge just by connecting to an external power source. A Plug-in hybrid electric vehicle shares the characteristics of both conventional hybrid electric vehicle having an electric motor and an internal combustion Engine and of an all-electric vehicle, having a plug to connect to an electric grid.

III. CONSTRUCTION DETAIL:

While converting the ordinary moped into hybrid moped. We required following components.

- Electric motor preferably (Hub motor).
- Batteries (Dry lead acid battery).

Moped (Kinetic kine).

This is main component of the . On the basis of availability and low cost We select this component. The various detail of the following component is as below

Electric motor:

The BLDC motor is widely used in applications including appliances, automotive, aerospace, consumer, medical, automated industrial equipment and instrumentation.

The BLDC motor is electrically commutated by power switches instead of brushes. Compared with a brushed DC motor or an induction motor, the BLDC motor has many

Advantages:

Higher efficiency and reliability Lower acoustic noise Smaller and lighter Greater dynamic response Better speed versus torque characteristics Higher speed range
Longer life Motor fundamental concepts:

1. General principle:

Motors convert electrical energy into mechanical energy using electromagnetic principles. The energy conversion method is fundamentally the same in all electric motors.

2. Magnetic Force:

Magnetic poles generate invisible lines of magnetic force flowing from the North Pole to the South Pole as shown in Figure. When magnetic poles of opposite polarity face each other, they generate an attractive force, while like poles generate a repulsive force.

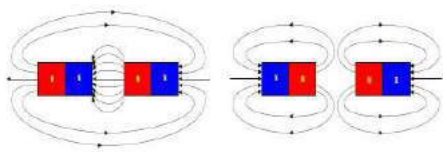


Fig No.2 Unlike-pole attraction & like-pole repulsion

3. Construction of BLDC motor:

*I) Stator:*There are three classifications of the BLDC motor: single-phase, two-phase and three-phase, the stator for each type has the same number of windings. The single-phase and three-phase motors are the most widely used. Figure shows the simplified cross section of a single-phase and a three-phase BLDC motor. The rotor has permanent magnets to form 2 magnetic pole pairs, and surrounds the stator, which has the windings.

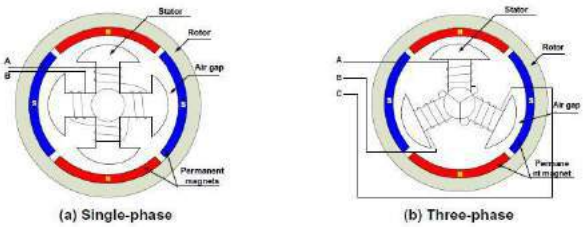


Fig no. 3 (a) & (b) Construction diagram

There are two types of stator windings: trapezoidal and sinusoidal, which refers to the shape of the back electromotive force (BEMF) signal. The shape of the BEMF is determined by different coil interconnections and the distance of the air gap. In addition to the BEMF, the phase current also follows a trapezoidal and sinusoidal shape. A sinusoidal motor produces smoother electromagnetic torque than a trapezoidal motor, though at a higher cost due to their use of extra copper windings. A BLDC motor uses a simplified structure with trapezoidal stator windings.

II) Rotor:

A rotor consists of a shaft and a hub with permanent magnets arranged to form between two to eight pole pairs that alternate between north and south poles. There are multiple magnet materials, such as ferrous mixtures and rare-earth alloys. Ferrite magnets are traditional and relatively inexpensive, though rare-earth alloy magnets are becoming increasingly popular because of their high magnetic density. The higher density helps to shrink rotors while maintaining high relative torque when compared to similar ferrite magnets.

IV. Working of motor:

Motor operation is based on the attraction or repulsion between magnetic poles. Using the three-phase motor shown in Figure, the process starts when current flows through one of the three stator windings and generates a magnetic pole that attracts the closest permanent magnet of the opposite pole. The rotor will move if the current shifts to an adjacent winding. Sequentially charging each winding will cause the rotor to follow in a rotating field. The torque in this example depends on the current amplitude and the number of turnson the stator windings, the strength and the size of the permanent magnets, the air gap between the rotor and the windings, and the length of the rotating arm.

ADVANTAGES OF BLDC MOTOR OVER OTHER MOTOR:

- Higher efficiency (75% vs. 40% of an AC motor)
- Less heat generated
- Higher reliability (no brushes to wear out)
- Safer to operate in a dangerous environment (no brush dust generated as is found with brushed motors).

Table No. 1

Key parameters	AC Motor	DC Motor
Size and Weight	100%	55%
Efficiency	40-50%	70-75%
Speed Control	Difficult	Easy & Excellent
Accuracy and Speed	3-5%	0.5%
Torque Control	Poor	Excellent

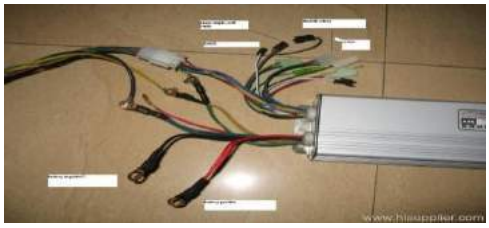


Fig. 4: controller for BLDC hub motor

The controller connects the power source to the motor. It controls speed, direction of rotation, and optimizes energy conversion. While batteries produce constant voltages which decrease as theyare used up, some controllers require a DC to-DC converter to step down this changeable voltage to the motors expected constant operating voltage, but other controllers incorporate a DC-to-DC converter and can accept a varying voltage. Converter efficiencies are typically greater than 90% [4]. The voltage control is achieved by

"chopping" the source current - the voltage is switched on and off, with the ratio of on to off determining the average voltage. Chopping is performed by power electronic circuitry such as diodes and thrusters and silicon control rectifiers (SCR). Controllers also effect regenerative braking, by which the motor is acted as a generator to recharge the batteries.

The controller which we used has following specification.

V. BATTERIES:

A lead-acid storage battery is an electrochemical device that produces voltage and delivers electrical current. The battery is the primary "source" of electrical energy used in vehicles today. It's important to remember that a battery does not store electricity is produced. Basically, two different types of lead in acid mixture react to produce an electrical pressure called voltage. This electrochemical reaction changes chemical energy to electrical energy and is the basis for all automotive batteries.

The purpose of the battery:

The battery supplies electricity to the BLDC motor while the engine is off. That is our second alternative of moped operation. The motor run the shaft of the rim through the coupling. the battery can use to run the other accessories of the moped.

The other battery in arrangement is to use in self-staring of the moped.

VI. TYPES OF BATTERIES:

- Primary cell
- Secondary cell
- Wet charge
- Dry charge

Primary cell:

This type of Batteries are such as flashlight battery once used, throw it away because the chemical reaction totally destroys one of the metals after a period of time, primary cells cannot be recharge. Small batteries such as flashlight and ratio batteries are primary cells.

Secondary cell:

The metal plates and acid mixture change as the battery supplies voltage. As the battery drains the metal plates become similar and the acid strength weakens. This process is called discharging .by applying current to the battery in the reverse direction.the battery materials can be restored, thus recharging the battery. This process is called charging. Automotive lead-acid batteries are secondary cells and can be recharged.

Wet charged:

The lead –acid battery is filled with electrolyte and charged when it is built. During storage, a slow chemical reaction will cause self-discharge. periodic charging is required. Most batteries sold today are wet charged.

Dry charged:

The battery is built, charged washed and dried, sealed, and shipped without electrolyte. It can be stored for up to 18 months. When put into use, electrolyte and charging are required Batteries of this type have a long shelf life. Motorcycle batteries are typically dry charged batteries

VII. BATTERY CONSTRUCTION:

An automobile battery contains a diluted sulfuric acid electrolyte and positive and negative electrodes in the form of several plates. Since the plates are made of lead or lead-derived materials, this type of battery is often called a lead acid battery. A battery is separated into several cells (usually six in the case of automobile batteries), and in each cell there are several battery elements, all bathed in the electrolyte solution.

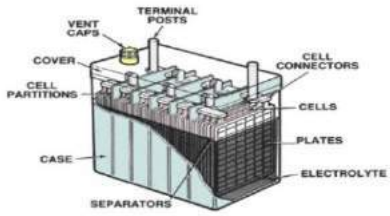


Fig No.5: Basic Construction

VIII. CELL OPERATION:

Two dissimilar metals placed in an acid bath produce electrical potential across the poles. The cell produces voltage by a chemical reaction between the plates and the electrolyte. The positive plate is made of reddish-brown material such as Lead Dioxide (PBO2). While the negative plate is made of grayish material called Sponge Lead (PB) the acid bath is a mixture of sulfuric acid and the water cell electrolyte. Together a cell element is formed.

CYCLING:

The battery stores electricity in form of chemical energy. Through a chemical reaction process the battery creates and releases electricity as needed by the electrical system or devices. Since the battery losses its chemical energy in this process, the battery must be recharged by the alternator. By reversing electrical current flow through the battery the chemical process is

reversed, thus charging the battery. The cycle of discharging and charging is repeated continuously and is called “battery”.

BATTERY CELL ELEMENT:

The key to the battery operation is the cell element. Positive plates and negative plates are each connected together by separate plate straps. These groups of positive and negative plates are then placed alternately, separated by micro-porous separators. Assembled together, the plates and separators form a battery cell element. Grouping the plates in this way serves to enlarge the surface area between the active materials and the electrolyte, thus allowing a greater amount of electricity to be supplied. In other words, the battery capacity is increased because of the increase in the surface area. More plate surface area means the battery can deliver more current.

PLATES:

Battery plates are constructed of a lead alloy containing a percentage of either antimony or calcium. The plates are designed as thin flat grid, grids crossing at right angles {shown below} or grids crossing diagonally at different angles which reduce internal resistance. The grid provides the necessary framework for active materials to be pasted on the plate, making either a positive or negative plate. The active material on a charge positive plate is a reddish brown Lead Di Oxide [Pbo2] while the active material on a charge negative plate is a grayish spongy lead.

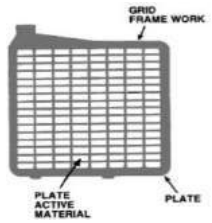


Fig no 6:Battery Case

The battery case holds the electrolyte and the individual battery cell elements. It is divided into six compartment or cells. The plates are raised up off the bottom of the case with ribs to prevent them from shorting out if any of the active materials (lead, etc) should happen to fall from the plates. The case is made of polypropylene, hard rubber, and plastic base materials. some battery manufactures use translucent plastic cases which allow checking electrolyte level without removing vent caps. These cases often have “upper” and “lower” electrolyte level markers on the outside of the case.

VENT CAPS:

Vent caps cover the holes that are used for adding electrolyte. They are also designed to separate the sulfuric acid mist and the hydrogen gas that forms when the battery charges. The caps are designed to the sulfuric acid mist to condense and drop back into the battery and allow hydrogen gas to escape through the vent holes to the atmosphere. Vent caps can cover each individual cell as shown below.

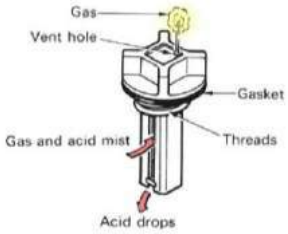


Fig no 7:Vent caps

IX. SEVERAL BATTERY MATERIAL AND THEIR ADVANTAGES:

Several variations of the lead-acid battery are used today. Variation to the battery plate material and electrolyte solution provides different battery characteristics. Construction is basically the same; however, the materials used are slightly different.

1. Lead Antimony:(Most commonly used) Is commonly used in conventional lead acid battery which uses lead antimony cell plates

ADVANTAGES

1. Longer service life than Calcium batteries.
2. Easier to recharge when completely discharged.
3. Lower cost.

2. *Lead Calcium*(AC Delco maintenance free batteries). Is a maintenance free lead acid battery which uses lead calcium cell plates.

ADVANTAGES

1. *Larger electrolyte reserve area* above the plates.
2. Higher Cold Cranking Amp ratings
3. Little or No maintenance
4. *Recombination (Gel Cell)*

Is a completely sealed lead acid battery which uses an electrolyte that in a gel (solid) rather than a liquid.

ADVANTAGES

1. No liquid electrolyte to spill or leak.
2. Can be Deep Cycled several time without damage.
3. Totally corrosion and maintenance free.
4. Three to four times longer battery life than regular batteries.
5. More plate surface and closer plate spacing provides a compact case size.

X. FULL SPCIFICATION OF KINE:

1. ENGINE, POWER AND TORQUE

Table 2

VARIABLS	VALUE
Displacement	71.55cc
Maximum power	4.2Bhp
Maximum Torque	5.7Nm
Engine Displacement	2 Stroke Single cylinder
Cooling	Air cooling

TRMISSION

Table 3

PART	TYPE
Gearbox	Automatic

3. BRKAES

Table 4

TYPE	SIZE
Front Brake	Drum 110 mm
Rear Brake	Drum 110 mm

4. DIMENSION ,WEIGHT, CAPACITY

Table 5

PART	SIZE
Overall Length	1740 mm
Overall Weight	640 mm
Overall Height	1076 mm
Wheel Base	1235 mm
Kerb /wet Weight	86 kg
Fuel Tank Capacity	4 liters
Front Tyre	3.00×10 inches
Rear Tyre	3.00×10 inches
Head Light	12v 25w/25w

This data is available from the manual of this product.

XI. DESIGN CRITERIA:

Some part is necessary to design, on the basis of the data available from the manual of the moped and standard data book the value are taken and their corresponding value is calculated.

Following part which are necessary to design.

(1) Design Procedure for shaft

Given Data

Torque on the Driving Shaft

=10N-m =10x103 N-mm

Total Load acting on the shaft

= 300 kg x 9.81

=2943 N

Total Length of driving shaft

= 0.125m = 125 mm

Design Procedure for Flange

: · d = 10.66 mm

Method (II)

For Simply Supported Beam

=WL/4= 2943 x 0.125/4

M=91.96 N-mm

M=91. 96N.m = 91.96 x10^3N-mm

$M=\pi/32 \times 6b \times d^3$

$91.96 \times 10^3/32 = 3.14 \times 42 \times d^3$

d = 28.14 mm

Coupling

Given Data =

N = 5000 rpm motor

T = 10 N-m

Actual Diameter of Engine shaft,

d = 14mm (given)

(a) P = 2 x N x T / 60 N-m

P = 5.235 KW

$T = \pi/16 \times s \times \tau s \times d^3$

$10 \times 10^3 = \pi/16$

$x = \frac{\pi}{16} \tau s \times 14^3$

$\tau s = 18.56\ N/mm^2$

Outer diameter of Hub

D = 2d = 2 x 14 mm

= 28mm,30mm

But Actual outer diameter of hub

D = 122mm

So for given data our design is safe.

(b) Hub is hollow shaft for that shear stress

$T = \frac{\pi}{16} x\ \tau s\ x\ [\frac{D^4 - d^4}{D}]$

$10 \times 10^3 = \frac{\pi}{16} x\ \tau s\ x\ [\frac{28^4 - 14^4}{28}]$

$\tau s = 2.47\ N/mm^2$

For actual diameter of engine shaft

d = 14 mm

Outer diameter of hub

d = 122 mm

$Ts = 0.23\ N/mm^2$

Form above given data design is safe.

(c)Desing For Flange

Thickness of Flange = 0.5d

Tf= 0.5 x 14 = 7mm

$T = \frac{3.14 \times D}{2}\ \tau c \times tf$

$10x103 = \frac{3.14 \times 28}{2}\ \tau c \times 7$

$\tau c = 1.16\ N/mm^2$

(c) Design for Bolt

Given Data

$\tau b = 20\ N/mm2$

No. Of bolts n=4

d1=Normal diameter of bolt .

D1 = Pitch circle diameter

D1= 3d= 3 x 14 = 42 mm

For stress

$T = \frac{\pi}{4} x\ d^2{}_1 x\ \tau b x\ n\ x\ [\frac{D1}{2}]$

$10x10^3 = \frac{\pi}{4} x\ d^2{}_1 x\ 20x\ 4\ x\ [\frac{42}{2}]$

d_1=2.75mm

Outer Diameter of Flange

D2 = 4d = 4 X 14 = 56mm

∵ Thickness of the Protective Circumferential Flange

tp = 0.25 d

= 0.25 X 14 = 3.5mm

= 5 mm

As our bolt actual diameter is 8 mm so our design is safe.

(3) (1) Design Specification of Coupling

d =Diameter of Shaft = 14mm

D= outside Diameter of flange = 44mm

Thickness of flange = 4 mm

Allowable shear stress for shaft

=18.58 N/mm2

(1) Design specification for Bearing

Bearing No. 202

Bore = 15mm

Outer Diameter = 35mm

Width = 11mm

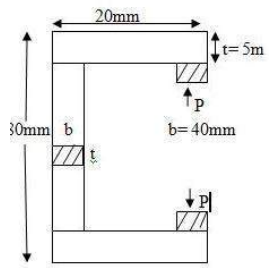
Bearing 203

Bore = 17mm

Outer Diameter = 40mm

Width = 12 mm

(4) Design Procedure for C- Clamp



Cross Section at X – X

A = b x t

40 x 5 = 200mm2

Consideration (I) =

∵ Direct tensile stress at x-x

$\sigma_0 = \frac{P}{A} = \frac{2943}{200}$

σ_0 = 14.71 N/mm2

Behind moment at X-X due to the load P
M = P X e

= 2943 X 17.5

M = 51502.5 N-mm
Section Modulus
$Z = \frac{t \times b^2}{6} = \frac{5 \times 40^2}{6}$
Z= 1333.33mm^3
Behind stress at X-X

$$\sigma b = \frac{M}{Z} = \frac{51502.5}{1333.33}$$

σb = 38.62 N/mm2

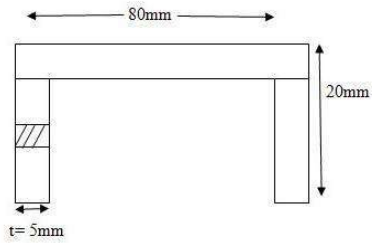
Maximum tensile stress

= σ0 + σb

= 14.17 + 38.62

= 53.33 N/mm2

Consideration (II)



Bending moment at X-X due to the load P
M= P X e

= 2943 X 77.5

M = 228.08 X 103 N-mm

XII. CAD MODEL:

1) Motor:

2) Bearing:

3) Clamp:

4) Rim:

5) Rim disc:

Coupling:

I) Main Coupling

II) Large Coupling:

Assembly: Explode View

XIII. ADVANTAGE'S:

- The range of an Electric bike increased.
- The city traffic air and noise pollution is decreased to a greater extent.
- One third of energy is captured by regenerative braking, which would otherwise go waste.
- Decreased the dependency of fossil fuels.

XIV. DISADVANTAGE'S:

- The initial cost of the vehicle is marginally increased, compared to the conventionally available.
- The disposal of battery is to be properly handed to avoid pollution.


d moped.

XV. CONCLUSION:

Finally, we conclude that canreduce consumption of the fuel to the great extent. There is always an alternative source of fuel to the vehicle as hybrid technology is the most promising technology. Typically, petrol engines effectively use only 15% of its fuel content to move the vehicle. Whereas an electric drive vehicle has an on-board efficiency of about 80%. But electrical vehicle cannot reach to the high speed as petrol engine that's why the hybrid technology is use.

This can efficiently work with the hub motor. And it supplies the power by the battery (lead acid battery). the disadvantages of the both electric moped and the petrol moped are compensated by the hybrid technology. and one whole automobile industry catch this concept soon.

XVI. RESULT:

The following are the result which are obtain from during operation of the vehicle.Charging Time of the battery – 6 hr. Max speed of the moped -40km/hr.

XVII. FUTURE SCOPE:

This modeled has a parallel hybrid structure. The main propulsion units consist of a two stroke internal combustion engine and a hub motor attached to the Rear wheel of the moped. The methodology used to optimize the energy and fuel consumption of the hybrid electric scooter is the multi-mode approach.

The hybrid vehicles have a wide scope in the upcoming future. The main reasons of it are-

- Regenerative braking actually makes city driving more economical than on the highway.Fuel efficiency is greatly increased (twice).
- Emissions are greatly decreased.
- Dependency on fossils fuels can be decreased.
- Hybrids can be run on alternative fuels as well.
- Battery can be charge by the solar energy.

This is the main area where we need to be focused in future. All the above option will increase its efficiency. but the initial cost we need to be work on.

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TECH-CHRONICLE
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Performance of Bullock Driven Tractors

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Abstract- ***Animal power does not get proper attention on the other hand; these days may be poses maintenance burden on the animal based farmers. However, on the other hand, one of the serious problems in Indian agriculture caused by increased cost of mechanical operations today is the extreme economic conditions which have been forcing farmers to commit suicides in thousands.***

A study was conducted in sandy soil at village Kharmanja Kutubpur, Post Office – Lashkara, Dist – Haridwar (Uttaranchal), and in black soil at Gram Khajuria, Dist – Indore, Village - Ugrani Dist – Bhopal for Kamdhenu and Brahmpuri Bullock Driven Tractors. Both bullock driven tractors are used for cultivation, ploughing, and harrowing, sowing and inter-cultivation operations. The desired depth and width of cutting soil were found for various attachment of Plough, cultivator, ridger, Seed drill to bullock driven tractor for black and sandy soil. For both types of the tractors no difficulties were noticed and no stresses were found on Bullock during operations. It is Easy to assemble and dissemble. Any farmer can do it easily. No vibration, no noise, no maintenance problems occurred. However, the two designs can learn from each other and there is enough scope for improvements.

To make this technology more viable and popular among the farmers it is necessary to adopt some improvements. The efficiency of the BDT can be improved and can be made more acceptances in the field.

Evaluating the two bullock drawn tractors on the basis of their cost, working capacity, number of implements, it can be said that the two types of tractor developed by Rajasthan Mechanical Works Limited and Bhartiya Cattle Resource Development Foundation are presently suitable for different conditions, may be so designed and can become more promising by improving design and learning from each other.

Keywords – Animal Power, cultivator, Plough, Ridger

INTRODUCTION

According to the 1972 census, (1976) the working animal population in India was 80 million and the total cropped area 167 million hectares (www.indiastat.com). Thus on an average one pair of working animals, i.e. bullock was available for 4.16 hectares of land. Management studies have shown that a pair of bullocks can manage about 3 hectares farm. According to Roy S.E. (1966) the maximum area of land which can be cultivated by a pair of bullock, not only depends on the efficiency of bullocks and the size of holding but also on factors such as period available for cultivation, nature of soil, crops grown and timeliness requirement of each operations and transportation work. It is pertinent to state that there is a direct relation between energy inputs to crop production in terms of output. The "tractorization" has grown at a rapid space and about 2.5 lack tractors are being added annually to the Indian farms to help farmer to supply energy for conducting various farm operation and transport activities. The tractors are suited for big size farms but farmers are not aware with the bad effect of tractorization.

Regular use of tractor makes the soil hard and compact and also reduces fertility and moisture content of the soil. Due to the compacted layer of the soil beneath the earth infiltration and percolation properties of the soil goes on decreasing and so sufficient soil moisture is not available for the depth of deep rooted crops and there is no rise in water table. For removing deep rooted weed and preparation of smooth seed bed multi-paired bullock drawn M.B. plough is used.

Considering these factors it was decided to undertake an experiment to evaluate the performance of multi-paired bullock drawn M.B. plough on the field over tractor drawn M.B. plough.

MATERIALS AND METHODS

The experiment trials were conducted in light soil at Anwi, Sawalapur, Dabhadi for multi-paired and Dhaga for tractor drawn M.B. plough on 2000 m^2 area. The trials were conducted according to RNAM test codes. The parameters like depth of operation (cm), operating speed (Km/ha), field efficiency (%), H.P., cost of ploughing (Rs/ha) were evaluated as per standard procedure mentioned below. The data was used for comparing the performance of tractor operated M.B. plough and multi-paired bullock drawn M.B. plough.

Table 1. General specification of tractor and bullocks used throughout experiment.

Particulars	Specification
Tractor used (HP)	35
No. of bullock pairs used	2 pairs
Size of M.B. plough for tractor drawn (cm)	52.5
Size of M.B. plough for bullock drawn (cm)	30
Average age of bullocks (years)	12
Breed of bullocks	Jersey breed

Site Selection

The site was selected by considering the suitability of land with uniform topography. The different sites were selected in different villages during kharip season.

Neck method of harnessing animals:

This method is most commonly used with bullocks in India and other countries because the neck muscles of bullocks are well developed and have sufficient strength against the depression caused by the harness. There is no direct compression given to any bone or muscular structure of the animal (Swamy Rao, 1966).

Procedure for Conducting the Trials

The trials were conducted as per the method generally followed in the rural areas and the parameters were tested according to the RNAM Test Codes for testing the implement.

Hitching

Hitching of bullocks to the implement was done according to the method generally followed in rural areas. In this method two yokes for two pairs were tied with the help of strong iron chain and it was connected to the ring of the plough with the help of peg.

M.B. plough arrangement

The selected plough was cleaned before operation and adjustment of horizontal and vertical clevis was done. The specification of the mould board plough used for multi-pared bullock and tractor drawn in different villages are given in Appendix- A and Appendix- B respectively.

Standing of pair

The selected two pairs were arranged in passion i.e. taller pair should be at front and the other pair was behind it shown in Fig 1. Previous work has shown (Adkine, Rapte & Acharya; 1977). Due to this reason maximum power of bullocks can be harnessed, this method was followed generally in villages. The two pairs were located just behind the plough.

Figure 1. Ploughing operation by multi-paired bullock drawn MB plough at Sawalapur.

Harnessing with yoke

The two labours, which were operators of each pair, put the yoke on the neck of front and rear pair.

Arrangement of dynamometer

Mechanical dynamometer was used for measuring draft (Fig 2). The details of dynamometer used while conducting trials is given in Appendix-C. Mechanical dynamometer was tied in between yoke and implement body. As Mechanical dynamometer was connected in the line of pull, the measured force represented the total pull (Ojha, 1958). For calculation of draft, the inclination of the line of pull from horizontal and horizontal angle from the direction of travel was measured. Draft required by the formula. At the same time, depth and width of tillage were measured. While conducting the trials, angle of inclination were also measured

Figure 2 Dynamometer during ploughing operation of multi-paired bullock drawn M.B. plough.

Depth of ploughing

While conducting the trials the depths of different locations were measured by removing the disturb soil from the furrow. Minimum five readings of depths were noted.

Width of ploughing

The width of ploughing was recorded at the place from where depth was taken. The top widths and bottom widths were measured by pushing the crown form on one side of ploughing.

Pull

It is the total force required to pull an implement. Dynamometer was used for measuring pull.

Draft

It is the horizontal component of pull, parallel to the line of motion. It is calculated by following way

$$D = P \cos\theta$$

Where,

D = Draft in (kgf)

P = Pull in (kgf)

θ = Angle between line of pull and horizontal.

The angle θ in calculated as the mean angle between the rope of front pair and rope of rear pair with horizontal.

$$\text{Draft} = P \cos\frac{\theta_1 + \theta_2}{2}$$

Where,

θ1 = Angle between the rope of front pair with horizontal.

θ2 = Angle between the rope of rear pair with horizontal.

Unit Draft

It is the draft per unit cross sectional area of the furrow. The cross sectional area of the furrow is computed by assuming the furrow cross section triangular.

Therefore, Area of Trapezoidal section = ½ (Top width + Bottom width) × Depth

Traveling speed

The traveling speed was computed with the help of stopwatch. It is the distance covered by the bullocks and tractor in given time.

Horse power

$$\text{Metric hp} = \frac{\text{Draft in (kgf)} \times \text{Speed (metre/sec)}}{75}$$

Theoretical field capacity

It is the of field coverage of the implement based on 100 percent of time at the rated speed and covering 100 percent of its rated width.

$$\text{Theoretical field capacity} = \frac{\text{width (cm)} \times \text{speed (metre/sec}}{10000}$$

Effective field capacity or Actual field capacity

It is the actual area covered by the implement based on total time consumed and its width.

Field efficiency

It is the ratio of effective field capacity and theoretical field capacity expressed in percentage.

$$\text{Field efficiency} = \frac{\text{Effective field capacity}}{\text{Theoretical field capacity}} \times 100$$

Soil Inversion Test

Weed and stubble count method suggested by (Prasad & Misgara, 1981) was adopted to find out the soil inversion. Randomly three plots of size 60 X 60 cm were selected in the field. The no. of weed and stubble present in each plot were measured before and after ploughing. The soil inversion was then expressed on percentage basis.

$$\text{Soil inversion} = \frac{\text{No. of weed before test - No. of weed after test}}{\text{No. of weeds before test}} \times 100$$

Soil Moisture

Moisture content on dry weight basis was selected for soil measurement. Core sample of wet three different location of test plot random will be weighted the sample in balance and it was kept in oven for dry for 105 ^{O}C –110 ^{O}C for at least 8 hours, cool in desiccators and weighted again.

Results and Discussion

Experiments were conducted with the help of bullock and tractor drawn M B plough for draft analysis. It was observed that the higher depth that is 17.50 cm was observed in case of tractor drawn M.B. plough compared to bullock drawn M.B. plough that is 11.50 which is obvious. It indicates the deformation of soil at higher depth by tractor drawn M.B. plough which is sometimes undesirable because soil manipulation below root zone depth is not required. Soil manipulation at greater depth also requires higher energy hence it is wastage of energy. Whenever deep ploughing is require, tractor drawn M.B. plough can be used.

The speed of operation for tractor drawn M.B. plough was 3.19 Km/h and that of bullock drawn M.B. plough was 1.5 Km/ha. Also the size of M.B. plough used with tractor was 52.5 cm and that used bullocks was 30 cm. Hence the field capacity of the tractor drawn M.B. plough was 0.12 ha/hr and that of bullock drawn M.B. plough was 0.03 ha/hr only. But the field efficiency of bullock drawn M.B. plough was found higher i.e. 91.42% compared to tractor drawn M.B. plough for which it was 85.85%. This was because of the fact that the tractor takes higher turning time at the head lands compared to bullocks.

The cost of operation in case of bullock drawn M.B. plough was found less than that of tractor drawn M.B. plough which is one more advantage of using bullock drawn M.B. plough.

Considering the time limits available for manipulation of soil and field capacity of tractor drawn M.B. plough it is advisable to use it on large fields. But the task can be done more efficiently by bullock drawn M.B. plough on small fields that in turn saves cost of operation. More number of bullocks pairs if used on the field can compensate the time, but it will add to the operational cost. Average value of parameters for comparing multi-paired bullock and tractor drawn M.B. plough, shown in Table 2.

Table 2. Average value of parameters for comparing multi-paired bullock and tractor drawn M.B. plough

S. N.	*Parameters*	*M.B. Plough*			
		Bullock Drawn			*Tractor Drawn*
		Sawalapur	*Anwi*	*Dabhadi*	*Dhaga*
1	Depth (cm)	14.49	11.50	13.48	17.51
2	Width of cut (cm)	2.217	2.017	1.74	2.79
3	Pull (Kg)	190	304.27	230.13	Use given hp
4	Draft (Kg)	164.54	292.50	204.12	
5	Unit draft (Kg/cm^2)	0.65	1.54	0.97	
6	Horse Power (hp)	1.41	1.5	1.47	35
7	Traveling speed (Km/h)	1.67	1.385	1.95	3.193
8	Theoretical field capacity	0.0542	0.0378	0.057	0.144
9	Actual field capacity (ha/hr)	0.0485	0.0345	0.038	0.144
10	Field efficiency (%)	89.64	91.42	75	85.85
11	Soil Inversion (%)	90.1	93	85	87
12	Soil moisture	11.52	9.692	15	10.20
13	Cost for ploughing (Rs/ha)	1758.47	1820.25	1799.10	2535.95

CONCLUSION

1. It is observed that harnessing of bullock is essential for bullock drawn M.B. plough.
2. Speed of operation by tractor drawn M.B. plough was more as compared to multi-paired bullock drawn M.B. plough
3. It is observed that average speed of ploughing was 1.5 km/h for bullock drawn M.B. plough
4. It is found that, field efficiency was more in bullock as compared to tractor drawn M.B. plough.
5. It was found, soil inversion test during all the trials was above 90%.

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TECH-CHRONICLE
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MICROWAVE DRYING OF GARLIC

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Abstract- Microwave drying, application of microwaves, are relatively new addition in the existing drying techniques. Whole garlic cloves were subjected to microwave drying as well as convective drying. The drying parameters for microwave drying were 1 W, 2 W, 2.5 W and 50^{0}C, 60^0, 70^{0}C for convective drying. For quality assessment garlic samples were dried to safe moisture content. The quality of the products evaluated by the flavour strength and color test. In both the test, microwave drying found better in terms of uniformity, time and quality of the products. The economics of microwave drying were evaluated and found viable as cost benefit ratio is 3.77 for 3 years.

Index Terms- microwave drying, convective drying, garlic, flavor strength

I. INTRODUCTION

Garlic (*Allium sativum* Linn.) is a bulbous perennial vegetable spice. The world production of garlic in 2002 was 12.23 MT from an area of 1.13 Mha, out of which 500,000 tones from an area of 120,200 ha was produced by India [1]. Due to lack of suitable storage and transportation facilities, about 30% of fresh crop is wasted by respiration and microbial spoilage [2]. More recently, it has found uses in its dried form, as an ingredient in precooked foods and instant convenience foods including sauces, gravies and soups which has led to sharp increase in the demand of dried garlic.

Drying of foods is aimed at producing high density product, which when adequately packaged has long shelf life and after which the food can be rapidly and simply reconstituted without substantional loss of flavor, taste, color and aroma. Most of the cost of final product is dependent on the drying process. So it is necessary to dry the product in minimum cost, energy and time for techno-econo-socio compatibility.

Garlic is a high-moisture commodity and microwave drying technique has attempted rarely. Microwave drying is relatively a new addition in the existing drying techniques, viz. convective air drying (cabinet, fluidized bed, tunnel), spray, vacuum, foam mat and freeze drying [3]. Published work in the microwave drying domain have pointed out that this technique leads to a greater reduction in drying time, increasing the production capacity. This is due to high thermal efficiency of the process increase quality attributes equivalent to or better than those dehydrated by convective drying [4, 5, 6].

II. MATERIALS AND METHODS

The microwave drying of garlic cloves were investigated in microwave dryer installed in the Department of Processing and Food Engineering, College of Technology and Engineering, MPUAT, Udaipur. A microwave dryer, having a capacity of about 15 kg of garlic cloves /day is shown in Figure 1 and its specifications given in Table 1.

Fig.1. Peeled garlic cloves being dried in microwave dryer

Table:1 Specification of microwave dryer.

Microwave Cavity	
Dimention	700 X 700 X 550 mm
Thickness of the cavity	16 gauges
Material of the cavity	S S 304 with mirror finish
Microwave generator	
Magnetron	1 no.
Type no	2M121A Hitachi Make
Power	2.5 kW

Pulsed operation	Duty cycle 10 to 100%
Freqency	2450 MHz
Efficiency	60-70%
Cooling of Magnetron	Air (Air blower be provided)
Mode of operation	Continuous & stepwise 0.25 kW variation.
Product Holder	Circular type having diameter 600 mm, height of rim 120 mm, made of Teflon & rotating product at 360 degree.
Control and Interlocks	An electronic control system, comprising of relays, contractors and switches be provided on the control console.

A. *Principle of microwave dryer*

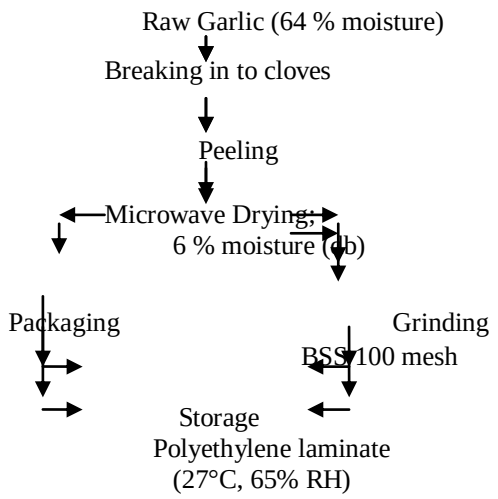
Microwaves are electromagnetic waves in the frequency range of 300 MHz – 30000 MHz. It is the combination of electrical and magnetic fields, with only the farmer being engaged in the conversion process when waves interact with the non-magnetic materials. The conversion of Microwave Energy in to heat in the food is because of the presence of water. As the water molecules are bipolar and rotate in the rapidly changing electromagnetic field (billion times a second), heat is evolved within the food stuff due to friction between the water molecules. As waves can penetrate directly in to material, heating is volumetric (from inside out) and provide fast and uniform heating through the product. The quick absorption of energy by water molecules causes rapid evaporation of water, resulting into high drying rates of the food.

B. *Specification of the raw material*

According to Indian standard for Garlic, IS: 3240 – 1965, the bulbs of garlic shall be mature, well cured, compact, that is, the cloves shall not be spreading out but shall fit closely together practical the entire length of individual of cloves and enclosed in an outer sheath. Mature and well cured means fully develop, fair, sufficiently dry and not soft and spongy. The cloves shall be well filled and fairly plump.
Fresh garlic (Allium sativum) bulbs were used in the investigation, which were procured in bulk from the local market. The Garlic had moisture contents ranging between 60 – 65 % (w.b.) and moisture content reduce up to safe moisture content of 6 % (w.b.). The vacuum oven method was used to determine the initial moisture content of the garlic cloves. Initial moisture content was determined with the help of vacuum oven with 70 °C with a gauge pressure of 85 kPa for about 24 h [7].

C. *Process Parameters*

Conventionally peeled garlic cloves are dried immediately in Microwave dryer applying 1 W, 2 W and 2.5 W through experiment. For convective heating, tray dryer was used with operating temperature of 50oc to 70 c with air velocity 2 m/s [8, 9]. A process flow chart of garlic cloves are furnish hereunder.

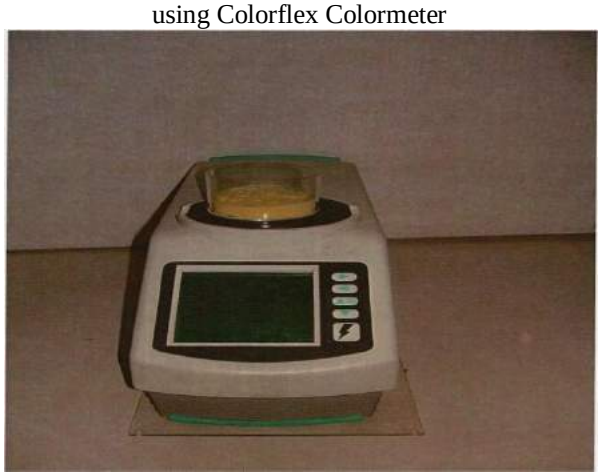


D. Quality Assessment

Color measurement

Color of fresh garlic and dried samples was evaluated by a Minolta Chroma Meter CR-200 Reflectance System shown in fig. 2. The results were expressed as L^* (whiteness–darkness), a^* (red–green), and b^* (yellow–blue) values. The measurements of color were repeated three times.

Fig. 2 Pictorial view of colour measurement of Garlic Powder using Colorflex Colormeter



Flavour strength

The flavor strength in the dried cloves was determined by Chloramine T method, a titration method. Garlic has charactorstic pungent flavor because of interaction of S – substitutes, L- cystein sulfoxide derivatives and the enzyme allinase. These sulfoxides are collectively called allins. Flavour strength can be determined by measuring the amount of Chloromine – T solution consumed for allin oxidation. The excess of Chloromine – T can be assessed by adding potassium thiosulphate using starch as indicator.

III RESULTS AND DISCUSSION

A amount of about 7.5 kg of peeled garlic cloves was loaded in the microwave cavity and it took about 6 hours for 2.5 W,

6.3 h for 2 W and 7 h for 1 W to dry to the product of final moisture content of 6.0 % (w.b.). The drying time can be greatly reduced by applying the microwave energy to the dried material [10, 11]. However, when the same load was kept in a tray dryer, drying took place in about 12 – 13 hours at 60^0C, in 16 h at 50^0C and 18 h at 40^0C. Increased drying temperature entails higher costs and may cause biochemical changes that degrade the dried product quality; whereas subdividing the material is an additional process that results, especially under industrial conditions, in mass losses and lowering of the product quality [12]**.** Garlic cloves dried in microwave dryer as shown in figure 3. respectively.

Fig. 3. Garlic cloves dried in microwave dryer

E. *Quality of Dried Products*

The dried garlic cloves were analyzed for quality with respect to flavor strength and color, because these two parameters become the basis of choice for acceptability by the consumers as far as garlic powder is concerned.

Color assessment

It was found that microwave drying made the color brighter (L = 73.42). Whereas drying slices with the convective method lessened the color brightness (L = 64.31), shifting it markedly towards red and yellow. Comparing the results presented with color assessment of garlic dried with the microwave method only [11, 13].

Flavour strength

Flavour strength for for microwave dried powder was found to be. 4.86 and for convective drying was 3.28. L value and favor strength are shown in Table 2 and Figure 4 (a), (b). This showed that favor strength was more in Microwave drying powder as compared to convective drying powder because uniformity and less time period increase the quality of the products. Same results were also be found, [11, 13].

Table: 2 Color Values and Favor Strength of Dried Garlic cloves

Drying Method	Flavour Strength (mg/g DM)	L-Value
Microwave Dried	4.86	73.42
Convective Dried 60^oC, 1 m/s	3.28	64.31

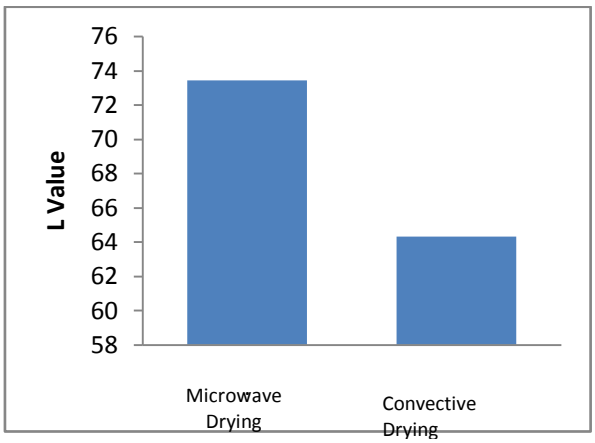


Fig. 4 (a) Color (L - value) of garlic powder dried by two methods.

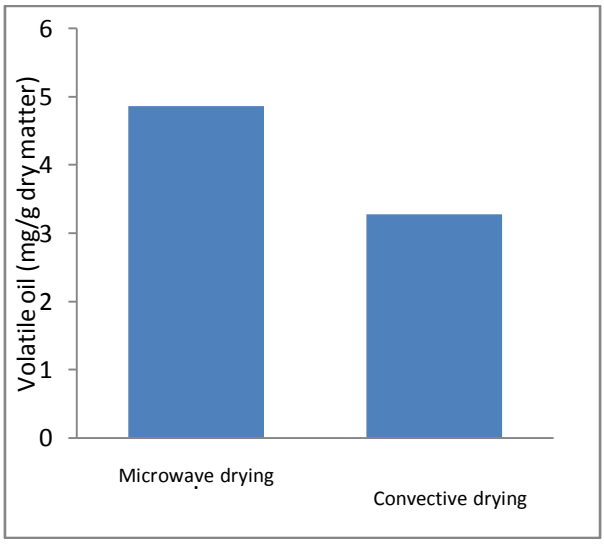


Fig. 4 (b) Flavor strength of garlic powder dried by two methods.

F. *Economics of the Microwave drying techniques*

When garlic processing and dehydration plant considered from a gross benefit steam the capital investment and operating costs i.e. cost of microwave dryer, packaging machine, labour input, electricity charges are deducted.

Financial Aspects

The following parameters have been considered for carrying out the economic analysis of the microwave dryer.

a) Life of the MW dryer 20 years
b) Life of packaging machine 10 years
c) Discount rate 8%
d) Capacity of the dryer 15 kg of raw material and processed product will be 6 kg per batch of 5 hours and two batches per day.
e) Number of days working for dryer = 300

The details of the fixed and operating cost shown in Table 3 and results of economic analysis shown in Table 4.

Table 3. The details of the fixed and operating cost.

Fixed capital	
Land and Building	***Amount (Rs Lakh)***
Land, 50 sq.m.	0.50
Built up area, 25 sq. m.	1.50
Total cost of land and building	2.0
Machinery and equipment Description Microwave dryer Packaging unit Total cost involved	 2.50 0.40 2.90
Total fixed cost (1.1.1 + 1.1.2)	**4.90**
Recurring expenses per annum Labour, 2 salary 10,000 per month	1.20
Raw material including packaging material Peeled garlic cloves, 30 kg per day for 300 days @ Rs. 40 per kg Packaging material	3.60 0.50
Utilities Power, 2.5 kWh for 10 hour per day @ Rs. 5 per kWh for 365 days per year water.	0.45 0.15
Other contingency Expenses Repair & maintainance charges	0.30
Total recurring expenditure (1.2.1 + 1.2.2+1.23+1.2.4)	**6.20**
Total Capital investment (Fixed capital + Recurring expenditure)	**11.10**
Sale proceeds per year Dehydrated cloves, 12 kg per day for 300 days @ Rs. 700 per kg	25.20

Table 4: Results of Economic Analysis

Economic indicators	
B/C ratio	3.7752
Pay back period	Less than 3 years

The Table shows the economic indicators determined for the garlic dehydration unit. It can be seen that benefit-cost ratio of the project is 3.77 and the payback period is less than 3 years. This indicates that project is economically viable.

IV. CONCLUSION

i. The drying time increased with increase microwave output power level.
ii. Microwave drying found better in terms of uniformity and reduce in time as compared to convective drying.
iii. Qualities of the microwave garlic cloves are found to be better.
iv. Microwave drying are economically viable.
v. The microwave drying could be employed in the drying of garlic cloves to produce dried cloves and garlic powder.

G. Future extension

Combination of microwave drying with other mode of heating, may give better results.
It is necessary to designed microwave dryer for more fruits and vegetables drying.

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TECH-CHRONICLE
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Diagnosis of Neuromuscular Disorder using EMG Signal and neural network

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***Abstract*—EMG Signal classification has become the area of interest for the researchers since past years. Electromyography is a technique which plays an important role in diagnosing neuromuscular disorders in the field of biomedical engineering. Multiple methods have been proposed for the classification of EMG signals. But the scholars are focusing on neural network due to its classification accuracy and Motor Unit Action Potential (MUAP) as a feature of classification to the neural network.**

This paper explores an approach for processing the EMG signal and its classification based on Artificial Neural Network (ANN) whereas Discrete Wavelet Transform (DWT) as a tool for classification of neuromuscular disorder. In this work a multilayer feed forward neural network with back propagation algorithm is used to train the Neural Network. For achieving maximum efficiency Back Propagation Algorithm (BPA) with Discrete Wavelet Transform (DWT) is used to classify the Neurological and Neuromuscular Disorders. This work explores a comparison between k-Nearest Neighbours (kNN) classifier and Feed Forward Neural Network (fNN).

Keywords—Electromyography (EMG); Artificial neural network (ANN);Motor unit Action Potential (MUAP); Amyotrophic Lateral Sclerosis (ALS); k-Nearest Neighbors (kNN);Discrete wavelet transform (DWT); feed forward neural network (fNN)

I. INTRODUCTION

Human body generates a set of electrical signals as a function of time. Electromyography evaluates and records electrical variations of skeletal muscles with time. Our interest is to make a tool for diagnosing neuromuscular disorders. The neurons that connect muscles and brain surface i.e. grey matter generates electrical signals to and fro ash shown in figure 1. These neuron fibers actually take the signal from brain to muscle or skin and from muscle to brain, thereby control the muscle movements.

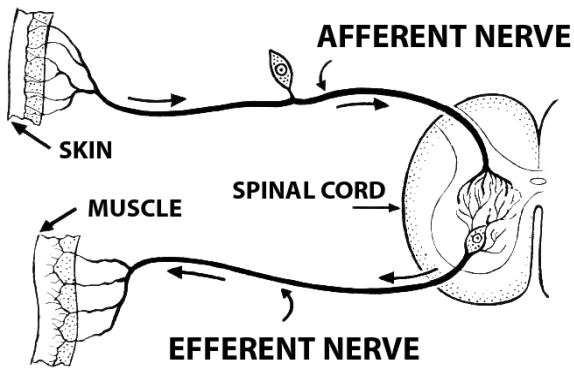

Fig 1.Nerve fiber taking the signal from skin or muscles to brain

Multiple types of electrodes are available for recording of EMG signal. Needle Electrode is used to read muscle EMG signal and Surface Electrode is used to read skin EMG signal.

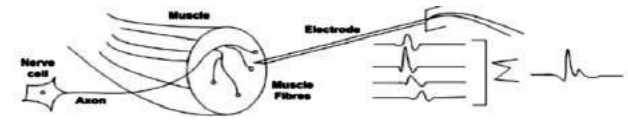

Fig 2.Anatomical Model for recording of EMG Signal.

For this research, a 25 mm Needle Type Electrode is suitable under hygienic clinical environment to read potential of motor nerve. This is called as Motor Unit Action Potential or MUAP. These signals are generated by muscles and goes to Central

Nervous System CNS through motor nerve. This is shown in figure 2.

The Neurophysiologist usually decode the MUAPs information from graphical patterns using oscilloscope [1]. As a single needle electrode makes the contact with multiple nerves, therefore receives a composite signal of different shapes and sizes on graphical screen. To classify muscular disorders visually from the received composite signal is very difficult, thus various algorithms have been developed.

In this work,to classify between myopathy, ALS and healthy patient signals we have used wavelet based classification scheme. This has been accomplishedthrough **F**eed **F**orward **N**eural **N**etwork using **B**ack **P**ropagation **N**eural **N**etwork.

Here, features are extracted using DWT (discrete wavelet transform). As we know that in practical case, EMG signal is a continuous composite signal varying with time, thus, decomposing it using wavelet transform is quite efficient. For decomposing a software known as EMG-LODEC is specially developed for recording multichannel long-term signals. The wavelet based algorithm distinguishes single MUAP by superposing the input signal [3].

II. METHODOLOGY

Classification of EMG signal needs following steps, which include (1)Reading EMG signal in wave format, (2) Feature extraction using wavelet, (3) Classification using NN. The block diagram of proposed work is shown in figure 3.

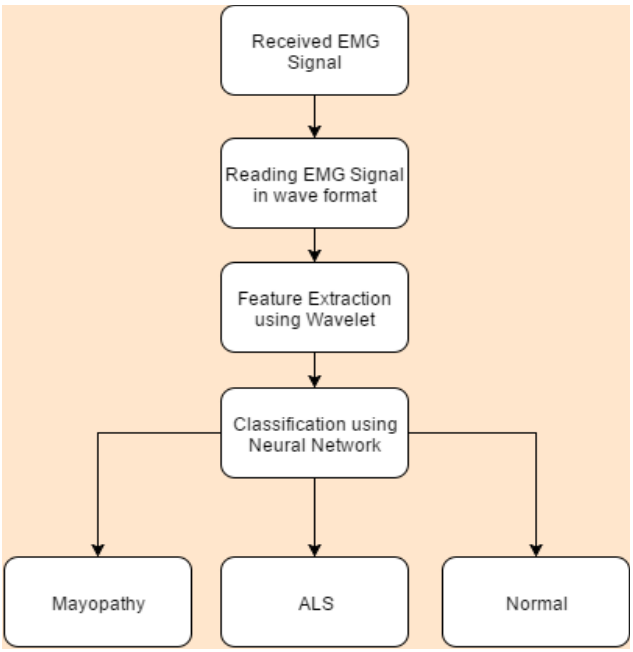

Fig 3. Block Diagram for Classification of EMG signal.

The EMG signal samples of a myopathy, ALS and a normalperson were collected from [4]. Signals from arm biceps of different persons are taken. The recording is done at low level but just above the threshold of constant contraction. The HPF of EMG amplifier is set at 2 Hz while LPFis set at 10 kHz [5].

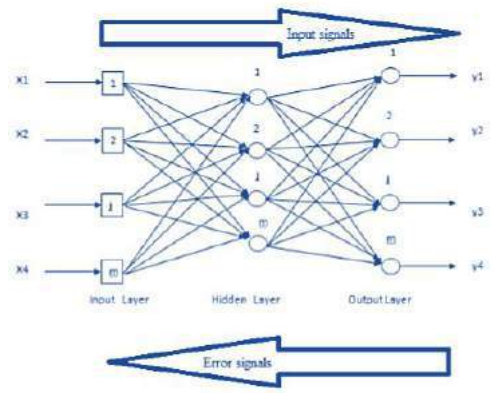

Fig4.Back Propagation neural network

III. DWT FEATURE EXTRACTION

Any classification method can't be directly to the EMG samples, due to the large amount and the high dimension of the examples are necessary to describe such a big variety of clinical situations. A set of algorithms is usually adopted to perform a quantitative description of the signal and a parameter extractionfrom the signal conditioning to the measurements of average wave amplitudes, durations, and areas, [6].

Discrete wavelet transform (DWT) in comparison with discrete Fourier transform (DFT) is anefficient time-frequency approach which has been used for processing multiple biomedical engineering signals, viz. EMG. Thus, for EMG, DWT provides the time and frequency information simultaneously [7]. Equation (1) showswavelet function.

$$X(a,b) = \frac{1}{\sqrt{b}} \int_{-\infty}^{\infty} x(t) \Psi\left(\frac{t-a}{b}\right) dt \qquad (1)$$

Where 'a' and 'b' are the dilation and the translation parameters respectively. In this present work Db4(Wavelet Daubechies-4) wavelet is used. For best result, the pre-processed EMG signal is decomposed by using the discrete wavelet transform up to the 10^{th}level because only 262134 samples are available with this work. The feature set consists of levels 1 to 10 and coefficients cd1 to cd10 and ca10. The energy peak of the EMG signal lies between 0.5 Hz and 40 Hz. This energy of the wavelet coefficients is muchintense in the lower sub-bands ca10, cd10, and cd9. The levels 1 to 8 and coefficients cd1 to cd8 areignored as they lack information and intolerable noise is present in the frequency band of these levels. Coefficients cd9 and cd10 shows the highest frequency components and ca10 shows the lowest one. The obtained feature vectors form Db4 and wavelets decomposition is given as an input to the Neural Network classifier.

A. *Discrete wavelet algorithm*

The EMG Signal information is passed through two convolutions functions (filters), each of which gives an output stream which is half in length to that of original input.One half of the output is produced by the LPFgiven by equation (2).

$$y_1[k] = \sum_n x(n)h_0[2k-n] \quad (2)$$

While another half of it is produced by the HPF given by equation (3).

$$y_2[k] = \sum_n x(n)h_1[2k-n] \quad (3)$$

Where y_1 and y_2 are the output of LPF & HPFrespectively, which are known as an approximate and detail component. These outputsare down sampled by a factor of 2, which is known as 1-level decomposition. This process is repeated up to 10 levels of decomposition, which results in a reduction of samples from 262134 to 262. This issuitable for training of neural network.

IV. NEURAL NETWORK AS A CLASSIFIER

The neural network is one of the efficient and accurate classifier. It hasdense parallel structure& it learns from previous experience. The accuracy of the classification is based on trainingof the neural network.Here,Multilayer Feed Forward Neural Network with Back Propagation Algorithm is used.

The informationobtainedfrom experience is stored in the form of connection weights. The weighs updatesafter training, which runs in multiple iterations to get the desired level of training.Since this algorithm is a supervised training algorithm,three issues need to be solved in designing an ANN for a specific application. In this work, total 14 hidden neurons are used, simplified network is shown in figure 4.

V. K-NEAREST NEIGHBOR TECHNIQUE

The k-Nearest Neighbor is denoted by k-NN. If the cost of error is same for each class, the estimated class of an unknown sample is chosen to be the class, which is normally represented in the collection of its K nearest neighbors. This technique does not consider a priori assumptions about the distributions wherefrom the training samples are taken. For classification of a new sample, the distance to the nearest training case is calculated then the sign (plus or minus) of this point classifies the sample. The k-NN classifier picks the k nearest points and allot the sign of the majority. Large value of k reduces the effects of noisy points within the training data set, andcross-validationis used to choose the value of k. This way, its Euclidean distance d is calculated. Equation (4) with all the training samples classifies to the class of the minimal distance.

$$q(x,y) = \sqrt{\sum_{j=1}^{n}\left(x_j - y_j\right)^2} \quad (4)$$

Each training example with a class label is a vector in a multidimensional feature space. The algorithm's training phase includes only storing of the feature vectors and class labels of the training samples. The algorithm's classification phase has 'k'as a user-defined constant, and the unlabeled vector is classified by assigning the label. Even if the Euclidean distanceis only applicable to continuous variables, it is used as the distance metric.

VI. RESULT AND DISCUSSION

In this method, features are extracted using wavelet for neural network. Decomposition up to 10 levels for the samples from ALS, Myopathy and Healthy person is shown in figure 5. Decomposition to higher levels depends on the number of samples present in a given signal. To get clear information for a very large number of samples, it can be decomposed to a level higher than tenth level.

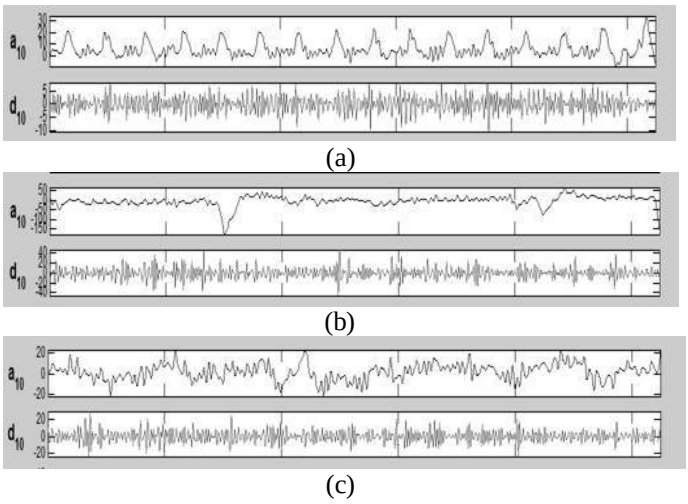

Fig 5. (a) Healthy (b) ALS (c) Myopathy

After tenth level of db4, the Histograms of samples shown in figure (6) distinguish the three classes, which are to be given to neural network.

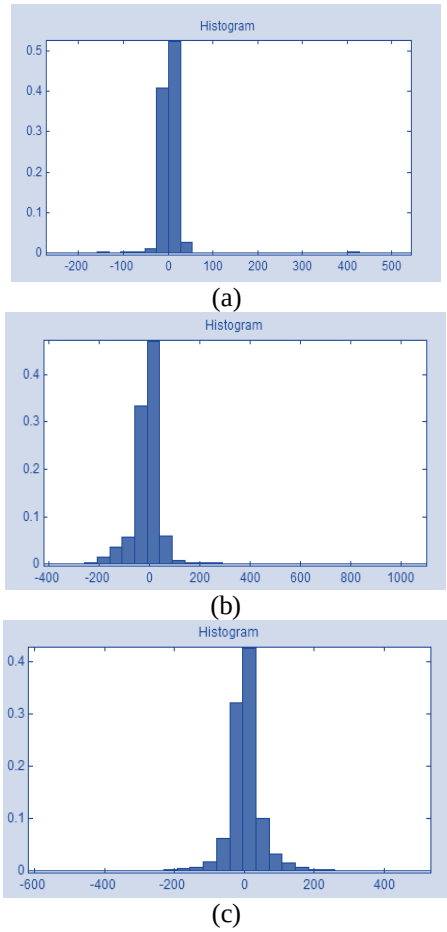

Fig 6. Histogram of (a) Healthy (b) ALS (c) Myopathy

VII. CONCLUSION

The results of Decomposition and Histogram is clearly showing the difference between Healthy, ALS & Myopathy. The kNN and fNN classifiers will be used to differentiate between Healthy, ALS and Myopathy.These classifiersare efficient to classify the data with a greater accuracy. This work will be an assistive contribution to doctors for a neuromuscular disorder.

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TECH-CHRONICLE
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DESIGN OF MACHINE ROOMLESS ELEVATOR

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Abstract- **The present invention relates to an installation structure for mounting an elevator traction machine at a rooftop floor being capable not only to distribute a concentrated operating load generated on the elevator traction machine during elevator operation over the guide rail to the bottom of a pit through the installation structure members, but also to remove a conventional machine room separately located at the upper end of a shaft and to minimize an installation space of the elevator traction machine without altering an operating height of elevator.**

Machine Room Less (MRL) elevator drives offer advantages over conventional traction drives such as a higher energy efficiency, low weight and more design freedom and better utilization of hoist-way space. MRL drives have emerged as the superior choice in most high rise applications. Currently a majority of MRL drives are mounted on a guide rail spanning beam which forces safety and stabilization components to act as load bearing component and degrades ride quality. The MRL drives are also difficult and costly to inspect and maintain if located in such a configuration. Alternate methods of mounting MRL drives on hoist-way spanning I beams if utilized can eliminate eccentric hauling leading to better utilization of guide rails and an improved ride quality. A hoist-way spanning support configuration also aids in decreasing inspection and maintenance costs by improving ease of access and increasing safety. Thus a properly located MRL drive can provide best possible operating parameters for a high rise application with lower costs of inspection and maintenance over the elevator lifetime.

Keywords—Machine roomless elevator

I. INTRODUCTION

Elevators are vertical transport systems that are utilized for efficient transport of passengers and goods between different efficient transport of passengers and goods between different floors (landings). An elevator differs from other hoisting mechanisms in that it runs at least partially on guide rails. The elevator is a mass transit system (conveyor) whose design has evolved rapidly from that of a simple drum and rope traction system to traction less and machine room less systems.

Elevator usage has grown exponentially in India but the adoption of newer technologies such as the MRL drive or systems is lagging behind because of additional costs of maintenance and inspection involved as convenience of machine room diminishes. It becomes imperative to establish MRL elevators as a superior choice and provide additional future changes that provide advantage of MRL drive during operation and the convenience of a machine room during inspection and maintenance. Such an elevator drive will provide least cost of maintenance and inspection for the customer over the elevator lifetime. The present invention relates to a machine-room-less installation structure for mounting an elevator traction machine at a rooftop. More particularly, the installation structure for mounting the elevator traction machine is capable not only to distribute a concentrated operating load being generated on the elevator traction machine over the guide rail to the bottom of a pit through the installation structure members, but also to remove a conventional machine room being separately located at the

upper end of the shaft and installation space of elevator traction machine without altering the traveling height of the elevator.

This paper is organized as follows. Firstly, literature review of IS: 14665 is discussed in section II. Problem and drawbacks of machine room elevators and proposed system is explained in section III. Finally we conclude in section IV.

II. LITERATURE REVIEW

Indian Standard for Electric Traction Lifts provides guidelines for outline dimensions of passenger, goods, service and hospital lifts. This standard was adopted by the Bureau of Indian Standard. This was done with a view to align the Indian Standards with the latest developments in the field of Lifts and also to align the standards with the European Norms on Lifts and Escalators EN 81. Moreover, these standards are published with a view to have a uniform code for electric traction lifts all over the country, where presently different rules are being followed by different states. This standard is one among the series of standards finalized by the Lifts and Escalators Sectional Committee as detailed below:

1. IS 14665 (PART 1) - 2000 ELECTRIC TRACTION LIFTS (GUIDE LINES FOR OUTLINE DIMENSION OF PASSENGER, GOODS, SERVICE & HOSPITAL LIFTS)[1]:
   This standard specifies outline dimensions of lift cars for passenger, goods, service and hospital lifts. The corresponding well sizes, pit depth, headroom, machine-room details and type of car and landing doors are also specified.

2. IS 14665 (PART 2 - SEC 1 & 2) - 2000 - CODE OF PRACTICE FOR INSTALLATION, OPERATION AND MAINTENANCE[2]:
   This standard (Part 2/Sec 1) covers the essential requirements, design considerations, testing and precautions to be exercised during installation of passenger and goods lifts operated by electric power, so as to ensure safe and satisfactory performance. It also provides guidance for proper maintenance after installation.

3. IS 14665 (PART 3-SEC 1 & 2)-2000 SAFETY RULES (SECTION 1 PASSENGER & GOODS LIFTS, SECTION 2- SERVICE LIFTS)[3]:
   3.1 This standard (Part 3/ Sec 1) applies to the construction and safety of new passenger and goods lifts suspended by ropes and employing a guided lift car.
   3.2 This standard does not apply to platform lifts, amusement devices, skip hoists, conveyors or similar apparatus used for raising, piling.

4. IS 14665 (PART 4-SEC 1 TO 9) – 2001[4]: Components
   Section 1- Lift Buffers
   Section 2- Lift Guide Rails and Guide Shoes
   Section 3- Lift Car frame, Car, Counterweight and Suspension
   Section 4- Lift Safety Gears and Governors
   Section 5- Lift Retiring Cam
   Section 6- Lift Doors and Locking Devices and Contacts
   Section 7- Lift machines and Brakes
   Section 8- Lift Wire Ropes
   Section 9- Controller and Operating Devices for Lifts

5. IS 14665 (PART 5) - 1999 ELECTRIC TRACTION LIFTS - SPECIFICATION (INSPECTION MANUAL)[5]:
   5.1 This standard (Part 5) applies to electric traction passengers/goods lifts erected at any place and intended for use by passengers.
   5.2 This standard does not apply to:
      a) Service lifts(dumbwaiters)
      b) Hydraulic lifts
      c) Escalators
      d) Cranes
   5.3 This standard is concerned with inspection of lifts from safety point of view and does not cover performance requirements and corresponding tests.

Yeti et al. [6] provides comparative design of direct drive PM synchronous motors in gearless elevator. In today's world electrical machines becomes irreplaceable for human beings to continue daily routines. Due to the features such as high efficiency, high starting torque, and silent working, permanent magnet synchronous motors (PMSM) are becoming more common in many applications. One of these applications is gearless elevator system where PMSM seems to be the best candidate so far. In this paper, comparative design of PMSM for gearless elevator has been investigated. Maxwell 2D Finite element analysis software has been used in this study. With comparative design, the influence of pole count on the machine performance is studied.

Kumar et al. [7] discusses about elevator control system which is one of the important aspects in infrastructure industry. This elevator control system is designed with the help of hydraulic motor and programmable logic control (PLC) while internal controlling is done through human machine interference (HMI). This research is divided into two Parts on the basis of programming. Firstly the program is developed on ladder logic and then simulated on software itself but for later testing and running the application a visualization is created on Indraworks engineering Software and testing of hardware is done. In the second level for controlling the internal commands of the system and for floor recognition HMI is developed on Rexroth touch screen HMI and internal switch for floor selection is done by HMI. The system consists of three floor hardware and recognition of floors is done by inductive proximity sensors and limit switch. Hydraulic motor used for UP-DOWN movement of the elevator is controlled through 4/3 Directional control valve (DCV).

Lee et al. [8] discusses about structure design and magnetic force analysis of a ropeless elevator model that employs permanent magnet linear synchronous motors (PMLSMs) with the structure of a double-sided long-stator. To obtain the optimal structure, the combination of response surface methodology and 2-D finite element analysis, which can solve the problem effectively without consuming much time, is utilized to estimate the design parameters of PMLSM. The numerical calculations and the experimental results are reported to validate the applicability of this double-sided long-stator type PMLSM for a ropeless elevator system.

Dae-Woong et al. [9] presents a new standardized type of gearless traction machine drive system with a PM motor for high-speed elevators. Some control functions which are indispensable for improving the performance of elevator systems have been addressed. Stringent evaluation, environment and life tests ensure that the presented system is not only high-performance but long-lasting and more reliable.

Wes et al. [10] discusses the overall importance and benefits of a complete and efficient preventative maintenance program. Implementing a strong program will have positive impacts on safety, early detection, predictive maintenance, life expectancy, and reducing operating costs. We will look at existing tools and new technologies; specifically the load measuring roller and analytical review.

III. PROBLEM DEFINITION

3.1 Problem and drawbacks of machine room elevators

The separate room is required at the top of the shaft for mounting traction machine and controller as shown in Fig. 1. It results in increase in construction cost as well as Elevator cost. Also, due to increase in height, motor power consumption also increases.

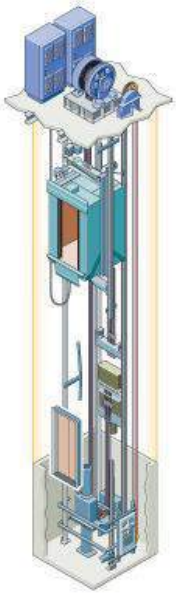

Fig. 1 Machine room elevator

3.2 Proposed system and conceptual design

To overcome the drawbacks of old systems, traction machine can be installed in shaft itself and control panel can be mounted near top floor landing door. Comparison between elevator with machine room and machine roomless elevator is as shown in Fig. 2.

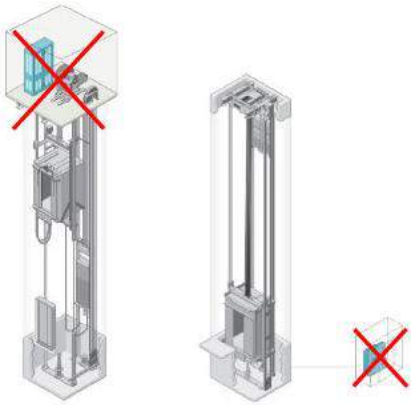

Fig. 2 Comparison between machine room elevator and machine roomless elevator

This reduces the cost of construction and increases efficiency and performance of elevators. Machine Room Less drives represent current pinnacle of elevator drive technology and have made other traction drives obsolete. MRL drives offer best operating parameters including costs, energy efficiency, and ride quality. Elevation view and Plan view of Machine Roomless Elevator are shown in Fig 3 and Fig. 4, respectively. This shows conceptual layout/arrangement.

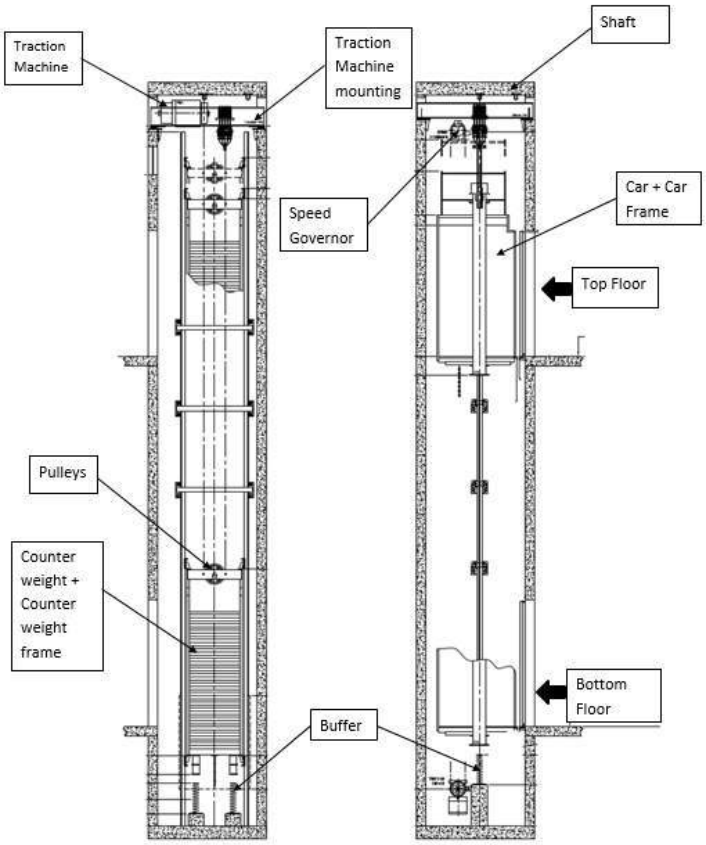

Fig. 3 Machine Roomless Elevator (Elevation view)

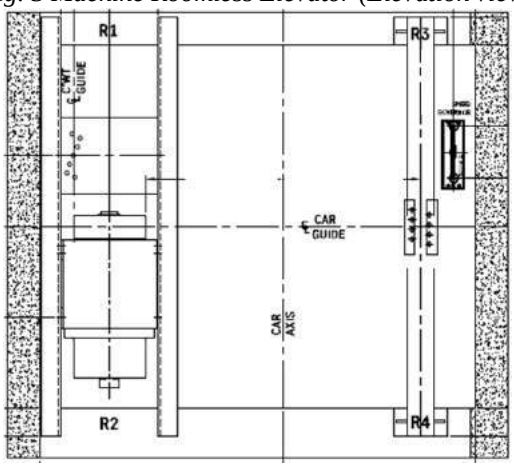

Fig. 4 Machine Roomless Elevator (Plan view)

IV. CONCLUSION

Machine Room Less drives represent current pinnacle of elevator drive technology and have made other traction drives obsolete. MRL drives offer best operating parameters including costs, energy efficiency, and ride quality. When compared to other types of drives for high rise applications and are being preferred to hydraulic drives in low rise applications. However MRL drives currently in use have few disadvantages including less seismic safety, eccentric haulage of cabin, difficulty and increased costs of inspection and maintenance. Most of these disadvantages occur due to older method of Supporting MRL drives on a Beam spanning the Guide rails. Use of alternate configurations with the drive housed in the hoist way at top or bottom locations (use of pit floor may be made when moving from hydraulic to traction drives) eliminates majority of disadvantages associated with MRL drives. Lower costs of inspection and maintenance over the elevator lifetime will also encourage widespread use of the highly efficient MRL drives.

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TECH-CHRONICLE
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Design and analysis of cutter drum for a cable laying machine

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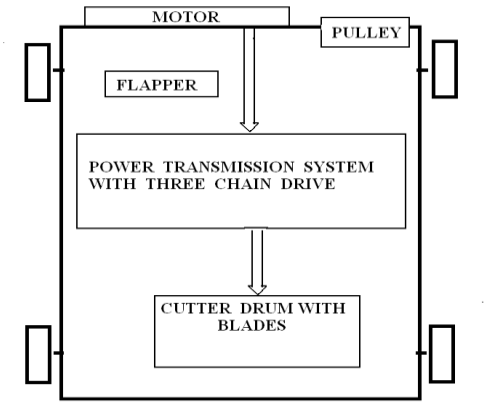
Abstract: A cable laying machine for underground placement of cable incorporating a basic frame and power unit incorporating a rear warred attractive component with the front and rear components with the front and rear components being articulately interconnected for steering control of the machine and the rear component including cable laying plough associated there with the rear component may be provided with cable reels and guide structures for guiding the cable the plough. The cable laying machine has a cutter drum at its front end which digs up the soil along linear channels rolls down the cable mounted on the roller behind. The proposed machine eliminates hazards faced by commuters solving three purposes simultaneously of digging, Cable laying and then covering the soil. The simulation model will be created in CREO-PARAMETRIC 2.0. Here dynamic mechanism will be made for calculating velocity, acceleration impact variation with respect to time. Design calculation in the reverse direction so that how much torque is required to dii up the soil. After that we design the whole system from bottom to top. MD SOLID software will be used to calculate the SFD and BMD Diagrams as well as deflection in the shaft.in terms of robustness we analyses the whole parts in the assembly which is made in Design software. Different analysis will be made such as structural analysis in ANSYS 16.0.

Keywords: Cable, Soil conditions,Creo,MDsolid,Ansys

INTRODUCTION:

The cable laying machine is to lay a utility cable underground and laying the cable at a uniform depth.it has a Cutter drum mounted on the front section, Cable drum along with cable on back section. Accumulated soil is removed by the flapper



BLOCK DIAGRAM OF CABLE LAYING MACHINE

The machine is run by motor whichperforms 4 functions:-

- digs up the soil (with the help of cutter drum)
- clears the channel (by means of flapper)

- lays the cable (through the cable roller drum)
- Refilling the channel.

LITERATURE SURVEY:

1. **Analysis of Power Transmission System for Ginning Machine with Feeding Mechanism using FEA**

Prof. P. S. Nerkar1, Dr. J. F. Agrawal2, Mr. P.D. Deshpande3 1 Assistant Professor, Department of Mechanical Engineering, S.V.P.C.E.T, Nagpur, Maharashtra, India. 2 Principal, Shri Sai College of Engineering & Technology, Bhadravati, Maharashtra, India. 3Application Engineer, DCS. PVT. Limited, Nagpur, Maharashtra, India.

ABSTRACT: In India, it was found that ginning factories do not operate efficiently with regard to the labour force employed and the amount of capital invested. In order to make a more concrete evaluation of the cotton ginning sector, it is necessary to determine the structural characteristics of the factories, costs and profitability, the level of technical efficiency, and the most important, potential for improvement in the industry. Irregular feeding of Seed Cotton to ginning machine decreases the production rate of seed and fiber. It also affects the quality of the fiber and seed. To overcome these difficulties feeding mechanism is developed. The primary function of feeding mechanism is to feed seed cotton uniformly to the ginning machine at controllable rates. Feed rollers, located at the bottom of the feeder, directly under the hopper, control the feed rate of seed cotton to the ginning machine. Stress analysis carried out by using FEA software and the results are compared with the calculated values. This paper illustrates how the chain drives are very important to carry forwards the power. In this Paper recommendations and suggestions to improve quality of cotton fiber, suggestions for ginning factories are highlighted.

2.ANALYSIS OF THERMAL GROWTH INFLUENCE ON V-BELT TRANSMISSION ALIGNMENT PRECISION

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Abstract. V-belt transmission alignment is a necessary criterion of its reliable and accident-free work. Most exact and useful is an alignment by laser equipment. However, during an alignment it is necessary not only exactly and correctly to align the drive and led units, but also to take into account the size of V-belt transmission component thermal growth. In this article the principle of thermal growth size determination will be considered, and also the analysis of thermal growth influence on the V-belt transmission alignment quality and precision will be conducted.

Keywords: laser alignment, reduction gearbox, V-belt transmission, test rig.

3.A DISCRETE ANALYSIS OF METAL-V BELT DRIVE

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Abstract
The metal-V belt drive includes a large number of parts which interact between them to transmit power from the input to the output pulleys. A compression belt composed of a great number of struts is maintained by a tension flat belt. Power is them shared into the two belts that moves generally in opposite directions. Due to the particular geometry of the elements and to the great number of parts, a numerical approach achieves the global equilibrium of the mechanism from the elementary part equilibrium. Sliding arc on each pulley can be thus defined both for the compression and tension belts. Finally, power sharing can be calculated as differential motion between the belts, is defined. The first part of the paper will present the different steps of the quasi-static mechanical analysis and their numerical implementations. Load distributions, speed profiles and sliding angle values will be discussed. The second part of the paper will deal to a systematic use of the computer software. Speed ratio, transmitted torque, strut geometry and friction coefficients effect will be analysed with the output parameter variations. Finally, the effect pulley deformable flanges will be discussed.

4.SPEED RATIO PREDICTION AND PERFORMANCE ANALYSIS OF SINGLE BALL TRACTION DRIVE FOR CVT

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ABSTRACT Drives are basically used to transmit power and speed from the prime mover to the machine. The power transmission and speed reduction between the prime-mover and the driven machine can be achieved by using conventional drives like Belt drive, Rope drive, Chain drive, Gears, etc. with their numerous advantages and disadvantages. There are many machines and mechanical units that under varying circumstances make it desirable to be able to drive at a barely perceptible speed, an intermediate speed or a high speed. Thus an infinitely variable (step less) speed variation in which it is possible to get any desirable speed. Some mechanical, hydraulic, drives serve as such step less drives.

However the torque versus speed characteristics of these drives do not match torque at low speeds. Hence the need of a step less or infinitely variable speed drive came into existence. The drive presented by the end of this research work is single ball traction drive for continuously variable transmission systems. Dissertation includes the brief history of existing drives, speed prediction methodology and performance analysis of the drive developed.
***Keywords* – Analysis, Ball, CVT, IVT, Traction**

5. DYNAMICS MODELING FOR MECHANICAL FAULT DIAGNOSTICS AND PROGNOSTICS

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ABSTRACT
While tremendous improvements have been made in the performance of modern engineered systems due to increased design cycle accuracy and testing capabilities, traditional time/use maintenance practices have not changed much. While wear longevity of many subsystem components has increased with a beneficial decrease in weight and size the margins of safety have also decreased because of greater accuracy in design analysis and improved testing techniques. In an effort to increase efficiency in use of high performance and heavy-duty systems, especially in power generation and transmission subsystems, Condition-Based Maintenance (CBM) has emerged as an improvement over more costly time/use maintenance practices. CBM is being enabled by the same technological (testing, modeling, analysis) improvements that have spawned increased system performance. As part of a combined experimental-theoretical analysis investigation effort related to CBM diagnostics and prognostics, an experimental gearbox failure test bed was constructed. The primary interest is the\ study of mechanical fault evolution in damaged rotating components that involve mechanical power transmission. As part of that same research effort a dynamics model of the system is being developed for response simulations and study of *in situ* mechanical dynamic fault models. Simulations of system vibratory responses will allow physical insights to be gained in vibratory measurement sensor placement and specification, dynamic system response to a fault, and fault detection signal processing algorithms. In this paper, the dynamics modelling of the gearbox drive rotor/bearing-foundation system using the Finite Element method is outlined and it's relevance to diagnostics and prognostics is highlighted.

6.ENERGY LOSS AND EFFICIENCY OF POWER TRANSMISSION BELTS

ABSTRACT: A comprehensive selection of belt type and construction from industrial and agricultural applications is extensively tested and compared for idling loss and power transmission efficiency. Data is documented for Vee, joined-V, V-ribbed, and synchronous belt types and for cogged, plain, and laminated V-belt constructions. The level of energy savings achieved by the replacement of plain-base wrapped V-belts with cogged V-belts is emphasized. Belt efficiency, slip, and temperature dependence on the basic drive parameters of torque, sheave diameter, belt tension, and contact angle is reported

7.THE BENEFITS OF A FINAL APPLIED DESIGN PROJECT THAT COMPREHENSIVELY INTEGRATES COURSE MATERIAL CONTENT & CONCEPTS

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Abstract: The objective of this paper is to explore the benefits of a final applied engineering design project, which serves to comprehensively integrate the content and concepts of a senior-level course. By integrating course content and concepts through an applied project, the benefits of a typical multi-semester capstone design project are translated to a single course. For this, an upper-level mechanics-track course that is being offered to seniors in the Manufacturing and Mechanical Engineering Technology (MMET) program at Texas A&M University was chosen. The course, titled "Mechanical Design Applications-II" involved the application of the principles of design to mechanical power transmission elements. The final assigned project was to complete the design of all the individual elements constituting the power transmission system that was intended to deliver power between two machines, and to put them together (with certain requirements and constraints). Periodic guidance was offered to the students on a need-basis for this open-ended project. On completion, it was observed that this interactive activity was very well received by the students, and that it clearly exhibited many short-term and long-term benefits in the form of concept and content clarity, problem-based learning, metacognition, and higher-order thinking skills.

8.CALCULATION OF THE STARTING REGIME OF THE POWER TRANSMISSION SYSTEM WITH A HYDRODYNAMIC COUPLING AND A DRIVING MOTOR

UDC 621.817.032

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Abstract. In this paper a graph-analytical procedure for calculating a starting regime of the power transmission with a hydrodynamic coupling and a driving motor is presented. The presented iterative

procedure for solving this problem provides for obtaining the starting power transmission system regime with accuracy determined in advance. The number of iterative steps depends on the defined accuracy.

Key Words: Hydrodynamic Coupling, Electromotor, Starting Regime

CONCLUSION:

After the completion of literature survey the cable laying machine is boon to the mankind. The machine is a first of its kind which digs up the soil, lays the cable and covers the channels simultaneously. The implementation of this machine would certainly reduce the time of cable laying work and will also assist in greater precision that manual cable laying work. The cable laying machine reduces the labour cost associated with the digging up the soil and covering the channels. It also reduces the traffic snarls and hazards faces by the commuters due to cable laying work. Having seen this machine working satisfactorily on a small scale, we can conclude that with the aid of high transmission system, high capacity motors and cutter teeth of high harden ability; it can be used in the large small project undertaken by the government for cable laying work.

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TECH-CHRONICLE
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DESIGN, ANALYSIS AND OPTIMIZATION OF PRESS MACHINE USING FEA

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***Abstract*—In hydraulic press, the force generation, transmission and amplification are achieved using fluid under pressure. The liquid system exhibits the characteristics of a solid and provides a very positive and rigid medium of power transmission and amplification. In a simple application, a smaller piston transfers fluid under high pressure to a cylinder having a larger piston area, thus amplifying the force. There is easy transmissibility of large amount of energy with practically unlimited force amplification. It has also a very low inertia effect. Main objective of project is to modify major component of one cylinder four post hydraulic press so that rigidity and strength of the components are increase by using optimum material. The function of the major component like frame, bottom plate, bed, top box are to absorb forces, to provide precise slide guidance and to support the drive system and other auxiliary units. The structural design of the component depends on the pressing force this determines the required rigidity. The current machine does not have high rigidity and needs to be redesigned.**

***Keywords:* hydraulic press, fluid,power transmission, cylinder.**

I. INTRODUCTION

HYDRAULIC PRESS: In hydraulic press, the force generation, transmission and amplification are achieved using fluid under pressure. The liquid system exhibits the characteristics of a solid and provides a very positive and rigid medium of power transmission and amplification. In a simple application, a smaller piston transfers fluid under high pressure to a cylinder having a larger piston area, thus amplifying the force. There is easy transmissibility of large amount of energy with practically unlimited force amplification. It has also a very low inertia effect.

In these types of presses, press-body is of C Shaped. When free space required from three sides of press table to work for loading and unloading of pressed component then this type of presses are designed. As main cylinder placed eccentric to central axis of press-body, it applies eccentric load on press-body hence heavier press body is required as compared to same capacity of other type of press. These types of presses are also called as single press.

Figure1: Existing Press machine

II. LITERATURE REVIEW

[1]Ankit H Parmar, Kinnarraj P Zala, Ankit R Patel Suggested thatthe goal of structure optimization is to decrease total mass of hydraulic press while assuring adequate stiffness. Structural optimization tools and computer simulations have gained the paramount importance in industrial applications as a result of innovative designs, reduced weight and cost effective products. A method of structure optimization for hydraulic press is proposed in order to reduce mass while assuring adequate stiffness. Key geometric parameters of plates which have relatively larger impacts on mass and stiffness are extracted as design variables. In order to research relationship between stiffness, mass and design variables, common batch file is built by CREO and analysis is done in ANSYS. Top plate, movable plate and column design and analysis done.

[2]B.PARTHIBANP.EAZHUMALI' S.KARTHI.A hydraulic press is a machine using a hydraulic cylinder to generate a compressive force. Frame and cylinder are the main components of the hydraulic press. In this project press frame and cylinder are designed by the design procedure. Press frame and cylinder are analyzed to improve its performance and quality for press

working operation. Structural analysis has become an integral part of the product design. The frame and cylinder are modeled by using modeling software CATIA. Structural analysis has been applied on C frame hydraulic press structure and cylinder by using analyzing software ANSYS. An integrated approach has been developed to verify the structural performance and stress strain distributions are plotted by using ANSYS software. According to the structural values the dimensions of the frame and cylinder are modified to perform the functions satisfactory.

[3]Muni Prabaharan and V.AmarnathStructural optimization tools and computer simulations have gained the paramount importance in industrial applications as a result of innovative designs, reduced weight and cost effective products. Especially, in aircraft and automobile industries, topology optimization has become an integral part of the product design process. In this project, topology optimization has been applied on various components of scrap baling press and 5Ton hydraulic press using ANSYS WORKBENCH software. Suitable loads and constraints are applied on the initial design space of the components. An integrated approach has also been developed to verify the structural performance by using ANSYS software. At the end, shape optimized design model is compared with the actual part that is being manufactured for the press. It is inferred that topology optimization results in a better and innovative product design. In this project, we showed 26.26 percent cost reduction in scrap baling press. And we fabricated 5ton hydraulic press with cost reduction of 24.54 percent.

III. IDENTIFIED GAPS IN THE LITERATURE

Main objective of project is to modify major component of one cylinder four post hydraulic press so that the rigidity and strength of the components are increased.

IV.PROBLEM FORMULATION

In hydraulic press, the force generation, transmission and amplification are achieved using fluid under pressure. The liquid system exhibits the characteristics of a solid and provides a very positive and rigid medium of power transmission and amplification. In a simple application, a smaller piston transfers fluid under high pressure to a cylinder having a larger piston area, thus amplifying the force. There is easy transmissibility of large amount of energy with practically unlimited force amplification. It has also a very low inertia effect. Main objective of project is to modify major component of one cylinder four post hydraulic press so that rigidity and strength of the components are increase by using optimum material. The function of the major component like frame, bottom plate, bed, top box are to absorb forces, to provide precise slide guidance and to support the drive system and other auxiliary units. The structural design of the component depends on the pressing force this determines the required rigidity. The current machine does not have high rigidity and needs to be redesigned.

V CONCLUSIONS

By undertaking this project, major component of one cylinder four post hydraulic press machines will be redesigned and optimized so that it has sufficient strength and stiffness.

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Design & CAD simulation of Right Side Dropping Dumper

(For Small Vehicle)

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***Abstract*—In this research work an improved way of unloading material from dumper is design. Conventional Dumper unloads material only at back side of dumper which may cause problem of road blockage in limited space area. The right side dropping dumper overcomes problem of unloading the material by using hydraulic cylinder. Modern right side dropping dumper has been conceived by observing difficulty in unloading the material. Hence suitable arrangement has been designed for small vehicle (TATA ace). The vehicles can be unloading material from right side. The concept leads to efficient working.**

Keywords—Dumper,dropping side,right side dropping.

I. INTRODUCTION

A dumper is a vehicle designed for carrying bulk material, often on building sites. Dumpers are distinguished from dump trucks by configuration: a dumper is usually an open 4-wheeled vehicle with the load skip in front of the driver, while a dump truck has its cab in front of the load. The skip can tip to dump the load; this is where the name "dumper" comes from. They are normally diesel powered. A towing eye is fitted for secondary use as a site tractor. Dumpers with rubber tracks are used in special circumstances and are popular in some countries.

Early dumpers had a payload of about a ton and were 2-wheel drive, driving on the front axle and steered at the back wheels. The single cylinder diesel engine (sometimes made by Lister) was started by hand cranking.

The steering wheel turned the back wheels, not front. Having neither electrics nor hydraulics there was not much to go wrong. The skip was secured by a catch by the driver's feet. When the catch is released, the skip tips under the weight of its contents at pivot point below, and after being emptied is raised by hand.

Modern dumpers have payloads of up to 10000kg and usually steer by articulating at the middle of the chassis. A dumper is an integral part of any construction work and hence its role is important for completion of any constructional site. One of the problem are cited with dumper in the time and energy for setting the huge dumper in the proper direction to dump the material it in carrying and hence the need of the project work riser which is about Design & CAD simulation of Right Side Dropping Dumper.

II. LITERATURE REVIEW

1. Design and Development of 3-Way Dropping Dumper, www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 9, September 2014)

A small scale model has developed using light weight material i.e. plastic and hydraulically operated piston and cylinder arrangement. This hydraulic arrangement actuates on motor driven which makes the prototype semi automatic. The trolley piston gets out and makes the trolley to tilt by operating various cylinders; the material can be dropped in 3 ways. Limitation- Increased complexity: It requires complex mechanism for getting desired

2. Development Of Three Axes Lifting Modern Trailer, Volume I, Issue 5, May 2015 (ISSN: 2394 – 6598)

In this work the trailer is pulled up in three axis. The figure 1 shows ths working principle of hydraulic cylinder used in this modern trailer. For the trailer action we are using hydraulic as a source. The 3/2 direction control valve is used to control the direction of the hydraulic. When the inlet port is open the hydraulic is pumped from the sump using hydraulic pump. The trailer is now pushed upward in the "Y" axis direction and the outlet port is activated now, then the trailer was pushdown in Y axis direction. Now the knee joint of the trailer is removed for trailer action in „Z" axis. Then again the inlet port is open. The trailer is now pushed upward in the "Z" axis direction and the outlet port is activated now, then the trailer was pushdown in „Z" axis. Again the knee joint is removed for the trailer action in „X" axis. Then again the inlet port is open. The trailer is now pushed upward in the "X" axis direction and the outlet port is activated now, then the trailer was pushdown in „X" axis.

we can dispatch the load in three axis in the trailer by using the universal joint in the hydraulic cylinder.

3.Design and Fabrication of Unidirectional Dumper, *International Journal for Scientific Research & Development| Vol. 3, Issue 02, 2015 | ISSN (online): 2321-061.*

An operating system consists of electric motor, worm & worm gear mechanism to rotate the dumper horizontally in required direction. Two Chassis (Frame) is provided on which trolley is mounted, where first frame of chassis is stationary & attached to the worm & worm gear to rotate the trolley horizontally in required direction.

Second frame of chassis consists, one end of Pneumatic cylinder which is hinged with this frame of chassis and other end of pneumatic cylinder is also hinged but to the one end of trolley to give vertical movement

Limitations:

Increased Complexity: As, it requires complex mechanism to get desired output.

Cost Increases. As more will be the complications to perform the operation, more will be the cost encountered with it.

Maintenance Increases: More parts in working leads to more maintenance.

III CONCEPT

Problem and drawbacks of existing Dumpers

1) Collisions:

Dump trucks are normally built for some amount of road or construction site driving; as the driver is protected by the chassis and height of the driver's seat, bumpers are either placed high or omitted for added ground clearance. The disadvantage is that in a collision with a standard car, the entire motor section or luggage compartment goes under the truck. Thus the passengers in the car could be more severely injured than would be common in a collision with another car.

2) Tipping:

Another safety consideration is the leveling of the truck before unloading. If the truck is not parked on relatively horizontal ground, the sudden change of weight and balance due to lifting of the skip and dumping of the material can cause the truck to slide, or even—in some light dump trucks—to turn over.

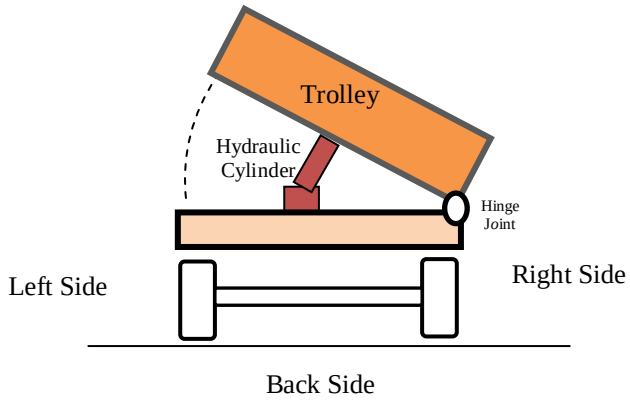
3) Back-up accidents:

Because of their size and the difficulty of maintaining visual contact with on-foot workers, dump trucks in car parks can be a threat, especially when backing up. Mirrors and back-up alarms provide some level of protection, and having a spotter working with the driver also decreases back-up injuries and fatalities.

4) Working condition:

Because of constructional side road limitation it is difficult to drop material at proper location

Also the problem are cited with dumper in the time and energy for setting the huge dumper in the proper direction to dump the material it in carrying and hence the need of the project work riser which is about Right side dropping dumper which can dump the material in side direction except the back one. The main objective of this project work is to improve dropping side. So here right side is selected instead of any side because in Indian vehicle driver seat is located in right side so it is very easy to see obstacles in dropping side.



In proposed work, dumper dropping components will be designed manually for Right side dropping. Different components required in designing Right side dropping dumper are: Trolley, Hinge joints, Cylinder mounting bracket, Chassis beams, Pins, Calculation of bending stress & deflection in trolley (dumper), Calculation for dia. of pin, Calculation Shear & Bending stress on cylinder mounting bracket. Standard components will be selected as per manufacturer catalogue.

The proposed method has several advantages.

Can be used in very compact places: Where reversing & turning of vehicle is difficult, Saves time & energy, Easy to unload material.

Hydraulic Cylinder

A hydraulic cylinder is placed below the body of truck longitudinally at one end of the truck, and the piston end of the hydraulic cylinders is connected by the means of a pivot joint to the chassis of truck. In the forward stroke of the cylinder, it pushes the truck body upward thus gives necessary lift for tipping dumping. So, in the forward stroke of the cylinder, the truck is unloaded. In the return stroke of the cylinder the body of the truck comes to its original position.

Hinge Joint

The other bottom end of the body of the truck is connected by a hinged joint with the chassis.

Mounting Brackets

Cylinder mounting bracket is mounted in crossbeam provided to chassis beam.

Pins

Pins are provided to joint trolley with chassis so that trolley can tilt about fix plane.

Advantages

1) Can be efficiently used in very compact places where turning of vehicle is difficult.

2) Reduction in amount of accidents on constructional site or plant.

3) Increased moving ability as it does not become tiresome to perform the job.

4) Reduces extra cost paid on unloading of material by labor or machines like cranes or any other pick and placer.

5) Saves times and energy.

Applications:

1) At Constructions site.

2) At remote locations where floor space area is less.

IV CONCLUSION

As this concept saves time & energy as well this may leads to efficient working, which helps constructional work or the infrastructural work demands of efficient and user friendly machinery will lead to more and more use of the project work like Right side dropping dumper.

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TECH-CHRONICLE
AN INTERNATIONAL E-JOURNAL ON
EMERGING TRENDS IN SCIENCE, TECHNOLOGY AND MANAGEMENT

"DESIGN, ANALYSIS AND VALIDATION OF CONCEPTUAL BRICK HANDLING TRAILER"

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Abstract

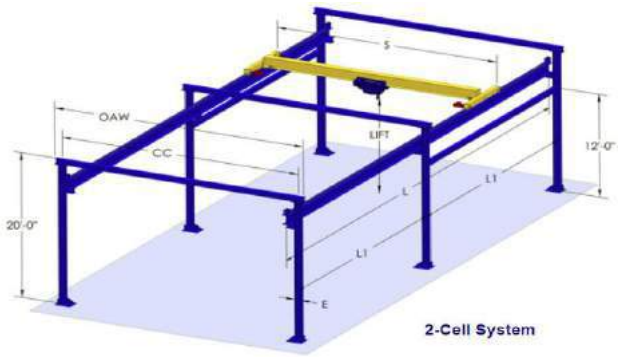
Nowadays, construction industry is on a boom. Almost everywhere one can find some kind of construction work in progress. At every construction site bricks are required. For normal wall construction bricks are must have. Bricks are of vital importance in construction. To provide bricks in time at the construction site and that too without damage is still a challenge in India. But manually handling these bricks cause workers to suffer from back injury and long-term pain if regularly lifting/carrying heavy or awkward objects. So, the palletizing and mechanization of the bricks is suggested so as to reduce the human injury and to increase the productivity and profitability.

Keywords: Bricks, construction side, palletizing, mechanization.

I. INTRODUCTION

Expressed in simple language, materials handling is loading, moving and unloading of materials, i.e. raw material, semi/finished good, etc. To do it safely and economically, different types of tackles, gadgets and equipment are used, for mechanical handling of materials. Since primitive times men discovered the use of wheels and levers, they have been moving materials mechanically. Any human activity involving materials need materials handling. However, in the field of engineering and technology, the term materials handling is used with reference to industrial activity. In any industry, be it big or small, involving manufacturing or construction type work, materials have to be handled as raw materials, intermediate goods or finished products from the point of receipt and storage of raw materials, through production processes and up to finished goods storage and dispatch points. A material handling as such is not a production process and hence does not add to the value of the product. It also costs money; therefore it should be eliminated or at least reduced as much as possible. However, the important point in favor of materials handling is that it helps production. Depending on the weight, volume and through put of materials, mechanical handling of materials may become unavoidable. In many cases, mechanical handling reduces the cost of manual handling of materials, where such materials handling are highly desirable. All these facts indicate that the type and extent of use of materials handling should be carefully designed to suit the application and which becomes cost effective.

Overhead cranes are commonly employed in the transport industry for the loading and unloading of freight, in the construction industry for the movement of materials and in the manufacturing industry for the assembling of heavy equipment, because they can move loads far beyond the normal capability of a human. Thus in this project a detailed design and analysis of the overhead hoist system is undertaken to handle construction bricks.



II. LITERATURE REVIEW

A.D.Anjikar [1] Handling of raw material, semi finished, finished product & other material is ever concern & cost in an industry. With increasing cost of labour & its scare city the manual work or operation in industries are now replaced by semi automatic or automatic system. These low cost systems are not only cost efficient but also enhance productivity & address the issues related to labour problem. Conventionally in micro or small scale industries which are labour intrinsic transportation of raw material, semi finished product is always an expensive & problematic issue. After visiting Waghmare food products, Nagpur & after discussion with the concern the shifting of raw material from store to the work place was a costly labour activity. Presently it is done manually. The industry was interested to identifying some optional material

handling system to encounter their problems After carefully survey of factory layout, discussing with management, concern exhaustively literature search it was preferred to design & develop a overhead monorail for handling of raw material The main aims to design cost efficient, overhead monorail material handling system. The detailed drawings will also drawn using the software's like CATIA/ PRO-E. The cost estimation along with economical feasibility and pay back will also be calculated.

Du-Ming Tsai [2] Material handling pallets are the most common tool used in warehousing industries. Nearly every warehouse uses them to some extent. Pallets have become an almost universal warehouse operations tool. They provide a convenient, simple way to transport, stack, and store materials.Traditional palletizing methods load only boxes of the same size on one pallet. For retail business such as grocery distribution or manufacturers that produce many products of small quantities, a wide product mix of different box sizes must be loaded onto the same pallet. The traditional palletizing method may not optimize the utilization of the pallet cube. Manual palletizing is an extremely tedious and fatiguing task. Automatic palletization is, therefore, a potentially attractive alternative. Commercially available palletizers handle only one box size at a time. They cannot meet the requirements of palletizing applications with mixed box sizes. Industrial robots have always been a viable solution to complex loading operations due to their flexibility and programming capability.

Sourabh R. Dinde, Rajashekhar S. Talikoti [3] According to the structural point of view Industrial Pallet rack structure can be considered typical steel framed structure. This work presents a general analysis of an industrial pallet rack structure, evaluating the influence of each of the components on the global stability. An analytical study for the sensitivity of pallet rack configuration in linear static equivalent lateral loads. The aim is to braced/unbraced frames were design and their analytical models are to be built in software. The finite element analysis is used to determine axial forces in beam and column, maximum storey displacement and buckling loads on braced/unbraced pallet rack structure. Bracing systems are mostly provided to enhance the stiffness factor of the structures with the seismic loads. Unbraced systems have mostly translational modes of failure and are very flexible due to excessive loads.

III. IDENTIFIED GAPS IN THE LITERATURE

Bricks are of vital importance in construction. To provide bricks in time at the construction site and that too without damage is still a challenge in India. But manually handling these bricks cause workers to suffer from back injury and long-term pain if regularly lifting/carrying heavy or awkward objects. So, the palletizing and mechanization of the bricks is suggested so as to reduce the human injury and to increase the productivity and profitability. After closely monitoring the brick handling process for a Heavy commercial vehicle, following problem were identified,

A. Labor Force is More:

In current material handling system the number of labor required for carrying material from intake zone to delivery zone is more.

B. Cost is More:

Due to large labor force the cost of material handling is increases.

C. Efficiency is Less:

The input provided to the system in terms of labor effort is more but output obtained interms of material delivered to the unloading zone is less.

D. Flexibility in System is Less:

There is no other option than the manual conveying system for conveying material which makes the system less flexible to suit changing atmosphere within industry.

E. Material Conveying Time is More:

Due to manual conveying system time required to deliver material is more as compare to other conveying system

F. Human Safety is Less:

Instead of motor or other driving mechanism humans are use to lift the bricks which create unsafe environment for them, also it may cause back injuries.

IV. PROBLEM FORMULATION

Design of conceptual trailer which would help in loading and unloading of bricks with much ease with the assistance of mechanical machine mounted on the trailer. Design a frame with some mechanical movement which would assist in the movement of the hoist mounted on it. The hoist can slide on the guide rail along the length of truck .It can also move perpendicular to it on sliding rail. The hoist can be manually operated, electrically or pneumatically driven and may use chain, fiber or wire ropes as its lifting medium.

V. CONCLUSIONS

To provide bricks in time at the construction site and that too without damage is still a challenge in India. But manually handling these bricks cause workers to suffer from back injury and long-term pain if regularly lifting/carrying heavy or awkward objects. So, the palletizing and mechanization of the

bricks is suggested so as to reduce the human injury and to increase the productivity and profitability.

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TECH-CHRONICLE
AN INTERNATIONAL E-JOURNAL ON
EMERGING TRENDS IN SCIENCE, TECHNOLOGY AND MANAGEMENT

"Design & Fabrication of Self-Guided Chair system for library book access"

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Abstract

A library is a collection of sources of information. It is necessary to provide comfort to access a book specially while selecting books from shelf. So in order to access book comfortably from shelf at height up to 4 ft and more, an innovative idea of auto guided smart chair system is implemented. Main motive behind this concept is to allow person to sit on chair which will be auto guided and same chair can lift to access books from a heighted shelf. Some ergonomic points are also considered to design chair. This paper discusses design and fabrication of smart library chair which will lift at a particular height and rotate at an angle of 45 degree. The operation of lifting and revolving of chair will done by pneumatic system and the base platform provided with wheels will turn and move by a battery operated system. This concept is more beneficial for a handicapped person.

Keywords: Pneumatic system, Library book issue, self-guided, human comfort.

I. INTRODUCTION

A library is a collection of sources of information and similar resources, made accessible to a defined community for reference or borrowing. It provides physical or digital access to material, and may be a physical building or room. There are lots of issues while taking out books from heighted shelves. Hereby, to overcome this issue we are implementing a new system which will be pneumatic based.

There are two main branches of fluid power.

1. Pneumatics
2. Hydraulics

These two branches of fluid power are very different in behavior and performance, and hence are treated separately. Often the two branches are used in conjunction with each other, but unless the basic laws are studied separately, the result could be misleading. The study of pneumatics deals with system operated with air or other gaseous media. The term "pneuma" is derived from the ancient Greek and means breath or wind. The term "pneumatics" was derived from the word "pneuma"; pneumatics, literally, "pertaining to air", has one set of fundamental laws governing the behavior of gaseous fluids. Pneumatics (Greek: which means "breath") is a branch of physics applied to technology that makes use of gas or pressurized air. Pneumatic systems used extensively in industry are commonly powered by compressed air or compressed inert gases. A centrally located and electrically powered compressor powers cylinders, air motors, and other pneumatic devices. A pneumatic system controlled through manual or automatic solenoid valves is selected when it provides a lower cost, more flexible, or safer alternative to electric and actuators. Pneumatic systems are cheaper and light in weight and air is easily available compared to hydraulic fluids.

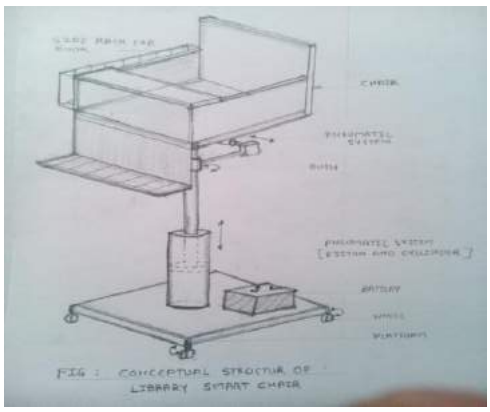

Fig 1. Concept diagram of smart chair system

II. LITERATURE REVIEW

Jasmer Singh (1990) carried out research for doctorate degree on the topic "College Libraries in Punjab: A Statistical Analysis of the Problems" He conducted a survey to find the problems being faced by college libraries of Punjab and Chandigarh and also attempted to study the use of libraries.

Mr. S.R. Mujumdar have discussed on pneumatic system working in which it has been explained, that in automation technology pneumatic technology is one of advance part in order to utilize a appropriate technology.

III. IDENTIFIED GAPS IN THE LITERATURE

The aim of the project is to overcome the problems faced while collecting books from heighted shelves which is a problem discussed in library analysis literature and use of pneumatic system compared to hydraulic system. Make use of pneumatic system that is readily available and cheap.

IV. PROBLEM FORMULATION

Many problems observed in library like to select books from big library shelves by manually effort. Problems face out to when we take out the books from heighted shelves.To prepare efficient and cost effective system.

V. CONCLUSIONS

We will fabricate such type of smart library chair that can easily lift a person to provide human comfort level inside the library while selection of books by the use of pneumatic system that is readily available and cheap to prepare efficient and cost effective system.

Lifting at a particular height and rotate at an angle of 45 degree.

Lifting and revolving of chair operation will be done by pneumatic system and the base platform provided with wheels will turn and move by battery operated system.

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TECH-CHRONICLE
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Desing And Analysis Of Roller Mill Bearing Using FEA

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Abstract: Tapered Cylindrical roller bearing is used in aircraft Rolling mill, machine tools, steel industries and other application due to their precision and high load carrying capacity. In this project tapered roller bearing which is use in rolling mill industry that will design and calculate the stress strain ,also design 4-Row tapered roller bearing and compare which is suitable. The theoretical value of stress and strain on bearing will compare with software value after applying a particular load, drafting file will generate in AutoCAD, 3-D model in pro-e and stress analysis in ansys.

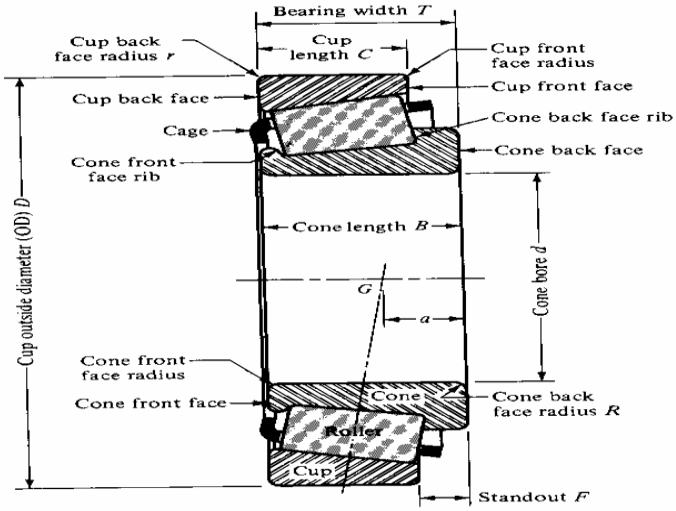
Keywords—Stress,strain

1. Introduction

There are five types of rolling-elements that are used in rolling element bearings: balls, cylindrical rollers, spherical rollers, tapered rollers, and needle rollers. Most rolling-element bearings feature cages. The cages reduce friction, wear, and bind by preventing the elements from rubbing against each other. Caged roller bearings were invented by John Harrison in the mid-18th century as part of his work on chronometers. Typical rolling-element bearings range in size from 10 mm diameter to a few meters diameter, and have load-carrying capacity from a few tens of grams to many thousands of tones. Cylindrical roller bearings with Deep end-cavity rollers are advantageous in applications where load and speed are major considerations in the operations of the bearings. An improvement in load distribution and thus load capacity may be realized, as well as contact stress is also reduced considerably by using a bearing with Deep end-cavity rollers. This bearing is basically used in rolling mill where heavy load is applied on bearing. Deep end-cavity roller is proposed for rolling mill bearings with a view to reducing the contact stress distribution for life improvement. Deep end-cavity rollers are one of the advanced concept used to eliminate the sharp edge-stresses at the apexes of the roller. The main objective of this work is to enlighten the engineers to make use of deep cavity rollers to increase load carrying capacity and improvement of fatigue life.

1.1Rolling Contact Fatigue:

The origin of RCF failure is understood to be stress concentrations, which initiate and propagate fatigue crack under cyclic loading. These stress concentrations occur due to surface or subsurface stress risers or to the geometry and kinematics of the contacting pair. Figure 4 summarizes a list of these stress risers, which have been the subject of numerous scientific investigations that have resulted in the improved life of rolling-element bearings. With the introduction of cleaner steels and greater precision in the manufacture of bearings, most of the surface and subsurface stress risers listed in Fig. 4 have been addressed. Nevertheless, the demand to operate rolling element bearings in harsh tribolgical environments of lubrication, load, contamination, and temperature push for higher fatigue limits, and thus call for improved understanding of the RCF failure modes. Four distinct failure modes have been established in rolling-contact bearings[3]. These classifications include wear-type failures, plastic flow, contact fatigue, and bulk failures.



Terminology of Tapered Cylindrical Roller bearing

Industrial bearing failure by rolling contact fatigue rolling element bearings are widely used in industrial machinery to allow relative motion and shaft load RCF fatigue occurs due to the result of cyclic stresses developed at bearing contact surface during operation. Rolling contact fatigue includes tri-axial stress state, high hydrostatic stress component, non-proportional loading, and during loading cycles changing planes of maximum shear stress, that leads to sub-surface cracks. Sliding forces can cause failure to originate at the subsurface that propagate parallel to the surface and it may significantly reduce bearing life. Rolling contact fatigue may divide into two categories [4], i.e. surface and sub-surface initiated. Further classification of RCF may do by location and appearance of the fatigue, and factor that leads to crack initiation which causes bearing failure. These factors may relate to lubrication, materials, operation and mountings. Fractography [4] plays a vital role to identify this defects.3.1. Wear mechanism RCF wear mechanism involves fretting. Fretting wear may be of two types, i.e. contact corrosion and brine ling. Contact corrosion takes place between the of the bearing and the shaft. Fretting occurs within the contact area of the bearing,

2. Objective: Bearing used for roller mill is very important bearing for that selection of proper bearing much important as well as maintain the life of bearing To increase the life of bearing by reducing the failure causes of bearing of it also to decrease the cost of bearing, sometimes cause of failure is contact fatigue between the rollers, if we improve the design of tapered roller to avoid the failure then we can improve the life of bearing which very beneficial to rolling mill industry.

3. FAILURE ANALYSIS OF HCRB

In the present work failure analysis of Hollow Cylindrical Roller Bearing (HCRB) made from material AISI 52100 is carried out to understand the type and mode of failure. This bearing is basically used in earthmoving equipments where heavy load is applied on bearing. The photograph of this bearing is shown in Fig. 5 with hollow roller in breakage condition. The objective of this work is to identify the type of failure by using material oriented investigations. Also Fig. 6 shows the cross section of hollow roller with its dimensions. The hollowness of this roller is 42%.

Much work has been devoted to characterizing alterations of the micro-structure, hardness and residual stress distribution occurring in rolling bearing components during bearing operations. The results of this work provide a technological

3.1 Rolling Bearing Life :

Life prediction of a roller or ball bearing is based on the statistical treatment of full-scale bearing tests conducted under controlled environments, for example, full-film lubrication regime, dust-free environment, and so on. Although these controlled environments are useful indicators of the RCF performance of rolling-element bearings, the actual life of a given bearing can significantly vary from the predicted life. It was reported that only 10% of all bearing replacements in the field can be attributed to classic RCF failure, whereas the remaining 90% are made for reasons and conditions not even closely related to RCF. Although this highlights the improvements achieved in designing and manufacturing better-quality bearings[9], it also indicates that other factors in addition to RCF need to be considered to predict the life of a bearing. Even under the controlled conditions of load, lubrication, and alignment in a dust-, corrosion-, and moisture-free environment, there is generally large scatter in the RCF performance for a given bearing. Bearing manufacturers thus provide a statistical probability of the life of a bearing on the basis of experimental results conducted at a given load, speed, and lubrication regime. Weibull analysis can then be used to estimate the life expectancy of the bearing. Bearing life is generally referred to as L10, L50 or L90 and indicate the probability of failure (e.g., L10 indicates that 10% of the bearings in a given population will fail before a fixed number of stress cycles are reached). Lundberg and Palmgren developed a theory that indicates the life of a roller or ball bearing at a given load (P) can be approximated using the relationL10=(C/P where L is the fatigue life in a million revolutions, C is the load that gives an L10 life of 1 million revolutions, and n is a constant for a bearing type (e.g., n _ 3 for ball bearings and 10/3 for roller bearings). A detailed list of various values of n for different bearing types can be seen elsewhere. The use of a specific value of n is critical for a given bearing type, and the product law of probability is in effect (e.g., as the design changes from single-row to double row bearings). Hence, the life of a double-row bearing under similar conditions to that of a single- row bearing of identical design will be less than that of a single-row bearing.

3.2 Vibration response due to local defecton bearing element.

The vibration signal generated by the faulty bearing can be analyzed in time domain or frequency domain. The time domain vibration analysis is depend on the estimation of statistical parameters like crest factor, skewness, kurtosis, probability density curve, etc. Among this kurtosis is the most effective parameter in a time domain which is calculated using following expression (1). For the healthy bearing the kurtosis is closer to 3 and for defective bearing it is more than 3. Another way of defect consideration adopted by the researchers is addition of extra displacement in total deflection. Initially a simple dynamic model was proposed by McFadden and Smith [14-15]. In their theoretical and experimental studies they have considered single point defect and multiple point defects on the inner race. The impulses generated by interaction of defect with inner race has been generated by delta function while, variations in the load around the bearing has been computed by Stribeck equation under radial load. Su and Lin [16] have extended the original work of McFadden to characterize the vibrations measured from bearings subject to various loading conditions and with

defects located on any bearing components. They have determined the periodic characteristics of various loading, transmission path and their influence on the vibration amplitude. Su et al. [17] have obtained a reliable model to predict the possible bearing frequencies, harmonics and sidebands for the various types of localized fatigue damage, the pattern of expected frequencies can be searched for as part of routine bearing condition monitoring. The information regarding frequency at any particular time is difficult to achieve either from frequency domain or time domain. The wavelets provide time-scale information of a signal, enabling the extraction of features that vary in time. The discrete wavelet transform (DWT) is derived from the discretization of continuous wavelet transform (CWT). The wavelet transform has proved its significance in bearing fault detection [20-24]. However, the effectiveness of the analysis depends on the selected mother wavelet. The defective frequencies of locally defective bearing were analyzed more accurately through DWT by Prabhakar etal.[20]. Rubini and Meneghetti [21] have proposed the method of envelope analysis and wavelet transform for the diagnosis of incipient bearing fault under very low radial load. The researchers of references [22-23] have used the Laplace wavelet transform for the defect detection. Hong and Liang [24] have proposed a new version of the Lempel–Ziv complexity as a bearing fault (single point) severity measure based on the continuous wavelet transform (CWT). The researchers [20] have proposed the method of singularity analysis using continuous wavelet transform for bearing fault diagnosis.

4. Conclusion:

On basis of this study it can be concluded that it is aimed at presenting the taperd Cylindrical roller bearing with Deep end cavity roller in various fields and the research and development conducted to improve technologies that will directly benefit the Rolling mill industries and other industries.

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TECH-CHRONICLE
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Dual Purpose Refrigeration System: A Review

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ABSTRACT:

A refrigerator is a common household appliance that consists of a thermally insulated compartment and a heat pump that transfers heat from the inside of the fridge to its external environment so that the inside of the fridge is cooled to a temperature below the ambient temperature of the room. Cooling is a popular food storage technique in developed countries. Lower temperature in a confined volume lowers the reproduction rate of bacteria, so the refrigerator reduces the rate of spoilage.

The Multipurpose refrigeration system is making use of both the temperature below the atmosphere and above the atmosphere is to be achieved in freezer section and the temperature above the atmosphere is maintained in hot section. The temperature will below the atmosphere can be used as a food preservative, because it prevents the bacteria which can spoil the food. Also this temperature can be used to make ice cubes and to cool water for drinking purpose. Heating chamber is the heart of this project. It is used for heating purpose which is the need of new era. No extra amount of energy is consumed during the working of heating chamber.

Keywords: Heat Transfer, Heating Chamber, Thermal Insulation.

INTRODUCTION

A refrigerator is a common household appliance that consists of a thermally Insulated compartment and which when works, transfer heat from the inside of the compartment to its external environment. Generally it works on the vapour compression cycle that uses a circulating liquid refrigerant which absorbs heat from the space to be cooled and subsequently rejects that heat elsewhere. All such systems have four components: - a compressor, a condenser, evaporator and expansion valve.

Circulating refrigerant enters the compressor in the thermodynamic state known as a saturated vapour and is compressed to a higher pressure, resulting in a higher temperature. The hot, compressed vapour is then in the thermodynamic state as a known superheated vapour and it is at a temperature and pressure at which it can be Condensed with typically available cooling water or cooling air. That hot vapour is routed through a condenser where it is cooled and condensed into liquid by flowing through a coil or tubes with cool water or cool air flowing across the coil or tubes. This is where the circulating refrigerant rejects heat from the system and the rejected heat is carried away by the air. The condensed liquid refrigerant, in the thermodynamic state known as a saturated liquid, is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in the adiabatic flash evaporation of a part of the liquid refrigerant. The auto-refrigeration effect of the adiabatic flash evaporation lower the temperature of the liquid and vapour refrigerant mixture to where it is colder than the temperature of the enclosed space to be refrigerated. The cold mixture is then routed through the coil or tubes in the evaporator. A fan circulates the warm air in the enclosed space across the coil or tubes carrying the cold refrigerant liquid and vapour mixture. That warm air evaporates the liquid part of the cold refrigerant mixture. At the same time, the circulating air is cooled and thus lowers the temperature of the enclosed space to the desired temperature. The evaporator is where the circulating refrigerant absorbs and removes heat which is subsequently rejected in the condenser and transferred elsewhere by the water or air used in the condenser. To complete the refrigeration cycle, the refrigerant vapour from the evaporator is again a saturation vapour and is routed back into the compressor. And cycle is continued.

In the project, the condenser tube is cut in two sections: one is for cooling purpose while other is for heating purpose. The waste heat from the compressor is delivered to the hot box and the hot temperature is maintained inside the heating chamber. The hot box is made up of steel box on which copper tubes are wound. Glass wool is used as insulation for this hot box so that the temperature inside the hot box is more than that of ambient temperature.

LITERATURE REVIEWS

A. MOHD FAIZANRAJA QASIMRAJA SHEIKH, PROF. P. P. MANWATKAR, presented a paper on "MULTIPURPOSE REFRIGERATION SYSTEM"

The Multipurpose refrigeration system is making use of both the temperature below the atmosphere and above the atmosphere is to be achieved in freezer section and the temperature above the atmosphere is maintained in hot section. The temperature will below the atmosphere can be used as a food preservative, because it prevents the bacteria and other type of formation which can spoil the food article. Also this temperature can be used to make ice cubes and to cool water for drinking purpose. Heating chamber is the heart of this project. It is used for heating purpose which is the need of new era. No extra amount of energy is consumed during the working of heating chamber. Total cost estimation of the project is near about Rs. 3300/-. After doing the analysis, COP of the system is increased, because of replacement of refrigerant from R-12 to hydrocarbon.

B. S. C. WALAWADE, B.R. BARVE, P. R. KULKARNI, presented a paper on "DESIGN AND DEVELOPMENT OF WASTE HEAT RECOVERY SYSTEM FOR DOMESTIC REFRIGERATOR"

Heat is energy, so energy saving is one of the key matters from view point of fuel consumption and for the protection of global environment. So it is necessary that a significant and concrete effort should be made for conserving energy through waste heat recovery too. The main objective of this paper is to study "Waste Heat recovery system for domestic refrigerator". An attempt has been made to utilize waste heat from condenser of refrigerator. This heat can be used for number of domestic and industrial purposes. In minimum constructional, maintenance and running cost, this system is much useful for domestic purpose. It is valuable alternative approach to improve overall efficiency and reuse the waste heat. The study has shown that such a system is technically feasible and economically viable.

C. ENG. NASER R. M. AL-AJMI, presented a paper on "COEFFICIENT OF PERFORMANCE ENHANCEMENT OF REFRIGERATION CYCLES"

Refrigerator is one of the home appliances utilizing mechanical vapour compression cycle in its process. Performance of the systems becomes the main issue and many researches are still on going to evaluate and improve the efficiency of any used system. Therefore, this paper presents an experimental investigation of the performance of the refrigeration cycles. A small refrigerator is used as the test rig. The Coefficient of Performance (COP) is studied by using different condenser designs and under varying evaporator loads. Three condenser designs are used in present work. These condensers are regular condenser of domestic refrigerator, condenser with copper plain tubes (Cond.1) and condenser with copper tubes welded with stainless steel flat plate (Cond.2). Pressures and temperatures measurements of each point in the refrigeration cycle are collected in order to evaluate the refrigerator performance. 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.

D. G.G. MOMIN, S.R.DESHMUKH, M.T. DESHMUKH, P.T.CHAVAN, P.P.CHOUDHARI, presented a paper on "COP ENHANCEMENT OF DOMESTIC REFRIGERATOR BY RECOVERING HEAT FROM THE CONDENSER"

Refrigerator has become an essential commodity rather than luxury item. The heat absorbed in refrigerated space and the compressor work added to refrigerant is too rejected to ambient through a condenser. Our aim is to recover waste heat from condenser unit of a household refrigerator to improve the performance of the system. The heat recovery from the household refrigerator is by thermo siphon. From the experimentation it was found that after recovering heat from the condenser of the conventional refrigerator its performance get improved than conventional refrigerator.

E. P.SANTOSH KUMAR, P.SITARAMA RAJU, S.SURESH KUMAR, P. V. V. SATYANARAYANA, T. ARJUN, G. S. D. K SRAVANI, presented a paper on "REFRIGERANT RECOVERY UNIT"

This project is made with preplanning, that it provides flexibility in operation. This innovation has made the more desirable and economical. This project "REFRIGERANT RECOVERY UNIT SYSTEM" is designed with the hope that it is very much economical to recover the refrigerants and useful to small and large industrial applications.

With the use of refrigerant recovery unit, we can

recover the refrigerant from Any Repair or service

or leakage systems (central AC systems).It is very

costly but we fabricate it as very low cost. It is very useful to recover the refrigerants in central 'AC' Plants because in that they use 50-3000 tons. By the using of refrigerant recovery unit, we protect

the ozone layer from the choro-fora carbons present in the refrigerants when they exposed to atmosphere. We can also protect the atmosphere from global warming temperature. These systems are used for most of air conditioning and refrigeration applications such as comfort air conditioning industrial applications. It is very useful in future to recover the banned refrigerants. It is very useful in every house.

F] Y. A. PATIL, H. M. DANGE, presented a paper on "IMPROVING THE PERFORMANCE OF HOUSEHOLD REFRIGERATOR BY RECOVERING HEAT FROM THE CONDENSER"

Refrigerator has become an essential commodity rather than luxury item. The heat absorbed in refrigerated space and the Compressor work added to refrigerant is too rejected to ambient through a condenser. Our aim is to recover waste heat from condenser unit of a household refrigerator to improve the performance of the system. The heat recovery from the household refrigerator is by thermo siphon. From the experimentation it was found that after recovering heat from the condenser of the conventional refrigerator its performance get improved than conventional refrigerator. The maximum temperature achieved in water tank with 100 litre of water is 45ºC at the full load condition. If the water tank contains 50 litres water then it gets heated to 45 ºC in just 5 to 6 hrs. After that performance of the system gets decreased. So it needs regular use of that hot water.

G] N. B. CHAUDHARI, P. N. CHAUDHARI, presented a paper on "HEAT RECOVERY SYSTEM FROM THE CONDENSER OF A REFRIGERATOR – AN EXPERIMENTAL ANALYSIS"

The Experimental apparatus of heat recovery system from the condenser of a refrigerator was designed, developed and constructed at cosmic refrigeration, Pune to estimate the waste heat recovery from the condenser of a refrigerator. In this article, we will presents an experimental setup that will help undergraduate mechanical engineering students in understanding the basic heat transfer processes by utilizing real life applications such as using waste heat from a condenser of a refrigerator to heat water for residential and commercial use. Heat recovery from condenser of a refrigerator by thermo-siphon system is attractive because it eliminates the need of a circulating pump.

H] TANMAY PATIL, NITESH MEDHANE, YOGESH MAHAPURE, KALPESH NAGMOTI, PROF. ANIL DUBE, presented a paper on "A REVIEW ON RECOVERING WASTE HEAT FROM CONDENSER OF DOMESTIC REFRIGERATOR"

To review the energy savings associated with improved utilization of waste heat from a domestic refrigerator. Domestic refrigerators may be operating continuously to maintain proper food storage condition. The continuous operation of this equipment accounts more electrical energy consumption. So it is that a significant and concrete effort should be made for conserving energy through waste heat recovery. A significant amount of waste heat is rejected by the condensers of refrigerator. So an attempt has been made to utilize waste heat from the condenser of a refrigerator. Practical uses of waste heat from the domestic refrigerators are typically to space heating and water heating in minimum constructional maintenance and running cost. A cabin was installed on a domestic refrigerator with condenser coils of refrigerator serving as heating coils inside the cabin. Known quantity of water was heated by the condenser coils (due to convection currents) thereby increasing the overall COP of the refrigerator. Besides, the refrigerator may be used as conventional refrigerator by keeping the cabin door open in case of absence of heat sink.

CONCLUSION

The paper undertook a review based study into coefficient of performance enhancement of a domestic air cooled refrigerator by recovering heat from condenser in terms of its background, originality, current status, and researches. This all work has great significant for developing new technologies relates to heat recovery from a domestic refrigerator, in order to get cooling at low energy cost, no harmful effect to environment and also having low initial cost. So more attention is required in this area and lot of work has to be done.

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TECH-CHRONICLE
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Design and Fabrication of Dual Purpose Refrigeration System

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ABSTRACT

In general, vapour compression cycle; the condenser is used only for condensation process & heat it expelled out to atmosphere, which is generally lost in atmosphere. This heat loss can be utilized for heating purpose by designing a condenser. The Multipurpose refrigeration system is making use of both temperature below the atmosphere and above the atmosphere is to be achieved in freezer section and the temperature above the atmosphere is maintained in hot section. The temperature will below the atmosphere can be used as a food preservative.

The hot section uses the temperature above atmospheric to preserve food article at this temperature is almost constant and well above atmospheric. It keeps temperature of food article high and constant. For example the milk when kept at continuous high temperature prevents the bacteria formation. Thus preventive its spoilage this section can also be used to heat various other food article. The heat used in the hot section is completely based on the heat withdrawn from chilling and cold section. The optimum number of turns can be used to heat the hot section compartment are used. So that working will not affect the working of compressor or whole refrigeration system.

The project describes the development of "Dual Purpose Refrigeration System". Normal refrigerator works on vapor compression cycle, extract the heat from substance to be cooled in evaporator and liberate that heat to the atmosphere through the device called as condenser. The refrigerator exerts a lot of heat through condenser which is totally wastage of heat. For recovery of that waste heat, design and fabricate a refrigerator which will utilizes that waste heat and maintain the things hot for a long time. The main important thing in the model is that it does not require any kind of additional power supply for its working operation. As the energy saving plays vital role in development, the model has lot of importance from that particular point of view. The developed system will perform operation without disturbing original refrigerator working.

Keywords: Vapour Compression System, Waste Heat, Condenser.

INTRODUCTION

A refrigerator is a common household appliance that consists of a thermally Insulated compartment and which when works, transfer heat from the inside of the compartment to its external environment. Generally it works on the vapour compression cycle that uses a circulating liquid refrigerant which absorbs heat from the space to be cooled and subsequently rejects that heat elsewhere. All such systems have four components: - a compressor, a condenser, evaporator and expansion valve.

Circulating refrigerant enters the compressor in the thermodynamic state known as a saturated vapour and is compressed to a higher pressure, resulting in a higher temperature. The hot, compressed vapour is then in the thermodynamic state as a known superheated vapour and it is at a temperature and pressure at which it can be Condensed with typically available cooling water or cooling air. That hot vapour is routed through a condenser where it is cooled and condensed into liquid by flowing through a coil or tubes with cool water or cool air flowing across the coil or tubes. This is where the circulating refrigerant rejects heat from the system and the rejected heat is carried away by the air. The condensed liquid refrigerant, in the thermodynamic state known as a saturated liquid, is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in the adiabatic

flash evaporation of a part of the liquid refrigerant. The auto-refrigeration effect of the adiabatic flash evaporation lower the temperature of the liquid and vapour refrigerant mixture to where it is colder than the temperature of the enclosed space to be refrigerated. The cold mixture is then routed through the coil or tubes in the evaporator. A fan circulates the warm air in the enclosed space across the coil or tubes carrying the cold refrigerant liquid and vapour mixture. That warm air evaporates the liquid part of the cold refrigerant mixture. At the same time, the circulating air is cooled and thus lowers the temperature of the enclosed space to the desired temperature. The evaporator is where the circulating refrigerant absorbs and removes heat which is subsequently rejected in the condenser and transferred elsewhere by the water or air used in the condenser. To complete the refrigeration cycle, the refrigerant vapour from the evaporator is again a saturation vapour and is routed back into the compressor. And cycle is continued.

In the project, the condenser tube is cut in two sections: one is for cooling purpose while other is for heating purpose. The waste heat from the compressor is delivered to the hot box and the hot temperature is maintained inside the heating chamber. The hot box is made up of steel box on which copper tubes are wound. Glass wool is used as insulation for this hot box so that the temperature inside the hot box is more than that of ambient temperature.

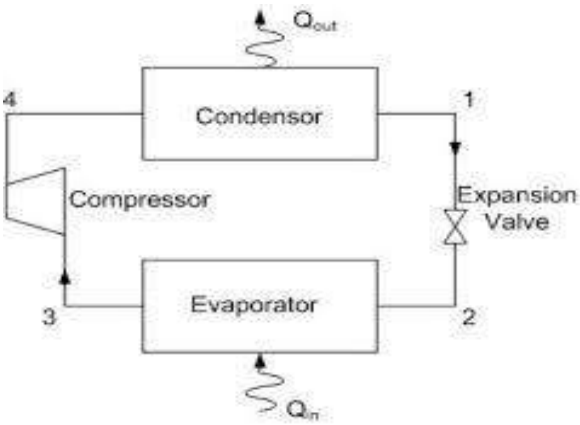

Fig. Vapour Compression Refrigeration System

DESIGN AND FABRICATION

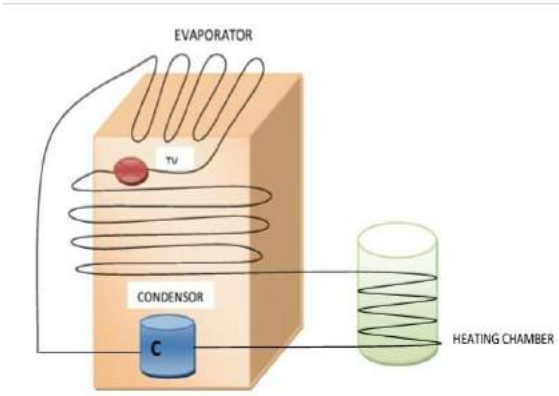

Fig. Design Of Dual Purpose Refrigeration System

In the re-design of condenser, the condenser is cut into two partitions with the ratio of 2:3 in which 40% length of condenser tube is used for cooling purpose. While remaining 60% length is used for heating purpose. For heating purpose the 60% of copper coil is wound around the periphery of heating chamber. The copper tube is selected in such a way that its diameter is more than the diameter of condenser coil used for cooling purpose. The reason behind selecting bigger diameter of copper coil in heating chamber than that of condenser coil, as that the high pressure & high temperature vapour refrigerant should flow slowly through the copper tube. So that we will get more heating effect due to more contact in the heating chamber.

Glass wool is used as insulation for the hot box so that the temperature inside the hot box will be more than that of ambient temperature. Hydrocarbon R-134a is used as a refrigerant in place of R-12 which causes depletion of ozone layer. It is expected to improve the coefficient of performance of this system so that it will add the value to the project.

WORKING PRINCIPLE

The compressed vapour comes out from the compressor at high temperature & high pressure into the copper tube, which is wound around the heating chamber. The heated vapour refrigerant flow through the copper tube. The heat from the vapour is transferred to the copper tube & hence to the heating chamber which will maintain the hot temperature of heating chamber to preserve the food.

TESTING AND READINGS

A] Before arrangement of heating chamber

T_2 = heat sink
= -8.8 + 273
= 264.2 k
T_1 = heat source
= 48.7+273
= 321 k

$$Cop = \frac{264.2}{321.7-264.2}$$

Cop = 4.594

B] After arrangement of heating chamber

T_2 = heat sink
= -6.4 + 273
= 266.6 k
T_1 = heat source
= 50.1+273
= 323.1 k

$$Cop = \frac{266.6}{323.1-266.6}$$

Cop = 4.718

RESULTS

1) It does not require any kind of additional power supply for working operation of heat chamber.
2) It performs operation without disturbing original refrigerator working.
3) It utilizes the waste heat from condenser.
4) It can be used for cooling as well as heating purpose.
5) Its C.O.P. is more than normal refrigerator.

FURTHER SUGGESTED WORK

1) Refrigerator with hot box and water heater tank.
2) C.O.P. enhancement of refrigeration cycle by using multistage compressor.

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TECH-CHRONICLE
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Determination of Optimum Tilt Angle of Solar Collectors for Solar Cities in Maharashtra, India

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***Abstract*—To cope with the increasing electricity demand of the country, 'Development of Solar Cities' programme is designed by the government of India. This programme aims at reduction in projected demand of conventional energy through enhancing supply from renewable energy sources like solar energy. It is proposed to enhance the installation of the solar collectors in the selected 'Solar Cities' in the country. It is well known that, the efficiency of the solar collector will increase when it is always facing the sun. To eliminate the expenses towards sun tracking systems, it is always desirable to install the collectors at an optimum tilt angle. The optimal tilt angle is the angle where the solar radiation will arrive perpendicularly upon the surface such that the annual insolation would be maximized for the solar collector. This angle is determined considering several factors like location, application, energy demand pattern, etc. In the current work, a mathematical model is used to determine the optimum tilt angle of the solar collectors for the six Solar Cities of Maharashtra state. In addition, month wise and season wise optimum tilt angles are also computed for specific applications in different seasons. The calculations and the computed angles are reported in this paper.**

Keywords—Optimum tilt angles, Solar Cities in Maharashtra

I. INTRODUCTION

The energy requirement in the world is increasing, particularly since the last few centuries. The main driver for further increase in the energy demand is techno-economic growth of the developing countries. The main sources of energy which fulfill the energy demand are generally fossil fuels. But the fossil fuel based energy sources are exhaustible and also causes an environmental pollution. Therefore there is a need for alternative energy sources which can provide energy in a sustainable manner and pollution free. One of the options is to make more regular use of renewable sources of energy derived from the sun. Solar energy is abundant and inexhaustible. The power from the sun intercepted by the earth is approximately 1.8 x 10^{11} MW, which is many thousands of times greater than present consumption rate on the earth which could meet all the energy requirement of the world, if utilized properly. Hence it is one of the most promising unconventional energy sources. It is environmentally clean source of energy and hence no potential damage to environment.

The solar energy utilization includes thermal and photovoltaic conversion. The varieties of thermal applications are water or air heating, drying, cooking and power generation. In photovoltaic, solar energy can be used to convert into electrical energy through photovoltaic effect.

To cope with the increasing electricity demand of the country, 'Development of Solar Cities' programme is designed by the Government of India. This programme aims at reduction in projected demand of conventional energy through enhancing supply from renewable energy sources like solar energy. It is proposed to enhance the installation of the solar collectors in the selected 'Solar Cities' in the country.

The amount of solar energy received by earth varies inversely with the square of the distance between sun and the earth. As sun- earth distance is not constant because earth keeps revolving around the sun as well as on its own axis, the amount of radiation received by the earth also varies throughout day and year. The variation is not much and accounts for only 5.9% [1]. So in order to collect the maximum solar radiation, it is important to determine the correct orientation and slope of the solar collectors. Solar tracking is one of the systems being used to maximize the amount of solar radiation falling on solar collectors. But tracking system is expensive and not easily applicable. To improve solar collector performance, optimum tilt angle is one of the alternatives, if solar tracking is not appropriate. Optimum tilt angle is the angle at which maximum solar radiation intercepted by the collector. There is reduction of an incident radiation by around 5% if tilt angle of solar collector is varied by 15^0 from the optimum tilt angle [2]. So, to receive the maximum solar radiation on collector, optimum tilt is necessary. In northern hemisphere, collector orientation is south facing ($\gamma = 0^0$). In summer months, optimum tilt is less (usually latitude – 15^0) and in winter months, it is greater

(usually latitude + 15^0) [3]. But annually, optimum tilt is given by $\beta = 0.9\Phi$ [4]. For Indian cities, in practice the collector plate is usually oriented south facing and at a fixed tilt to receive maximum solar radiation.

II. SOLAR RADIATION TERMINOLOGY

A. Extra-terrestrial Radiation

Extra-terrestrial radiation is the radiation just outside the earth surface (Isc). Its value is taken as 1367 W/m^2 [5]. Extra-terrestrial flux varies throughout the year due to changes in sun and earth distance and it is given by,

$$Isc' = Isc\left(1 + 0.0333\cos\frac{360\,n}{365}\right) \quad (1)$$

Where n is the day of the year.

B. Declination Angle (δ)

The angle made by lines joining center of earth to the center of sun with its projection on equatorial plane of the earth is called as declination angle (δ). It varies between -23.45^0 to +23.45^0 due to inclination of the earth's polar axis and its revolution around the sun. The declination angle is determined as

$$\delta = 23.45\sin\left(\frac{360}{365}(284 + n)\right) \quad (2)$$

Monthly average extra-terrestrial solar radiation (Ho)on the horizontal surface is given by [6]

$$Ho = \frac{24}{\pi} Isc\left(1 + 0.0333\cos\frac{360n}{365}\right)(\omega\sin\Phi\sin\delta + \cos\Phi\cos\delta\sin\omega) \quad (3)$$

Where, ω is sunshine hour angle and is given by,

$$\omega = \cos^{-1}(-\tan\Phi\tan\delta) \quad (4)$$

C. Global, Beam and Diffused Radiation

The solar radiation which directly reaches at the earth surface without change of direction is called as beam or direct radiation. The radiation received at the earth surface from all parts of the sky's hemisphere called as diffused radiation. Global radiation is the sum of beam and diffused radiation.

Gopinathan[7] have been suggested a correlation to determine the monthly average daily global radiation on a horizontal surface (Hg) at a location which is given by,

$$\frac{Hg}{Ho} = a + b\left(\frac{S}{Smax}\right) \quad (5)$$

The constants a, b are related to three parameters i.e. latitude of the location, elevation and sunshine hours as follows.

$$a = -0.309 + 0.539\cos\Phi - 0.0693EL + 0.290\left(\frac{S}{Smax}\right) \quad (6)$$

$$b = 1.527 - 1.027\cos\Phi + 0.0926EL - 0.359\left(\frac{S}{Smax}\right) \quad (7)$$

Where, EL is the elevation of the given location above mean sea level in kilometer.

Smax is the monthly average of the maximum possible sun hours per day at a location i.e. day length in hours.

$$Smax = \frac{2}{15}\omega \quad (8)$$

S is the monthly average of the sunshine hours per day at a location in hours.

Garg and Garg[8] proposed the equation for predicting daily diffused radiation (Hd) for the locations in India.

$$\frac{Hd}{Hg} = 0.8677 - 0.7365\left(\frac{S}{Smax}\right) \quad (9)$$

Now, monthly average daily beam radiation (Hb) for the locations is given by,

$$Hb = Hg - Hd \quad (10)$$

For radiation flux to be maximum, optimum tilt angle of the collector is given by [9],

$$\beta opt = \tan^{-1}[\{\sum_{i=1}^{i=12} Hbi\tan(\Phi - \delta i)\}/\{\sum_{i=1}^{i=12} Hbi\}] \quad (11)$$

D. Total Radiation on a Tilted Surface

Liu and Jordan [10] have proposed the relation for total radiation falling on a tilted surface (Ht) which is given by an equation as

$$\frac{Ht}{Hg} = \left(1 - \frac{Hd}{Hg}\right)Rb + \frac{Hd}{Hg}Rd + Rr \quad (12)$$

For south facing surface ($\gamma = 0^0$),

$$Rb = \frac{\omega'\sin\delta\sin(\Phi-\beta) + \cos\delta\sin\omega'\cos(\Phi-\beta)}{\omega\sin\delta\sin\Phi + \cos\delta\sin\omega\cos\Phi} \quad (13)$$

$$Rd = \frac{1+\cos\beta}{2} \quad (14)$$

$$Rr = \frac{\rho(1-\cos\beta)}{2} \quad (15)$$

Where, ω' and ω are the sunrise or sunset hour angle for tilted surface and horizontal surface respectively. ρ is the ground reflectivity.

III. METHODOLOGY

Using equations 1 to 15, the maximum solar radiation incident on collector and optimum tilt angle are calculated for different solar cities in Maharashtra, India. With the help of MS-Excel, graphs were plotted between various entities. The data of latitude, longitude and elevation above mean sea level for solar cities in Maharashtra is tabulated in table 1.

TABLE 1. LATITUDE, LONGITUDE AND ELEVATION OF SOLAR CITIES

Solar Cities	Latitude (in degrees)	Longitude (in degrees)	Elevation (in meters)
Nagpur	21.14	79.08	310
Thane	19.22	72.98	11
Kalyan-Dombivli	19.24	73.13	10
Aurangabad	19.88	75.34	595
Nanded	19.14	77.32	356
Shirdi	19.77	74.48	516

IV. RESULTS AND DISCUSSION

The monthly average daily extra-terrestrial, beam, global radiations are calculated using equations (1) to (10). It is found that the radiation decreases in the month of July to August i.e. in rainy season due to scattering radiations.The variation of extra-terrestrial, beam and global radiation on horizontalsurface

for Nagpur is shown in Fig. 1.

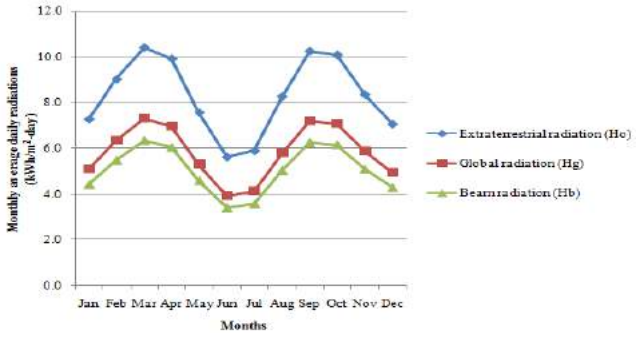

Fig. 1. Monthly average daily extra-terrestrial (Ho), beam (Hb) and global radiation (Hg) on horizontal surface

The angle of the collector at which maximum solar radiation intercepted is calculated using equation (11), which is optimum tilt angle of the collector. The tilt angle is varied from 0 to 90^0 for twelve months of the year with variation of solar radiation.Also, the average optimum tilt angles are calculated for four seasons of the year. Annual optimum tilt angle is calculated by averaging the monthly optimum tilt angles over the year.The monthly, seasonal average and annual optimum tilt angles for six solar cities in Maharashtra are given in Table 2.

TABLE 2. MONTHLY, SEASONAL AND ANNUAL OPTIMUM TILT ANGLES (IN DEGREES) FOR SIX SOLAR CITIES IN MAHARASHTRA

City / Month	Nagpur	Thane	Kalyan-Dombivli	Aurangabad	Nanded	Shirdi
Jan	42.0	40.1	40.1	40.8	40.0	40.7
Feb	34.1	32.2	32.2	32.8	32.1	32.7
Mar	23.5	21.6	21.6	22.3	21.5	22.2
Apr	11.7	9.8	9.8	10.4	9.7	10.3
May	0.0	0.0	0.0	0.0	0.0	0.0
June	0.0	0.0	0.0	0.0	0.0	0.0
July	0.0	0.0	0.0	0.0	0.0	0.0
Aug	7.7	5.8	5.8	6.4	5.7	6.3
Sept	19.0	17.0	17.1	17.7	17.0	17.6
Oct	30.8	28.8	28.9	29.5	28.8	29.4
Nov	40.1	38.2	38.2	38.8	38.8	38.7
Dec	44.2	42.9	42.3	42.9	42.2	42.8
Winter	42.1	40.2	40.2	40.8	40.1	40.7
Spring	23.1	21.2	21.2	21.8	21.1	21.7
Summer	0.0	0.0	0.0	0.0	0.0	0.0
Autumn	19.1	17.2	17.2	17.9	17.1	17.8
Annual	21.1	19.2	19.2	19.9	19.1	19.8

The variation of optimum collector tilt angle for monthly, seasonally and annually basis for Nagpur city is shown graphically in Fig. 2.

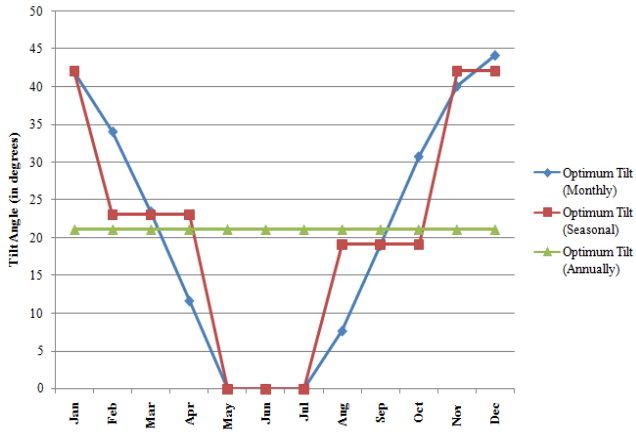

Fig. 2. Variation of monthly, seasonal and annual optimum tilt angles for Nagpur

For implementation of seasonal optimum tilt angle, the collector tilt has to be changed four times in a year. The annual optimum tilt angle is fixed value for any solar collector throughout the year. The value of total solar radiation with different collector tilt angle is calculated for Nagpur which is given in Table 3.

TABLE 3. MONTHLY AVERAGE DAILY GLOBAL SOLAR RADIATION FOR VARIOUS COLLECTOR TILT ANGLES FOR NAGPUR (IN KWH/M^2-DAY)

Month	Hg (β=0)	Ht (β=βopt)	Ht (Seasonal βopt)	Ht (Annual βopt)
Jan	5.093	7.769	7.771	6.771
Feb	6.321	8.057	7.733	7.650
Mar	7.291	7.957	7.955	7.940
Apr	6.955	6.965	6.749	6.802
May	5.301	5.301	5.301	4.770
June	3.938	3.938	3.938	3.409
July	4.127	4.127	4.127	3.635
Aug	5.800	5.752	5.532	5.475
Sept	7.179	7.500	7.500	7.493
Oct	7.070	8.513	8.192	8.269
Nov	5.860	8.503	8.558	7.601
Dec	4.942	7.998	7.922	6.758

The value of Table 3 is graphically shown in Fig. 3 for easy interpretation on variation in values of solar radiation.

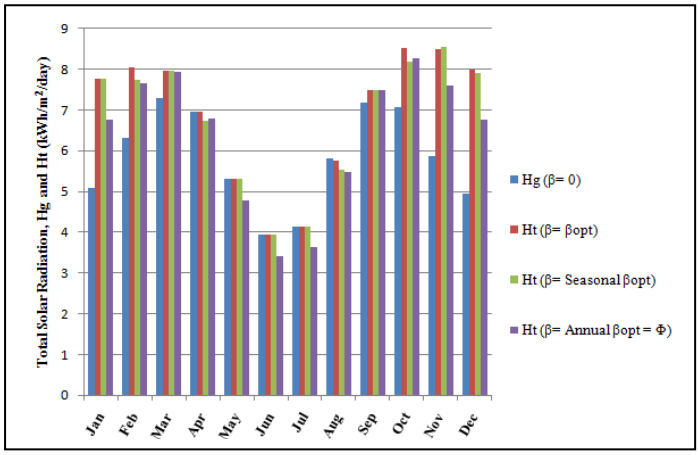

Fig. 3. Monthly average daily global solar radiation on various collector tilt angles for Nagpur

Similarly, the values of monthly average daily global solar radiation with various collector tilt angles for other solar cities have been calculated.

TABLE 4. ANNUAL AVERAGE SOLAR RADIATION (IN KWH/M^2-DAY) FOR VARIOUS COLLECTOR TILT ANGLES FOR SOLAR CITIES IN MAHARASHTRA

City	Hg for horizontal surface, (β=0)	Ht for monthly optimum tilt	Ht for seasonal optimum tilt	Ht for annual optimum tilt
Nagpur	5.822	6.866	6.773	6.381
Thane	5.847	6.778	6.688	6.304
Kalyan-Dombivli	5.847	6.778	6.688	6.304
Aurangabad	5.934	6.918	6.825	6.430
Nanded	5.918	6.858	6.764	6.375
Shirdi	5.923	6.899	6.805	6.414

The annual average solar radiation that falls on a meter square area of solar collector for different collector tilt angles for six solar cities is given in Table 4. The maximum solar radiations can be received by monthly adjustment of the collector tilt angle and the minimum is for horizontal surface. For Nagpur city, the annual average solar radiation fall on a horizontal surface is measured to be 5.822 kWh/m^2-day. The annual average solar radiation is found to be 6.866 kWh/m^2-day for collector at monthly optimum tilt, 6.773 kWh/m^2-day for seasonal optimum tilt and 6.381 kWh/m^2-day for annual optimum tilt which is same as collector tilt equal to latitude.

It can be seen from Table 4, for Nagpur city, 9.6% increase in annual average solar radiation can be obtained by placing the collector at a tilt angle equal to the latitude when compared it with the collector placed horizontally. Further 6.1% more radiation can be received by seasonally adjusting the tilt angle of the collector. 1.4% more radiation can be collected by implementing monthly tilt angle. Similar results have been obtained for other solar cities in Maharashtra.

V. CONCLUSION

In the current work, a mathematical model is used to determine the optimum tilt angle of the solar collectors for the six different locations. The annual average insolation for the optimum tilt is also reported. In addition, month wise and season wise optimum tilt angles are also computed for specific applications in different seasons. In this analysis it is observed that the significant gain in the annual average solar radiation can be obtained by placing the collector at optimum tilt angles.The reported values are useful for the purpose of installations of different solar utilities for year round or for seasonal applications at the locations considered in this analysis.

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DESIGN AND DEVELOPMENT OF HYBRID MOPED USING ELCTRICAL AND PETROL OPERATING ARRANGEMEN

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ABSTRACT

Rapid depletion of fossil fuels has forced the necessity of an alternate energy vehicle. Electric vehicles serve as promising technology for the future world transportation arena Due to minor drawbacks the electric vehicles cannot match up with the fossil fuel powered vehicle which made the invention of hybrid technology. Concentrated efforts are mainly towards implementing a concept called as hybrid system by which one system will be charged while the other system provides propulsive power to the vehicle. When the s runs on the electric motor it is almost nonpolluting.

This project is deal with the development of the as the only petrol vehicle or electrical vehicle is not as sufficient as hybrid vehicle. This hybrid technology can compensated the disadvantages of both type of vehicle. There is various type of base on the type of charging as it becomes plug-in type or other.

I. INTRODUCTION

Hybrid electric moped (HEM) have a great potential in lowering emissions and reducing fuel demand as the ever growing problems of air pollution and global warming reached its critical stage. Although various researches are carried out to reduce emissions and fuel dependencies for four-wheeled vehicles, not much research is focused on two wheeled vehicles for example, motorcycles in Jakarta, Indonesia contributed to more than 20% in both PM10 and CO and 40% of HC emissions during 1998. Whereas in Hanoi, Vietnam, motorcycles contributes to about 54% of CO,HC and Pb and 43% of dust Finally, in Taiwan where emissions reports indicate that 38% of CO, 3% of NOx, 64% of NMHC and 30% of PM were emitted from motorcycles and scooters alone.

Internal combustion engines are relatively less efficient in converting the on-board fuel energy to propulsion as most of the energy is wasted as heat. On the other hand, electric motors are efficient in converting the stored energy in driving a vehicle, and electric drive vehicles do not consume power while coasting. Some of the energy loss in braking is captured and reused by regenerative braking. With the help of regenerative braking one fifth of the energy loss can be regenerated. Typically, petrol engines effectively use only 15% of its fuel content to move the vehicle. Whereas an electric drive vehicle has an on-board efficiency of about 80%. But due to reasons such as cost, inability to reach higher speeds electric drive vehicles failed to capture markets. Contrary to this petrol vehicle can cover longer distances with higher speed but it cannot cover shorter distance with slow speed (say in traffic) in an efficient way. Two-wheeled vehicles, especially motorcycles and scooters contribute to a major part of air pollution, especially in the Asia region.

Thus a hybrid approach, which is to utilize an internal combustion engine (ICE) and a battery, is more feasible as a much higher range could be achieved compare to pure electric scooters. The only trade-off is that emissions are not reduced to zero. Thus two-wheeled hybrid research is as equally as important

II. CONCEPT OF HYBRID VEHICLE

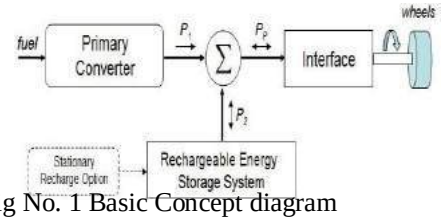


Fig No. 1 Basic Concept diagram

It is basically a two-way source one of which is rechargeable energy storage system. As shown in diagram that the wheels are get power by the two sources P1 and P2 this are the two way sources.

Hybrid vehicle is an automobile which combine more than one method of Propulsion system. It cans anything from petrol with combine's more than one method

of propulsion system. It can be anything from petrol with a hydraulic motor, diesel with electric or even solar power. In fact, we already see around us so many hybrid cars and motorcycles running on CNG with petrol with electric motor, petrol with a hydraulic motor diesel with electric or even solar power, In fact, we already see around us so many hybrid cars and motorcycles with LPG. They are nothing but form of a parallel Hybrid system. Hybrid technology is nothing but the solution to the problem of pollution by fuel and limited availability of the storage. In future we have to think out any alternative source so why not from now? That's why we are dealing with this concept.

TYPES OF HYBEID VEHICLE

Hybrid vehicle is mainly classified in two main types on the basis of power supplied to the vehicle. The types are as below,

- Parallel hybrid vehicle
- Plug-in hybrid vehicle

A. Parallel hybrid vehicle

In parallel hybrid vehicle, the internal combustion engine and the electric motor are connected to mechanical transmission and can transmit power simultaneously to drive the vehicle. The commercialized parallel hybrid vehicles use a single small electric motor and a small battery pack. Parallel hybrid vehicles are capable of regenerative braking and the internal combustion engine present in it is capable of supplemental charging of the battery.

B. Plug-in hybrid vehicle

A Plug-in hybrid electric vehicle(PHEV), also called as Plug-in hybrid, is a hybrid electric vehicle with rechargeable batteries that can be restored to full charge just by connecting to an external power source. A Plug-in hybrid electric vehicle shares the characteristics of both conventional hybrid electric vehicle having an electric motor and an internal combustion Engine and of an all-electric vehicle, having a plug to connect to an electric grid.

III. CONSTRUCTION DETAIL:

While converting the ordinary moped into hybrid moped. We required following components.

- Electric motor preferably (Hub motor).
- Batteries (Dry lead acid battery).

Moped (Kinetic kine).

This is main component of the . On the basis of availability and low cost We select this component. The various detail of the following component is as below

Electric motor:

The BLDC motor is widely used in applications including appliances, automotive, aerospace, consumer, medical, automated industrial equipment and instrumentation.

The BLDC motor is electrically commutated by power switches instead of brushes. Compared with a brushed DC motor or an induction motor, the BLDC motor has many

Advantages:

Higher efficiency and reliability Lower acoustic noise Smaller and lighter Greater dynamic response Better speed versus torque characteristics Higher speed range

Longer life Motor fundamental concepts:

1. *General principle:*

Motors convert electrical energy into mechanical energy using electromagnetic principles. The energy conversion method is fundamentally the same in all electric motors.

2. *Magnetic Force:*

Magnetic poles generate invisible lines of magnetic force flowing from the North Pole to the South Pole as shown in Figure. When magnetic poles of opposite polarity face each other, they generate an attractive force, while like poles generate a repulsive force.

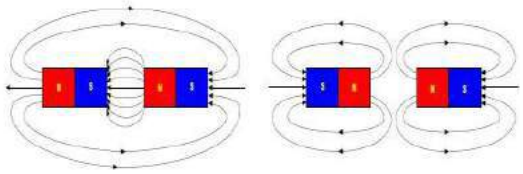


Fig No.2 Unlike-pole attraction & like-pole repulsion

3. Construction of BLDC motor:

I) Stator: There are three classifications of the BLDC motor: single-phase, two-phase and three-phase, the stator for each type has the same number of windings. The single-phase and three-phase motors are the most widely used. Figure shows the simplified cross section of a single-phase and a three-phase BLDC motor. The rotor has permanent magnets to form 2 magnetic pole pairs, and surrounds the stator, which has the windings.

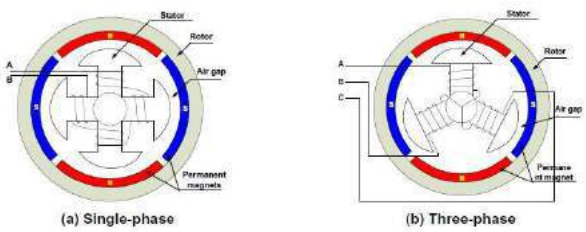


Fig no. 3 (a) & (b) Construction diagram

There are two types of stator windings: trapezoidal and sinusoidal, which refers to the shape of the back electromotive force (BEMF) signal. The shape of the BEMF is determined by different coil interconnections and the distance of the air gap. In addition to the BEMF, the phase current also follows a trapezoidal and sinusoidal shape. A sinusoidal motor produces smoother electromagnetic

torquethan a trapezoidal motor, though at a higher cost due to their use of extra copper windings. A BLDC motor uses a simplified structure with trapezoidal stator windings.

II) Rotor:

A rotor consists of a shaft and a hub with permanent magnets arranged to form between two to eight pole pairs that alternate between north and south poles. There are multiple magnet materials, such as ferrous mixtures and rare-earth alloys. Ferrite magnets are traditional and relatively inexpensive, though rare-earth alloy magnets are becoming increasingly popular because of their high magnetic density. The higher density helps to shrink rotors while maintaining high relative torque when compared to similar ferrite magnets.

IV. Working of motor:

Motor operation is based on the attraction or repulsion between magnetic poles. Using the three-phase motor shown in Figure, the process starts when current flows through one of the three stator windings and generates a magnetic pole that attracts the closest permanent magnet of the opposite pole. The rotor will move if the current shifts to an adjacent winding. Sequentially charging each winding will cause the rotor to follow in a rotating field. The torque in this example depends on the current amplitude and the number of turns on the stator windings, the strength and the size of the permanent magnets, the air gap between the rotor and the windings, and the length of the rotating arm.

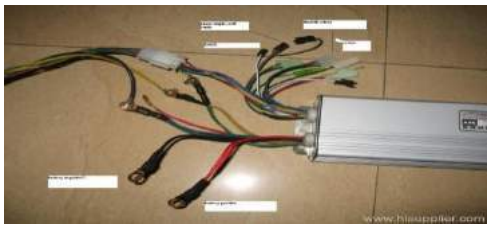
ADVANTAGES OF BLDC MOTOR OVER OTHER MOTOR:

- Higher efficiency (75% vs. 40% of an AC motor)
- Less heat generated
- Higher reliability (no brushes to wear out)
- Safer to operate in a dangerous environment (no brush dust generated as is found with brushed motors).

Table No. 1

Key parameters	AC Motor	DC Motor
Size and Weight	100%	55%
Efficiency	40-50%	70-75%
Speed Control	Difficult	Easy & Excellent
Accuracy and Speed	3-5%	0.5%
Torque Control	Poor	Excellent

Fig. 4: controller for BLDC hub motor



The controller connects the power source to the motor. It controls speed, direction of rotation, and optimizes energy conversion. While batteries produce constant voltages which decrease as theyare used up, some controllers require a DC to- DC converter to step down this changeable voltage to the motors expected constant operating voltage, but other controllers incorporate a DC-to-DC converter and can accept a varying voltage. Converter efficiencies are typically greater than 90% [4]. The voltage control is achieved by “chopping” the source current - the voltage is switched on and off, with the ratio of on to off determining the average voltage. Chopping is performed by power electronic circuitry such as diodes and thrusters and silicon control rectifiers (SCR). Controllers also effect regenerative braking, by which the motor is acted as a generator to recharge the batteries.

The controller which we used has following specification.

V. BATTERIES:

A lead-acid storage battery is an electrochemical device that produces voltage and delivers electrical current. The battery is the primary “source” of electrical energy used in vehicles today. It’s important to remember that a battery does not store electricity is produced. Basically, two different types of lead in acid mixture react to produce an electrical pressure called voltage. This electrochemical reaction changes chemical energy to electrical energy and is the basis for all automotive batteries.

The purpose of the battery:

The battery supplies electricity to the BLDC motor while the engine is off. That is our second alternative of moped operation. The motor run the shaft of the rim through the coupling. the battery can use to run the other accessories of the moped.

The other battery in arrangement is to use in self-staring of the moped.

VI. TYPES OF BATTERIES:

- Primary cell
- Secondary cell
- Wet charge
- Dry charge

Primary cell:

This type of Batteries are such as flashlight battery once used, throw it away because the chemical reaction totally destroys one of the metals after a period of time, primary cells cannot be recharge. Small batteries such as flashlight and ratio batteries are primary cells.

Secondary cell:

The metal plates and acid mixture change as the battery supplies voltage. As the battery drains the metal plates become similar and the acid strength weakens. This process is called discharging .by applying current to the battery in the reverse direction.the battery materials can be restored, thus recharging the battery. This process is called charging. Automotive lead-acid batteries are secondary cells and can be recharged.

Wet charged:

The lead –acid battery is filled with electrolyte and charged when it is built. During storage, a slow chemical reaction will cause self-discharge. periodic charging is required. Most batteries sold today are wet charged.

Dry charged:

The battery is built, charged washed and dried, sealed, and shipped without electrolyte. It can be stored for up to 18 months. When put into use, electrolyte and charging are required Batteries of this type have a long shelf life. Motorcycle batteries are typically dry charged batteries

VII. BATTERY CONSTRUCTION:

An automobile battery contains a diluted sulfuric acid electrolyte and positive and negative electrodes in the form of several plates. Since the plates are made of lead or lead-derived materials, this type of battery is often called a lead acid battery. A battery is separated into several cells (usually six in the case of automobile batteries), and in each cell there are several battery elements, all bathed in the electrolyte solution.

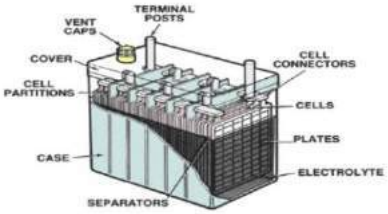


Fig No.5: Basic Construction

VIII. CELL OPERATION:

Two dissimilar metals placed in an acid bath produce electrical potential across the poles. The cell produces voltage by a chemical reaction between the plates and the electrolyte. The positive plate is made of reddish-brown material such as Lead Dioxide (PBO2). While the negative plate is made of grayish material called Sponge Lead (PB) the acid bath is a mixture of sulfuric acid and the water cell electrolyte. Together a cell element is formed.

CYCLING:

The battery stores electricity in form of chemical energy. Through a chemical reaction process the battery creates and releases electricity as needed by the electrical system or devices. Since the battery losses its chemical energy in this process, the battery must be recharged by the alternator. By reversing electrical current flow through the battery the chemical process is reversed, thus charging the battery. The cycle of discharging and charging is repeated continuously and is called “battery”.

BATTERY CELL ELEMENT:

The key to the battery operation is the cell element. Positive plates and negative plates are each connected together by separate plate straps. These groups of positive and negative plates are then placed alternately, separated by micro-porous separators. Assembled together, the plates and separators form a battery cell element. Grouping the plates in this way serves to enlarge the surface area between the active materials and the electrolyte, thus allowing a greater amount of electricity to be supplied. In other words, the battery capacity is increased because of the increase in the surface area. More plate surface area means the battery can deliver more current.

PLATES:

Battery plates are constructed of a lead alloy containing a percentage of either antimony or calcium. The plates are designed as thin flat grid, grids crossing at right angles {shown below} or grids crossing diagonally at different angles which reduce internal resistance. The grid provides the necessary framework for active materials to be pasted on the plate, making either a positive or negative plate. The active material on a charge positive plate is a reddish brown Lead Di Oxide [Pbo2] while the active material on a charge negative plate is a grayish spongy lead.

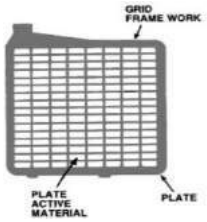
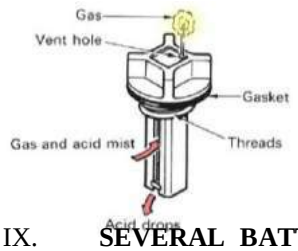


Fig no 6:Battery Case

The battery case holds the electrolyte and the individual battery cell elements. It is divided into six compartment or cells. The plates are raised up off the bottom of the case with ribs to prevent them from shorting out if any of the active materials (lead, etc) should happen to fall from the plates. The case is made of polypropylene, hard rubber, and plastic base materials. some battery manufactures use translucent plastic cases which allow checking electrolyte level without removing vent caps. These cases often have “upper” and “lower” electrolyte level markers on the outside of the case.

VENT CAPS:

Vent caps cover the holes that are used for adding electrolyte. They are also designed to separate the sulfuric acid mist and the hydrogen gas that forms when the battery charges. The caps are designed to the sulfuric acid mist to condense and drop back into the battery and allow hydrogen gas to escape through the vent holes to the atmosphere. Vent caps can cover each individual cell as shown below.



IX. SEVERAL BATTERY MATERIAL AND THEIR ADVANTAGES:

Several variations of the lead-acid battery are used today. Variation to the battery plate material and electrolyte solution provides different battery characteristics. Construction is basically the same; however, the materials used are slightly different.

1. Lead Antimony:(Most commonly used) Is commonly used in conventional lead acid battery which uses lead antimony cell plates

ADVANTAGES

1. Longer service life than Calcium batteries.
2. Easier to recharge when completely discharged.
3. Lower cost.

2. *Lead Calcium*(AC Delco maintenance free batteries). Is a maintenance free lead acid battery which uses lead calcium cell plates.

ADVANTAGES

1. *Larger electrolyte reserve area* above the plates.
2. Higher Cold Cranking Amp ratings
3. Little or No maintenance
4. *Recombination (Gel Cell)*

Is a completely sealed lead acid battery which uses an electrolyte that in a gel (solid) rather than a liquid.

ADVANTAGES

1. No liquid electrolyte to spill or leak.
2. Can be Deep Cycled several time without damage.
3. Totally corrosion and maintenance free.
4. Three to four times longer battery life than regular batteries.
5. More plate surface and closer plate spacing provides a compact case size.

X. FULL SPCIFICATION OF KINE:

1. ENGINE, POWER AND TORQUE

Table 2

VARIABLS	VALUE
Displacement	71.55cc
Maximum power	4.2Bhp
Maximum Torque	5.7Nm
Engine Displacement	2 Stroke Single cylinder
Cooling	Air cooling

TRMISSION

Table 3

PART	TYPE
Gearbox	Automatic

3. BRKAES

Table 4

TYPE	SIZE
Front Brake	Drum 110 mm
Rear Brake	Drum 110 mm

4. DIMENSION ,WEIGHT, CAPACITY

Table 5

PART	SIZE
Overall Length	1740 mm
Overall Weight	640 mm
Overall Height	1076 mm

Wheel Base	1235 mm
Kerb /wet Weight	86 kg
Fuel Tank Capacity	4 liters
Front Tyre	3.00×10 inches
Rear Tyre	3.00×10 inches
Head Light	12v 25w/25w

This data is available from the manual of this product.

XI. DESIGN CRITERIA:

Some part is necessary to design, on the basis of the data available from the manual of the moped and standard data book the value are taken and their corresponding value is calculated.
Following part which are necessary to design.

(1) Design Procedure for shaft
Given Data
Torque on the Driving Shaft
=10N-m =10x103 N-mm
Total Load acting on the shaft
= 300 kg x 9.81
=2943 N
Total Length of driving shaft
= 0.125m = 125 mm

Design Procedure for Flange
: · d = 10.66 mm
Method (II)
For Simply Supported Beam
=WL/4= 2943 x 0.125/4
M=91.96 N-mm
M=91. 96N.m = 91.96 x10^3 N-mm
M=π/32 × 6b × d^3
91.96 × 10^3/32 =3.14 x42 x d^3
d = 28.14 mm

Coupling

Given Data =
N = 5000 rpm motor
T = 10 N-m
Actual Diameter of Engine shaft,
d = 14mm (given)
(a) P = 2 x N x T / 60 N-m
P = 5.235 KW
T = π/16 x s xτs x d^3
10 x 10^3 = π /16
x= $\frac{\pi}{16}$τs x 14^3
τs=18.56 N/mm^2
Outer diameter of Hub
D = 2d = 2 x 14 mm
= 28mm,30mm
But Actual outer diameter of hub
D = 122mm
So for given data our design is safe.

(b) Hub is hollow shaft for that shear stress
T = $\frac{\pi}{16}$x τs x [$\frac{D^4-d^4}{D}$]
10 x 10^3=$\frac{\pi}{16}$x τs x [$\frac{28^4-14^4}{28}$]
τs =2.47 N/mm^2
For actual diameter of engine shaft
d = 14 mm
Outer diameter of hub
d = 122 mm
Ts= 0.23 N/mm^2

Form above given data design is safe.
(c)Desing For Flange
Thickness of Flange = 0.5d
Tf= 0.5 x 14 = 7mm
T=$\frac{3.14 \times D}{2}$ $\tau c \times tf$
10x103 =$\frac{3.14 \times 28}{2}$ $\tau c \times 7$
$\tau c = 1.16\ N/mm^2$

(c) Design for Bolt
Given Data
$\tau b = 20\ N/mm2$
No. Of bolts n=4
d1=Normal diameter of bolt .
D1 = Pitch circle diameter
D1= 3d= 3 x 14 = 42 mm
For stress
T= $\frac{\pi}{4}$x $d^2{}_1$x τbx n x [$\frac{D1}{2}$]
10x10^3=$\frac{\pi}{4}$x $d^2{}_1$x 20x 4 x [$\frac{42}{2}$]
d_1=2.75mm
Outer Diameter of Flange

D2 = 4d = 4 X 14 = 56mm

∵ Thickness of the Protective Circumferential Flange
tp = 0.25 d

= 0.25 X 14 = 3.5mm = 5 mm
As our bolt actual diameter is 8 mm so our design is safe.

(3) (1) Design Specification of Coupling
d =Diameter of Shaft = 14mm
D= outside Diameter of flange = 44mm
Thickness of flange = 4 mm
Allowable shear stress for shaft
=18.58 N/mm2

(1) Design specification for Bearing

Bearing No. 202

Bore = 15mm

Outer Diameter = 35mm

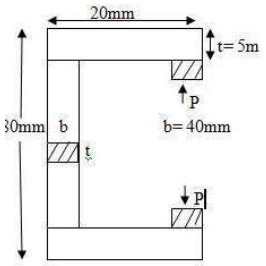
Width = 11mm
Bearing 203

Bore = 17mm

Outer Diameter = 40mm

Width = 12 mm

(4) Design Procedure for C- Clamp



Cross Section at X – X
A = b x t

40 x 5 = 200mm2

Consideration (I) =

: · Direct tensile stress at x-x

$\sigma_0 = \frac{P}{A} = \frac{2943}{200}$

σ_0 = 14.71 N/mm2

Behind moment at X-X due to the load P
M = P X e

= 2943 X 17.5

M = 51502.5 N-mm
Section Modulus
Z= $\frac{t \times b^2}{6} = \frac{5 \times 40^2}{6}$
Z= 1333.33mm^3
Behind stress at X-X
σb= M = 51502.5

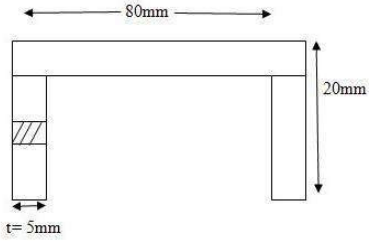
Z 1333.33
σb = 38.62 N/mm2
Maximum tensile stress

= σ0 + σb

= 14.17 + 38.62

= 53.33 N/mm2

Consideration (II)



Bending moment at X-X due to the load P
M= P X e

= 2943 X 77.5

M = 228.08 X 103 N-mm

XII. CAD MODEL:

1) Motor:

2) Bearing:

3) Clamp:

4) Rim:

5) Rim disc:

Coupling:

I) Main Coupling

II) Large Coupling:

Assembly: Explode View

XIII. ADVANTAGE'S:

- The range of an Electric bike increased.
- The city traffic air and noise pollution is decreased to a greater extent.

- One third of energy is captured by regenerative braking, which would otherwise go waste.
- Decreased the dependency of fossil fuels.

XIV. DISADVANTAGE'S:

- The initial cost of the vehicle is marginally increased, compared to the conventionally available.
- The disposal of battery is to be properly handed to avoid pollution.

Fig no. 8: Actual design and development of hybrid moped.

XV. CONCLUSION:

Finally, we conclude that canreduce consumption of the fuel to the great extent. There is always an alternative source of fuel to the vehicle as hybrid technology is the most promising technology. Typically, petrol engines effectively use only 15% of its fuel content to move the vehicle. Whereas an electric drive vehicle has an on-board efficiency of about 80%. But electrical vehicle cannot reach to the high speed as petrol engine that's why the hybrid technology is use.

This can efficiently work with the hub motor. And it supplies the power by the battery (lead acid battery). the disadvantages of the both electric moped and the petrol moped are compensated by the hybrid technology. and one whole automobile industry catch this concept soon.

XVI. RESULT:

The following are the result which are obtain from during operation of the vehicle.Charging Time of the battery – 6 hr. Max speed of the moped -40km/hr.

XVII. FUTURE SCOPE:

This modeled has a parallel hybrid structure. The main propulsion units consist of a two stroke internal combustion engine and a hub motor attached to the Rear wheel of the moped. The methodology used to optimize the energy and fuel consumption of the hybrid electric scooter is the multi-mode approach.

The hybrid vehicles have a wide scope in the upcoming future. The main reasons of it are-

- Regenerative braking actually makes city driving more economical than on the highway.Fuel efficiency is greatly increased (twice).
- Emissions are greatly decreased.
- Dependency on fossils fuels can be decreased.
- Hybrids can be run on alternative fuels as well.
- Battery can be charge by the solar energy.

This is the main area where we need to be focused in future. All the above option will increase its efficiency. but the initial cost we need to be work on.

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POWERGENERATION FROM BIOMASS BRIQUETTES

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ABSTRACT:

Today the energy is vital part of our life. Demand of energy is everywhere Energy is the key factor in economic development of any country. The demand of energy increases rapidly in all sectors like domestic use, infrastructure, agriculture, automobile, power etc. That's why there is a huge requirement to find alternative green energy sources to the coal, charcoal, oil, petrol diesel and fossil fuels to prevent the environment from toxic gases and harmful pollution. Also Deforestation is the global problem and thus from the old days Biomass is use as a source of energy in India and it shows great potential. Biomassbriquettes are a renewable source of energy and avoid adding fossils carbon to the atmosphere. Therefore this substitute energy medium is given national priority as appears to be the only permanent solution into restriction of the national laws and avoid pollutions. 'Biomass Briquetting' is the process of physical transformation of loose raw bio waste material like rice husks, saw dust briquette, ground nut shells, bark woods etc into high density fuel briquettes through a compacting process. The resultant form change increases the calorific value (combustion efficiency) of the product as compared to lose material. As it increases the density of the product.

KEYWORDS: Ingredients, Manufacturing, Types, Techniques, Case study.

INTRODUCTION

BIOMASS BRIQUETTE INGREDIENTS

The carbon and oxygen content is important in biomass energy analysis. As the high Oxygen content tends to lower the calorific value while high carbon content tends to form high-grade biomass fuel. The calorific value is one of the most important characteristics which is the amount of energy per kg it gives off when burnt. Thus it be used to calculate the competitiveness of a processed fuel in a given market situation also the ease of handling, burning characteristics are also the factors to be consider while selecting the raw material.

The table no.1 depicts some important characteristics of mostly used biomass briquettes.

Fuel name	C%	H%	S%	N%	O %	ASH %	GCV in Kcal	HHV in MJ/Kg
Coconut shells	40.23	2.48	0.01	0.88	56.39	2.3	4524	11.07
Coffee husk	53	5.3	0.01	1.05	39.78	10	4045	20.7
Bagasse	45.21	4.93	0.01	0.88	48.96	3	4380	16.46
Cotton stalks	38	3.44	0.02	1.75	56.77	5	4252	11.32
Saw dust	46.12	4.631	0.024	0.70	48.524	5	3898	16.42
Groundnut shells	55.41	4.147	0.01	3.50	36.929	5	4524	20.25
Rice husk	64.5	3.782	0.01	2.1	29.6	20	3200	23.45

Table No.1 Ingredient of Biomass Briquettes

The measured percentage H, N and S contents are generally much lower to that of hydrocarbon fuels and oxygencontent is high to that of hydrocarbon. The total nitrogen varies in the range 0.88-3.50 (wt %) and the total sulfurrange 0.0106-0.1090 (wt %). Both nitrogen and sulfur content are not important in biomass combustion. They tend
to increase the release of toxic gases that are either irritants (NOx, SO2, aldehydes and acrolein) or asphyxiants(HCN) which may cause adverse effect to living organisms

MANUFACTURING PROCESS

Biomass briquetting project is simply a process of densification of agro waste and forestry waste into biomass

briquettes also called as white coal. All materials containing lignite and cellulose are suitable for densification. Successful test have been carried out with variety of materials from saw dust, sander dust, etc. The bio residues can be briquetted individually or in combination depending on their availability and blending properties. Main concept of this process is to produce the material as a white-coal, which is made from the wastages. We cannot destroy the wastage totally. But we can use it with the help of briquetting plant and produce the briquettes, which ultimately produce the energy. The use of these cheap fertilizers gives low yield as compared to the modern fertilizer. The briquette made from press mud after drying and briquetting have calorific value 4000 Kcal. /Kg Approximately. It can be illustrate step by step.

Sorting/sieving: All unwanted materials or largebiomass waste are removed to ensure that all thefeedstock is of the required size. For example, the rawsawdust you collect could contain unwanted larger piecesof wood. These can be sieved out with a wire mesh.

Shred biomass materials into small pieces: Thebiomass materials are chopped into small pieces so asto enhance their workability and compactness. Theprocess is dependent on the type of biomass feedstock.

For example, coffee husks and saw dust would notrequire shredding but materials such as groundnutwaste, bagasse, wheat straws, barley and maize strawsand cobs would need to be chopped into small sizes. Inthe case of carbonized biomass, the materials wouldneed to be grounded into small pieces after they havebeen carbonized.

Mixing: This process is done in situations where youwant to use a range of different feedstock to optimize the burning characteristics of the final fuel. For example,biomass materials with high ash content could be mixed with biomass material of low ashcontent. Biomass with low energy content such aspapers can be appropriately mixed with those of highenergy content. This helps to attain the right quality(long burning period, non-smoking and odor free) thatwill make briquettes competitive in the market.

Binder: In addition to biomass mixing, an appropriatebinder is added and mixed with the biomass thoroughly.

This enhances the compactness of the biomassmaterials and prevents them from falling apart. An example of such binders includes starch or clay rich inbiomass.

Adding water: Water is usually added to thefeedstock to make them loose and easy to work on.Some biomass materials require to be soaked in waterfor a number of days to ensure that they are soft enoughto work on.

Compaction & Drying: Finally the feedstock is readyfor compaction, either by machine or by hand. Thebriquettes will need to be left to dry for up to a week.

The Production of Biomass Briquettes is as shown in fig no.1

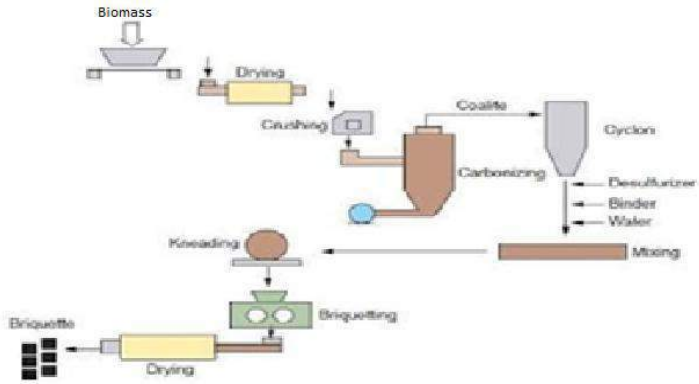

Fig. No.1 Biomass Briquette Production

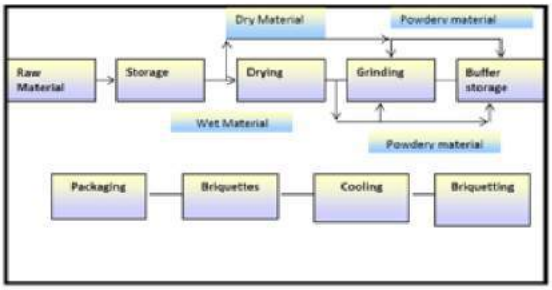

Fig No.2 Flow Diagram of Briquette Production Process

Screw Press and Piston Press Technologies:

High compaction technology or binder less technology consists of the piston press and the screw press. Most of the units currently installed in India are the reciprocating type where the biomass is pressed in a die by a reciprocating ram at a very high pressure. In a screw extruder press, the biomass is extruded continuously by a screw through a heated taper die. In a piston press the wear of the contact parts e.g., the ram and die is less compared to the wear of the screw and die in a screw extruder press. The power consumption in the former is less than that of the latter. But in terms of briquette quality and production procedure screw press is definitely superior to the piston press technology. The central hole incorporated into the briquettes produced by a screw extruder helps to achieve uniform and efficient combustion and, also, these briquettes can be carbonized. The following table shows a comparison between Piston press and Screw Extruder.

Parameters	Piston press	Screw Extruder

Optimum moisture content	10-15 %	8-9%
Wear of contact parts	Low in case of ram and die	High in case of screw
Output from the machine	In strokes	continuous
Power consumption	1-1.2 gm/cm^2	60kw/h ton
Density of briquettes	high	1-1.4 gm/cm^2
Maintainance	Not so good	low
Combustion performance of briquettes	Not possible	Very good
Carbonization of charcoal	Not suitable	Makes good charcoal charcoal
Suitability in gasifiers	non	suitable
Homoginiety of briquettes	homogeneous	homogeneous

Table No.2 Comparison between Piston Press and Screw Extruder.

TYPES OF BRIQUETTES

Briquettes are generally made up from Agriculture and forest waste and used in various Industries. Biomass Briquettes, Recycle Briquettes, White coal Briquettes, Saw dust Briquettes, etcIn the below diagram some important and regularly used Briquettes are mentioned.

Fig no.2 Types of Biomass Briquettes

Following Industries Can Make Maximum Use Of Briquettes:

- Ceramic and Refractory Industry
- Solvent Extraction Plant
- Chemical Units
- Dyeing Plants
- Milk Plants
- Food Processing Industries
- Vegetable Plants
- Spinning Mill
- Lamination Industries
- Leather Industries
- Brick Making Units
- Other Industries having Thermal Applications
- Gasifires system in Thermal
- Textile Units

ADVANTAGES OF USING BRIQUETTES:

- Briquettes can replace conventional fuels like Diesel, Kerosene, Furnace oil, Lignite, Coal ,Firewood.
- Environmentally, the use of biomass briquettes produces much fewer greenhouse gases, specifically, 13.8% to 41.7% CO2and NOX. There was also a reduction from 11.1% to 38.5% in SO.
- Briquettes production is much easier at anywhere thus it does not requirement of transportation.
- Briquettes give much higher boiler efficiency because of low moisture and higher density.
- It having higher calorific value, biomass briquettes on average saved 30–40% of boiler fuel cost.
- It is cheaper than coal and There is no sulfur in briquettes, thus does not pollutes the environment.

ADVANTAGES OF SETTING UP PLANT PROJECT

There is no fly ash when burning briquettes.

- Briquettes have consistent quality **BRIQUETTES**, have high burning efficiency, and are ideally sized for complete combustion.
- Compared to fire wood or loose biomass, briquettes give much higher boiler efficiency because of low moisture and higher density.
- Briquettes, are easy to store, pack and hygienic to handle.
- High sulfur content of oil and coal, when burnt, pollutes the environment.
- Combustion is more uniform compared to coal and boiler response to changes in steam requirement is faster due to higher quantity of volatile matter in briquettes.

DISADVANTAGES OF USING BRIQUETTES:

- Specific heat at constant volume of briquettes is comparatively very small with coal.
- ATF of biomass briquettes is also very very small as compared coal.
- It results in deaerating.

CASE STUDY:The Industry had two RFO fired boilers: one of 10 TPH (smoke tube boiler) and another of 8 TPH (water tube boiler). RFO is atomized with air in the RFO burner and fired, which produces hot flue gases that pass into the boiler tubes to generate steam. Water tube boiler, which otherwise kept as standby is retrofitted to facilitate briquette firing.In future, it is also envisaged that the steam generation might be shifted to the existing smoke tube boiler, which will be retrofitted to facilitate the briquette firing. However in that case, total steam generation from the boiler will be the same as that of the briquette fired water tube boiler. Change in the briquette consumption & efficiency of the boiler will be get accounted in the monitoring table.

Details of Retrofit Technology:

In the project activity, water tube boiler has been retrofitted with external furnace to facilitate briquette firing. The technology involves a Retro-fitting operation(RFO) where a burner and a RFO firing system are removed and replaced by a hot duct, a biomass based fired furnace, and an induced draught system. A well insulated extended furnace is constructed near the boiler to facilitate manual briquette firing. Briquettes burn over the grate and the hot flue gas resulting at a temperature of 1300-1400ºC is supplied to the shell side of the boiler through a connecting duct of 6m long. Here the water is passed through the tubes of the boiler. After going through the boiler, heat from the flue gases is recovered in the economizer. Since there is no sulphur in the fuel, heat can be extracted at a much higher extent from hot flue gases. In this project, two dust settling chambers are provided for burnt gases treatment:

- One at the exit of the furnace.
- The other, at the economizer

This is where dust particles from the flue gases get settled and are removed. GHG Emissions from the boiler after the retrofit are better than that with RFO firing and also well within prevailing norms. The technology is safe and environmentally sustainable. The ash generated during the project activity because of briquette firing, is collected & drenched with water. Wetted ash is then carried away with the help of trolleys & used for land filling in the plant itself.

In the absence of the project activity, one of the existing RFO fired boiler would have been used for steam generation. In this project activity, 8 TPH water tube boiler is retrofitted to facilitate briquette firing and is used for steam generation. Steam production of briquette-fired boiler is 3.81 TPH.

Through this conversion, the boiler efficiency goes down from 79.73% to 75.31% and increases electricity consumption by 1.12 KWh/MT of steam generated.

RESULT ANALYSIS

Switching from RFO to Briquette offers various advantages with respect to emissions, safety, and leakage of fuel during transportation and storage, which are as follows:

1. GHG(Green House Gases) emissions are reduced from 7,856 to 1,298 tonnes of CO_2 equivalent per year. Thus the project has the capacity to reduce GHG emissions by 6558 tonnes of CO_2 equivalent per year. In addition to this, SO_X& NO_X emissions are also reduced significantly. Thus the briquette fuel is environment friendly.

2. During transportation of RFO, losses due to evaporation of fuel are more. Chances of leakage during transportation are also there. In case of Briquette, such losses are not there. Thus the transportation losses are minimized.

3. During storage of RFO, if the fuel leaks then there is a chance of fire hazard. During handling ofBriquette such situation does not arise. Thus the handling of briquette as fuel is also comparatively safe.

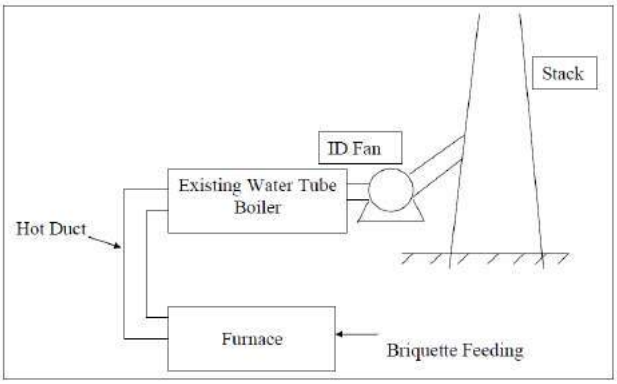

Fig. No.3 Arrangement of the Retrofit External Furnace

CONCLUSION:

Biomass briquette is the best alternative for the coal and charcoal. Biomass briquettes it gives two advantages first is it reuses the agriculture waste which is abundant in agriculture fields and another one that it is environment friendly. Also it is used in lot of Industries. In case Study we seen that if we use the retrofitting of Briquette to the RFO Boiler it produce tremendous change in GHG, CO_2, SO_X&NO_X emissions per year. Therefore in India, the Indian Renewable Energy Development Agency (IREDA) promoting the utilization of Biomass Briquettes.

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DEVELOPMENT AND FABRICATION OF MULTI-NOZZLE PESTICIDES SPRAYING PUMP

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ABSTRACT

India is a land of agriculture which comprises of small, marginal, medium and rich farmers. Small scale farmers are very interested in manually lever operated knapsack sprayer because of its versatility, cost and design. But this sprayer has certain limitations like it cannot maintain required pressure; it lead to problem of back pain. However this equipment can also lead to misapplication of chemicals and ineffective control of target pest which leads to z cause environmental pollution and imbalance in natural echo system. This paper suggests a model of manually operated multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time. Constant flow valves can be applied at nozzle to have uniform nozzle pressure.

Key words: **Mechanization, spraying time, pesticides sprayer and organic fertilizer**

INTRODUCTION

Agriculture plays a vital role in Indian economy. Around 65% of population in the state is depending on agriculture. Although its contribution to GDP is now around one sixth, it provides 56% of Indian work force [10]. Table 1 shows that share of marginal and small farmer is around 81% and land operated is 44 % in 1960-61. As far as Indian scenario is concerned, more than 75 percent farmers are belonging to small and marginal land carrying and cotton is alone which provide about 80 % employment to Indian workforce. So any improvement in the productivity related task help to increase Indian farmer's status and economy. The current backpack sprayer has lot of limitation and it required more energy to operate. The percentage distribution of farm holding land for marginal farmers is 39.1 percentage, for small farmers 22.6 percentage, for small and marginal farmers 61.7 percentage, for semi-medium farmers 19.8 percentage, for medium farmers 14 percentage and for large farmers 4.5 percentage in year 1960-61.Table 1 clearly explain that the maximum percentage of farm distribution belonged to small and marginal category..

In India about 73% of population is directly or indirectly depends upon the farming. Hence it is said that India is an agricultural based country. But till now our farmers are doing farming in same traditional ways. They are doing seed sowing, fertilizers and pesticides spraying, cultivating by conventional methods. There is need of development in this sector and most commonly on fertilizers pesticides spraying technique, because it requires more efforts and time to spray by traditional way.

Most of Asian nations are at developing stage and they are facing the problem of high population and as compared to that agricultural productivity is much lower as compared to developed nations. India is one of the nations who is facing the same problem. This is caused due to low level farms, insufficient power availability to farms and poor level of farm mechanization.

In order to meet the requirement of food of growing population and rapid industrialization, there is a need of the modernization of agriculture sector. On many farms production suffers because, delay in sowing, improper distribution suffer because delay in sowing, improper distribution of pesticides and fertilizers, harvesting. Mechanization solves all the problems which are responsible for low production. It conserves the input and precision in work and get better and equal distribution. It reduces quantity needed for better response, prevent the losses and wastage of input applied. It get high productivity so that cost of production will reduced.

To reach the requirement of production Agriculture implement and machinery program of the government take

steps to increase availability of implement, pumps, tractors, power tillers, harvester and other power operated machines. Special emphasis was laid on the later as more than65

LITERATUREREVIEWS

A. ***Spraying Methods****:*

One of the more common forms of pesticides application, especially in conventional agriculture is the use of mechanical sprayers. Hydraulic sprayers consists of a tank, a pump,lance(for single nozzle) or boom and a nozzle (or multiple nozzles).sprayers convert a pesticides formulation, often containing a mixture of water(or another liquid chemical carrier, such as fertilizer) and chemical into droplets, which can be large rain type drops or tiny almost invisible particles. The size of droplets can be altered through the use of different nozzle sizes, or by altering the pressure under which it is forced. Large droplets have advantage of being less susceptible to spray drift, but require more water per unit of land covered.

Large size droplets are advantages in being less drift while spraying but there is wastage of pesticides in this method. The smaller size droplet is more evenly sprayed. The main demerit of back pack sprayer is that the labour has to carry nearly 5 gallon capacity on his back which cause severe back pain and cause fatigue to labour.

1) Backpack (Knapsack) Sprayer:

the main principle use in spraying with knapsack type of sprayer is pressure difference created by hand operated lever. It has usually single nozzle through which liquid pesticides is forced to come out of the nozzle in fine droplet form. Some sprayers can generate pressure of 7kg/ cm^2. Capacity are usually less than 20 liter or less.

The main components of hydraulic sprayer are tank, pump, lance, boon and a nozzle. Sprayers convert the pesticides into small droplets which can vary according to pressure & size of perforation of the nozzle.

2) Hydraulic Sprayer:

Most of the world's pesticides are mixed with water and sprayed through hydraulic nozzle: of one short of another. There are enormous variation in the scale, the way pumping is achieved and the configuration of atomizer, this >100 year old technology is still considered the method of choice by farmers and other spray operators.

3) Large –Scale Tractor Mounted & Self Propelled Equipment Or Lite-Trac:

In this the motorized technique of spraying the pesticides in which "lite-tractor" is used. The lite- trac name comes from "lite tractor" due to patented chassis design, facilitating the naturally leaving machines manufactured by company to have a light footprint for minimal soil compression. Lite-Trac is currently the European largest manufacturer of four wheeled.spraying tractor for crops. The stainless steel can accommodate around 8000 liters of pesticides for spraying so no need of frequent refilling. But main drawback is its high cost which small or medium scale farmer in India can't bear. So we have designed a less expensive device for spraying of both organic pesticides and fertilizer for small scale farmers.

Sr. no.	Types of sprayer	Area for which spraying is used	Time required
1	*Bullock driven*	*Larger area*	*Less time and effort*
2	*Hand driven*	*Smaller area*	*Larger time and effort*

Table1: Existing high features of sprayer

DESIGN REQUIREMET

A. Shortcoming in Existing Sprayer Pumps:

The normally used spraying pump by farmers in India (small, marginal or medium) is the back pack sprayer. The main limitation of using it is that of its small capacity and carrying it on back cause back pain and continuous lever movement for pressure generation can cause muscular disorder. Developing adequate pressure is a laborious and tedious and time consuming process. It takes longer time to spray the entire land due to frequent refilling it because it has small capacity of 10-15 liter tank

B. Providing Alternative to Small Farmers:

the backpack(Knap-sack) sprayer for spraying pesticides by the farmer cost around Rs. 2000-4500 and for rich farmers there are lite-Trac available ch are beneficial for larger land a but it cost more which the small farmers can't bear.

So, we have proposed an organic fertilizer cum pesticides sprayer device for convenience of the farmer. Which can be hand driven or bullock driven. The cost may be around Rs. 25000/- but it would be one time investment for the farmers for higher productivity of crops.

Sr. no.	Name of crop	Distance between(mm)	Height of crop(mm)
1	*cotton*	600-900	600-1500
2	*groundnut*	400-500	400-450
3	*Pigeon pea*	400-500	250-300
4	*Sugarcane*	400-500	1600-2100

working of this manually operated organic fertilizers cum pesticides sprayer is based on the principles of motion of trolley which transmit its rotary motion from slider crank mechanism arrangement and reciprocating piston into the cylinder for pumping the pesticides. When the operator pushes the trolley forward, the wheel rotates in counter clockwise direction hence slider move in counter clockwise which is attached to crank shaft. This motion is transfer through slider crank to disc, it rotates in counter clockwise direction. Its motion rotates the disk on which there is a linkpresentwhich move reciprocating motion.the piston or plunger also move in reciprocating motion, hence spray the pesticides through the nozzle.

CONCLUSION

1)The suggested model has removed the problem of back pain, since there is no need to carry the tank (pesticides tank) on the back.

2) as suggested model has more number of nozzles which will cover maximum area of spraying in minimum time & at maximum rate.

3) The c.f. valves can also be applied which help in reducing the change of pressure fluctuation and c.f. Valves helps to maintain pressure.

4) Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result into less pollution.

5) Imported hollow cone nozzles should be used in the field for better performance.

6) Muscular problems are removed and there is no need to operate the lever.

7) This alone pump can used for multiple crops

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TECH-CHRONICLE
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DEVELOPMENT AND FABRICATION OF MULTI-NOZZLE PESTICIDES SPRAYING PUMP

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ABSTRACT

As the world's population increases and the diets of the developing world continue to improve, demand for meat and crops means food production could need to increase by up to 70% by 2050. Fertilizers will undoubtedly play a major role in this production uplift. The mechanization process may helpful in yields of crop, small scale farmers are aiming for less investment in form of backpack type sprayer's but it may causes mainly back pain and muscular disorder so to avoid all these demerit we have propose sprayer of fertilizer and pesticides which can simply be pulled by hand. This paper suggest a model of manually operated multi-nozzle pesticide sprayer. This will perform spraying at maximum rate in minimum time and optimum utilization of organic pesticides and evenly distributing it. In another tank there is of organic fertilizer and two knob arrangement for flow of liquid fertilizer which flows with gravity force, constant flow, valve can be provided at nozzle to have control the flow of fertilizer.

Keywords: Mechanization, spraying time, pesticides sprayer and organic fertilizer

INTRODUCTION

India is agricultural country, most of people in India are farmer and they lives in villages, so we have made suitable pump for the farmer. Because they have used harmful and expensive fertilizer and pesticides, there is need for improvement in farming procedure and used of cheep and beneficial equipment for effective spraying and weeding for increase in productivity. Insects are largely responsible for crop destruction and for curing we use chemical fertilizer and pesticides which causes adverse effect on our health. Insecticides preparation is used to kill insects otherwise we can control their reproduction. These are sprayed on the crops by devices known as sprayer. For small farmer one of the reason in less yield of crops in improper seed bed, preparation and late sowing, harvesting and threshing. Mechanization will improve the circumstance through definiteness in metering ensuring more appropriate distribution lessening quantity needed for better prevention of wastage of fertilizer and pesticides.Mechanization helps in giving higher productivity through less effort. Most farmer are acapital thus, there is an apportunity to suggest on inexpensive mechanical sprayer for organic pesticides which can be easily mobile and carry large capacity tank so no need of frequent refilling the traditional backpack.

LITERATUREREVIEW

A. Spraying Methods:

One of the more common forms of pesticides application, especially in conventional agriculture is the use of mechanical sprayers. Hydraulic sprayers consists of a tank, a pump,lance(for single nozzle) or boom and a nozzle (or multiple nozzles).sprayers convert a pesticides formulation, often containing a mixture of water(or another liquid chemical carrier, such as fertilizer) and chemical into droplets, which can be large rain type drops or tiny almost invisible particles. The size of droplets can be altered through the use of different nozzle sizes, or by altering the pressure under which it is forced. Large droplets have advantage of being less susceptible to spray drift, but require more water per unit of land covered.

1. Hand driven sprayer:

Hand driven pumps consist of a flexible diaphragm made of synthetic rubber connected to the pump handle by a crankshaft mechanism, a rigid diaphragm chamber and either flat or ball-type inlet and outlet valves. The outlet

valve is connected to a pressure chamber, which in many hand driven pump sprayers has a variable pressure setting valve. These pumps typically operate between pressures of 1 and 3 bar (15-44 psi) and it is suitable for herbicideapplication where large droplets are required to minimize spray-drift.

2) Hydraulic Sprayer:

Most of the world's pesticides are mixed with water and sprayed through hydraulic nozzle: of one short of another. There are enormous variation in the scale, the way pumping is achieved and the configuration of atomizer, this >100 year old technology is still considered the method of choice by farmers and other spray operator.

3. Fuel Operated Sprayer:

The power sprayer consists of an integrated or external spray tank; a high pressure piston pump usually powered by a petrol engine a pressure regulating valve and a hose of up to 50 m of length. Spray tanks are too big to be carried as a knapsack. The power sprayer is produced in a number of versions. Most simple and common is an Engine driven pump mounted on a frame.

DESIGN REQUIREMET

A. Shortcoming in Existing Sprayer Pumps:

The normally used spraying pump by farmers in India (small, marginal or medium) is the back pack sprayer. The main limitation of using it is that of its small capacity and carrying it on back cause back pain and continuous lever movement for pressure generation can cause muscular disorder. Developing adequate pressure is a laborious and tedious and time consuming process. It takes longer time to spray the entire land due to frequent refilling it because it has small capacity of 10-15 liter tank.

B. Providing Alternative to Small Farmers:

the backpack(Knap-sack) sprayer for spraying pesticides by the farmer cost around Rs. 2000-4500 and for rich farmers there are lite-Trac available ch are beneficial for larger land a but it cost more which the small farmers can't bear. So, we have proposed an organic fertilizer cum pesticides sprayer device for the convenience of the farmer. Which can be hand driven or bullock driven. The cost may be around Rs. 25000/- but it would be one time investment for the farmers for higher productivity of crops.

Sr. no.	Name of crop	Distance between(mm)	Height of crop(mm)
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3	Pigeon pea	400-500	250-300
4	Sugarcane	400-500	1600-2100

Sr. no.	Types of sprayer	Area for which spraying is used	Time required	
1	Bullock driven	Larger area	Less time and effort	
2	Hand driven	Smaller area	Larger time and effort	

Table1: Existing spraying methods

Table2: distance between and height of crops

WORKING

The working of this manually operated organic fertilizers cum pesticides sprayer is based on the principles of motion of trolley which transmit its rotary motion from slider crank mechanism arrangement and reciprocating piston into the cylinder for pumping the pesticides. When the operator pushes the trolley forward, the wheel rotates in counter clockwise direction hence slider move in counter clockwise which is attached to crank shaft. This motion is transfer through slider crank to disc, it rotates in counter clockwise direction. Its motion rotates the disk on which there is a linkpresentwhich move reciprocating motion.the piston or plunger also move in reciprocating motion, hence spray the pesticides through the nozzle

CONCLUSION

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2) as suggested model has more number of nozzles which will cover maximum area of spraying in minimum time & at maximum rate.

3) The c.f. valves can also be applied which help in reducing the change of pressure fluctuation and c.f. Valves helps to maintain pressure.

4) Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result into less pollution.

5) Imported hollow cone nozzles should be used in the field for better performance.

6) Muscular problems are removed and there is no need to operate the lever.

7) This alone pump can used for multiple crops

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TECH-CHRONICLE
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Digital Human Modeling an Aid For Ergonomic Evaluation

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***Abstract*— over the last few years there has been a massive development and use of information technology. These technologies are probably the only answer to success in a highly globalized and turbulent market environment. The development of computer and communication technology enables that the methods of engineering work can be changed from scratch. This trend in digitalization has an effect on ergonomics. Digital Human Modeling is the state of the art technology for virtual ergonomic evaluation of products and workstations. Ergonomic evaluations using Digital Mock-up and Digital Human Models which are computer generated two dimensional or three dimensional structure of a human representing the complex physical and cognitive aspects of human beings are economical in the long run when compared with traditional ergonomic evaluation process in a typical product or process development sequences Traditional ergonomic evaluation methods for studying human performance and productivity, involves physical mock ups and trial with real human beings are found to be time consuming and quite expensive. This paper reviews the literature of Digital Human Modeling and provides overview of up-to-date research in virtual ergonomics evaluation technology through DHM. An Attempt has also been made to highlight future research direction in many areas**

Keywords—digital human modelingt; ergonomic evaluation;simulation

I. Introduction

Ergonomics is according to IEA (International Ergonomics Association,2000) defined as a scientific discipline concerned with the understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance[1]. Ergonomics promotes a holistic approach in which considerations of physical, cognitive, social, organizational, environmental and other relevant factors are taken into account. Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. Applying a scientific, evidence-based approach to ergonomics process is important with the goal to identify ergonomic risk factors, quantify then, and then make measurable improvements to the workplace, ensuring that jobs and tasks are within workers' capabilities and limitations [2]. Traditional ergonomic evaluation methods for studying human performance and productivity, involves physical mock ups and trial with real human beings are found to be time consuming and quite expensive. As computer technology has become advanced and affordable, spreading its tentacles in each and every scientific discipline(s), ergonomics proved to be no exception [3].

II. IMPORTANCE OF DHM

A. Ergonomics and musculoskeletal disorders (MSDs)

Ergonomics is the science of fitting jobs to people. The discipline encompasses a body of knowledge about physical abilities and limitations as well as other human characteristics that are relevant to job design. Essentially ergonomics is the relationship between the worker and the job and focuses on the design of work areas to enhance job performance. Ergonomics can help prevent injuries and limit secondary injuries as well as accommodate individuals with various disabilities; including those with musculoskeletal disorders (MSDs).Disorders Musculoskeletal of the system that is caused precipitated or aggravated by repeated exertions or movements of the body. MSDs are caused from wear and tear on tendons, muscles, and sensitive nerve tissue caused by continuous use or pressure over an extended period of time [4]. Through ergonomic assessment and related interventions not only the WMSDs risk factors will be explored but also some practical ways for the prevention of awkward postures are introduced. According to WHO (1985), there are some factors that create or aggravate work-related disorders, such as work demands, social and cultural factors, work place characteristics, and environmental factors. In this respect, as ergonomics covers all of the mentioned farms, it has an important role in occupational health [5].

B. Digital human modeling

The development of computer and communication technology enables that the methods of engineering work can be changed from scratch. This trend in digitalization has an effect on ergonomics [6]. As computer technology has become advanced and affordable, spreading its tentacles in each and

every scientific discipline(s), ergonomics proved to be no exception. In today's scenario, Digital Human Modeling (DHM) is fast becoming an integral part of Computer Aided Ergonomics (CAE). It is the state of the art technology for virtual ergonomic evaluation of products and workstations. Simulations/ergonomic evaluations using Digital Mock-up and Digital Human Models (computer generated two dimensional or three dimensional structure of a human representing the complex physical and cognitive aspects of human beings) are economical in the long run when compared with traditional ergonomic evaluation process in a typical product/process development sequences. Repeated trials which were otherwise not easily possible in traditional ergonomic investigations are now achievable due to virtual simulations using DHMs [7]. DHM can be used advantageously to a great extent in developing countries for variety of applications and its diverse scope of application is yet to be explored to its full potential Further it is deemed important to highlight that traditional ergonomic evaluation techniques based on trial and error method using physical mock-ups and real human, has proved to be time consuming, costly and mostly overlook anthropometric and biomechanical aspects involved in performing tasks [8]. Virtual evaluations of a CAD product with digital manikins have the potential to overcome known drawbacks of traditional ergonomic evaluation methods [9]. As a technology, digital human modeling (DHM) which has always been at the forefront of ergonomic research is being propelled at an unprecedented tempo in the digital age by the advancement of computer technology. DHM is a means to create, manipulate, and control human representations and human–machine system scenes on computers for interactive ergonomics and design problem solving.

C. Digital human modeling:evaluation tools

Digital Evaluation tools could be divided in three groups:

- Quantitative evaluation tools
- Semi-quantitative tools
- Tools for discomfort, anthropometry, human Anthropometry, human performance, and cognition

Quantitative tools are used to evaluate working postures and physical workloads, considering specific risk factors related to a single posture/movement or to a complete task [10].

TABLE I.

Quantitative evaluation tools	
Lower Back Analysis (LBA)	determines the forces acting on the low back by evaluating postures and load conditions.
Static Strength Prediction (SSP)	estimates the percentage of the working population able to perform (in terms of muscular static strength) a task.
NIOSH	calculates a recommended weight limit and a lifting index for a given manual lifting/lowering action or an overall index in the case of multiple tasks.
Predetermined Time Standards (PTS)	quantifies the time required to perform a task by dividing it into a set of elementary movements.
Rapid Upper Limb Assessment RULA)	identifies the manual tasks, mainly of handling of low loads at high frequency, which expose workers to increased risk of upper limb disorders, taking into account posture, muscular strain, weight, duration and frequency of the tasks
Quantitative evaluation tools	
Metabolic Energy Expenditure (MEE)	characterizes the requirements of tasks in terms of metabolic energy expenditure.
Manual Handling Limits (MHL)	assesses tasks that require carrying, lifting, lowering, pushing or pulling in relation to the percentage of working population able to execute the tasks.
Fatigue Analysis (FA)	determines whether, after each task, there is an adequate recovery time able to avoid excessive physical fatigue for the worker.
Ovako Working Posture Analysis (OWAS)	estimates the possible discomfort related to the posture taken by the worker.
Force Solver (FS)	predicts the maximum acceptable force that a human could exert under the prescribed conditions.

Fig. 1. *Quantitative evaluation tools*

- Semi-quantitative tools

Semi-quantitative tools are used to visualize or analyze the manikin's interaction with the environment. Examples of such tools are Eye View (EV), View Cones (VC), Reach Zones (RZ), Collision Detection (CD), and Foot Prints (FP).

- Tools for discomfort, anthropometry, human

Anthropometry, human performance, and cognition are used for many applications, such as to support vehicle interior design or to create manikins with specific anthropometric measurements [11].

III. APPLICATION OF DHM

Throughout the globe, diverse industrial sectors are harnessing benefits of DHM applications. Some of them include automobile, aviation and aerospace, defense research, healthcare, general industrial applications, clothing and textile, service and animation, agricultural division, product design and applications of DHM technology in reference to various industrial sectors and also manufacturing shop-floor [3]. In India, available literatures indicate that DHMS are being used in diverse application fields by Indian engineers, designers and people from other professions.

- Automobile Sector

DHM has ability to improve efficiency and ergonomics of assembly operations using participatory ergonomic approach. It is capable to optimize comfort, reach, fit, and vision for user/occupant [12] and thus improve vehicle design in accordance with sound ergonomic principles [13]. DHM is helpful in achieving quicker and cost effective design process as this software can be used in design, modification, visualization, analysis of workplace layouts/product interactions in automobile industry and has potential to be used in operator training [14]. Mueller and Maier[15] stated that user centered vehicle layout can be generated systematically from ergonomic point of view using DHMs giving due consideration to trunk loading and unloading movements.

- Aviation and Aerospace Technology

"Open Skies" policy of various Governments across world has led to the foray of many companies in this sector resulting increased air travel. DHM is now playing a significant role in

this sector to improve passenger amenities and will be sought after by aeronautic industries. These software are being used in assessing comfort of airplane passenger seats from user's perspective [16]. Manikins can be accurately positioned for accommodation related investigations in cockpit design [17]. Fighter aircraft pilots are required to make split second decisions in real battlefield situations based on visual inputs from cockpit displays/instrumentation. Presence of displays in blind spot regions can prove to be fatal. DHM can be productively used to perform vision analysis for pilots in a jet aircraft as shown in a case study [18].

- Defense Research

Differently built human models representing diverse anthropometry of army personnel are used to evaluate their workstations easily [19]. Manikins can be accurately positioned for accommodation related investigations in cockpit design [16]. Fighter aircraft pilots are required to make split second decisions in real battlefield situations based on visual inputs from cockpit displays/instrumentation. Presence of displays in blind spot regions can prove to be fatal. DHM can be productively used to perform vision analysis for pilots in a jet aircraft as shown in a case study [18].

- Healthcare Industry

Simulation using DHM with respect to ladder climbing scenario for an under-knee amputee was performed with an aim to design comfortable limb prosthesis for complex motions [20]. Surgeries can be performed effectively and efficiently as [21] explains application of DHMs to identify ergonomic problems while performing laparoscopic surgery in an operation room.

- General Industrial Applications

DHMs are now being used in secondary manufacturing sectors to develop ergonomically sound workplace [22]. evaluation of manual material handling and user interface evaluation in shop floor[23], biomechanical and vision analysis while using a machine tool [24], and so on.

- Clothing Sector, service and animation

A survey on CAD methods in 3D garment design gives ample insights in visualizing role of DHM in this sector [25]. In addition to that hand loom industries have several ergonomic problems which need to be evaluated by DHMs. People today are short of time and seek convenience in their everyday life. DHM has started to cater the needs of service sector too.

- DHM –important tool for virtual ergonomics

Computer-aided technology enables many novel approaches in modeling, design and fabrication of farm tools and machines. CAD is mainly used for detailed engineering of 3D models and/or 2D drawings of physical components under a wide variety of representations. However, digital human representations in various forms are now being incorporated in computer-aided design of human- machine systems for simulating man-machine interactions in virtual environment as real-world conditions. Application of DHM is becoming increasingly popular today among designers and manufactures as it increases productivity, reduces design time-frame and decreases associated costs. Core functionality of DHM software is realistic display of anthropometric data and efficient analysis of ergonomic questions concerning sight, maximum force, reach ability and comfort. Designers can subsequently utilize a human model in the creation, modification, presentation and analysis to ensure enough clearance and space to human for their ease and comfortable movement within workplace [26].

IV. DISCUSSION aND conclusion

DHM software are now successfully being used in various sectors including military research .automobile sector, aerospace and aviation technology ,industrial applications , health care and occupational safety , service industry etc. DHM tools provide complete digital humans to explore infinite number of ergonomic scenarios including human size scaling, evaluation of posture, motion, reach, and vision within a computer-rendered environment. It is expected that present review on DHM an aid for ergonomic evaluation would deliver a concrete knowledge. Adoption of DHM looks very promising in near future.

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TECH-CHRONICLE
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EMERGING TRENDS IN SCIENCE, TECHNOLOGY AND MANAGEMENT A

Review on Study of Saw Gin Stand for Improving the Ginning Process

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Abstract: Ginning is the first effective process of separating the seeds from cotton.Harvested cotton is taken to ginning mills where it is separated from seeds. Cotton fiber quality is mainly dependent on ginning processes. In India, roller and saw ginning technologies are used.Nowadays it is necessary to improve these technologies for increasing the outturn and to preserve the quality of fiber as cotton sector in India is progressing with high speed.In India comparatively very less research has been done in saw ginning. This review paper includes the present scenario of ginning technologies used in India. This article focuses more light on the saw gin stand component and parameter study which should be considered during investigation process. . This article suggests the new possible developments in saw gin stand used in India.

Keywords– Cotton; Ginning; Ginning technologies; saw gin stand.

1. Introduction

Ginning is the first mechanical process involved in the cotton processing. Ginning mill separates cotton fiber from seeds and dust particles. The primary function of the ginning mill is to separate fiber from seed. The main application of ginned cotton is for spinning operations. The ginned cotton is also called as lint and the lint is converted to yarn. As fibers are attached to seed, the harvested cotton can be referred to as seed cotton. Ginning process mainly removes seeds along with cleaning of fiber.

According to Roy V. Baker,(ARS-USDA Lubbock Texas), "The principal function of a cotton gin is to convert the farmers‟ harvested seed cotton into salable commodities, i.e., fiber and seed. Thus, ginning is the bridge between cotton production and cotton textile manufacturing. To satisfactorily convert today‟s mechanically harvested cotton into salable commodities, gins have to dry and clean the seed cotton, separate the fibers from the seed, further clean the fibers and place the fibers into an acceptable package for commerce. Cottonseed are sold to dairies for feed, to oil mills for production of many valuable products, or saved for planting next year‟s crop. The fibers are the more valuable product, however, and the design and operation of cotton gins are oriented toward fiber production. In essence, the modern cotton gin enhances the value of the cotton by separating the fibers from the seed and by removing objectionable non-fiber matter, while preserving as nearly as possible the inherent qualities of the fiber.

The earliest gin was probably invented in the days when price of animal skin in market became so great that it was necessary to look for a cheaper substitute for clothes. The „charkha‟ is an early gin. It consists of two plain rollers mounted on a frame & revolved in contact.

In northern and central region of India the saw gin which Eli Whitney invented in 1794 is still used to gin cotton. This cotton gin is a perfect machine invented by the inventor. Very little evolution has been done to change its three essential elements, the saws, ribs and brush. There is no any machine invented till today which can excel saw gin in capacity. It was found that fibers of cotton were injured by saw action then the McCarthy roller gin was introduced.

2 Present Scenario:

2.1 Ginning technologies

In olden days, the charkha was used for cotton ginning process. Then it was upgraded to single crank charkha consisted of one serrated steel roller and one wooden roller along with crank and flywheel. With the development of roller and saw gin, history of cotton ginning changed completely. Basically there are two methods employed for cotton ginning process. In first the fibers are held firmly by external mechanism and simultaneously seed itself is being hit to separate fibers from seed. In second fibers are pulled from

seed which is held firmly. First principle is used in roller gin while latter one is used in saw gin.

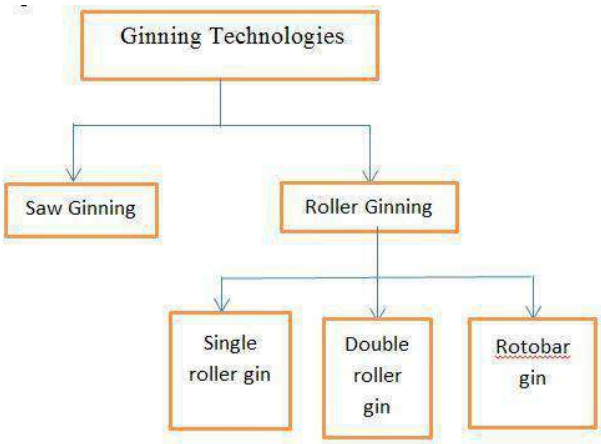

Fig 1: Ginning Technologies

2.2 Roller ginning

In this the roller are provided which carry the seed cotton to a stationary knife and rotary or reciprocating knife. In this process cotton fibers are separated from seeds by adhering to roller surface. This surface (leather or any suitable material) holds the cotton fiber on surface and carries it between stationary knife and roller so that fibers are partially gripped between them. Fibers are separated by stretching action as oscillating or rotary knife beats the seeds. This process is repeated and fibers are separated from seed due to push-pull-hit action. This process is gentle and produces less short fiber content, fewer neps. Less qualified and experienced workers can work on roller gin. Maintenance of roller gin is easy but sometimes more costly (roller replacement). Quality of lint and seeds produced is better than the saw ginning.

Fig. 2 : Roller gin[1]

2.3 Saw ginning

Saw gin belongs to second generation tool invented by Eli Whitney in 1794 in USA. It consists of series of circular saws 305 to 407 mm in diameter. All saws which are mounted on an axle are made to revolve at high speed to tear lint from seed cotton. The saw projects slightly between the bars referred as ribs. These ribs are spaced such that they prevents the seeds from going forward. These ribs are also called as ginning ribs. Thus fibers are separated from seeds at high speed. The seed cotton is fed continuously into hopper. The seedsfall through a grid onto seed conveyor. The lint is whipped off the teeth of sawa by an air blast or rotating high speed brushes.

Fig. 3: Saw gin[1]

The Saw Ginning Technology is normally used for short and medium staple cotton i.e. up to 28 mm and the plant designs developed so far in the world is keeping in view the machine picked cotton with higher trash contents and most of the cleaning equipments and feeders to the gins have been designed to handle high trash cotton however the fibre parameters get deteriorated in terms of neps, length and spinability parameters more particularly when any long or extra longfibre is ginned on Saw Gin.

3 Saw gin stand

The gin stand consists of a set of saws rotating between ginning ribs. The saw teeth pass between the ribs at ginning point. Here the leading edge of the teeth is approximately parallel to rib to pull the fibers from seed rather than cutting them. In traditional gin stand, there is a huller front from where cotton enters the stand. The rotating saws grasp the cotton and draw it through a widely spaced set of ribs known as “huller ribs”. This causes hulls and sticks to fall out of the

machine. The locks of cotton are drawn into the bottom of roll box through the huller ribs.

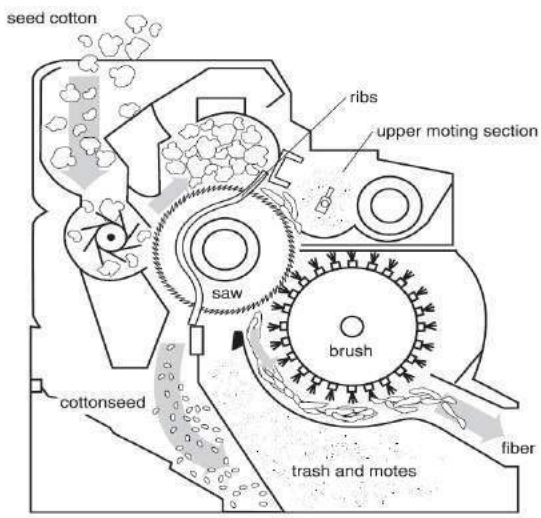

Fig 4: Gin stand of saw ginning machine without huller front[2]

In newer gin stand, there is no provision of huller front. The seed cotton drop directly into the roll box. Because of this elimination of huller front, stand capacity increases but the final stage of seed cotton cleaning is eliminated. The actual separation of seed and cotton takes place in roll box. After separation seeds fall along the ginning rib onto the seed conveyor under the stand. Rotating brush or an air blast is provided to remove lint from rotating saws. It is then conveyed to next machine for further processing.

4 Saw gin stand- components and their parameter study

Gin stand is the heart of ginning process where actual separation of lint and seed takes place. The performance of ginning machine mainly depends on the gin stand performance. Three essential elements of gin stand are ginning ribs, saws and brush. These components are mainly responsible for ginning process. The combination and setting of ginning ribs and saws affect the quality of lint and discharge of seeds.

4.1 Ginning ribs

Ginning ribs are important. The crucial aspect is its alignment in the machine. They should be fitted in level with a space of 2 mm between each other as it avoids cut seed coming in lint. The major concern for ginners at the present is the gradual progression of smaller cottonseeds through the introduction of new varieties. These smaller cottonseeds are looked upon as a challenge for ginners. These smaller seeds affect the quality of lint produced. The quality parameters of lint produced deteriorates due to entry of seeds along with cotton. So, it is important factor in preserving quality of lint. Also its alignment with saws is a measure aspect. The alignment should be such that it should not touch the saw which may lead to damage of either. Ginning rib also plays important in seed discharge.

Fig 5: Ginning ribs

4.2 Gin saws

The gin saws are steel discs rotating on axle to tear lint from seed cotton. These saws have number of teeth which directly affect the ginning and quality of lint produced. Saws are rotating with high speed. Numbers of teeth on saw, diameter of saw, saw tooth design are important parameters in performance gin stand.

Fig 6: Gin saw

4.3 Frictional forces in roll box

The roll box of the gin stand is subjected to friction as a result of force applied to the stainless steel casing by the seed cotton. Friction is an important aspect of the workings of the seed roll and the ginning process. As the mass of seed cotton increases within the roll box, the density increases. With the increase in density comes an increase in forces that are applied to the surfaces within the roll box. These surfaces include the roll box stainless steel skin, the ribs, the seed fingers and the saw blades.

4.4 Saw teeth density

The saws ranged in teeth quantity from 264 up to 600 teeth.

The saw teeth density usually changes with respect to diameter. The saws used in existing machine have 352 teeth. The performance with this number seems to be good. The increasing number of teeth adversely affects the ginning rate. In study it is realized that if the teeth density increased to increase ginning rate, most of the teeth operates without performing ginning action. Consequently, the ginning rate reduces. It also plays important role in keeping maximum length of cotton. With maximum teeth density, the length of lint produced is less.

4.5 Saw diameter

Saw teeth are subjected to continuous wear and become worn as a result of the interaction of the saw teeth with the lint and other matter. The gin saws are steel discs approx. 0.037 inches thick. Generally the standard diameter of the saw is 12" or 16" and running speed from 650 to 700 revolution / min. An ideal saw should have straight edges for leading and with slightly curved "modified roach back" or trailing edge. The saw must be sharp and the teeth undamaged. The pitch and the shape of the saw teeth are also important in maintaining capacity and cotton quality. To ensure good ginning the teeth must pass through the ribs at the proper angle. Saws should be replaced once they reduced in diameter by more than approximately 1.6 mm. This reduction in diameter reduces the ginning capacity of the gin stand.

4.6 Rib spacing

It is the important parameter as far as the quality of lint produced at gin stand is concerned. Rib spacing is that portion in which saws are to be placed. It is also responsible for the progression of smaller cottonseed along the lint. This parameter is having special importance since it directly influence the quality of lint produced. Rib spacing should be maintained so that there will not be any entrance of the seeds along with lint considering saws also.

The spacing between ribs at ginning point is maintained around 2.5 to 4mm. For portion above the ginning point, spacing is 2.5 to 4.5 mm and for portion below ginning point, 3 to 6 mm.

4.7 Saw spacing

The wider saw spacing produced greater fiber length and less neps. The amount of lint produced per unit time decreased with the higher saw spacing. However, the wider saw spacing‟s were ginning at a higher rate (per saw) than that of the close saw spacing. A 30 per cent increase in the amount of saws on the gin stand for the same area increased ginning rate by only 7 per cent. The effect decreased the ginning rate by 17 per cent per saw blade.

5 Related works

Various researchers had done research work in the machinery required for the cotton ginning. In ginning of cotton, important aspect is the quality of lint produced. Another important aspect is capacity of gin stand as far as mass production of cotton is concerned. Researchers had concentrated on improving the quality of lint.

G. Holt [3] conducted the study on design of experiments optimization study on the powered roll gin stand and

presented results of an optimization study concentrating three main components of the power roll gin stand that is paddle roll, seed finger roll, and gin saw.The results were based on lint samples taken after the gin stand (before lint cleaning) and after one stage of lint cleaning, seed samples, and performance data.

E. Koc [4] conducted theoretical study to investigate the performance of a saw-gin ginning machine with special reference to separator units. A theoretical model of separator unit was developed by introducing the non-dimensional parameters defining the mechanical operating conditions and also designed the procedure to estimate cotton flow rate and cotton loss. Flow rate estimation results were obtained.

N. Soomro [5] examined that rough ginning is often caused by dense seed rolls, also found that dense seed rolls come from feeding cotton to the gins beyond the capacity which occur damage to cotton at gins has incorrectly been credited to the speed of the gin saws, rather than to the rate of feeding.

AzizovShuhratMamatovich [6] carried out mathematical simulation of brush drums in a dual saw cylinder chamber gin for the purpose of increasing the quantity of captured cotton fiber from saw. An analysis of the efficiency of the ginning of cotton fibers with two saw cylinders carried out and it was found that, in comparison to a one-cylinder machine, the 2 cylinder approach can help to preserve the natural characteristics of cotton fiber and seeds.This technology allowed economizing electricity and decreasing damage to fiber and also increased the productivity of the machine.

W. Stanley Anthony [7] reviewed and compiled most of the significant developments and research conducted on saw gin stands for cotton gins since about 1958. Also described the design and operation of various types and models of saw gin stands, and had given an appraisal of gin stand designs and settings that may be most useful at current cotton gins.

M. Pelletier [8] conducted research work to evaluate the influence of grid bar cross sectional geometry on extractor performance with regard to foreign matter removal, seed cotton loss, and fiber quality preservation. The results indicated that as open space between grid bars increased, foreign matter removal and seed cotton loss increased.

S. Azizov [9] carried out analysis of the strength of the saws to the dynamic and static loads and found that saw wear-out occurs due to the bending of the shaft under dynamic loads and also observed that the high density of raw cotton leads higher damage to fibers during ginning.

Hughes [10] developed a simple plastic guide that was attached to the gin ribs, yet wider than the gin ribs and resultantly, much closer to the saw surface than a gin rib. The guide restricts the gin saw gap from increasing as a result of seeds flexing the saw blade to an extent that seed was able to pass through the gap between the saw blade and the rib.

6 Objectives of study

The study of gin stand of 161 saw gin is required to achieve following objectives

- To improve overall performance of 161 saw gin stand.
- To improve the quality of lint produced.
- To analyze all working parts.
- To make necessary modifications in existing machine.
- To increase the capacity of gin stand.
- To achieve better seed discharge from gin stand.

7 Possible modifications to gin stand

As far as performance of gin stand is concerned, saws and ginning ribs are two significant parts. These two parts contributes more to the gin stand performance. Saws separate the seed from cotton and ginning ribs prevent the entry of seeds along with lint produced.

To achieve the objectives of increasing the capacity of gin stand and improving quality of lint, the major factors to be changed or to be modified are saws and ginning ribs.

Saw blades plays very important role in increasing capacity of gin stand. If number of saw blades is increased, the capacity of the gin stand can be improved. But increasing the amount of blades for same area reduces the ginning rate per saw blade. So, it is required to find the optimum amount of saw blades so that the ginning rate can be increased and ginning rate per saw blade should not be reduced by significant amount. So it is the area where it is possible to make modifications.

Ginning rib is very important and plays crucial role in preserving quality of lint in gin stand as prevents seed entry through ribs. After the separation of seed and lint, seeds fall along the ginning rib. So it also plays a very important role in seed discharge. The seeds should not be accumulated on ginning rib. The ginning ribs with existing machine have the profile which is more elevated below the ginning point. Because of this profile the possibility of wad formation is more on the ginning ribs. This affects the performance of the machine along with quality of lint.

So it can be possible to modify the profile of the ginning ribs to achieve better seed discharge and avoid progression of small cottonseeds. So, it is another area where modifications are possible.

8 Conclusion

This paper focuses more light on the ginning technologies used in India. The saw gin stand component and their parameter study for investigation process has been done which suggests the possible modifications in gin stand for its overall performance improvement.

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Comparative Evaluation of Hex Socket Used In Torque Wrench by Using Finite Element Analysis Approach

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Abstract:

A torque wrench is used in bolting application for tightening or loosening of connections in automobile industries, petrochemical industries, refineries and small scale industries. Hex socket is interchangeable component of wrench which connects the drive shaft of torque wrench to the bolts to be tight or loose. In Present work finite element analysis approach is used to modify existing hex socket of torque wrench. Fatigue failure of the hex socket finite element model was predicted after the torque was imposed on it. The finite element analysis of existing hex socket of torque wrench revealed the stresses distribution on hex socket. So, an effort is made to modify the design of existing hex socket along with change of material so that advantage of minimizing failure rate and safe stress can be obtained.

Keywords: Fatigue failure, finite element analysis, hex socket.

1. Introduction:

Hex socket is a tool designed to exert a torque on a fastener to achieve proper tightening or loosening of a connection. A torque wrenches are applied to the nut or Allen bolt either directly or in conjunction with an impact socket. Torque wrenches apply control amount of torque to a properly lubricated fastener through hex socket. The purpose of hex sockets is to withstand the force applied by impact tools, which cause the standard sockets to failure. The hex socket have female square groove at one end. The drive shaft of torque wrench connected to the female square groove of impact socket by pins andring arrangement to secure with the drive. The impact socket having hex bit structure at other end is casted to the main cylindrical body. A hex bit of socket is used for transmitting high torque provided by the torque wrench to the fastener for tightening or loosening of the connections. Hex socket rotated in a strokes provided by the hydraulic torque wrench. In one stroke of hydraulic cylinder impact socket rotated by 36^0 causes fastener to rotate by 36^0. Impact sockets are interchangeable tools that can allow a single wrench, impact driver or breaker bar to work with a large number of fastener sizes.

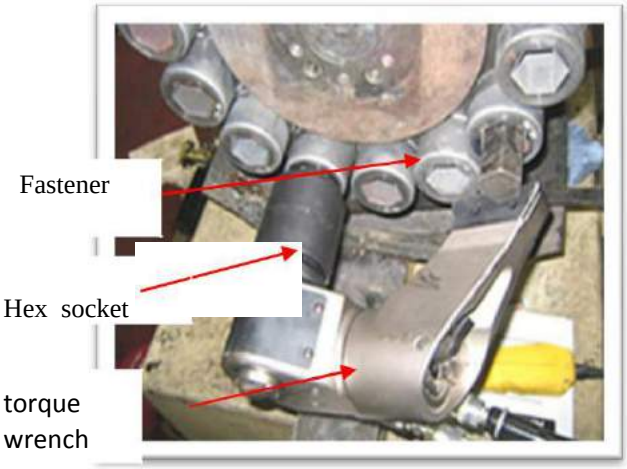

Fig 1. Torque wrench setup.

2. Investigation on Existing Hex Socket:

The hex socket under consideration is hot rolled square section of low carbon steel of cross section 23x35.9mm & length 100mm, machined at both ends for fitment of hubs and bit. The elemental analysis of materials is done on

spectrometer and as per the component wt % found; steel belongs to SAE9840 standard of steel, as shown in Table 1, having typical microstructure as shown in fig 2 with around 25% of pearlite (black) & 75% of ferrite matrix (white).

Table. No. 1 Chemical composition of the failed hex socket and SAE 9840

Element	Failed hex socket	SAE 9840
C%	0.392	0.38-0.43
Si%	0.290	0.2-0.32
Mn%	0.690	0.7-0.9
Ni%	1.207	0.85-1.15
Cr%	0.856	0.7-0.9
Mo%	0.224	0.2-0.3
S%	0.018	0.04 MAX
P%	0.019	0.04 MAX

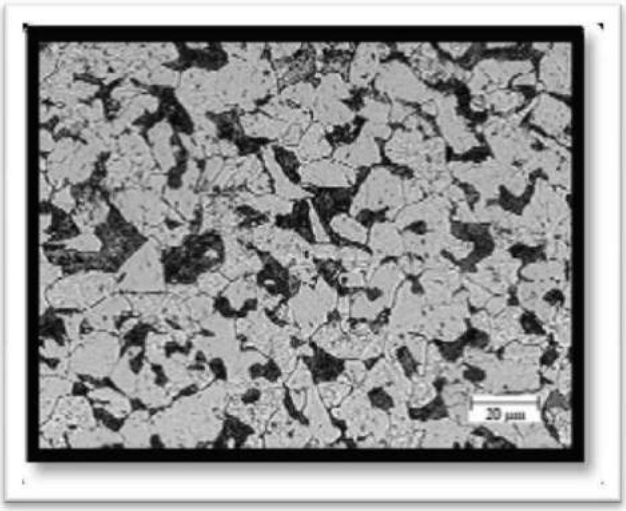

Fig 2. Typical microstructure of low carbon steel (SAE9840)

Visual examination of the failure hex socket revealed that the fracture had been initiated close to the hex bit, at the bit from where the corners starts for fitting of hub. This fracture location is to be expected because fatigue failures start at the most vulnerable point in a dynamically stressed area particularly where there is a stress raiser, as in our case sharp corners to facilitate proper sitting of bearing locking ring as shown in fig 3. The highest stress concentration and high residual stress would be anticipated to occur in this region.

The fracture surface of the failed hex socket exhibits stress concentration regions as shown in fig3, where crack initiation starts, progressive flat fatigue fracture regions, and the final fracture region produced by overload as shown in fig 3.

The fracture appeared to be typical of unidirectional bending fatigue under conditions of a low stress with a high stress concentration. From the above observations, it is clear that fatigue cracks have initiated at stress concentration points leading to fracturing of the axle shaft. When the local stress exceeds the material yield strength, it is possible to form a fatigue crack. Since the resistance of steel to fatigue initiation in proportional to its yield strength, the low properties of the steel in this case left it open to fatigue initiation [2][7]. The area of final fracture due to overload is large, approximately 40% of total area, indicating that the material is also not adequate for the applied stresses.

Fig 3 Failure of Hex socket at the hex bit

2.1 **Building Finite Element Model of Existing Hex socket:**

For the FE Analysis, it is necessary to create a solid model of hex socket and also to create a FE model. In the present work, static analysis has been carried out for the hex socket considering sudden load effects. As shown in figure 4, PRO-E is used for modeling the Hex socket. The model has a solid hex socket of square cross sectional area of 23mmX35.9mm, machined at both ends with length 100 mm. using the technical specification of impact socket the FE analysis has been carried out in ANSYS 12.0. A higher order 3-D, 10-node element having three degree of freedom at each node, translations in the nodal x, y and z directions SOLID187 were used. In this analysis, the moment of 4500 Nm is applied at the end of impact socket and remote displacement is given in y-direction. The boundary condition and FE results in Ansys for moment and remote displacement at static and dynamic are as below.

Mesh model:

Number of nodes- 22312

Number of element-12853

Type of element-Tetrahedral (SOLID187)

Behavior of element-DOF-3

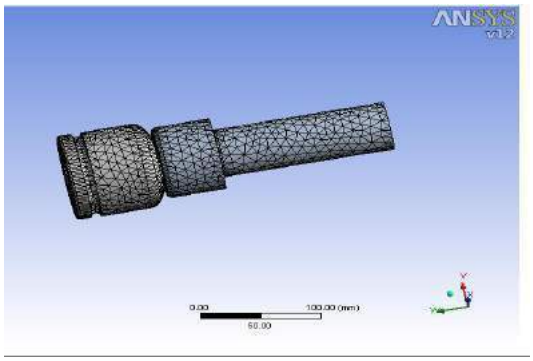

Fig. 4 Mesh model of impact socket and fastener assembly.

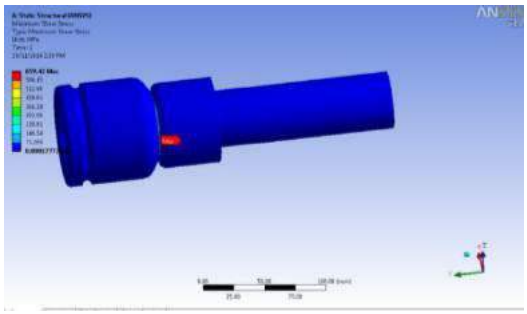

Fig. 5 Shear stress distribution in assembly.

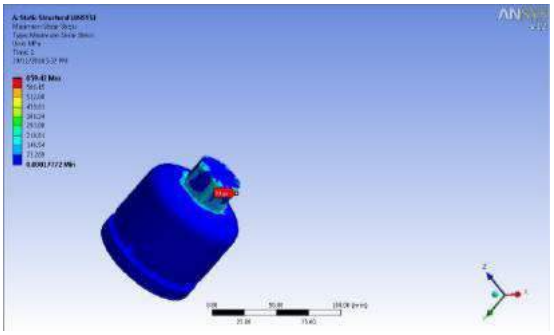

Fig. 6 Shear stress distribution in impact socket

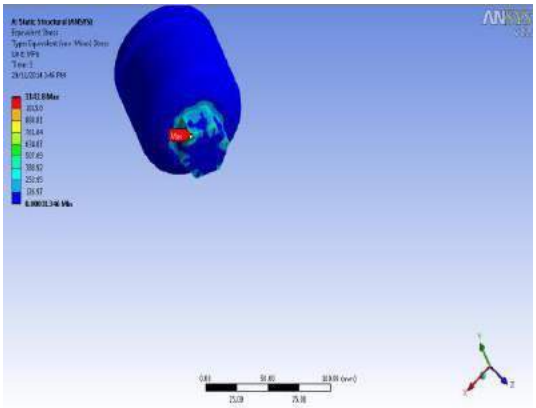

Fig. 7 Equivalent Von- Mises stress distribution on impact socket

2.2 Finite Element Analysis and Results:

Structural analysis revealed that the failed impact socket material is SAE 9840 alloy steel. Stress analysis performed by Ansys 12.0 software show that maximum stresses generated at corner of male hex of impact socket. This indicates that wear failure initiate at that area. The component to be preventing wear failure, maximum shear stresses should be less than allowable stress of material. In this case it is greater than the allowable shear stress of material. For static loading maximum shear stress 659.43 MPa is develop which exceeding the allowable stress of 552.5 MPa. Equivalent (von-mises) stress is 1142.8 MPa which is also exceeding the allowable equivalent (von-mises) stress of 1105 MPa. This results in shear failure of impact socket. The failure of the impact socket is taking place at the corner of male hex.

3. Modifications Suggested In Existing Hex socket:

From the investigation of material & FE analysis it is seen that tensile stress concentrated regions are at transition area of hex bit in hub mountings due to sharp corner at the start of torque to facilitate proper tightening causing slippage of joint due to clearance results into stress concentration area.Modification of existing hex socket is done aiming to avoid this stress concentration region which is possible ifexisting rear axle is manufactured with casting process with close tolerances and subsequently finished by machining operations atboth ends for fitment of hub, as it is done in this work. The design flexibility offered by the casting process farexceeds that of any other process used for the production of engineering components. This flexibility enables thedesign engineer to match the design of the component to its function. Metal can be placed where it is required tooptimize the load carrying capacity of the part. Changes in cross-section can be streamlined to reduce stress concentrations.

3.1 Selection of Material:

EN 31 contains nodular graphite (black) in a matrix of ferrite (white) with small amounts of pearlite(black). The ferritic structure gives excellent machinability with good surface finishes along with optimal impact strengths, fatigue properties. Ferritic/Pearlitic matrix obtained as cast. Having good machinability, excellent surface finish and very good strength. They present ultimate tensile strength and yield strength which is close to SAE 9840 steel grades. This grade is good for applications such as machine components that suffer impact and are crack-resistance. Table 2 showing the typical chemical composition of class EN31.

Table No. 2chemical composition of EN31

Element	EN 31

C%	0.9-1.20
Si%	0.1-0.35
Mn%	0.3-0.75
Ni%	0.85-1.15
Cr%	0.1-1.6
Mo%	0.2-0.3
S%	0.04 MAX
P%	0.04 MAX

4. Finite Element Analysis of Modified Hex socket:

EN31 material is used for the redesign purpose. The material properties have been collected. The different materials of hex socket have been selected and calculate the value of maximum shear stress and equivalent stress. Analysis of different materials has done with the help of ANSYS 12.0. EN31 is a high carbon Alloy steel which achieves a high degree of hardness with compressive strength and abrasion resistance. The mechanical properties of material are as fallow:

Table No. 3 Mechanical properties of EN31

Properties	Value	Unit
Ultimate tensile strength	750	MPa
Ultimate yield strength	900	MPa
Poisson's ration	0.28	-
Young's modulus	215	GPa
Density	7810	kg/m^3
Hardness	63	HRC

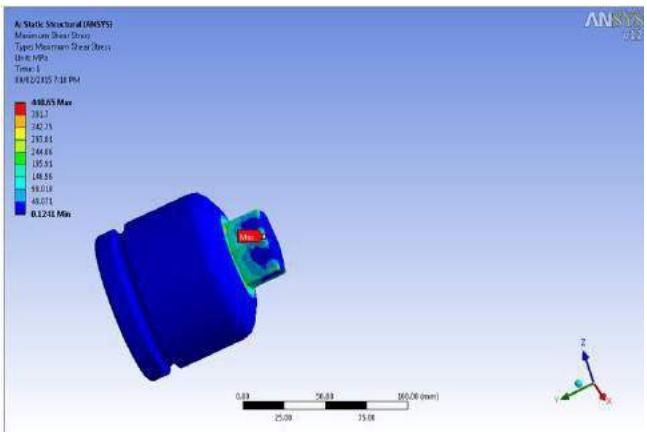

Fig 7 Maximum shear stress in EN31

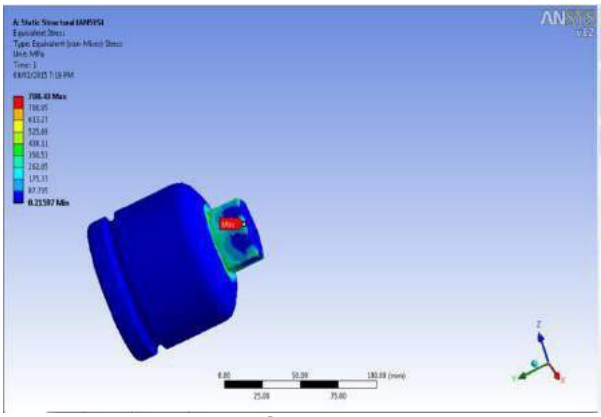

Fig 8 Equivalent stress in EN31

5. Comparative Evaluation:

Any comparison of material/process combinations must be justified with the results of the materials & process under consideration. Table 4 shows the comparison of result with both the cases.

Table No 4: Comparative Evaluation.

Stresses	**SAE 9840**	**EN 31**
Maximum shear stress (MPa)	526.25	452.64
Allowable maximum shear stress (MPa)	592.5	450
Equivalent stress (MPa)	911.75	784.04
Allowable equivalent stress (MPa)	1185	900

From table 4, it has been found that, maximum stress present in existing hex socket is 526.25Mpa which is more than thetensile yield strength of material. Whereas maximum stress present in modified hex socket is452.64 which is much lessthan the tensile yield strength of its material. We therefore conclude that the torque wrench having modified hex socket will defiantly work satisfactorily under this stress level without fatigue initiation.

Conclusion:

This study was conducted on a existing Hex socketused in torque wrench. Spectrum analysis revealed that the failed hex socket material is SAE 9840 steel. Fractographic features indicated that fatigue was the main cause of failure of the hex socket. It was observed that the fatigue cracks originated from transition areas due to sharp corners. Modified hex socket produced with casting process with the use of EN31 material.This ultimately solves the problem of initiation of fatigue cracks in this area.An application including both redesigning of the hex socket transition area and change of material i.e. suitable for casting of hex socket which may be a

good alternative to enhance the fatigue life and can satisfy minimum design criteria.

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DESIGN, ANALYSIS AND OPTIMIZATION OF AUTOMOBILE TRAILER USING FEA

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Abstract
The portable toilets are mounted on the trailer, this trailer is manufactured by a company (ExcellFibrotech, MIDC Nagpur). Many of new product designs are based on existing products and years of experience. Therefore, the trailer is assumed to have unexplored areas of potential improvements. Today the trailer is a mainly welded design, which is both expensive and unsatisfactory from a maintainability viewpoint. Welding is not only expensive but introduces heat to the steel alloy, and thereby changes the material properties, and also requires a high degree of manual labor. A truck chassis has a more standardized manufacturing method and application of some of the manufacturing techniques from it to the trailer could perhaps make the production of it more efficient. The current trailer have robust designs, and there have been no actual calculations or investigation to find out what dimensions are needed to withstand the forces applied to a trailer during use. Instead, the design is based on experience of what works, and what does not. A more thorough investigation of the design parameters can create better understanding of which parts of the trailer that are most exposed to high stresses, and which parts that can have reduced dimensions.

Keywords:trailer, truck chassis.

I. INTRODUCTION

Portable toilets, are simple portable enclosures containing a chemical toilet (a toilet bowl filled with disinfectant instead of water) which are typically used as a temporary toilet for construction sites or large gatherings because of their durability and convenience. Most portable toilets have black open-front U-shaped toilet seats with a cover. They are often constructed out of lightweight molded plastic.

Mounted on purpose built trailers, these standard toilets provide a convenient and cost effective option to satisfy all requirements. The trailer gives the added benefit and cost saving choice of being able to pick up the unit yourself, plus you can maneuver between locations at your own convenience.

The efforts required where car is moving are comparatively less with stationary car. The working strength of the tie rod is that of the product of the allowable working stress and the minimum cross-sectional area.

II. LITERATURE REVIEW

L.A.W. Horn, HAN University of Applied Sciences[1] During the previous HVTT conference in Melbourne, results have been presented of a project FORWARD, including eleven different trailer manufacturers, involving testing and modeling activities to establish a practical basis for realistic fatigue assessment as a step towards an improved light-weight trailer design. The present paper describes the next step as part of the follow-up project LIFE (Lifetime Fatigue Enhancement), starting with the model-based assessment of a realistic loading history for a semi-trailer. Representative loading conditions in this history, being derived from three weeks of field testing, are then used in Finite Element analyses to estimate fatigue life at a critical high loaded welded connection in the aluminum trailer chassis. Results are discussed with respect to the order of different loading cycles (Palmgren-Miner number, based on fatigue tests), 3D loading at the weld, the varying weld quality, and the impact of bonded connections in the trailer. These „lessons learned‟ are interpreted, to result in improved general guidelines in light-weight.

AslıSoytürk, HüseyinYıldırım, VolkanAkıncı[2]Semi–trailers are manufactured in long body design and aimed for heavy

load transportations. As so, torsion stiffness in these vehicles is the key element in a design which provides light chassis weight, while obtaining high performance, high load carrying capacity, driving securely and stable road holding. In this study, torsional stiffness of semitrailer chassis was analyzed by finite element method, fundamental static rules, also experimental datas were used for calculations and all results were compared with respect to each other. Fundamental static calculations for torsional stiffness were performed per guidelines of rigid body mechanics and vehicle dynamics having some assumptions. In the finite element method, the semi-trailer chassis was modelled in CATIA software and stiffness was calculated in mesh form in ANSYS Workbench 14.5. In experimental studies, chassis frames‟ torsional stiffness test method was used. Torsional stiffness was calculated by obtaining applied force, strain and torsion angle. These results show that both methods are convenient and confident in calculations of torsion stiffness and can be used in designs for succeeding light and robust trailer chassis goal.

Mr. Venukumar R Bankapur1, Prof. Sanjeev. A. Janawade[3] Tractor trailers are agricultural products transporting vehicle, this vehicle used to transport agricultural products from one place to other place. Therefore, it is essential to do static fatigue analysis of trailer chassis. Based on analysis the life estimation of trailer chassis can be done. In this project work, the trailer chassis model has been designed using 3D modeling software CATIA. The designed 3D model is imported into FEA software Ansys. On imported 3D model the pre-processed, postprocessed and solving are performed in FEA software Ansys Meshing model with different element size are performed in pre-processing on imported 3D model, in next stage, the boundary condition on meshed model are applied. In last stage, solving for different loading with varied element size is performed. For 3 different fatigue theories, those three different fatigue theories are Goodman, Gerber and Soderberg, the analysis results are obtained for 3 different load scenarios with varied element size. 3 different loads are consider in this project are, 6Tonne, 12 Tonne and 18 Tonne. Analysis results have demonstrated that the chassis has 106 cycles of life time for 12 Tonne of loading without fatigue failure. It is observed that there is a fatigue failure for 18 Tonne loading. The convergence method is used to verify the accuracy of analysis results for element size: 15 mm, 10mm and 5 mm. The summary of this project work is analysis results are approximate to convergence method and the chassis has lifetime of 106 cycles for 12 Tonne load without fatigue failure.

III. IDENTIFIED GAPS IN THE LITERATURE

The portable toilets are mounted on the trailer, this trailer is manufactured by a company (ExcellFibrotech, MIDC Nagpur). Many of new product designs are based on existing products and years of experience. Therefore, the trailer is assumed to have unexplored areas of potential improvements.

IV. PROBLEM FORMULATION

The portable toilets are mounted on the trailer; this trailer is manufactured by a company (ExcellFibrotech, MIDC Nagpur). Many of new product designs are based on existing products and years of experience. Therefore, the trailer is assumed to have unexplored areas of potential improvements. Today the trailer is a mainly welded design, which is both expensive and unsatisfactory from a maintainability viewpoint. Welding is not only expensive but introduces heat to the steel alloy, and thereby changes the material properties, and also requires a high degree of manual labor. A truck chassis has a more standardized manufacturing method and application of some of the manufacturing techniques from it to the trailer could perhaps make the production of it more efficient. The current trailer have robust designs, and there have been no actual calculations or investigation to find out what dimensions are needed to withstand the forces applied to a trailer during use. Instead, the design is based on experience of what works, and what does not. A more thorough investigation of the design parameters can create better understanding of which parts of the trailer that are most exposed to high stresses, and which parts that can have reduced dimensions.

V. CONCLUSIONS

The current trailer has robust designs, and there have been no actual calculations or investigation to find out what dimensions are needed to withstand the forces applied to a trailer during use. Instead, the design is based on experience of what works, and what does not. A more thorough investigation of the design parameters can create better understanding of which parts of the trailer that are most exposed to high stresses, and which parts that can have reduced dimensions.

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DESIGNING AND DEVELOPMENT OF DIE WITH LEAN MANUFACTURING

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Abstract:***This paper gives the general introduction to the arrangement, design and some basic concept of designing the die. CAD plays an important role in this type of die design. Some losses due to design parameters are also discussed. To meet the requirements of low cost, good performance and manufacturing feasibility. This paper will provide a design overview of the die designing, main characteristics, key subsystems and control strategies.This gives better understanding about working principle of lean manufacturing to avoid the un-necessary operation and minimise the waste materials. Effect of design consideration can be further studied during its application in various conditions. In the CAD model actual designhas also been explained. The design approach is in the way of improving the efficiency of manufacturing efficiency. Lastly there is the solution given to the analysed error. Advantages, disadvantages and various practical applications are also discussed.***

1. Introduction

1.1 Background

This paper also examines the drivers and barriers that influence the implementation of lean manufacturing.The findings show that most of the respondent firms are classified as in-transition towards lean manufacturing practice.Service organisations are now pursuing lean thinking and actively deploying lean principles.Onepartis usingclipfunction andanotherpartis using tick function. In thecomputer-aideddesign(CAD), two plasticpartsweredrawnin 3dimension(3D) viewbyusingPro-Engineer(Pro-E) parametricsoftware. These firms believe that the factors that drive the implementation of lean manufacturing are the desire to focus on customers and to achieve the organisation's continuous improvement.In the computer-aidedmanufacturing(CAM), Pro-Manufacturingfrom Pro-Eparametricsoftware wasused to develop theMachiningprogram.

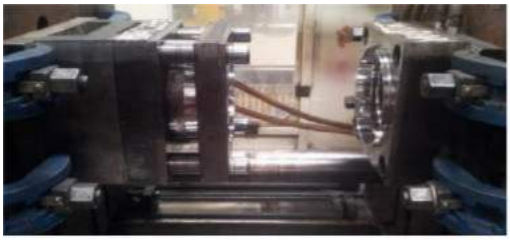
{Reference from Defining Lean Production: Some conceptual and practical issues By: JosteinPettersen}

1.2 Literature Review

The concept of LM was pioneered by a Japanese automotive company, Toyota, during 1950's which was famously known as Toyota Production System (TPS). The primary goal of TPS were to reduce the cost and to improve productivity by eliminating wastes or non-value added activities. During 1980's there was an intense interest on LM implementation among the western manufacturers because of growing Japanese imports. It became a serious concern to the western producers. After the oil crises in the early of 1990's, in a published book named

Whereas,Operations strategy is the total pattern of decisions which shape the long-term capabilities of any type operation and their contribution to overall strategy, Slack and Lewis (2002). Firms and companies which focus is on the production of goods use to refer their operations as Manufacturing. Thus, Manufacturing Strategy (MS) comprises a series of decisions concerning process and infrastructure investments of a production firm, i.e. what the manufacturing has and what it does. { *Reference from Lean in Product Developmentby Marc Lind}*

It aims to provide the necessary support to develop strategic competences, which will enable the company to develop a sustainable competitive advantage in its markets. Competitive advantages that might be considered as qualifiers(Q), those that get and keep the company in the marketplace, or as order winners(OW), those that let the company win orders in the marketplace, Hill (2000).



Injection Moulding Machine

1.3 Materialsof DIE

Sr.no.	Raw material	Drying temp.	Time
1	PE, PP	80 ^{0}c	2 hr
2	PS	82 ^{0}c	2 hr
3	Acrylic ABS,AS	82 ^{0}c	2 hr
4	Cellulose series	71 ^{0}c	3 hr
5	Poly carbonate	120 ^{0}c	3 hr
6	Hylon	82 ^{0}c	2.5 hr
7	PVC	71 ^{0}c	1.6 hr

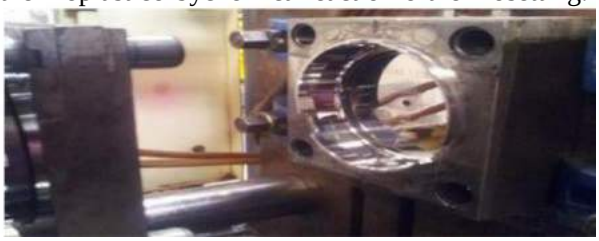
1.4 Components of Injection mould Die

- Cavity
- Cavity back-up plate
- Core
- Core back-up plate
- Stripper plate
- Ejector plate
- Ejector pins
- Bottom plate

DIE CORE

2. Design optimisation

Nowadays,the technology ofthe tool anddiefabrication in plasticinjection is oneofthe world'sfastest growing industries. Plasticis nowusedin almosteveryapplication,ranging from householdarticles to space travel, from transportation to packing,frommedicineto toys, from bridgebuildingto sports. Generally,injectionmouldingis aprocessthat forms the plasticinto adesiredshapebymeltingthe plastic material landforcing the plastic materialunderpressureinto the mouldcavity. Theshape ofthePlasticthatis desiredis achievedbycoolingin thermoplasticorbychemicalreactionforthermosetting.



DIE CAVITY

LEAN WASTES

Different kinds of wastes in a process are categorized in following categories.

1. Overproduction
2. Waiting
3. Unnecessary Transport
4. Over processing.
5. Excess Inventory
6. Unnecessary Motion
7. Defects
8. Unused Employee Creativity

- *{from Seven wastes elimination by lean manufacturing case study "gaza strip manufacturing firms'' By: Khalil A. El-Namrouty, Mohammed S. AbuShaaban.}*

Lean Thinking
Five step approach:

• Find a change agent.
• Find a sensei (to get the knowledge.)
• Seize or create the crisis.
• Map your value streams.
• Get started on creating better value streams.
But…how do lean leaders lead this process?

5. Result

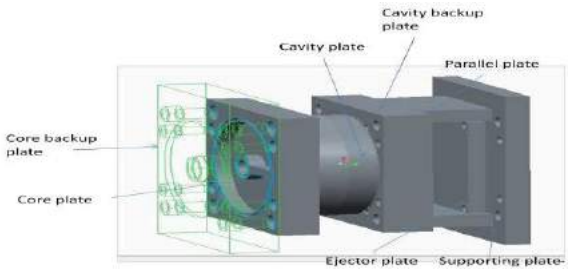
This study analyzed the existing state of manufacturing and testing the medical devices in batches. An implementation plan was developed to implement lean manufacturing principles to support one-piece flow. The plan was implemented and the results of the implementation resulted in improved productivity and resulted in a reduction in work-in-process.

6. Conclusion

Manufacturers are under intense, remorseless pressure to find a new ways to production cost, elimination of waste, enhance high quality of product, increase the productivity, and better customer satisfaction through the implementation of

lean traditional manufacturing practices are indicated inadequate representation in lean Manufacturing. This project manufacturing implementation in manufacturing industries. Hence, appropriate lean education, training, and research setup in association with manufacturing industries are to stimulate the lean awareness and technologic in all type of manufacturing industries. This helps to industries and researchers create awareness about Lean Manufacturing opt suitable lean practices for implementation, continuous in the competitive environment of current scenarios. There is our final product is decided according to which we have calculated only overall cost which will be up to 32000-35000 rupees.

6.1 Design in 3D



Conceptual Die Model in CRE-O

7.Future work / scope

This is a general decision methodology, which can be adapted and enriched with the information of a firm, and according to its specific needs. Also, as new alternatives and techniques come out, they can also be considered in this framework. There are some alternatives that can be adapted to combine differentproduction processes, e.g. using a focused facility it is possible to have separate production processes for different products. But it wasn't found any framework including different alternatives, or any proposal for deciding which one to use. As the existing theories and proposals do not seem to be enough, it was necessary to propose a solution for the problem of deciding a manufacturing strategy for products with different life cycles. A solution for this decision problem was already proposed and explained in the present paper. Now the question would be to apply the proposed methodology in real cases, in several companies, and evaluate the results.

8. Acknowledgement

First of all we thank the almighty for providing us with the strength and courage to do the research study.
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Our best regards go to all my colleagues for their pleasant cooperation last but not the least, we wish to express our sincere thanks to all our friends for their goodwill and constructive ideas. .

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DESIGN , ANALYSIS AND RAPID MANUFACTURING OF TURBINE BLADE

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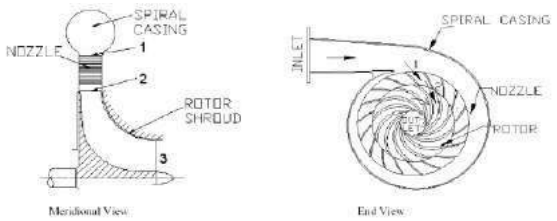
1.1 INTRODUCTION

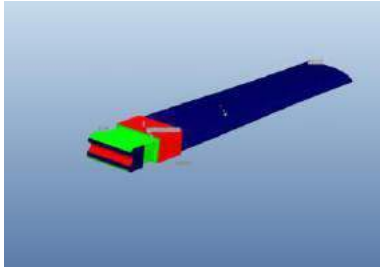
Gas turbine blades are as complex industrial parts due to their material, narrow dimensional tolerances and complicate freeform surfaces. In gas turbines, compressor and turbine blades play vital roles and one or aeries of blades transfer energy through dynamical function. The function of any industrial turbine directly relates to angular movement changes of fluid while passing through a row of blades. As the surface of blades is comprised from freeform surfaces, they accounted as complex industrial parts. At present, there are used processes such as forging, investment casting, machining and single crystal growth for manufacturing of the blades but any of these methods are time consuming and expensive especially in Research and Development, optimization and prototyping steps and have some limitations. Specially, in the phase of Research and Development while turbine blades with complex internal cooling channels are considered, even CNC machines having 4 or 5 simultaneous axis have such complications. Hence manufacturing these parts required another approaches like rapid prototyping technologies [3]

A gas turbine is a rotating engine that extracts energy from a flow of combustion gases that result from the ignition of compressed air and a fuel either a gas or liquid, most commonly natural gas as shown in fig 1 . It has an upstream compressor module coupled to a downstream turbine module, and a combustion chambers module with igniters in between. Energy is added to the gas stream in the combustor, where air is mixed with fuel and ignited Combustion increases the temperature, velocity, and volume of the gas flow. This is directed through a nozzle over the turbine's blades, spinning the turbine and powering the compressor Energy is extracted in the form of shaft power, compressed air, and thrust, in any combination.



1.2 COMPUTER AIDED DESIGN

CAD has, in recent years, become an important and widely used technology. CAD systems have the potential to improve design quality, cut design costs, and shorten the development time of new products .Companies have invested large amounts in the systems and are becoming very dependent on CAD technology for the development of new products yet the effective application of CAD technology has proven to be a difficult task in many companies. Many managers feel that CAD systems have not delivered the benefits expected of them. The results of years of CAD research show mixed and inconclusive results, Even when CAD technology is applied in ways that produce ostensible gains, these gains may not translate into overall improvements in product development effectiveness. The mixed results, reported by both researcher and practitioners, can be attributed to widely varying perceptions of the technology and its capabilities. These perceptions affect how CAD technology is applied, and will thus affect the benefits received from the technology.



1.2.1 CAD MODEL

PART MODELLING:

The pro-e modeling was carried out using the 2 D drawing provided by C.P.R.I, Nagpur. The various options used for modeling are discussed in brief as below:

- Starting Out in Part Mode--Describes how to start creating a part with Pro/ENGINEER.
- Sketcher--Describes how to create sketches in a stand-alone Sketcher mode.

- Datum's--Describes how to create datum features: datum planes, datum points, datum curves, datum axes, coordinates features, graphs, evaluate features.
- Sketching on a Model--Describes how to create 3-D sections in the process of feature creation.
- Feature Creation Basics--Describes how to create extruded and revolved protrusions.
- Sweeps, Blends, and Advanced Features--Describes how to create sweeps, blends, and advanced features. Construction Features--Describes how to create construction of features such as holes, slots, and cuts.

Rounds--Describes how to add rounds to part geometry.

- Tweak Features--Describes how to create tweak features, such as draft, local push, and section dome.

1.3 RAPID PROTOTYPING

Today, the competition of the industries in the overall the world are provided to fabricate a new product with high quality, low cost and low lead time of marketing, thereby, using of CAD/CAM systems, rapid prototyping and rapid tooling are not avoidable. At the present time, in most large industries such as automotive, aerospace, house equipments and medical facilities, rapid tooling is used. When solid modeling system was introduced in 1970, many researchers try to make physical model directly from geometric model data without using traditional tooling. From 1970 to 1980, companies had some achievement in manufacturing parts layer by layer by photopolymer material. In 1986, 3D System company was introduce SLA rapid prototyping method and first rapid prototype machine was manufactured . In rapid prototyping against traditional machining method, work piece is produce with additive method and layer by layer, result in this method is faster than from the subtraction of the material. This method hasn't the restriction of machining method and complex feature can produce with high accuracy and high quality . Rapid tooling is extension of rapid prototyping, in reality it is the development of CAD/CAM and rapid prototype technologies. It uses from rapid prototype technology directly or indirectly and reduce the product cycle time. Using of RP&RT allow the casting foundry to produce work piece without using tooling in low volume production. That helps to approve design, process condition and runner parameters. Result in this method decreases time and cost for production of sample parts with best quality, rapid and low cost [3, 4]. While 20 or 50 casting parts are required, RP method isn't economic, especially if it is required surface roughness. For simple and small part, using of the multiple cavity die is economical. This die can save 50% in production cost due to the reduction of production cycle time and elimination of connection runner to model. It is also reduce probable failure of small part and brittle material due to the reduction of displacement. The machining of cavity can't sure all models are the same, but the entire models are the same by using RT [5]. Furthermore, RT is allowing casting foundry to apply contraction parameter in production .

1.4 OPERATIONAL DESCRIPTION

The existing commercial RP processes use a layered fabrication method to create the physical prototype from a 3D CAD model. The CAD model to be prototyped is first converted into a standard format known as STL file format. In this format the surface of the CAD model is approximated by triangular faces[7]. The STL file consists of a list of the vertices of each of these triangles and a unit normal to each triangle indicating which side of the triangle is solid The rapid prototyping device reads the STL file and decomposes the 3D part into a series of 2D cross sections or slices[7]. The machine then constructs the physical prototype by sequentially creating each cross sectional layer and bonding each layer to the previous layer. Once all the layers are created and registered, a solid object is obtained. The accuracy of the object formed depends on the slice thickness and material dependent factors such as shrinkage, war page etc

1.4.1 Making SLA Model

Among RP methods, SLA has better feature definition and can create better surface roughness [7]. Turbine blade model is made by SLA method by the following procedure;

1. Convert CAD model in the STL format and send to 3DLightyear software.

2. Positioning workpiece on the SLA5000 platform

3. Positioning support

4. Slicing workpiece and support by thickness 0.15mm

5. Preparing SLA5000: content define recoat in any slice and Z-wait

6. Making workpiece

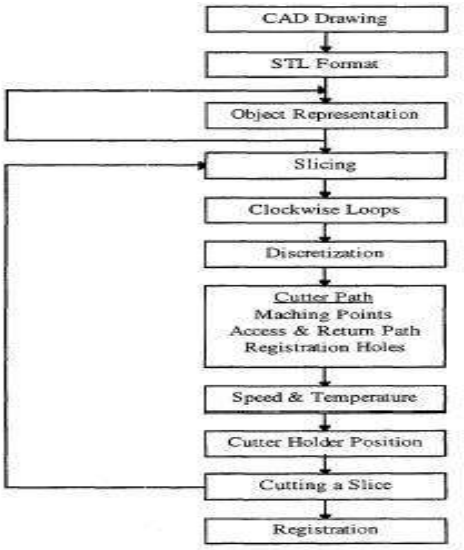
7. Remove SLA model from machine chamber and remove support

The maximum error of SLA model is about 0.017 mm [3] these deviation is measured by a CMM supplied PC-DMIS software to find the accuracy of SLA model.

Gambar 1. Part Files are Converted to STL Files

1.4.2 Prototype Or Production Parts

While many commercial rapid prototyping machines have made significant improvements with their fabrication techniques during the past five years, it is not yet possible to go directly from the CAD model to the final production part as is done with Computer Numerical Control machining However, new alternative modeling materials are currently being tested by all commercially available rapid prototyping machines. Many of these new materials have already demonstrated they are acceptable for producing 3- D objects with limited function Current limitations result from size, surface finish, and tolerances RP is expanding its usefulness from prototyping parts into the manufacture of actual production parts An electronics manufacturer uses Stereo lithography to fabricate final-use carrier components for use in manufacturing integrated circuits In another example, replacement of a cam follower was accomplished overnight using Stereo lithography and high strength photopolymer. Normally this cam follower would take two to three weeks for delivery Likewise, 3-D printing, using a colloidal silica binder and alumina-silica ceramic powder has been used to fabricate ceramic cores for lost wax casting models . Adding to that, Fused Deposition Modeling has been used to produce wax patterns to fabricate moulds for investment casting .



Gambar 2. Machine Control Flow Chart

1.4.3 Example: Prototype Wind Turbine Blade

A prototype wind generator turbine blade, based on a NASA design referred to as the LS(1)-417MOD, has been produced using SM2. First, a computer solid model was generated using a series of spline points to describe the foil cross-section geometry at specific points along its longitudinal axis Using these spline points and commercial solid modeling software, a surface model and subsequent solid model were generated. Next, the model file was exported as an STL file and the airfoil was sliced into 1" thick layers, to match the foam thickness. Each layer's slice geometry was ported to Shape Maker II and the layer geometry was cut from a sheet of extruded polystyrene foam. Finally, a thin coat of adhesive was applied to each layer, and the layers were manually registered and bonded together The gross dimensions for this turbine blade design are 46" x 7" cross-section and 7' long Fabrication time, excluding CAD modeling was approximately 11 hours. The accuracy for this first attempt at fabricating the airfoil is in the range of 0.1-0.6% of cross-section dimensions. Translating these values into useable dimensions, all dimensions were within 0.135" of the desired value. The z-axis accuracy is estimated to be 1% of the overall length or approximately 0.7".

1.4.4 Abbreviations and Acronyms

Computer Numerical Control (CNC) , Computer-Aided Design (CAD) , Rapid Prototype (RP) , Rapid Prototype Manufacturing (RPM) , Stereo lithography (SLA) , 3 Dimensional (3D) , 2 Dimensional (2D) , Reverse Engineering (RE) , Coordinate Measuring Machine - CMM

1.5 CONCLUSION

We came to the conclusion after the above discussion that the rapid Prototyping is one of the best methods to manufacture turbine blades within the given tolerance level

Some important advantages achieved by using rapid prototyping as follows

1. Reduction in cost and time while for this blade observe in comparison with traditional method we save 50% in time and 60% in cost

2. Develop machining technology in short time: because for production of any blade, it required some test cut in order to solve machining problems

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TECH-CHRONICLE
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The Perception and Methodology of Lean Manufacturing

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Abstract— In the present global and competitive environment all organizations needs to perform efficiently with higher productivity. For performing efficiently with higher productivity there are so many tools and techniques. Lean is one of them it means using only what is necessary lean manufacturing techniques aim to significantly identify waste and eliminate it from the manufacturing processes. Purpose of this paper is to present Lean Manufacturing elements, benefits, implementation strategy and obstacles in implementation for small scale manufacturing units and industry.

INTRODUCTION:

Lean is defined as a strategy for achieving significant continuous improvement in performance thought the elimination of all wastes of resources and time in the total business process.. It evolved from Toyota after world war 2nd as a business strategy due to the limited resources available in Japan, in contrast to the vast resources available to manufactures in the US. Its principles apply to nearly all business operations, from administration and product design to hardware productions. Lean manufacturing is about eliminating waste and non value added tasks. Examples of waste in manufacturing include overproduction, over processing, waiting, unnecessary part movement, excess inventory and defects, as applied to hardware production lean manufacturing focuses on eliminating all sources of waste by applying the following strategies

1. One piece workflow

2. Take time

3. Pull system

Lean identifies the bottlenecks in design and development processes that add unnecessary delays and cost. It can help create a more efficient system that reduces time to market without compromising on quality. Lean has a key role to play in new product development and the improvement of existing products and the improvement of existing products, including idea creation, design for manufacture, assembly and test, rapid prototyping, product portfolio management, market and competitor analysis, risk management, sales forecasting, setting key performance indicators and value analysis to reduce the cost of existing products.

Lean Manufacturing in India:

India is emerging as a new manufacturing destination and many industries are seeking ways to excel their manufacturing capabilities by elimination of wasteful activities from their systems. Lean is one of the approach the Indian industries are looking to become more competitive in local as well as global market. Yadav indicated in their study a keen interest on the part of Indian manufacturing companies to adopt or learn new approaches and techniques in order to improve their performance; but it was only the beginning of a long journey for them. In recent study, Panizzolo et al. (2012) investigated the adoption of lean production in India. The Indian Automotive sector has the very high level of lean implementation followed by Mechanical / Engineering sector. Other sectors are seen on medium to low level.

Industry sector in India	Level of diffusion
Automotive	Very high
Machine tool	Medium to low
Electronics/ IT /engineering	High
FMCG	Medium to low
Process industries	Medium to low
Aerospace	Medium to low

Decision-making (MCDM) for lean assessment to assess lean performance holistically. The literature pointed toward popularity of lean in India; but when it comes to success, its only start of journey. Other than automobile and electronics industry, others are having medium to low diffusion of lean in India.

2. Principles and Practices of LeanManufacturing

Lean production is a multi-dimensional approach that encompasses a wide variety of managementPractices, including just-in-time, quality systems, Work teams, cellular manufacturing, supplier Management, etc. in an integrated system (Shah et al., 2003).Yadav et al. (2010) identified ten fundamental Lean principles (Table 1) on the basis of exhaustive Literature review and authors' industrial experience, Which further used for investigation of lean Implementation.

Lean manufacturing Principles	What it means?	Enablers
1.Standardization	Standardized work procedure to do routine and repetitive tasks to improve efficiency and quality	Standard work procedures,Design blue prints
2. Simple and specified Pathways	Flow of work to the right machine or person in the rightform at the right time at the lowest cost with the highest Quality possible which reduces production lead time.	Kanban system, JIT
3. Teaching and learning	Through continuous effort of managers and supervisors Acting as enablers or mentor in solving problems.	Scientific methods of problem solving
4. Socialization	An atmosphere of trust, respect and common purpose in which work is performed to improve efficiency and Productivity.	Consistency, consensus and communication
5. Continuous Improvement	Experimentation by the people at every level toward Improving their own work systems.	Kaizen, TQM, Six Sigma, JIT etc.
6.Supplier-customer Relationship	Supplier-customer relationship specifies the form and Quantity of the goods and services to be provided, the way Requests are made by each customer, and the expected time In which the request will be met.	Long term cooperative relationship
7. Coordination through rich communication	Coordination through rich communication is required to Develop the idea into an innovation.	go-see, involvement of suppliers early during PD
8. Functional expertise and stability	Every company depends on highly skilled engineers, designers, and technicians to bring a product to the market; It is about developing standard set of skills.	Job rotation policy
9. Pursuit for perfection / striving for ideal goal	It is a common sense of what the ideal system would be, and that shared goal motivation to make improvements beyond what would be necessary to meet the current Needs of their customers.	Sharing a common goal
10. Cultivating organizational knowledge	It shows the faith of organization that the skills and Knowledge generated will pay off later.	knowledge sharing practices

MUDA, MURI, AND MURA

Muda, Muri, and Mura (1988) are Japanese words that were regularly used by Toyota through their development of Lean. Muda means waste, Muri means overburden, and Mura means unevenness. Variation in the order arrival rate and deviation in the capacity is unevenness (Mura). Capacity is straight connected with overburden. Mura and Muri lead to Muda‖. According to Ohno Muda is categorized into seven wastes Figure: Wastes are

Seven Wastes:

- Overproduction/early production—producing what the customer does not want.
- Waiting—idle time when no value is being added to the product or service.
- Transportation—unnecessary moving or handling, delays in moving material.
- Inventory—unnecessary stored materials, WIP, finished products.
- Motion—movement of equipment, inventory, or people that adds no value.
- Over processing—unnecessary processing and procedures that add no value.
- Defects—producing defective products.

Fig. **7 Wastes**

BENEFITS RESULTING FROM LEAN MANUFACTURING:

Lean manufacturing has a group of benefits for the growth of organization. The establishment of lean manufacturing will provide the following benefits for a particular organization

1. Waste reduction by 75%-80%

2. Production cost reduction by 30%-40%

3. Manufacturing cycle time reduction by 60%-70%

4. Labour reduction by 55%-65%

5. Inventory reduction by 40%

6. Capacity increase by 40%-50%

7. Production of better quality

Barriers to implement lean:

Barriers to Implement Lean	Small Organizations	Medium sized Organizations	Large sized Organizations	Sources
Cost of the investment	√		√	(1)
Insufficient internal funding	√	√		(1)
Insufficient supervisory skills to implement lean	√	√	√	(1)
Insufficient management time	√	√	√	(1), (2)
Employee attitudes/resistance to change	√	√	√	(1), (2), (3)
Insufficient external funding	√			(1)
Insufficient senior management skills to implement lean	√	√	√	(1)
Insufficient workforce skills to implement lean	√	√	√	(1)
Cultural issues		√	√	(1), (4), (5)
Insufficient understanding of the potential benefits		√	√	(1), (6)

- Lean Manufacturing Implementation strategies: Lean manufacturing is a philosophy which cannot be implemented instantly so it requires tolerantly developing understanding within the organization about lean, starting with smaller projects of lean at tool level, taking guidelines of an expert, making and following the strategy with due course correction in strategy while implementing lean throughout the organization. Some of the steps are as follows:

- Senior Management Involvement-For any major change, support and commitment from top management is vital. It is very much possible that problems will arise when lean implementation will progress and these issues must be understood and solved by top management without effecting lean implementation process.

- Initiate with smaller projects - Initial project must be small so that more resources are utilized and more chances are for better results with lesser risk moreover people working on project and around will learn while doing project. The results will motivate other to follow the same and people will start having faith in lean techniques. So recommendation is to start with smaller project at tool level.

- Start with limited execution – Lean implementation should be within limited area during start so that it can be monitored, corrected and directed for further implementation starting lean all-around the organization will reduce control and mentoring of people involved in lean implementation. Once movement is gained it should be spread in other areas.

- Employ a professional –Services of a professional mentor should be taken at least at the start. During conversion of a conventional organization to a lean organization lots ofIssue will arise and should be handled professionally they can be taken care with the use of expert.

***Obstacles in Lean Manufacturing implementation*:**

- Lack of management support: the reason can be pressure from customer side; competitor is following lean practices or others. In this case management just starts and does not propel further this results only superficial lean and neither lean is implemented nor does it get benefit.

- Lack of training: Another reason is lack of clear understanding about lean throughout the organization. The organization where knowledge of lean lacks it cannot be implemented.

- Communication – Lack of communication is one of the prime obstacles in lean manufacturing implementation.

- Resistance to Change – Resistance to change is very common phenomena as it increases fear of failure, initial cost so many of routine liking people doesn't want to change and hence it stops the progress of lean implementation.

- No direct financial advantage – Lean does not produces any direct financial benefits but it helps in identification and elimination of waste hence reduction of cost. Lean does not

have any financial measure in terms of input and output so sometimes lean idea is superseded by other organizational priorities.

Past failures – In case of poor launching of Lean is itself big obstacle. Lack of implementation strategy may lead to lack of faith in whole philosophy.

CONCLUSION:

This paper presents the review of lean thinking and its concept through definitions from literature. The main focus of lean manufacturing is to eliminate waste, doing things better in half of the resources as mass production requires, providing higher quality with lesser cost. More and more facets of lean manufacturing will come forth as researchers are keenly bringing through continual research. The good understanding of lean principles and practices is required for successful implementation of lean as lean practices without knowing lean principles can give short term success but may fail as long term strategy. The paper tried to present best way for lean implementation available in literature along with discussion that lean is applied successfully in different sectors than automobile sector such as service sector, discrete manufacturing, etc. The recent literature shows that the trend in lean manufacturing for research now is focused on lean assessment. Leanness attracts focus to answer specific questions of managers responsible for lean implementation to assess the lean implementation level and to justify spending over lean implementation. In this paper, presents the review of barriers of lean implementation from literature review. Understanding the barriers is important for managers to avoid failures and to sustain lean leap. The future research may be to identify such barriers through extensive literature review and interviews of working professionals as very little work happened on this subject. The way forward for research in this area may be multiple criteria. The paper contributes by identifying enablers & barriers in implementing the lean principles and practices, methodologies used in leanness measurement of an organization in the Indian manufacturing industry.

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MIST BASED HVAC PERFORMANCE OPTIMISATION OF AIR CONDITIONER

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ABSTRACT:

Air conditioning units are used for small and medium scale residential buildings. With the ever increasing energy cost the operations of the Air conditioners are further escalating the allocated budgets. Our project aims at establishing easy, practical and cost effective way to achieve the performance optimization without compromising the output (comfort levels). The project will investigate and identify various possible and effective methods to improve thermal performance of existing AC systems without retrofitting the cost centric components (compressor, condenser, evaporator).

Our project concentrates at optimization of the vapor based compression cycle. The energy efficiency can be achieved by below measures[1], [2][3]

- **a. Reducing compressor work/ power utilization**
- **b. Increasing cooling effect**
- **c. Increasing temperature difference between condenser and ambient air (since Q α ΔT)**
- **d. By using a material having high thermal conductivity (Q α K)**

Considering the least amount of retrofitting is incurred for step a,b,c the project concentrates to achieve reduction in the condenser pressure. Thus basic theme for achieving the energy efficiency is reduction of the condenser pressure. The reduction in the condenser pressure is proposed by increasing the rate of heat transfer; by increasing temperature difference between the condenser tubing and surrounding. By spraying water around condenser theoretically air (at DBT[4]) can be cooled upto WBT[5]. Practically we have planned to undertake experimentations on the proposed experimental setup. Before undertaking experimentation the Assessment Team knows that water contains dissolved solids which will form scaling on the tubings thus compromise on the heat transfer was upfront accommodated by coating the tube by Teflon coating. The length of the condenser tubes will be increased to compensate the reduction in heat transfer.

A mist box arrangement has been provided to the condenser. The mist box includes fine orifice through which a spray of water will be discharged on the condenser coils. This arrangement has been installed at the inlet of the condenser circulation fan. Due to this evaporation of water takes place and it results in the cooling of the incoming ambient air.

Due to continuous evaporation of water a residual of calcium carbonate remain on the tubings which results in scale formation. This can be eliminated by coating a Teflon PTFE of 0.4mil (1mil= 0.01 inch). This will greatly increase the performance of air conditioner and will increase the life of condenser.

Keywords

Water mist, air cooled condenser, air conditioner, Thermal performance.

INTRODUCTION:

Refrigeration system is used to provide cooling by the use of mainly four components Compressor, Condenser, expansion device and evaporator. These four components are operated with a refrigerant which works as heat carrier in this system. It extracts the heat from evaporator in the form of latent heat and rejects that heat to atmosphere through the condenser. Therefore heat rejection capacity depends on difference between refrigerant temperature at condenser and atmospheric temperature. Quantity of heat rejection also affects the quantity of heat absorption through evaporator. It is clear that more heat rejection will result more heat absorption. [6]Atmospheric temperature varies according to Environmental

[1] HEAT AND MASS TRANSFER by R. K. RAJPUT
[2] ENGINEERING THERMODYNAMICS by P. K. NAG
[3] BEE Book 03
[4] THERMAL ENGINEERING by R. K. RAJPUT
[5] Dry bulb temperature
[6] Wet bulb temperature

[6] VCR is a closed loop system, the amount of heat extracted from the system will be equal to the amount of heat gainedto

condition i.e. during the summer atmospheric temperature becomes higher which decreases the temperature difference between refrigerant and atmosphere, results less heat rejection which decreases the overall performance of refrigeration system.

LITERATURE SURVEY:

Condenser Misting System is a cost-effective, sensible solution to capacity and energy usage issues that occur during upper ambient temperatures. By injecting atomized water in the inlet air of condenser the temperature is reduced and the condenser is able to reject significantly more heat. This reduces the head pressure and compression ratio, so electrical demand (kW) and usage (kWh) are reduced and cooling capacity is increased. Furthermore, these benefits are realized exactly when the load on the system created by high ambient temperatures exceeds the system's cooling capability i.e. the higher the ambient temperature, the better the performance of the Condenser misting system.

The Condenser Misting System is a simple, elegant, measurable solution. With no moving parts to malfunction, it is safe, dependable, and requires little maintenance. Furthermore, the cost of the Condenser Misting System is quickly recovered through reduced demand charges, energy usage, water and sewerage usage.

Eghtedari H. et al. investigated about the Application of evaporative cooled air condenser instead of air cooled condenser to solve the problem of maintaining higher COP in hot weather conditions. He built an evaporative cooler and coupled it to the existing air-cooled condenser of a split air conditioner in order to measure its effect on the cycle performance. . Experimental results showed that application of evaporative cooled air condenser has significant effect on the performance improvement of the cycle and the rate of improvement increases as ambient air temperature increases. HajidavallooEbrahim investigated incorporation of evaporative cooling in the condenser of window-air-conditioner. An air conditioner was used to test the innovation by putting two cooling pads in both sides of the air conditioner and injecting water on them in order to cool down the air before passing it over the condenser.

The experimental results show that thermodynamic characteristics of new system are considerably improved. The power consumption decreased by about 16% and the coefficient of performance increased by about 55%.Chan et al. described how direct evaporative coolers can be used to improve the energy efficiency of air-cooled chillers in various operating conditions and with different strategies for staging condenser fans. These coolers are installed in front of air-cooled condensers to precool outdoor air before entering the condensers. With the direct evaporative cooler, compressor power dropped following the decrease in the condensing temperature in most operating conditions, while the pressure drop across the cooler caused additional condenser fan power. The overall saving of chiller power varied from 1.4 to 14.4% Hassan et al. studied an innovative condenser for residential refrigerator. To allow for evaporative cooling, sheets of cloth were wrapped around condenser to suck the water from a water basin by capillary effect.

The experimental results showed that the dry bulb temperature of entering condenser air with water mist pre-cooling could drop by up to 9.40 C from the ambient air temperature. COP could be improved by up to 8.6%[7]his study showed that the water mist system coupled to air-cooled chillers is an energy efficient and environment friendly technique. Kopko et al. investigated evaporative cooling and conventional cooling for a split heat pump system. The evaporative condenser was retrofitted onto an existing split heat pump system. For the purpose of this test heat pump only operated in cooling mode. Two separate sections maintained indoor & outdoor conditions for the respective units.

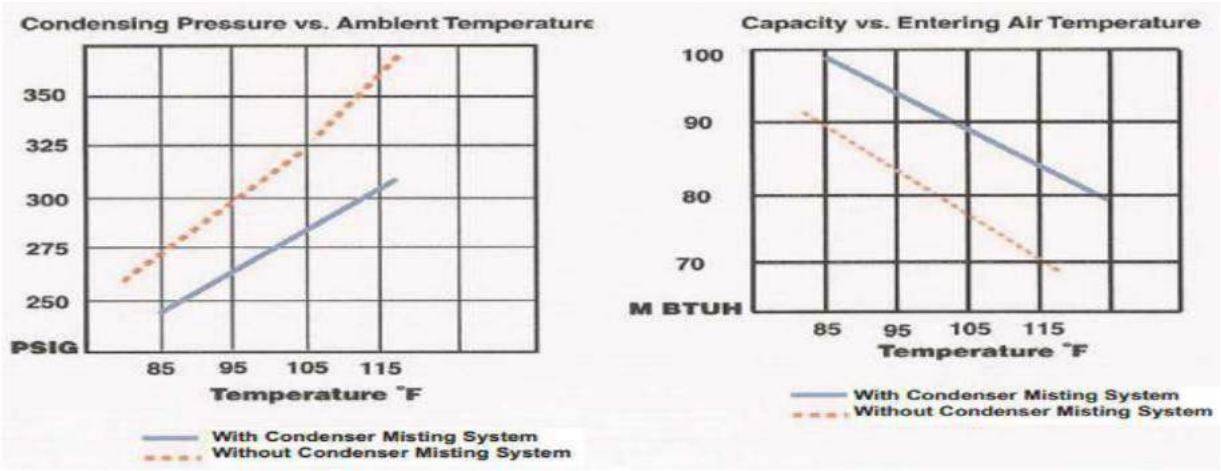
In the evaporative condenser, as the disks rotate, their wetted surfaces pull a film of water out of the bath into the air stream. The passing air evaporates some of the water film, cooling the water that remains on the disks. This cooled water is returned to the bath as the disks rotates, cooling the bath and thus the condenser tubes. The final results showed improved steady state performance; a higher capacity of COP by 11.1 to 21.6%. R. Boukhanouf et al presented a computer model and experimental results of a sub-wet bulb temperature evaporative cooling system for space cooling in buildings in hot and dry climates. The cooler uses porous ceramic materials as the wet media for water evaporation.

The porous ceramic panels were placed between the dry and wet air ducts to form small and narrow ducts with air flowing at low velocity. The dry channel side of the porous ceramic panel is sealed with a thin non-permeable membrane while the wet channel side allows water to sip through its micro-pores onto its surface forming a thin water film. This allows direct contact with the airflow and hence causing water evaporation. The air streams in the dry and wet channel flow in counter flow arrangement and the supply air exchanges sensible heat with the water in the porous ceramic panels that in turn are cooled through water evaporation on the wet channel side. This results in a drop in temperature of the air in the dry channel without changing its moisture content while the air in the wet channel is rejected at saturation state. Under selected

the refrigerant. So the refrigerant will dissipate heat through the condenser.

[7] $= 1 - \frac{2}{} =$

test conditions of air flow dry bulb temperature of up to 45° C and relative humidity of up to 50%, it was found that the supply air could be cooled to below the wet bulb temperature with a maximum cooling capacity of 280 W/m2 of the wet ceramic surface area. It was also shown that the overall wet bulb effectiveness is greater than unity. This performance would make the system a potential alternative to conventional mechanical air conditioning systems in hot and dry regions. K.A. Jahangeer et al. [8] concentrated on lowering of the condensing temperature will help to reduce compressor pressure lift, thereby reducing the power required by the compressor. This paper reports a numerical investigation of the heat transfer characteristics of an evaporative-cooled condenser. A detailed model is developed and numerical simulations are carried out using finite difference techniques. The simulations are performed for a single unfinned tube of the condenser with the air flowing across the tube. Water is sprayed on top of the tube in the form of fine sprays and the flow rate is set to achieve film thicknesses of 0.075, 0.1, and 0.15 mm, respectively. The tube wall temperature is assumed constant due to the fact that for most of the tube length, condensation of the refrigerant occurs at the saturation temperature of the refrigerant. Wall to air overall heat transfer coefficient value as high as 2000 W/m2 K was observed with the incorporation of the evaporative cooling.



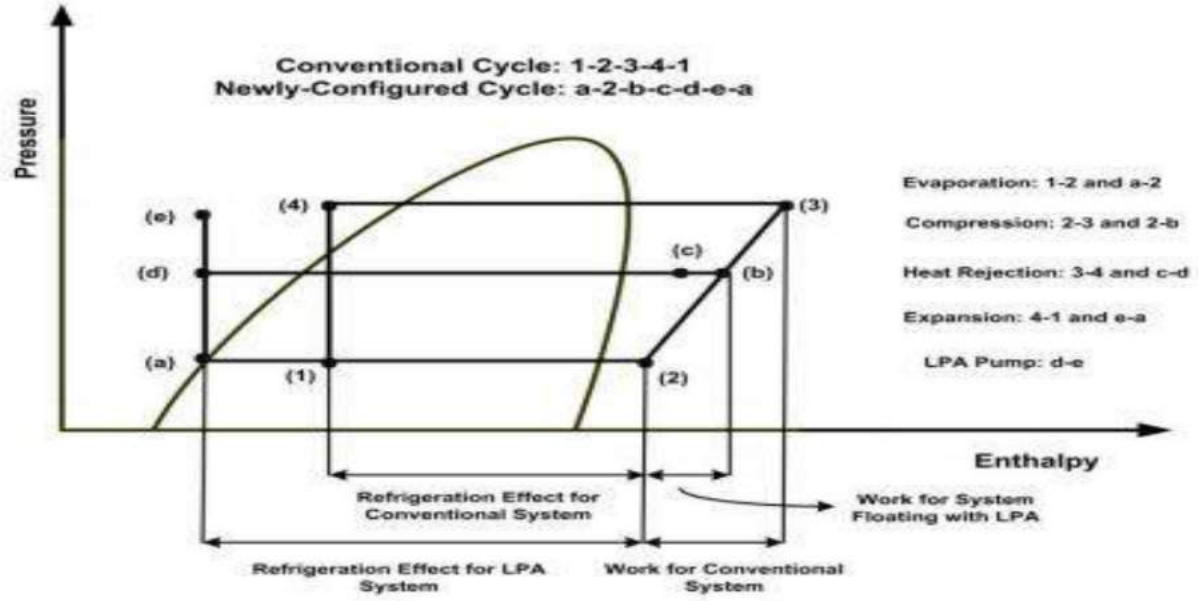


Fig P-H Diagram Of The Conventional And Mist based Air Conditioning System

Many studies report that reduced compressor discharge pressures and the corresponding reduction of compression ratios in a refrigeration cycle are advantageous when it comes to HVAC energy saving and increasing its service time. There are, however, some solutions to significantly lower compressor discharge pressures whilst preventing the flash vapour occurrence. For example, pre-cooling the ambient air before it reaches the air-cooled condenser of the vapour compression cooling systems can reduce the condensing temperatures to drop the condensing pressure. Yu and Chen investigated how the coefficient of performance (COP) of air-cooled chillers can be improved by using mist pre-cooling. They estimated around 18% decrease in the annual electricity usage could be achieved with mist pre-cooling of air entering the air-cooled condenser of chiller, used to serve a hotel in a sub-tropical climate. The application of LPA[8] to air cooled air conditioning systems can assist in achieving a considerable reduction in compressor discharge pressure. LPA can be realized with a hermetically-sealed, magnetically-driven liquid refrigerant pump installed in the liquid line between the condenser and expansion valve. The LPA pump increases the pressure of the liquid refrigerant before it enters the expansion valve. This method allows the condensing temperature to fluctuate with ambient temperature changes, and hence, reducing the condensing pressure and lowering overall energy consumption.

METHODOLOGY:

The Paper "MIST BASED HVAC PERFORMANCE OPTIMISATION OF AIR CONDITIONING" relates to highly efficient air conditioning units; and more specifically, to a method of improving the efficiency of the air cooling function in air conditioners by dispersing a Water or vapour mist onto the condensers of air cooling units effectively and efficiency thereby reducing the use of power by the condenser and reducing the time the condenser must run.

The proposed setup applies Water or mist to a condenser by utilizing a mist dispersal system for dispersing Water or vapour mists over a condenser unit. As described herein, dispersing Water or vapor mist onto the condenser of an air cooling unit, improves the efficiency of the air cooling function in air conditioners. The setup provides a novel project and method for increasing the efficiency of the air conditioner.

The heat transfer through the condenser can be increased by spraying a fine mist of water on the condenser. This can be done with the help of a fine orifice nozzle attached to a supply pipe of water. The condenser will be surrounded by a cage of piping arrangement to which orifice will be connected. The supply water will consists of condensate of air conditioner & make up water.

The supply water contains sediments & suspended solid particles which deposits as a hard layer on the condenser tubes so compensation is made on the heat transfer rate for the protection of condenser tubes which involves a coating of Teflon FEP on the condenser tubes. This eliminates the risk of hard deposited scaling layer over condenser.

This arrangement facilitates the efficient utilization of energy by reducing compressor work and increasing heat transfer rate.

CALCULATION:

Based on the modifications of our project, we have stated the effect on heat transfer rate theoretically. The following are the calculation which shows the percentage increase in the length of copper tubes.

For Bare Copper tube:

$$= \frac{1}{\;_2} \left\{ \frac{1}{\;_h} + \frac{1}{\;_1} \ln \frac{\;_2}{\;_1} + \frac{1}{\;_h} \right\}$$

For coated Copper Tube with Teflon:

$$= \frac{1}{\;_2} \left\{ \frac{1}{\;_h} + \frac{1}{\;_1} \ln \frac{\;_2}{\;_1} + \frac{1}{\;_2} \ln\left(\frac{\;_3}{\;_2} \right) + \frac{1}{\;_h} \right\}$$

Where:

$K_1 = 375$ W/mK

$K_2 = 0.25$ W/mK

$h_a = 10^0$ w/m^2 $\quad r_1 = 6.15*10^{-3}$m

$r_2 = 6.35*10^{-3}$ m

$r_3 = 6.39*10^{-3}$m

$$= \frac{1}{\;_1} \left[\frac{1}{\;_{2 \times 10 \times 6.35 \times 10^{-3}}} + \frac{1}{375} \ln \frac{6.35 * 10^{-3}}{6.35 \times 10^{-3}} + \frac{1}{10 * 6.35 * 10^{-3}} \right]$$

$$= 5.0942$$

$$= \frac{1}{\;_2} \left\{ \frac{1}{\;_{2 \times 10 \times 6.35 \times 10^{-3}}} + \frac{1}{375} \ln \frac{6.35 * 10^{-3}}{6.35 \times 10^{-3}} + \frac{1}{\;_{.25}} \ln\left(\frac{6.39 \times 10^{-3}}{6.35 * 10} \right) + \frac{1}{10 * 6.39 * 10} \right\}$$

[8] LPA – Liquid Pressure Amplification Pump

% of Increase Q = $\frac{1-2}{1}$ $2 = 5.0825$

CONCLUSION:

The dependency of air cooled condensers on the ambient air temperature prevents it from giving a constant performance. Here the water cooled condensers prove beneficial as their performance is independent of the atmospheric temperature. A golden mean has to be achieved. There are lot of investigations carried out on the performance improvement of air cooled condensers using evaporative cooling. The evaporative cooling is generally achieved by evaporating some portion of water which will cool the remaining water. The evaporating cooling may be direct or indirect. Depending upon the atmospheric conditions and system parameters either may be more effective. From the papers reviewed here it can be concluded that the performance of air cooled condensers can be improved up to some extent. Many different methods like using cooling media, water mist spraying etc. can be used.There is scope for exploring different cooling media's.
Many other different innovative methods for evaporative cooling can still be developed.

Based on the research, we have reached to a conclusion that by using a mist box arrangement, we can improve the performance

Q = $\frac{5.0825 - 5.0942}{5.0942}$
$Q = 2.2967*10^{-3}$
= 0.2296%

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TECH-CHRONICLE
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IMPORTANCE OF RENEWABLE ENERGY IN AGRICULTURE

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Abstract-

Energy is one of the major parameters for establishing growth and progress of the country, rather the standard of living depends directly upon the per capita energy consumption. Most of energy on the earth is received from the sun. Solar energy creates circulation of wind and ocean water, causes water evaporation and consequent precipitation. Plants use solar energy for photosynthesis and store carbohydrates, protein, fats, oils, alcohols, cellulose and lignin.. In agricultural systems, energy is available from different sources as human, animal, sun, wind, biomass, coal, fertilizer, seed, agro-chemicals, petroleum products, electricity etc. Energy sources that release availableenergy directly to the system are classified as direct energy sources. Renewable energy and farming are a winning combination. Wind, solar, and biomass energy can be harvested forever, providing farmers with a long-term source of income. This paper is an overview of renewable energy uses for farmers and ranchers on how they can help make renewable a growing source of energy and rural income in India.

Keywords: Photosynthesis, Yard, Manure, Agrochemicals

I. INTRODUCTION

Use of renewable energy in farming systems can mean several different things. For example, fossil fuels such as oil are non-renewable, so finding alternative ways of fertilizing the land and controlling pests that do not depend on chemicals, will normally involve the use of renewable resources. Such methods reduce farmers‟ vulnerability to the rising price of oil. Renewable energy also includes generation of power to do a number of farm tasks: pumping water for irrigation, for livestock or for domestic use; lighting farm buildings; powering processing operations and others. These forms of renewable energy include solar energy, wind and water power, oil from plants, wood from sustainable sources, other forms of biomass (plant material), and biogas (gas produced from fermentation of manure and crop residues).

II. SOLAR ENERGY

Widespread use of solar energy for domestic, agricultural and agro-industrial activities has been practiced almost since the development of civilization. Increasing threat of acute shortage of the commercial sources of energy coupled with serious environmental pollution problems has accelerated interest in the scientific exploitation of renewable sources of energy. Energy available from the sun is inexhaustible and environment friendly.

Therefore, the solar energy technologies are likely to play an important role in the near future through a variety ofthermal applications and decentralized power generation and distribution systems. The power from the sun intercepted by the earth is approximately 1.8 x $l0^{ll}$ MW. This makes it one of the most promising unconventional energy sources. Solar energy is available in abundance in most part of our country throughout the year. In India,' the annual average daily solar radiation received over the whole of the country is around 1800 J/cm^2/day. Drying of various agricultural produce in open sunlight is an age-old practice. Development of various solar devices for thermal applications such as water heating and space heating, drying, cooking and power generation began during the most centuries.

Fig.1 Solar PV panels providing green energy for agricultural growth

2.1. Solar cookers

Two different types of solar cookers i.e. indirect and direct focusing type have been developed in the country. The indirect type solar cookers consisting of an insulated box with transparent window through which sunlight enters into the box

have been satisfactorily developed and commercially exploited for domestic cooking. Such solar cookers are being marketed on commercial scale in most of the states through State Energy Development Corporations or other nodal agencies of the Ministry of Non-conventional Energy Sources (MNES), Government of India.

2.2. Solar dryers

Open sun drying of various agricultural produce is the most common application of solar energy. With the objective of increasing the drying rate and improving quality of the produce, natural convection and forced convection type solar dryers have been developed for various commodities. The movement of air in the forced convection solar dryer is through a power blower whereas in natural convection solar dryer air moves through the produce due to natural thermal gradient.

Fig.2 Rice grains dried using solar Dryer

2.3. Solar water heater

Water heating is one of the most common applications of solar energy for domestic and industrial applications. Similar to solar dryers, water heating systems are also available in natural convection and forced convection designs. Natural convection water heating system is known as thermo syphon water heating system.It consists of a flat plate solar collector, insulated water storage tank and necessary insulated pipe fittings.

Fig3. Solar Water Heating system

2.4. *Solar photovoltaic systems*

In solar photovoltaic (SPV) technology the solar radiation falling on a device called solar cells and is converted directly into electricity without any environmental pollution. Spy pumping systems are ideal for lifting water for drinking and irrigation without harming the environment. These pumps can be installed in boreholes, tanks, cisterns or rivers. DC surface pumps are designed for high flow rates at low heads. DC floating pumps are suitable for wide range of flow and head situations.

III. HOW WIND ENERGY CAN HELP FARMERS

Farmers and ranchers are in a unique position to benefit from the growth in the wind industry. To tap this market, farmers can lease land to wind developers, use the wind to generate power for their farms, or become wind power producers themselves. Farmers and ranchers can generate their own power from the wind .Small wind generators, ranging from 400 watts to 40 kilowatts or more, can meet the needs of an entire farm or can be targeted to specific applications. In Texas and the West, for example, many ranchers use wind generators to pump water for cattle. Electric wind generators are much more efficient and reliable than the old water-pumping fan-bladed windmills. They may also be cheaper than extending power lines and are more convenient and cheaper than diesel generators.

"Net metering" enables farmers to get the most out of their wind turbines. When a turbine produces more power than the farm needs at that moment, the extra power flows back into the electricity system for others to use, turning the electric meter backwards. When the turbine produces less than the farm is using, the meter spins forward, as it normally does.

At the end of the month or year, the farmer pays for the net consumption or the electric company pays for the net production. Net metering rules and laws are in place in most states.

Fig.4 Wind farms as a source of energy for the farmers

IV. EFFECTIVE UTILISATION OF HYDRO ENERGY ON AGRICULTURE

Hydroelectric power comes from the natural flow of water. The energy is produced by the fall of water turning the blades of a turbine. The turbine is connected to a generator that converts the energy into electricity. The amount of electricity a system can produce depends on the quantity of water passing through a turbine (the volume of water flow) and the height from which the water „falls" (head). The greater the flow and the head, the more electricity produced.

Hydropower is a clean, domestic, and renewable source of energy. It provides inexpensive electricity and produces no pollution. Unlike fossil fuels, hydropower does not destroy water during the production of electricity. Hydropower is the only renewable source of energy that can replace fossil fuels" electricity production while satisfying growing energy needs.

Hydroelectric systems vary in size and application. Micro-hydroelectric plants are the smallest types of hydroelectric systems. They can generate between 1 kW and 1 MW of power and are ideal for powering smaller services such as processing machines, small farms, and communities. Large hydroelectric systems can produce large amounts of electricity. These systems can be used to power large communities and cities.

4.1. Water use for irrigation

Agriculture is by far the largest water use at global level. Irrigation of agricultural lands accounted for 70% of the water used worldwide. In several developing countries, irrigation represents up to 95% of all water uses, and plays a major role in food production and food security.

Future agricultural development strategies of most of these countries depend on the possibility to maintain, improve and expand irrigated agriculture.On the other hand, the increasing pressure on water resources by agriculture faces competition from other water use sectors and represents a threat to the environment.

Water is a resource that may create tensions among countries down and upstream. Irrigated agriculture is driving much of the competition since it accounts for 70-90% of water use in many of these regions. Water used for agriculture comes from natural or other alternative sources.

Natural sources include rainwater and surface water (lakes and rivers). These resources must be used in a sustainable way.

Rain water resources rely on the atmospheric conditions of the area. Surface water is a limited resource and normally requires the construction of dams and reservoirs with a significant environmental impact. Alternative sources of irrigation water are the reuse of municipal wastewater and drainage water.

However the use of recycled water for irrigation may have some adverse impacts on the public health and the environment. This will depend on the recycled water application, soil characteristics, climate conditions and agronomic practices.

Therefore it is important that all these factors are taken into account in the management of recycled water.

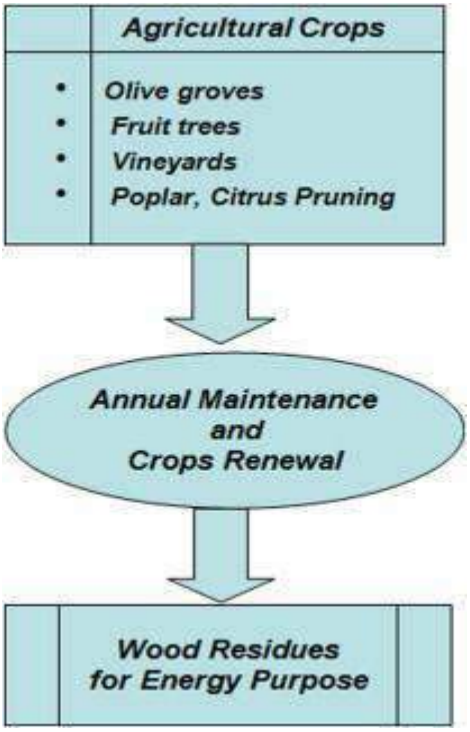
Water reuse for irrigation is a normal practice worldwide. In Europe, for example there is a large project in Clermont-Ferrand, France since 1997 where more than 10.000m^3/day of tertiary treated urban wastewater are reused for irrigation of 700Ha of maize. In Italy more than 4000 Ha of various crops are irrigated with recycled water. Spain also counts with several similar projects. The water quality used for irrigation is essential for the yield and quantity of crops, maintenance of soil productivity, and protection of the environment. For example, the physical and mechanical properties of the soil, ex. soil structure (stability of aggregates) and permeability are very sensitive to the type of exchangeable ions present in irrigation.

Fig.5 Hydroenergy (water from dams)is used for irrigation purpose.

V. ROLE OF BIOMASS

Authorities" studies reveal that that the forest cover of country is depleting every year at a rate more than 1.5 million hectares. The situation is particular grave in rural areas. This

rate of deforestation is alarming. Much of the wood felled is used as fuel for cooking. Charring and briquetting technologies reduce various problems associated with the management and utilization of biomass in domestic and industrial sectors. Briquetting of some of the crop residues has becomes cost competitive and the briquettes being used as replacement of firewood in many regions of the country.



Domestic biogas plants instal1ed in our country use cattle dung mixed with an equal quantity of water to maintain 8-9% total solids concentration (TSC) in the influent sl7urry. The effluent discharged from the plants is, in general, col1ected into the slurry pits or spread on to the ground for drying before transportation to fields for use as organic manure.

Fig6. Unloading of Rice Husks

VI. CONCLUSION

The only realistic solution to the problem go non-renewable is to find sources of renewable energy to replace today‟s dwindling supplies of affordable and usable fossil energy. Solar energy is the only source of truly renewable energy – renewable at least for the next few billion years. Windmills, falling water, solar collectors, and photovoltaic cells are all sources of renewable solar energy. The most common solar energy collectors are green plants. After all, plants were the original collectors of today‟s fossil energy. So, it‟s only logical to look to agriculture as a renewable source of alternative energy for the future. However, we need to be realistic about the extent to which energy from agriculture can replace our current use of fossil energy. While the energy experts may not agree on specific quantities or percentages, the overall limits on energy from agriculture are fairly basic and straightforward.

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"DESIGN AND FABRICATION OF REVERSE GEAR MECHANISM IN HANDICAPPED PERSON VEHICLE- AN OVERVIEW"

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ABSTRACT

Mobility of physically disabled persons is a concerning social issue nowadays.In case of the handicapped people, who drive two wheelers with extra support wheels face much problem to take the vehicle out of the parking by pushing the vehicle with legs. In order to take the vehicle out of the parking, they need to seek others help or they should push it out of the parking. As a help to them this research paper aims at designing and fabrication a reverse gear mechanism, which will be fitting to the vehicle with little modifications of the existing mechanism.

Keywords: Mobility, Handicapped person, reverse gear mechanism.

I. INTRODUCTION

Nowadays, the intensity of traffic on Indian roads is increasing at high pace.As in this date there are many options for transportation available for physically challenged persons like, Motorized wheel chair, Hand powered tri-cycle, Scooters..etc. The problem associated with motorized wheel chair is that it way too costly and is not suitable for commuting. Hand powered tri-cycle requires heavy human effort. So, disable people, now days prefer two wheelers as better mode of transportation.Since it is comfortable and cost efficient.The major problem associated with the two wheelers that are available in India is that they don‟t have provision for reversing the scooter which is very much necessary for a disable person. In order to overcome this drawback, we‟ve designed and fabricated a vehicle with reverse mode.

II. LITERATURE REVIEW

G.Satish Kumar, et al. [1] This research paper gives the detail about designed a gear box which will be fit to the rear side of vehicle without altering the existing gear box.Vinod K. Banthia, et. al [2] This research work deals with feasible design solution in form of a user friendly three wheeler vehicle, which allows physically challenged people to commute on their own and perform their activities without anyone‟s assistance, has been proposed.Sandesh G.Ughade, et al. [3] This paper gives the details about the solar power tricycle project and includes the methods and considerations regarding the proper working of the tricycle.Ajit A. Mohekar, et al. [4] This paper discusses an attempt to design and fabricate a retrofitted tricycle for disabled people. This tricycle is specifically designed to suit wheelchair occupants.Arpit Mehra, et al. [5] In this paper, an attractive modern electric car also called Electro Handy has been designed for handicapped people. Electro Handy is a powerful car for disabled people powered by rechargeable battery.

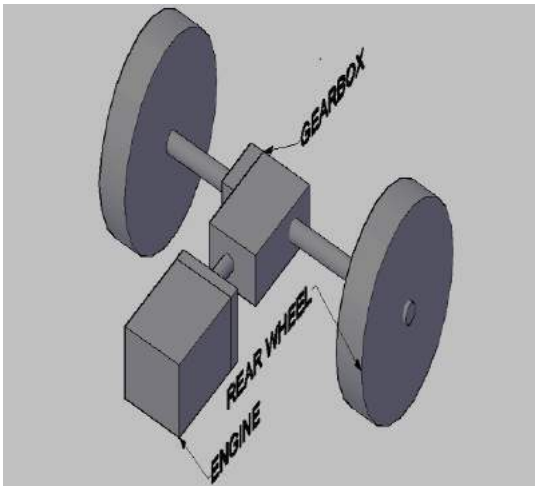
After going through the exhaustive literature survey, we very well understood that it is very difficult for handicapped person to drive the vehicle on the road due to heavy intensity and as well as for parking and un parking vehicle.

III. METHODOLOGY

The following methodology is adopted for the designing and fabrication of the reverse gear mechanism:

- Design Calculations.
- Identification of components.
- Fabrication and assembly of mechanism.
- Inspection and Testing.
- Result and Conclusion.

IV. PROPOSED SKETCH



Gearbox Conceptual Sketch

V.DESIGN CALCULATION

Design of gear box:

Concept:

The engine drives provides the power to the gear box and the gear gives out the power to the rear wheel in two direction .when output in clockwise direction the vehicle move forward and when the output is in counter clockwise direction vehicle moves backward. Thus reversing of the vehicle can be achieved.

The following calculations are to be performing for the designing and fabrication of the reverse gear mechanism.

(1) Design of gear box.
- Input Gear.
- Intermediate Gear.
- Output Gear.
- Gear ratio calculation.

(2) Design of Shaft.
- Input Shaft.
- Intermediate Shaft.
- Output Shaft.

(3)Design and selection of bearing.

(4)Design of frame.

(5)Selection of Suspension system.

VI. IDENTIFICATION OF COMPONENTS

- Moped vehicle.
- Two wheels with tyre.
- Axel shaft.
- Suspension system.
- Gear box of autorikshaw‟s.
- Frame.
- Hand lever for shifting gear.

Vehicle

Tyre **Axle shafts**

Gearbox

Suspension system **Frame**

VII.CONCLUSION

Thus, by adopting the methodology as discussed above the design and fabrication of vehicle will be carried out. The designed vehicle will prove to be of great importance for the handicapped persons and aid them in driving on the heavy traffic intensity roads. Also it will provide a lot of comfort and safety while driving. So, implementing our project will surelyprovide mobility to all disabled people without any help from others.

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INTRODUCTION TO HYBRID VEHICLE

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ABSTRACT

A'gasoline-electric hybrid car' or 'hybrid electric vehicle' is a vehicle which runs on batteries as well as on the internal combustion engine which drive a generator cum motor to provide the electricity and also the vehicle. It has great advantages over the previously used gasoline engine that drives the vehicle from gasoline only. It is also a major source of air pollution. The objective is to design and fabricate a hybrid electric vehicle powered by battery and gasoline both. The combination of power makes the vehicle simple in nature and efficient. It provides its owner with advantages in fuel economy.

Hybrid electric vehicles combine an electric motor, battery and power system with an internal combustion engine to achieve better fuel economy and reduce the pollution emissions. In HEV, the battery alone provides power for low-speed driving conditions where internal combustion engines are less efficient. In long highways, or hill climbing the electric motor provides additional power to assist the engine. Thus a smaller, more efficient engine can be used. Besides it also utilizes the concept of regenerative braking for optimized utilization of energy. Energy dissipated during braking in HEV is used to charge the battery. Thus the vehicle is best suited for growing urban areas with high traffic.

KEYWORD

Regenerative braking system, plug in hybrid, series and parallel hybrids, Supervisory Control, Four wheel drive

INTRODUCTION

Ferdinand Porsche in 1901 developed the Lohner-Porsche Mixed Hybrid, the first gasoline electric hybrid automobile in the world. The hybrid-electric vehicle did not become widely available until the release of the Toyota Prius in Japan in 1997, followed by the Honda Insight in 1999 While initially perceived as unnecessary due to the low cost of gasoline, worldwide increase in the price of petroleum caused many automakers to release hybrids in the late 2000s; they are now perceiving it as a core segment of the automotive market of the future.A hybrid electric vehicle is a combination of gasoline or diesel vehicle and electric vehicle which combine's a conventional internal combustion engine with an electric motor to obtain the maximum fuel efficiency. This combination offers the extended range and avoid frequent refueling that consumers expect from a conventional vehicle, with a significant portion of the energy and environmental benefits of an electric vehicle. The practical benefits of HEVs include improved fuel economy and lower emissions of the full host of criteria pollutants, as well as CO2, compared to conventional vehicles.

Modern HEVs make use of efficient technologies such as regenerative braking, which converts the kinetic energy of vehicle into electric energy to charge the battery, rather than wasting it as heat energy by conventional braking system. Some type of HEVs use their internal combustion engine to generate electricity by rotating an electrical generator to generate the electricity and recharge the batteries or to directly power the electric motors. Many HEVs reduce idle emissions by shutting down the IC engine at idle and restarting when it needed this is known as a start-stop system. A HEV produces less emissions from its IC engine as compare to the normal gasoline car, therefore in HEV the engine is comparatively smaller in size as normal gasoline car.

CONSTRUCTION

Hybrid electric vehicle consist of an electric storage device such as battery and ultra-capacitor. They also combines the energy storage source with a mechanical device are internal combustion engine, fuel cell. This combination reduces both fuel consumption and tailpipe emission.

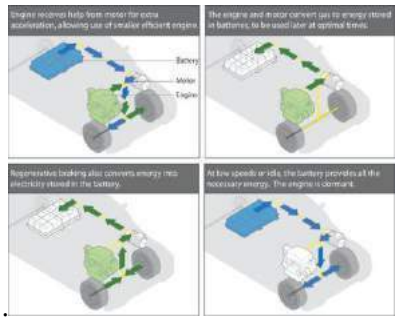

Figure 1; show the construction of hybrid vehicle with regenerative braking system

The hybrid vehicle serves several advantages over pure electric vehicle because hybrid vehicle engine shares the workload with electric motor. And also it allow to construct the engine smaller in size and reduces the weight and give good fuel economy. Also hybrid electric vehicle engine can be optimized to operate within the specific speed range characterized by better fuel economy and reduces emission. This eliminate the poor fuel economy.

One of the most important advantages of hybrid vehicle is regenerative braking system. In which powertrain converts stored energy into vehicle motion moreover, it convers vehicle motion back into stored energy through the use of regenerative braking. Regenerative braking system provide vast benefits and estimated 60% of the total energy consumption in urban driving is spent for overcoming the effect of inertia. Means half of energy may be recovered in hybrid electric vehicle.

The hybrid vehicle contain the following main parts that is

1) Battery
2) Internal combustion engine
3) Generator
4) Power split device
5) Electric motor

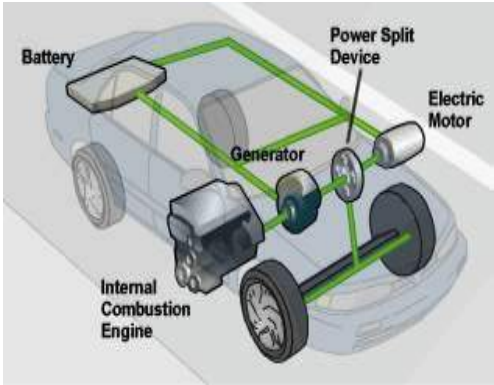

Figure 2; show the parts of hybrid electric vehicle

BATTERY

The batteries in a hybrid car are the energy storage device for the electric motor. Unlike the gasoline in the fuel tank, which can only power the gasoline engine, the electric motor on a hybrid car can put energy into the batteries as well as draw energy from them.

INTERNAL COMBUSTION ENGINE (ICE)

The hybrid car has an ICE, also known as a gasoline engine, much like the ones found on most cars. However, the engine on a hybrid is smaller and uses advanced technologies to reduce emissions and increase efficiency. Receives its energy from the fuel tank where the gasoline is stored.

GENERATOR

The generator is similar to an electric motor, but it acts only to produce electrical power for the battery.

POWER SPLIT DEVICE

The power-split-device resides between the two motors and together with the two motors creates a type of continuously variable transmission.

ELECTRIC MOTOR

The electric motor on a hybrid car acts as a motor as well as a generator. For example, when needed, it takes energy from the batteries to accelerate the car. But acting as a generator, it slows the car down and returns energy to the batteries.

WORKING

The hybrid electric vehicle work and constructed in two way are,

1) Series hybrid vehicle
2) Parallel hybrid vehicle

SERIES HYBRID VEHICLE

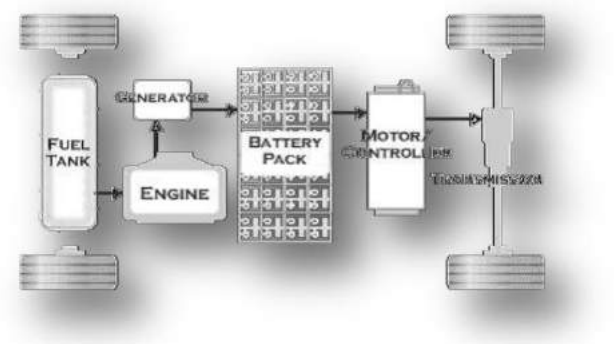

Figure 3(A) schematic of a series hybrid propulsion system

In a series hybrid the IC engine runs an electric generator which produces electricity to charge batteries. The batteries drive the electric motor to run the vehicle – the arrangement is similar in principle to well-known diesel-electric locomotives. Since the engine does not `see' the wheel, it can be made torun at an optimized operating condition (best in terms of fuel efficiency and emissions). The DC motor driving the wheel can take care

of all vehicle speed changes. It is also possible to charge the batteries by connecting to external grid power, and depending on the storage capability of the batteries the vehicle can run in a purely electric mode for certain distances with the IC engine started only when the batteries are almost discharged.

PARALLEL HYBRID VEHICLE

In a parallel hybrid, the power can flow in parallel to the wheels from either the batteries or the IC engine. An electronic controller can sense the load and speed of the wheel/vehicle and using built-in algorithms, the power can be made to flow either from the batteries or the IC engine or from both. In most urban driving (especially in crowded and narrow streets in less developed countries), the peak speed or power is rarely required. In such situations, the parallel hybrid can be configured in a way such that most of the time, the vehicle runs on batteries resulting in low emissions and high fuel efficiency.

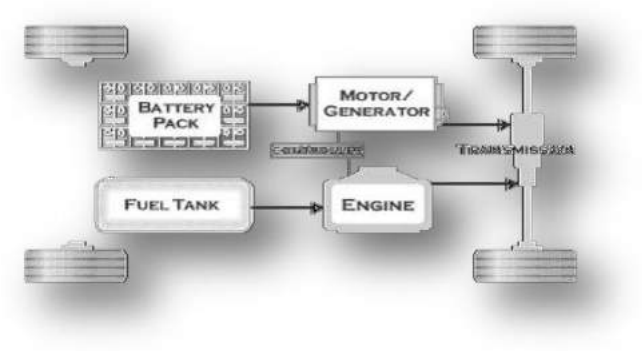

Figure 3(B) schematic of a parallel hybrid propulsion system

Only when required, power can be added to the wheels from the IC engine. In this framework, the IC engine, the batteries and generator, and the electric motor individually need not be designed to meet peak requirements. This makes a parallel hybrid configuration potentially cheaper. There is the added complication of designing power trains where power can be added and use of an electronic controller. The basic parallel hybrid architecture of figure is often implemented in several ways. Figure shows four ways a parallel hybrid propulsion system can be implemented.

REGENERATIVE BRAKING SYSTEM

When braking in a conventional vehicle, the friction brakes converts much of the kinetic energy into heat that is emitted unused into the environment. Hybrid vehicle with regenerative braking system are different in that they recover some kinetic energy by the electric motor and stored it as an electric energy in a high voltage battery. This process known as regenerative braking. The electric motor can the used this stored energy when driving or acceleration.

Regenerative braking make it possible to increase the range of electric vehicle and reduces the fuel consumption and carbon footprint of hybrid vehicle.

When braking in the hybrid vehicle the electric motor switches to generator mode. The wheel transfer kinetic energy via the drivetrain to the generator. The generator turns in a similar way to a bicycle light generator transfer part of kinetic energy into electrical energy which is then stored in a high voltage battery at the same time generator resistance produces from the electricity created slow the vehicle. When more braking torque is required then additional braking is provided by frictional brakes.

In many situation the generator braking power is sufficient to slow the vehicle as desired by the driver as a result the friction brakes is used less often for example in instances of very rapid deceleration at very low speed and stationary regenerative braking contributes toward increasing the range of electric vehicle it help to save fuel in hybrid vehicle and to reduced emission of CO2 and pollutants particularly in urban traffics situation involving frequent braking and acceleration using the generator for braking also reduces brakes wear and the buildup of brakes dust.

Regenerative braking system control the interaction between frictional brakes and the generator to generate efficient energy. Recuperation they also ensure that deceleration behavior and pedal feel are identical to conventional braking system.

The generator braking potential is dependent on the engine driving speed. At low engine speed maximum braking torque is available. At high or very low speed, sufficient braking torque cannot be provided meaning the friction brakes must be activated. Generator brakes torque is proportional to the generator output and is also influenced by the battery level of charge. Brake torque from the generator is only available when the high voltage battery is not fully charge.

Brakes torque is distributed between the frictional brakes and generator taking safety comfort and efficient criteria into consideration. If the vehicle becomes unstable. It is usually deceleration safely via the friction brake as wheel specific invention of the antilock braking system or electronic stability program.

CONCLUSION

HEV is a vehicle that uses two sources of power- gasoline and battery. For low power application battery drive is used whereas for high

power application where power requirement is very high gasoline engine is used. Gasoline drive is most efficient at high speed drive. Thus HEV's both mode of operation occurs at their maximum efficiency. But in gasoline engine low speed operation is not efficient. Its high speed mode is only efficient. Therefore, it gives twice the mileage given by a normal vehicle. As this hybrid vehicle emits 50% less emission than normal vehicle it plays an important role for reducingpollution to certain extent without compromising with efficiency. Thus it is most efficient in urban areas mainly in high traffic where gasoline engines are least efficient as the energy from gasoline is being wasted away and creates pollution.

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FINITE ELEMENT ANALYSIS OF RECIPROCATING SCREW FOR MINIMIZING THE WEAR OF SCREW IN INJECTION MOULDING MACHINE

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Abstract

Injection moulding machine is used in the industries for manufacturing or fabrication of the plastic parts. The screw issubjected to different temperature zones. It is the most critical components of the injection moulding machine. The raw granules of plastic is melted in the injection moulding machine and injected into the mould .The material is feed into the hopper in the granules form. The barrel contains reciprocating screw for infusing the material into the mould and material is additionally liquefied into the barrel. The issue happen in the screw of machine which is wearing of screw because of influence of mould temperature and utilizing 30% glass field material i. e. Nylon, low thickness polypropylene, polystyrene ,PVC etc. The industries are having temporary solutions but it is not so effective in improving life of the screw, because the stresses will be more in machined screw on lathe machine as compared to normal screw. Hence, the modeling and analysis technique is used to solve the problem.This project deals with, the solution of problem occurred for reciprocating screw of Injection molding machine. It identifies andsolves the problem by using the modeling and analysis techniques. The problem occurred in the reciprocating screw of machine which is wearing of threads due to effect of temperature of mold materials (flow materials).

Keywords— reciprocating screw, Barrel, and mould, wear, Plastic Injection moldingmachine.Pro-E 5.0 and Ansys R15

INTRODUCTION

Injection moulding is the most commonly used manufacturing process for the fabrication of plastic parts. A wide variety of products are manufactured using injection moulding machine, such as plastics housings, consumer electronics , medical devices including valves and syringes which vary greatly in their size, complexity and application. The plastic is melted in the injection moulding machine and then injected into the mould, where it cools and solidifies into the final part. The injection moulding process requiresthe use of raw plastic material, and a mould. The barrel contains the mechanism for heating and injecting the material into the mould. The reciprocating screw advance the material forwarded by either a hydraulic or electric motor. During this process material is melted by heat and pressure. The material enters the grooves of the screw. The screw completes the shot volume and retunes to reverse position. Due to the effect of high melting temperature and pressure of mold material the problem is occurred in the reciprocating screw. To make repair of threads on the lathe machine industries are having this temporary solution. This reduces weight and strength of screw resulting misalignment in assembly. The screw is the crucial part of the screw. The material for the screw is Latrobe LSS 01 Tool steel (ASTM 01) OHNS, and other alternate materials areAISI Type 06 Tool Steel , HSS 142 Tool steel.

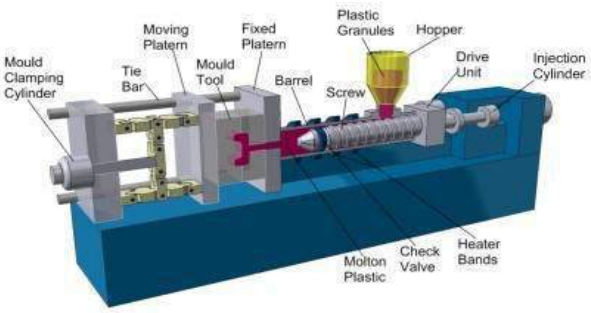


Fig 1.Injection molding machine arrangement

Description of machine

a) Injection system

This system transports the plastic. The injection system are having hopper, barrel, reciprocating screw and injection nozzle assembly. It progress through melting compressing, degassing, injection, feeding and packing stages.

b) The hopper

In the form of small pellets the thermoplastic material is supplied to molders. The hopper hold the pellets. The barrel and screw assembly pellets are gravity –fed from hopper through the hopper throat.

c) The barrel

The reciprocating plastering screws are supported by barrel in the injection moulding machine. The electric heater bands are used for the heating purpose.

d) The rotating screw

For compress, melt, and convey the material the rotating screw is used. There are three zones in rotating screw (illustrated below):

- the feeding zone
- the metering zone
- the compressing (or transition) zone

e) The nozzle

It is forms seal between barrel and the mold because the nozzle is connects the barrel to spur bushing of the mold. The temperature of the nozzle should be set to the material's melt temperature or just below it, depending on the recommendation of the material supplier.

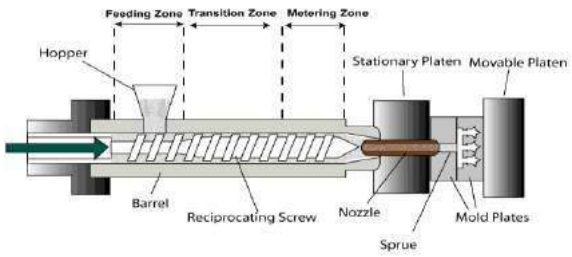


Fig 2. Reciprocating screw arrangement

Objective

The problem occurred in the reciprocating screw of injection moulding machine was wearing of threads. The objective of project is to find out the causes of wearing and provide the solution. The industries are having temporary solution to make repair of threads on the lathe machine industries are having this temporary solution. This reduces weight and strength of screw resulting misalignment in assembly. The objectives involved are:-

a) To model all the components using modeling software Pro-E 5.0
b) To assemble all the components in the software.
c) Analysis of screw using ANSYS software.
d) To identify the wearing of threads and to provide the possible Solutions.

Problem Statement

The problem identified in the operation condition of injection moulding machine of reciprocating screw is the wear of screw takes place after 3 to 4 months due to the use of glass filled material (i.e., nylon66, low density polyethylene, PVC, polystyrene) in plastic injection moulding machine. The cost of the reciprocating screw is about 4 to 5 laces.

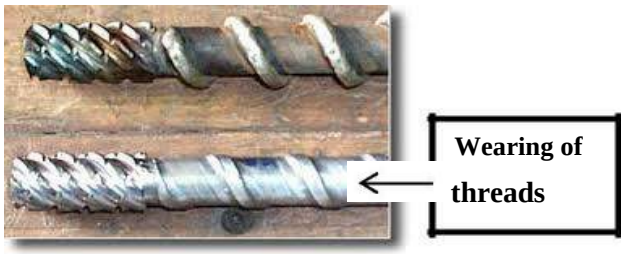


Fig 3:Wearing of threads of reciprocating screw

Materials AndMethods

This are describes the details of injection molding process, design of reciprocating screw with different two material is used with having their properties they are LSS 01 Tool steel (ASTM 01) OHNS (existing material of screw). Then change or replace the material of the screw by using this two new materials AISI Type 06 Tool ,HSS 142 Tool Steel and compare the results of this two material with the existing material of the screw. We used the different mold materials such as nylon 66,(LDP), polypropylene in this two new material of the screw and analyze the results compare their results with existing one and find out which material is better for the replacement of the screw material. Various mold materials can be used in this process like linear low density polyethylene, Nylon, polystyrene, PVC etc.

Input Parameters For Finite Element Analysis Of Screw Using ANSYS R15

- ***Materials for Reciprocating Screw (Physical Properties)***

Materials	**Latrobe LSS 01 Tool steel**	**HSS 142 Tool steel**
Young's modules(PA)	200Gpa	215Gpa
Poisons ratio	0.3	0.3
Density (kg/m³)	7800	7850

Thermal Expansion	12×10^{-6}	10×10^{-6}
Yield Tensile strength(PA)	350×10^{-6}	350×10^{-6}
Ultimate Tensile Strength(PA)	630×10^{-6}	585×10^{-6}
Specific heat J/g-K	0.434	0.4
Thermal conductivity W/m-K	60.5	42.7

Modeling of Reciprocation Screw Using Pro-E Wildfire 5.0

Click on new part file

a. Give name as screw.prt
b. Click on the features tool bar. Revolving the sketch by using revolve feature.
c. Select the sketcher plane, make the sketch and select the centerline (vertical axis) about which we revolve the sketch.
d. Spin the model to see it in the 3-D view.
e. Activate helical sweep from insert menu.
f. Select plane to draw profile.
g. Use attribute tool box for right hand square threads.
h. Draw the screw cross sectional tool.
i. Geometry is created.

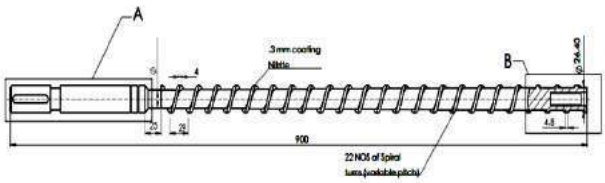
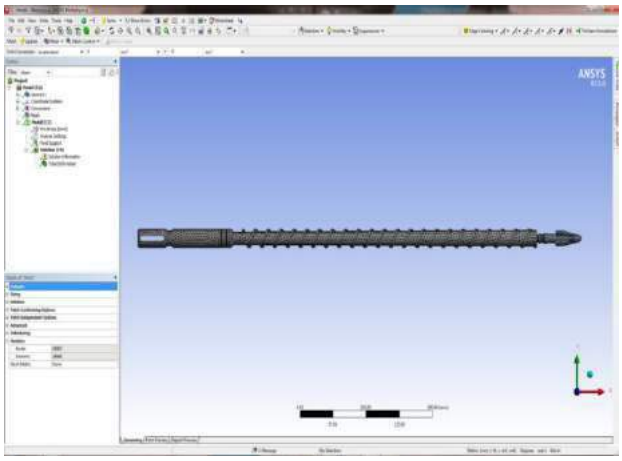


Fig Nomenclature of screw

Fig Screw Tip

Finite Element Analysis of reciprocating screw

As mesh model of assembly is prepared for which tetrahedron element is used with fine meshing and boundary conditions of torque 4942.6 N-mm applied at one end and remote displacement are provide to the assembly. And stress results is obtained.



Torsional analysis using different materials

Boundary condition is loading condition to the assembly. Supplied a torque of 4942.6 N-mm at one end of reciprocating screw. And reciprocating screw transmits this torque at another end of the screw. The maximum stress is shown in the below figure.

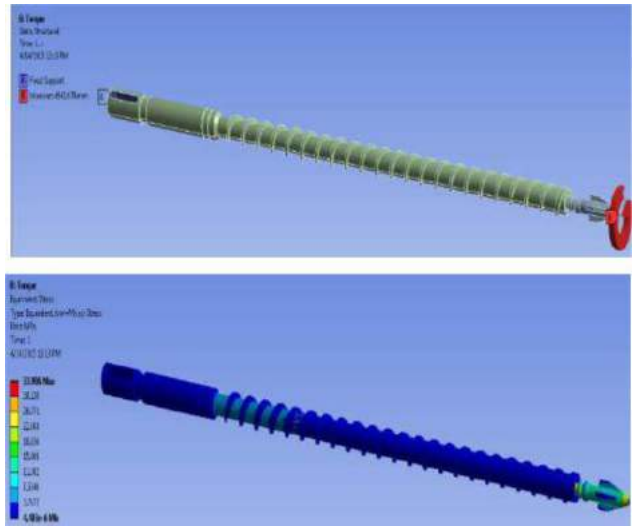
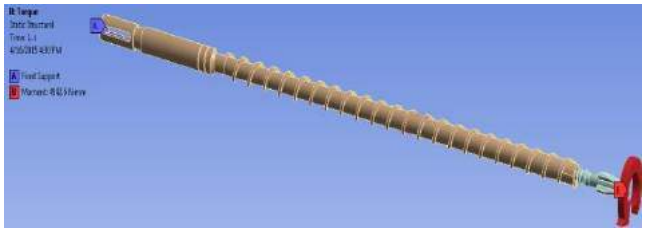


Fig:- LSS 01 Tool steel (ASTM 01) OHNS (existing material of screw) - Boundary condition Torsion Analysis



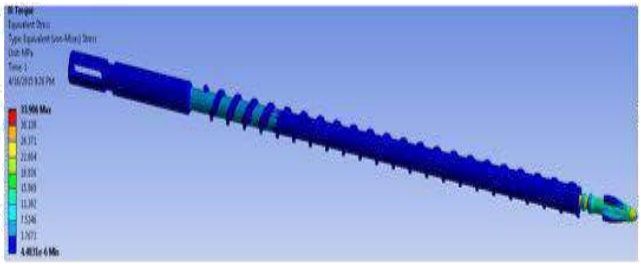


Fig: - HSS 142 Tool steel (material) Boundary condition Torsion Analysis

Analysis of Existing Reciprocating Screw

Analysis of existing reciprocating screw is done by using software ANSYS R15 by providing properties of reciprocating screw material and CATIA model. Then it is feed into the ANSYS R15 and static and thermal analysis has been done. We have madeanalysis by using properties of three different materials. First of all we have made analysis by using material Latrobe LSS 01 Tool steel (ASTM 01), it could not avoid that much failure of reciprocating screw**.**

Here, main material of screw is used i.eLSS 01 Tool Steel (ASTM01) OHNS where various different temperatures are applied in different zones. Further, using different mold materials such as nylon 66, total heat flux, directional heat flux and maximum temperature is analyzed.

Thermal Analysis

Analysis results for material LSS 01 Tool steel (ASTM01)

Temperature for mould materials applied at various zones of screw

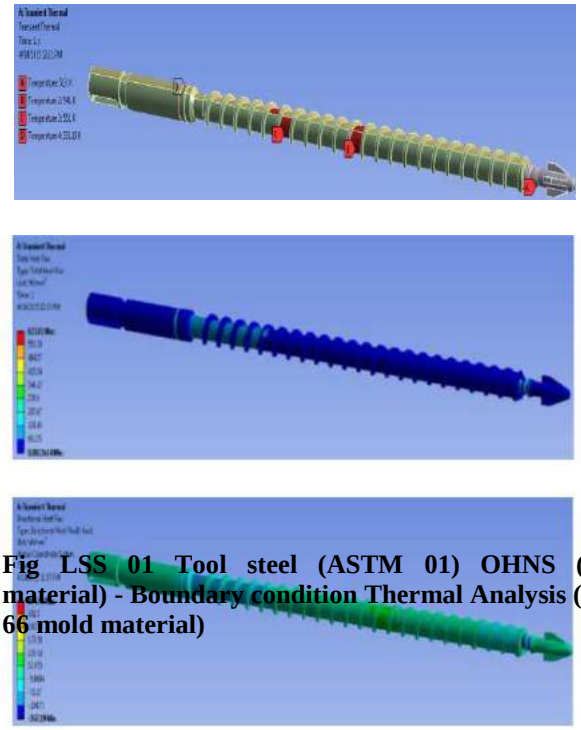


Fig LSS 01 Tool steel (ASTM 01) OHNS (screw material) - Boundary condition Thermal Analysis (Nylon 66 mold material)

Here, main material of screw is used i.e. .LSS 01 Tool Steel (ASTM01) OHNS where various different temperatures are applied in different zones. Further, using different mold materials such as (LDP), total heat flux, directional heat flux and is analyzed.

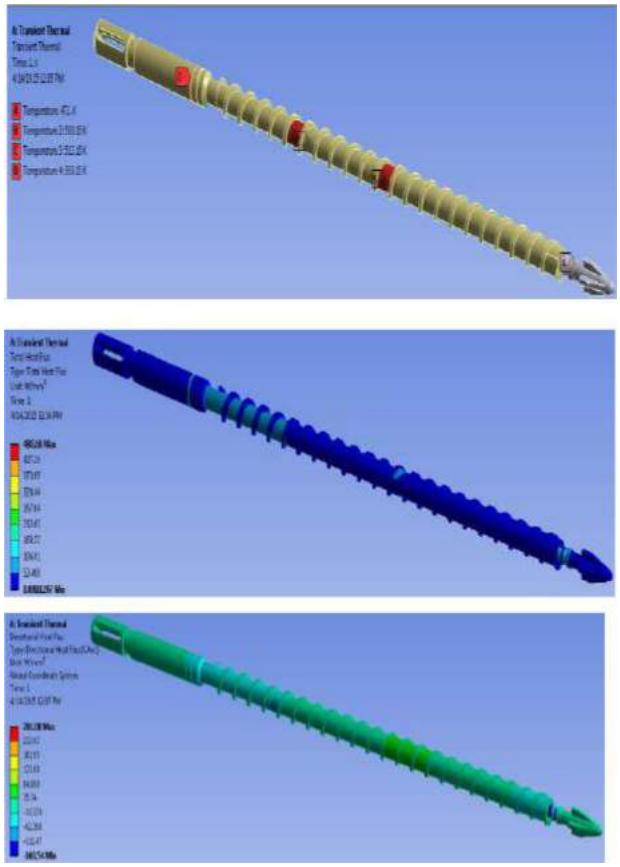
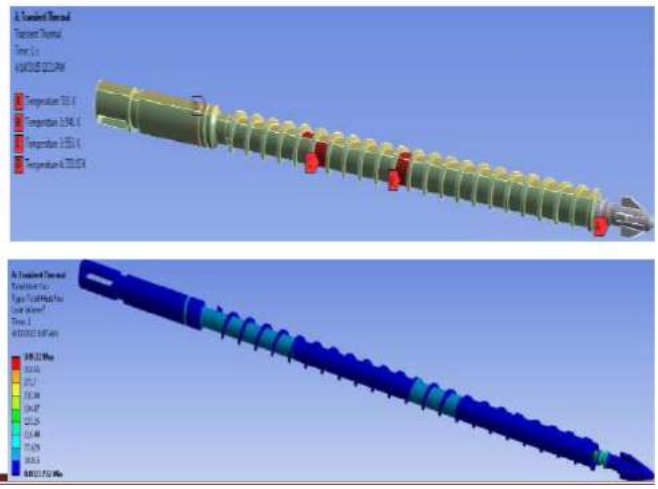


Fig :- Boundary condition Thermal Analysis of screw using mould material (low density polyethylene)

Analysis results for material HSS 142 Tool Steel

Here, main material of screw is used i.e. HSS 142 Tool Steel where various different temperatures are applied in different zones. Further, using different mold materials such as nylon 66, total heat flux, directional heat flux and is analyzed.

Temperature for mold materials applied at various zones of screw



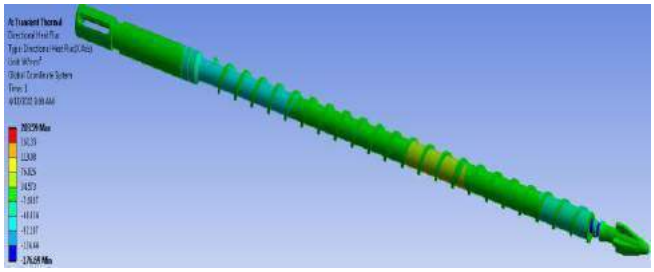
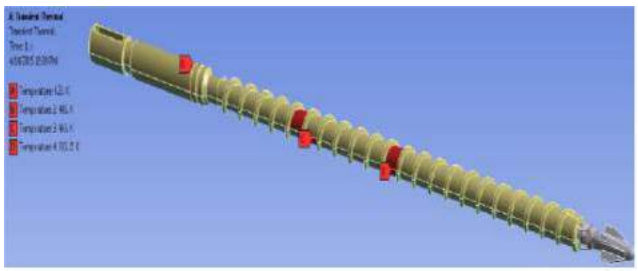
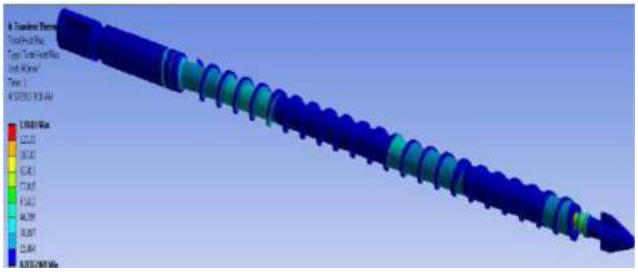


Fig:-Boundary condition Thermal Analysis of screw using mould material(Nylon 66)

Here, main material of screw is used i.e. HSS 142 Tool Steel where various different temperatures are applied in different zones. Further, using different mold materials such as LDP, total heat flux, directional heat flux and is analyzed.





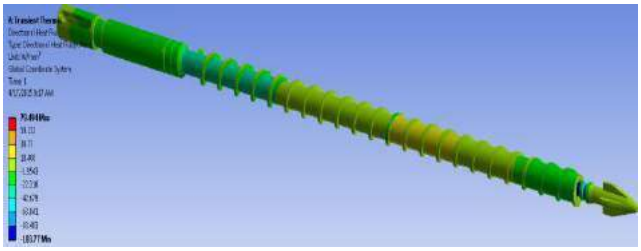


Fig: Boundary condition Thermal Analysis of screw using mold material (LDP)

Results Using Screw Material And Mould Material

Thermal analysis

Results Using Screw Material Latrobe LSS 01 Tool Steel (ASTM 01) OHNS

Mold Materials	Total Heat Flux	Directional Heat Flux	Highest Temp
Nylon-66	623 W/mm2	364 W/mm2	553k
Low density polyethylene	301 W/mm2	175 W/mm2	463k

Results Using Screw MaterialHSS 142 Tool steel

Mold Materials	Total Heat Flux	Directional Heat Flux	Highest Temp
Nylon-66	623 W/mm2	364 W/mm2	553k
Low density polyethylene	301 W/mm2	175 W/mm2	463k

Torsional analysis:-

Latrobe LSS 01 Tool steel (ASTM 01) OHNS		HSS 142 Tool steel	
Von-misses Stress	34Mpa	Von-misses Stress	34Mpa
Displacement	0.037	Displacement	0.0346

Conclusion

This is presents reciprocating screw of material Latrobe LSS 01 Tool steel (ASTM 01) OHNS of injection molding machine thermal and torsional analysis performed on screw using ANSYS R15 software analysis applying torque at the end on motor side and keeping whole surface of screw as fixed support side and different temperatures are applied at the various zones of the screw and having different mold material ,it is found that reciprocating screw has more chances of failure. In the same way For reciprocating screw of material HSS 142 Tool steel of injection molding machine Steady state Thermal analysis & torsional analysis performed on screw using ANSYS R15 software analysis applying torque at the end on motor side and keeping whole surface of screw as fixed support side, The HSS 142 Tool steel material is better than the existing material of the screw. The thermal heat flux is minimum 349 W/mm2 and the directional heat flux is 203 W/mm2. Hence, the HSS

142Toolis better material for minimizing the wear of screw and increase the life of screw.

FUTURESCOPE

a) For analyzing load condition, analysis results of reciprocating screw to be carried out with the help of ANSYS software.

b) New fabrication Methodology workout for fabrication of reciprocating screw which can be replaced with current system.

c) Various heat treatment processes will be applied so that we can improve material properties of reciprocating screw.

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LEAN MANUFACTURING: ELEMENTS AND ITS BENEFITS FOR MANUFACTURING INDUSTRY

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Abstract
In today's competitive environment organizations needs to leverage the strength it has and must work to improve upon its weakness. Lean manufacturing has been recognized as a key to improve aspect competitiveness for manufacturing organizations throughout the world. Lean manufacturing offers a basket full of tools and techniques which can help in waste identification, reduction or elimination, to enables manufacture of product with superior quality, lower cost and on time with lesser efforts. Considering its potential of improving operational performance lean manufacturing is gaining popularity among manufacturing industries.
Purpose of this paper is to present Lean Manufacturing elements, benefits, implementation strategy and obstacles in implementation for manufacturing industry.

Keywords:-Productivity, lean, waste, quality, technique.

I. INTRODUCTION:

Lean is defined as a strategy for achieving significant continuous improvement in performance through the elimination of all wastes of resources and time in the total business process. Its principles apply to nearly all business operations, from administration and product design to hardware productions. Lean manufacturing is about eliminating waste and non-value added tasks. Examples of waste in manufacturing include overproduction, over processing, waiting,Unnecessary part movement, excess inventory and defects, as applied to hardware production lean manufacturing focuses on eliminating all sources of waste by applying the following strategies.

1. One piece workflow
2. Take time
3. Pull system

Lean identifies the bottlenecks in design and development processes that add unnecessary delays and cost. It can help create a more efficient system that reduces time to market without compromising on quality.

Lean has a key role to play in new product development and the improvement of existing products and the improvement of existing products, including idea creation, design for manufacture, assembly and test, rapid prototyping, product portfolio management, market and competitor analysis, risk management, sales forecasting, setting key performance indicators and value analysis to reduce the cost of existing products.

Lean manufacturing is "A systematic approach for identifying and eliminating waste through continuous improvement by flowing the product at the pull of customer in pursuit of perfection".
Various techniques such as Six Sigma,5S, Total Quality Management (TQM), Theory of constraints(TOC), Total Productive Maintenance (TPM), Business Process Management (BPM), Visual Management, etc. supports the lean transformation in order to remove waste, variability and overburden and deliver improvements in specific areas. Every tool has its own way of eliminating waste; SMED reduces waiting and overproduction by creating shorter machine setup times. Value Stream Mapping draws the actual product flow through the manufacturing resources and can uncover important areas for improvement.

II. Literature review:

The works on the lean manufacturing are abundant; those that concern lean manufacturing in India are rather limited. Approaches towards lean manufacturing practice have been identified by various researchers. A case was described where lean principles were adapted for the process sector

for application at a large integrated steel mill. Value Stream Mapping was the main tool used to identify the opportunities for various lean techniques. They also described a simulation model that was developed to contrast the "before" and "after" scenarios in detail and in order to illustrate potential benefits such as reduction in production lead time and work in process inventory. The lean practices was divided into six areas which are process and equipment; manufacturing, planning and control, human resources, product design, supplier relationships and customer relationships. This study confirms that many firms seem to have difficulty in adopting lean tools that concern with external relationships with suppliers and customers even for high performance firms. Empirical results from this study also prove that lean tools in internal areas are adopted most widely in the firms, where the operation and management methods are more direct. Lean manufacturing was defined as an integrated system composed of highly inter-related elements and a wide variety of management practices, including Just-in-Time (JIT), quality systems, work teams, cellular manufacturing. The success of Lean Manufacturing implementation depends on four critical factors: leadership and management; finance; skills and expertise; and supportive organizational culture of the organization. Some researchers also suggested that applying the full set of lean principles and tools also contribute to the successful Lean Manufacturing transformation.

Table 1: Traditional manufacturing v/s lean manufacturing.

Parameters	Traditional Manufacturing	Lean Manufacturing
Production	Made to Stock	JIT(Customized)
Manufacturing lead time	Long	Short
Both quantity	Large	Small
Scheduling	Push	Pull
Inspection	Sampling	100% at source
Layout	Activity based	Cellular type
Inventory twins	Low	High
Flexibility	Low	High
People empowerment	Low	High

III. Principles and Practices of LeanManufacturing

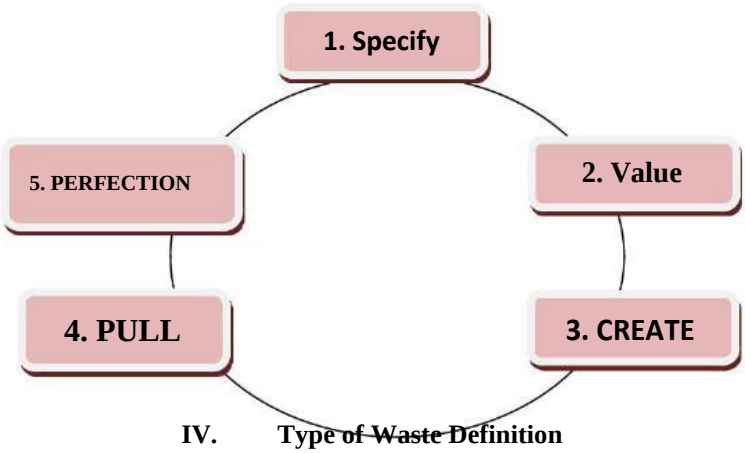
There is a one methodology of lean implementation according to lean principles.

The first principle is to specify value from the point of view of the customer‖ Manufacturers will give to their customers what is suitable for them, or imagine as cheap for the customers. It is imperative to know who the customer is: the final customer, next process, next company along the supply chain, or the customer,,s customer.

The second principle is the Value Stream. This refers to the series of processes from raw resources to the final client, or from the invention to its market open. The value stream should permit for unobstructed material, information, and people flow; the material flow focuses on the flow of materials from raw to ending product, the information flow focuses on the communication flow of customer necessities and orders within a supply chain, and people flow focuses on how people are able to move within and around the processes.

The third principle is Flow. Batch and queue processes should be avoid or continuously compact so that there is a smooth and quick flow of information, products, and services. Flow requires much preparation activity. But the most important thing is vision‖. According to Trent when looking through the point of view of an entire supply chain, it makes sense for activities to be organized in a way that allows for uninterrupted flow of work at the rate of demand pull from the customer. Disruptions to the supply chain flow affect the supply chain throughput, capacity, and cycle time and it ultimately adds little value that the customers appreciate‖.

The fourth principle is Pull. Pull means short-term reply to the customer,,s rate of demand, and not over produce.
The fifth principle is Perfection. Having worked one after the other through the previous four principles, a company would now be able to see that perfection within the company processes is now possible. This not only means a imperfection free company but also means delivering exactly what the customer desires, exactly when, at a light price and with smallest amount waste.



IV. Type of Waste Definition

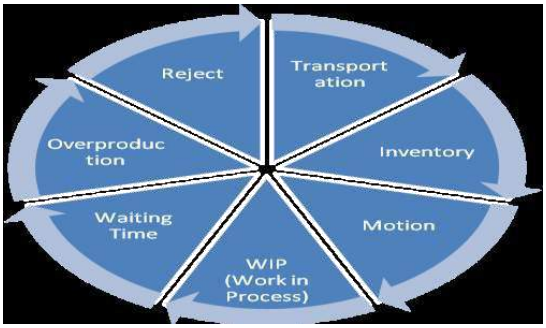


Fig. **7 Wastes**

- **A.** *Waiting*:-Time spent waiting for items required to complete a task (i.e. information, material, supplies, instruction etc.)
- **B.** *Unnecessary Motion:* - Any motion that does not add value to a product or service
- **C.** *Over processing*: - Effort and time spent on processing material which doesn‟t add value
- **D.** *Excess Inventory*: - Material that is waiting for processing or not required per customer demand
- **E.** *Unnecessary Handling:* - Unnecessary transportation of material by conveyor, forklift, or foot travel
- **F.** *Overproduction:* - Producing more products than the ultimate customer requires
- **G.** *Rework or Defects:* - Time spent on reworking or repairing defective products

V. Lean Manufacturing Tools and Techniques:-

Lean manufacturing is based on the continuous identification & removal of all kinds of wastes which are explained above. All the tools for LM aim at identifying different kinds of waste and their sources and then devise methodology to remove these from the system continuously. For highlighting the root causes of the problem and method to remove these, the following tools and techniques are used.

1.*Total Quality Management (TQM*)**:** It is a philosophy which is totally based on the customer‟s approach. It means "SATISFYING CUSTOMER FIRST TIME EVERY TIME".

2.*7-Quality Control (QC):*The seven QC tools are used in any industry to solve the problems. The seven QC tools are divided into four stages as given in fig below.

i) Identify the Problem

ii) Development of planning

iii) Formulation of action plans

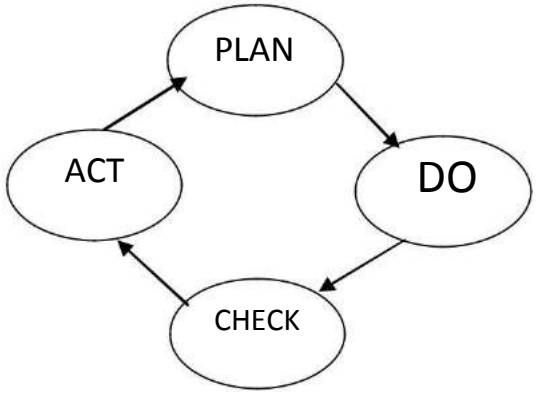
iv) Continuous small improvements

3. *Just In Time (JIT):*JIT concepts are based on pull demand model. Everything is done when they are actually needed.

4. *POKA YOKE*: It is a Japanese technique which means mistake proofing. Innovation is the key for POKA YOKE.

5. *KAIZEN*: Kaizen means small continuous improvements. It is a Japanese philosophy.

KAIZEN helps to decrease the risk in process improvement, which is involved in the lean implementation. It is basically dependent on PDCA cycle which is also called Deming cycle.



6. *5S's***:** "A place for everything and everything in its place" is the slogan that is usually followed when 5 S is applied. Following five elements are fundamental to 5S.

(1) SERI: Sorting and disposing of unwanted item

(2) SEITION: Organizing

(3) SEISO: Cleaning

(4) SEIKETSU: Standardizing

(5) SHITSUKE: Discipline

VI. CHALLENGES IN LEAN IMPLEMENTATION

The challenges face in the procedure of implementing and maintain lean is a boring job as the concept relate to time, cost, awareness, and participation, the concepts that jointly support the new revise for growth in an firm. The following important factor of resistance to change in manufacturing sectors is

Fear to change the bequest system with the new winning trend and methodologies

Not utilize the opportunity and return of the new policy

Market damage will lead to force the change, which will be in a non-standard format.

VII. Benefits of Lean Manufacturing:-

1. Reduced cost: By implementation of Lean Manufacturing organizations can achieve reduced cycle times, increased labour productivity and elimination of bottlenecks and reduced machine downtime can be achieved, and companies can generally significantly increased output with reduced cost from their existing facilities.
2. Reduced lead time: With the effect of reduced cycle time and work in progress inventory lead time to manufacture and deliver the product is drastically reduces.
3. Waste reduction: Waste identification and reduction is one of the main functions of Lean Manufacturing implementation plan. All the form of waste i.e. overproduction, defect, transportation, work in progress inventory, over processing, waiting and motion are reduced with Lean manufacturing implementation.
4. Improved productivity - Improve labour productivity, both by reducing the idle time of workers and ensuring that when workers are working, they are using their effort as productively as possible (including not doing unnecessary tasks or unnecessary motions).
5. Reduced work in progress (WIP) Inventory - Minimize inventory levels at all stages of production, particularly works-in-progress between production stages. Lower inventories also mean lower working capital requirements.
6. Lower Cycle Times - Reduce manufacturing lead times and production cycle times by reducing waiting times between processing stages, as well as process preparation times and product/model conversion times.
7. Improved Flexibility - Have the ability to produce a more flexible range of products with minimum changeover costs and changeover time.
8. Multi skill worker – Involvement of worker in various Lean tools i.e. quality circles, kaizen circle, layout improvement; value stream mapping, set up time reduction etc. creates better understanding of processes, machines, material flow among the team and improves core competencies of worker.
9. Better Utilization of equipment and space - Use equipment and manufacturing space more efficiently by eliminating bottlenecks and maximizing the rate of production though existing equipment, while minimizing machine downtime

10. Reduced Defects - Reduce defects and unnecessary physical wastage, including excess use of raw material inputs, preventable defects, costs associated with reprocessing defective items, and unnecessary product characteristics which are not required by customers.

VIII. Obstacles in Lean Manufacturing implementation:

The following may be some obstacles in Lean manufacturing implementation:

1. Lack of management support: the reason can be pressure from customer side; competitor is following lean practices or others. In this case management just starts and does not propel further this results only superficial lean and neither lean is implemented nor does it get benefit.
2. Lack of training: Another reason is lack of clear understanding about lean throughout the organization. The organization where knowledge of lean lacks it cannot be implemented.
3. Communication – Lack of communication is one of the prime obstacles in lean manufacturing implementation.
4. Resistance to Change – Resistance to change is very common phenomena as it increases fear of failure, initial cost so many of routine liking people doesn‟t want to change and hence it stops the progress of lean implementation.
5. No direct financial advantage – Lean does not produces any direct financial benefits but it helps in identification and elimination of waste hence reduction of cost. Lean does not have any financial measure in terms of input and output so sometimes lean idea is superseded by other organizational priorities.
6. Past failures – In case of poor launching of Lean is itself big obstacle. Lack of implementation strategy may lead to lack of faith in whole philosophy.

IX. Conclusion:

This paper presents the review of lean thinking and its concept through definitions from literature. The main focus of lean manufacturing is to eliminate waste, doing things better in half of the resources as mass production requires, providing higher quality with lesser cost. More and more facets of lean manufacturing will come forth as researchers are keenly bringing through continual research. The good understanding of lean principles and practices is required for successful implementation of lean as lean practices without knowing lean principles can give short term success but may fail as long term strategy.

Lack of Planning, Lack of top management commitment, Lack of Methodology, Unwillingness to learn and see and Human Aspects are the main barriers or problems which can be faced while implementing the Lean Manufacturing. These have already been discussed in the previous section. This paper shows that one the major difficulties companies encounter in attempting to apply lean is not knowledge of particular tools and techniques, perhaps lack of comprehensive and suitable lean knowledge related to probable problems within the companies by the managers, direction, gap and a lack of recognition of lean culture in whole of the organization and planning cause the fails within the implementations. Additionally, some managers try to enhance the implementation by some of the lean tools and mostly try to only implement the "continuous improvement" and explicitly forget

another basic lean principle, "respect for people". The managers should know that lean thinking won't derive during a short time, and they should prepare the context of implementations before every decision making.

The paper tried to present best way for lean implementation available in literature along with discussion that lean is applied successfully in different sectors than automobile sector such as service sector, discrete manufacturing, etc. The recent literature shows that the trend in lean manufacturing for research now is focused on lean assessment. Leanness attracts focus to answer specific questions of managers responsible for lean implementation to assess the lean implementation level and to justify spending over lean implementation. In this paper, presents the review of barriers of lean implementation from literature review. Understanding the barriers is important for managers to avoid failures and to sustain lean leap. The future research may be to identify such barriers through extensive literature review and interviews of working professionals as very little work happened on this subject. The way forward for research in this area may be multiple criteria. The paper contributes by identifying enablers & barriers in implementing the lean principles and practices, methodologies used in leanness measurement of an organization in the Indian manufacturing industry.

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TECH-CHRONICLE
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DESIGN AND ANALYSIS OF DISC BRAKE

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ABSTRACT

Each single system has been studied and developed inorder to meet safety requirement. Instead of having air bag, goodsuspension systems, good handling and safe cornering, there isone most critical system in the vehicle which is brake systems.Without brake system in the vehicle will put a passenger inunsafe position. Therefore, it is must for all vehicles to haveproper brake system. In this paper carbon ceramic matrix disc

Brake material use for calculating normal force, shear force andpiston force. And also calculating the brake distance of discbrake. The standard disc brake two wheelers model using inAnsys and done the Thermal analysis and Modal analysis alsocalculate the deflection and Heat flux, Temperature of disc brakemodel. This is important to understand action force and frictionforce on the disc brake new material, how disc brake works moreefficiently, which can help to reduce the accident that mayhappen in each day.

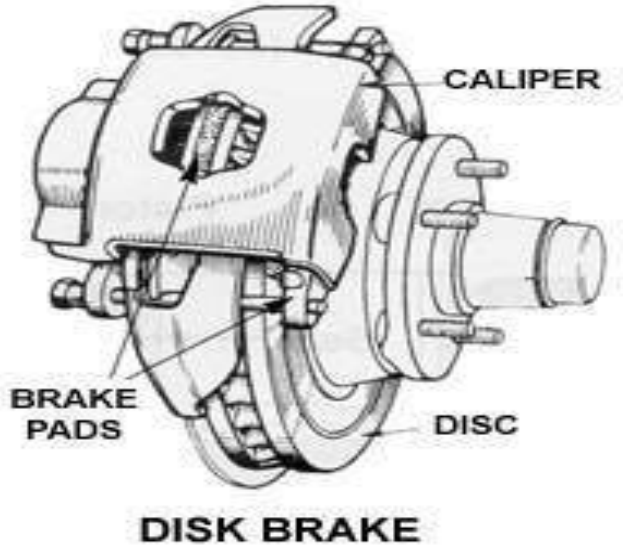
KEYWORDS— Disc Brake, Thermal Analysis, Modal Analysis,Heat flux

I. INTRODUCTION

The disc brake is used to stop or slow down the vehicleeffectively. The brake disc or rotor is usually made of cast iron, but may insome cases be made of composites such as reinforced carbon-Carbon or ceramic matrix composites. This is connected to theWheel and/or the axle. To stop the wheel, friction material inthe form of brake pads, mounted on a device called a brakeCaliper, is forced mechanically, hydraulically, pneumaticallyor electromagnetically against both sides of the disc. FrictionCauses the disc and attached wheel to slow or stop. A brake disk rotor forms pan of a foundation brake and rotates with the wheel hub assembly. The mainFunction of a foundation brake is to generate aRetarding torque by converting mechanical energy toThermal energy by virtue of the frictional work donein relative sliding at the rotor-pad interface. Disc-style brakes development and use began in Englandin the 1890s. The first caliper-type automobile disc brake waspatented by Frederick William Lanchester in his Birmingham,UK factory in 1902 and used successfully on Lanchestercars. Recently,Disk brakes have been widely used in light vehicles.Long repetitive braking leads toTemperature rise of various brake components of theVehicle that reduces the performance of the brakeSystem. Long repetitive braking, such as one whichOccurs during a mountain descent, will result in aBrake fluid temperature rise and may cause brakeFluid vaporization. This may be a concern particularlyfor passenger cars equipped with aluminum calipersand with a limited airflow to the wheel brake Systems.

A schematic diagram is shown in the fig

Fig1DiskBrake.



1 CALLIPER

Foundation of any disc brake is the caliper body: the U-shaped casting thatwraps around the rotor (like a hydraulic C-clamp) is usually made of NodularCast iron but some are aluminum for lighter weight. Single piston calipers are usually one piece, and multi pistoncalipers that have pistons on both sides of the rotor are madein two pieces that are bolted together with high strength bridgebolts. Most calipers have an inspection hole in the bridge where the padthickness can be quickly checked.

1.1 Fixed Caliper: Body usually manufactured in two halves; has two, three or fourpistonsGets its name from the fact that it is rigidly mounted to theknuckle; no part of the caliper body moves when the brakesare applied.

1.2 Floating / Sliding Calipers: Not rigidly mounted, are free to move within a limited range on ananchor that is solidly mounted to the vehicle

Anchor may be cast into the knuckle or it can be a separate piecethat bolts onWhen floating / sliding disc brakes are applied the caliper piston moves out ofits bore and forces the inner pad against the rotor while the pressure on theclosed end of the bore moves the caliper body in the opposite directionforcing the outer pad against the rotor at the same time.

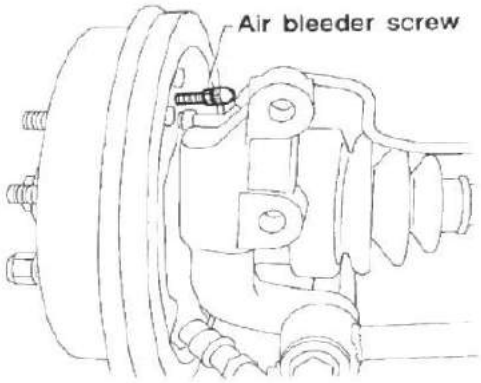
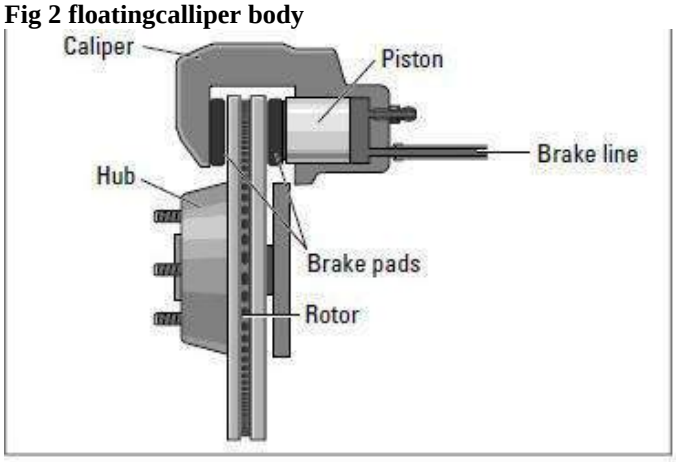


Fig 2 floatingcalliper body



floating calliper with piston

2Bleed Screw: Bleeder screws are located at the highest point of the bores

When the caliper is installed on the vehicle (don‟t forget the Caster angle).Bleed screw always on top where the air will be and try to

Think about the technicians who will be working on your design in this

Regard and with other features incorporated.

Fig 3 Bleed Screw

3Piston: Brake caliper pistons form the interface between the hydraulicsystem and the mechanical action of the disc brake by moving

Outward in the bore converting pressure to mechanical force Pushing the pads against the rotor to stop the vehicle.

They must be:

- strong
- durable
- resist corrosion
- maintain size & shape under extremes of temperature and pressure
- light as possible to reduce unsprung weight
- Prevent or slow the transfer of heat to the brake fluid.

3.1 Aluminum pistons: These are very light weight with some disadvantages:

• Expands much faster than cast iron when heated; requires Fairly large clearance in the bore and can lead to leaks (also Shrinks much faster in cold) and other problems.

• Although anodized, more susceptible to corrosion and scuffing

• Excellent conductor of heat and poor at keeping heat away From brake fluid.

3.2 Steel pistons: very strong and maintain size and shape over a

Wide range of temperature and pressure

• Chrome plated to resist corrosion

• Relatively heavy and conduct more heat than desirable in Hotter running brake systems

4 DiscBrakes Seal

Calipers require seals to prevent fluid from escaping through the clearance

Between the piston and its bore.Early disc brake designs sometimes experienced unacceptable piston“knockback”. This knockback causes inconsistent and excessive pedal travel

at brake apply. Can be quite a surprise. Most seals are lathe-cut “O” rings with a square cross section thatfit into a groove machined into the caliper body bore.

The piston slides through the inside of the seal; outside diameter

of the piston provides one sealing surface and the seal groove Is the other sealing surface. This is usually a compression fit.

5 BrakePads: Contact the rotor to create the friction that converts kinetic

energy into heat when stopping the vehicle

Two pads are used in a disc brake: one on each side of the rotor

Designed and manufactured in all sorts of various shapes and Sizes usually to fit the package space available while Maximizing lining area and volume for optimum lining life

All have a metal backing plate (usually steel) to which lining is
Molded or riveted

6 DiskRotor
Rotors are the largest and heaviest parts of the disc brake Assembly.They provide friction surfaces for the linings to rub against and
Together these parts create the "friction couple" that converts Kinetic energy into heat and stops the vehicle.
They absorb and dissipate most of the heat generated in braking.
Made of cast iron because of its relative: low cost, good wear andfriction properties and ease of machining

II. DISK BRAKE CALUCALTION

Disc Brake Standard
Rotor disc dimension = 240 mm. (240×10-3
m) Rotor disc material = Carbon Ceramic
Matrix Pad brake area = 2000 mm2 (2000×10-
6 m) Pad brake material = Asbestos
Coefficient of friction (Wet) = 0.07-0.13
Coefficient of friction (Dry) = 0.3-0.5
Maximum temperature = 350 ºC
Maximum pressure = 1MPa (106 Pa)

3.1 Tangential force between pad and rotor (Inner face)
FTRI = μ1.FRI
Where, FTRI = Normal force between pad brakeAnd Rotor (Inner)
μ1 = Coefficient of friction = 0.5
FRI = P max / 2 × A pad brake area
So, FTRI = μ1.FRI
FTRI = (0.5)(0.5)(1×106 N/m2) (2000×106
m2) FTRI = 500 N.
Tangential force between pad and rotor (outer face) , FTRO.
In this FTRO equal FTRI because same normal force and same material

3.2 Brake Torque (TB) –
With the assumption of equal coefficients of friction and Normal forces FR on the inner and outer faces:
TB = FT.R
Where TB = Brake torque
μ = Coefficient of friction
FT = Total normal forces on disc
brake, = FTRI + FTRO
FT = 1000 N.
R = Radius of rotor disc.
So, TB = (1000) (120×10-3)
TB = 120 N.m

3.3 Brake Distance (x) –
We know that tangential braking force acting at the point of contact of the brake, and
Work done = FT. x .....(Equation
A) Where FT = FTRI + FTRO
X = Distance travelled (in meter) by the
vehicle before it come to rest.
We know kinetic energy of the vehicle.
Kinetic energy = (mv2) / 2 .....(Equation
B) Where m = Mass of vehicle
v = Velocity of vehicle
In order to bring the vehicle to rest, the work done against friction must be equal to kinetic energy of the vehicle.
Therefore equating (Equation A) and (Equation B)
FT. x = (mv2) / 2
Assumption v = 100 kg/h = 27.77 m/s
M = 132 kg. (Dry weight of
Vehicle)
So we get x = (mv2) / 2 FT
x = (132×27.772) / (2×1000)
m. x = 50.89 m
Heat Generated (Q) = M .Cp. ΔT J/S
Flux (q) = Q/A W/m²
Thermal Gradient (K) = q / k K / m
Carbon Ceramic Matrix –
Heat generated Q= m*cp*ΔT
Mass of disc = 0.5 kg
Specific Heat Capacity = 800 J/kg 0 c
Time taken Stopping the Vehicle = 5sec
Developed Temperature difference = 15 0 c
Q = 0.5 * 800 * 15= 6000 J
Area of Disc = Π * (R2 – r2) = Π * (0.120 2 – 0.055 2) = 0.03573 m 2
Heat Flux = Heat Generated /Second /area = 6000 /5 / 0.0357 = 33.585 kw/m 2
Thermal Gradient = Heat Flux / Thermal Conductivity
= 33.582*10 3 / 40
= 839.63 k/m

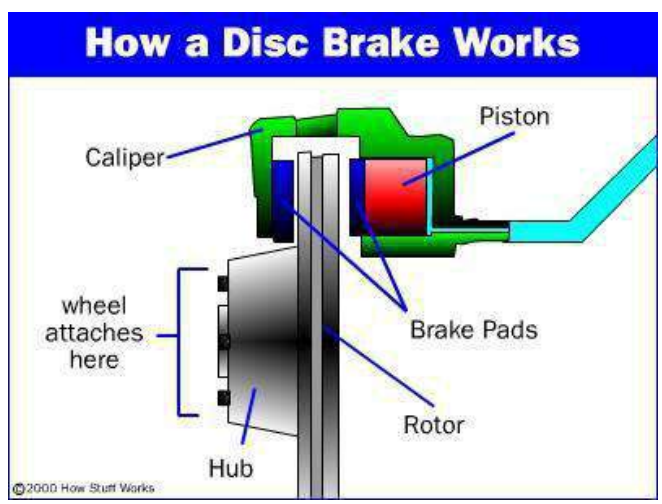


Fig 4 How Disk Brake Works

III. PROBLEMS IN DISK BRAKE

Braking performance of a vehicle can be significantlyaffectedby the temperature rise in the brake Components. High temperature during braking mayCause brake fade, premature wear, brake fluid Vaporization, bearing failure, thermal cracks, andthermallyexcited vibration. Therefore, it is importanttopredict the temperature rise of a given brakeSystem and assess its thermal performance in theearlydesign stage. Recently, brake fluid vaporizationhasbeen suspected as a possible cause of someCollisions and a proper inspection procedure has beenrecommended. Disk brakes are exposed to large thermal stresses

During routine braking and extraordinary thermalStresses during hard braking. High decelerationsTypical of passenger vehicles are known to generateHigh temperatures in a fraction of a second. TheseLarge temperature excursions have two possibleOutcomes: thermal shock that generates surfaceCracks; and/or large amounts of plastic deformation

In the brake rotor. In the absence of thermal shock, arelativelysmall number of high braking cycles arefoundto generate macroscopic cracks runningthroughthe rotor thickness and along the radius of

The disk brake. Heat generation due to friction in theSliding contact of two bodies influences friction andWear characteristics of brake systems

IV. ACKNOWLEDGMENT

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TECH-CHRONICLE
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BAMBOO: AN ECOFRIENDLY MATERIAL FOR SUSTAINABLE DEVELOPMENT

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Abstract:
Widely used in Asian, Pacific Islander and Central and Southern American cultures, bamboo is a sustainable and sturdy building material.. Bamboo is a naturally occurring composite material which grows abundantly in most of the part of the world. It is treated as a composite material because it has cellulose fibers imbedded in a lignin matrix. Using bamboo rather than metal also holds several advantages for producers — and for the environment. As a cheap and fast-grown resource, with superior physical and mechanical properties, bamboo offers great potential as an alternative to wood. Using bamboo rather than metal also holds several advantages for producers — and for the environment. Bamboo based industry has vast potential for generating income and employment, especially in the rural areas. The paper brings out the taxonomy, chemical composition, physical and mechanical properties of bamboo with a focus on sustainable development.

Keywords: Sustainable Development, bamboo, mechanical properties

Introduction

Unlike wood, bamboo (a member of the grass family) regenerates very quickly. It is, in-fact, one of the fastest growing plants in the world, with the fastest growth rate reaching 100cm in a 24-hr period (Farrelly, David (1984). The Book of Bamboo. Sierra Club Books.). Sustainable development (Carlos J. Castro, 2004) is widely acknowledged as a key concept for humanities future. Sustainability calls for balancing short term business interest and long term development of both the society and company itself. It involves the simultaneous pursuit of economic, social and environmental objectives (Markus will, 2005). After more than 200 years of industrialization in the Western world and more than 50 years of 'development' in the Third World, the benefits delivered by the grand design of progress and modernity are, at best, ambiguous. Despite phenomenal advances in science, technology, medicine and agricultural production, the promise that 'development' would eradicate world poverty remains unfulfilled in several parts of the globe, especially in the Third World (Subhabrata Bobby Banerjee, 2003). Even the biggest economies shiver with small up and down in the industry. Reason behind this ambiguity is that the sustainability aspect is not being addressed properly in fast moving development efforts (Brian Kermath, 2007). Sustainable development refers to the equity, in particular concerning the todays's and future generations as defined by Brundtland Commission (WCED, 1987).This true for the resources as well as for any business. If we consider the sustainability of wood resource around the globe, availability of industrial wood from natural forests has been on decline for many years. This has raised a growing concern to save forests. Consequently the wood based industry as well as the opportunities in this area have also affected to a large extent. Wood is largely being replaced by plastics, wherever possible. However the environmental hazards of the plastics always keep a hanging sword. On the other hand the strength properties of the plastics can never be compared with the industrial wood. Even the timbers available from fast growing plantation species generally have lower strength properties, dimensional stability and service life. Bamboo is renewable, abundantly available, low cost and environment friendly (Azmy H.J. Mohamed et al., 2007) wood resource that creates an eye of hope for the struggling wood based industry with its excellent strength (A.C. Sekhar et al, 1962; Limaye, V.D., 1952). It has tremendous economic potential with its significant applications and innovative products. Since the bamboo is widely available across the different parts of India, it offers great opportunities to the micro, small and medium scale enterprises (Markus Will, 2008). Since the bamboo resource is widely available across the rural domains and industrial effort requires a lot of labour, bamboo has a great potential to offer job opportunity and income source to the rural masses. This can ultimately lead to the sustainable development of rural folks (V. Sorna Gowri, 2003;

Suresh Moktan, 2007) and hence contributing significantly to the economy.

Mechanical and Physio-chemical Properties of Bamboos

Bamboo offers a vast variety of commercial and domestic products due to its excellent mechanical, physical and chemical properties (Li Xiaobo, 2004). Bamboo is a natural lingo-cellulosic composite in which cellulose fibers are

embedded in the lignin and hemi cellulose matrix. Bamboo contains 44.5% cellulose, .5% lignin, 32% soluble matter, 0.3% nitrogen and 2% ash. Average length is 2 mm and average diameter is between 10-20m (Adamson, W.C, 1978). The geometry of bamboo's longitudinal profile has macroscopically functionally graded structure, which can withstand extreme wind loads. Fiber distribution is transverse cross-section at any particular height of bamboo, is dense in outer periphery and sparse in inner periphery. Bamboos mainly consist of the roots, culm and leaves. The culms are the most useful part in a bamboo. They are hollow and vary in sizes, diameters, colors and textures. The culm consists of the strands of cellulose fibers and the lignin matrix. Spaces between adjacent strands of fibers are filled with lignin, a type of resin. The number of fibrous strands increases toward the outer surface of the culm. Cellulose fiber is stronger than the lignin matrix. Also the cross-sectional area of the culm changes from location to location. Hence, the cellulose strand distribution would be different at different sections plant species. Bamboo has different mechanical properties in the three dimensions: axial, radial and tangential. However, bamboo is a biological material and it is subjected to great variability and complexity due to various conditions such as years of growth, soil and environmental conditions and the location of bamboo culm within the bamboo. Hence, it is observed that the mechanical properties of bamboos vary enormously (A. K. Ray et al., 2005). Bamboos are available in the form of different species and the mechanical and physio-chemical properties vary from one species to other species.

Throughout the world there are about 500 different species of bamboo. Mechanical and chemical properties are not fixed for all the species. It depends on type of species, length (from top to bottom), horizontal layer (from inner side to outer periphery), age of the tree (in years). N. K Naik (2005) characterized seven species of bamboos: Bambusa Balcooa, Bambusa Bambos, Bambusa Nutans, Bambusa Tulda, Dendrocalamus Giganteus, Dendrocalamus Strictus, and Melocanna Bambusoides. He found great variation in mechanical properties for these seven species. Aging of a bamboo culm affects physical, chemical, and mechanical properties. The physical and mechanical properties of bamboo vary with the age of the bamboo and the height of the culm (Chauhan, 2000) bamboo. The increase in weight is cumulative and directly related with age. Strength properties are reported to decrease in older culms (Zhou, 1981). Limaye (1948,1952) found that older culms of Dendrocalamus strictus became 40-50 percent stronger and stiffer than young ones. Sekhar et al. (1962) found highest values in 3-4 year old culms of Bambusa nutans.

Except one year old bamboo, alcohol-toluene and hot water extractive contents increased from the bottom to the top portion. Alcohol-toluene extractive content showed a continuous increase from one year old to five year old bamboo. Hot water extractives showed an increase from one year old to three year old bamboo and then decreased from three year old to five year old bamboo. Li Xiaobo (2004) found that the fiber distribution has the highest concentration in the outer layer of bamboo. The moisture content of three year old bamboo in the green condition decreased from the bottom to the top portion. Specific gravity and bending properties of bamboo vary with age , height location as well as horizontal layer. They all increase from one year old to five year old culms. The outer layer had significantly higher specific gravity and bending properties than the inner layer. The top portion had a consistently higher specific gravity than the bottom portion. The outer layer had a more decisive role in supporting bamboo than the inner layer. Bending strength had a strong positive correlation with specific gravity. In order to industrially use bamboo strips efficiently, it is advisable to retain outer surface material to produce high strength bamboo composites. Compression properties parallel to the longitudinal direction were significantly higher than perpendicular to the longitudinal direction. The variability of compression perpendicular to the longitudinal direction was significantly higher than parallel to the longitudinal direction. Bamboo grows in different climates from plane to high mountain side. The mechanical and physico-chemical properties of the bamboo as well as bamboo composites are also influenced by the climatic and ecological factors, cultivation techniques and harvesting details. Thus the origin of the bamboo must be considered, whenever finding specific applications.

Bamboo Products

Bamboos is most suitable for structural products due to its good mechanical and physical properties. Bamboo composites (Seema Jain et al., 1992) are normally used for structural products rather than the raw bamboos. This is because of possible variability of properties along the longitudinal and radial directions as well as physical dimensions of the products required. For load carrying structural composite products, mechanical properties such as tensile strength, compressive strength, shear strength, flexural strength and bending elasticity modulus are important. For flooring tiles and veneers, through-the-thickness compressive strength, hardness, abrasion resistance and slip resistance are important. For structural assemblies, nail withdrawal strength is important. Applications of bamboo products have been increasing. The main application areas are: flooring, veneer, handicrafts, decorative boards, sports equipment and other building materials. Bamboo is used as raw material for pulp, paper and panel board industries. They are also common in many traditional applications such as: for fencing, water pipes, fishing rods, umbrella handles, musical instruments and decorative handicrafts. The applications of bamboo, which can really push the small and medium scale enterprises, are discussed in the following section.

Bamboo Based Panels

Bamboo based panels are products made from raw bamboo through a series of mechanical and chemical procedures,

such as spraying glue, laying up, and hot pressing. The bamboo-based panels have advantages of large size, high strength, stabilization in shape and size, and its parallel and perpendicular strength and property that can be adjusted according to different demands (Zhang et al, 1995). Bamboo based panels are relatively ideal engineering materials. At present, the main sorts of bamboo based panels which can be developed in the construction field are: Mat Plybamboo, Curtain Plybamboo, Laminated Bamboo of Strips, Plybamboo, Bamboo Particleboard, Bamboo Composite Board. At present, bamboo based panels have been widely used to the manufacture the bottom boards of vehicles, moulding boards of construction, scaffoldings, and has partly taken the place of wood, steel, plastic etc as raw materials of furniture and decorating materials. Bamboo-based composite may also be the suitable alternative as the materials of prefabrication in terms of the various advantages they contain. However, the application of bamboo based panels for this utilization is still very limited. Development of panel products based on bamboo strip are gaining importance as these panel products reassemble wood when used in a particular fashion as in parallel laminates. These laminates will have superior physical mechanical properties and are suitable for structural and specialized application. More over requirement of resin adhesives is expected to be lower compared to bamboo mat based composites and therefore making the products cost effective which are considered to be ideal for alternates to wood and plywood for several end use applications. Bamboo laminates could replace timber in many applications such as doors and windows, frames, partitions, furniture, flooring and some structural applications. IPIRTI has already developed a technology for bamboo laminates that is ready for commercialization.'

Paper, Textiles and Board

Bamboo fibers are relatively long (1.5-3.2 mm) and thus ideal for paper production (El Bassam, 1998). In India, 2.2 million tonnes of bamboo per year are processed into pulp, making up about two-thirds of total pulp production (Adamson et al., 1978; IFAR/INBAR, 1991). At least eight North American suppliers are importing and marketing tongue-and-groove flooring made from laminated bamboo, which is said to be as hard, durable and dimensionally stable as oak or other hardwood flooring (e.g. Plyboo America Inc., Kirkville, NY). Bamboo culms are sliced into strips, which are boiled to remove starch, dried, and laminated into solid boards using urea-formaldehyde adhesives. The boards may be treated with preservatives such as boric acid, before or after laminating, or both, and a darker amber color may be produced by pressure-steaming the bamboo to carbonize it. Although the adhesive tends to emit formaldehyde for a long time after production, the amount of ureaformaldehyde resin in a laminated product is much less than in a panel board product (Environmental Building News, 1999). Bamboo textiles are much softer than the softest cotton, bamboo fabrics have a natural sheen to the surface and they really do feel similar to silk textiles or cashmere fabrics. Bamboo fiber based fabrics are naturally anti-microbial and requires no harmful chemicals. Bamboo textiles contain an agent, called 'bamboo kunh', this agent prevents bacteria from cultivating. Bamboo clothing not only feels cooler in the summer but it is significantly warmer in the winter. Bamboo fabrics make a lighter garment that is more comfortable.

Bamboo Food

Bamboo finds a new fashion in food with wonderful recipes of Bamboo shoots. These bamboo shoots are young, new canes that are harvested for food before they are two weeks old or one-foot tall. Bamboo shoots are crisp and tender. Bamboo shoots are low in fat and calories. The shoots are a good source of fiber. Fiber helps keep cholesterol levels in check and plays a role in preventing colon cancer. Bamboo shoots are also a good source of potassium. It helps to maintain normal blood pressure and a steady heart beat. When it comes to phytochemicals, natural substances found in plants, bamboo shoots hold promise. They contain lignans and phenolic acids. Lignans, a component of fiber, exhibit a number of important properties that are undergoing research. Lignans appear to have anticancer, antibacterial, antifungal and antiviral activity. Phenolic acids have mild anti-inflammatory properties and are potent antioxidants. Antioxidants help prevent cancer and the blood vessel injury that can start atherosclerosis. About 200 species of bamboo can provide edible and palatable bamboo shoots, including: monopodial bamboos: Acidosasa edulis, Chimonobambusa quadrangularis, Phyllostachys heterocycla var. pubescens, P. praecox, P. dulcis, P. iridescens, P. makinoi, P. nuda, P. prominens, P. sulphurea cv. viridis, P. vivax, Pleioblastus amarus and Qiongzhuea tumidinoda; and 2. sympodial bamboos: Bambusa rigida, B. pervariabilis, Dendrocalamus latiflorus, D. asper, D. brandisii, D. hamiltonii, Dendrocalamopsis oldhami, D .beecheyana, D. beecheyana var. pubescens, D. stenoaurita, D. variostriata and Schizostachyum funghomii. Fresh bamboo shoots are delicious and healthy, with a high fibre content. Bamboo vegetables can be found in Chinese grocery stores and restaurants worldwide. After cooking the shoots are still crisp, because cooking does not destroy their texture. Cooked bamboo shoots can be stored in containers and shipped worldwide. bamboo shoots of a number of species are a well-known feature of Chinese and other Asian cuisine, generally imported into the USA in canned form (one estimate suggests 30,000 t/year in the early 1990s). Exports from Taiwan are worth $50 million annually, and those from Thailand $30 million, with much of this going to meet Japanese demand (Scurlock et al., 2000).

Combustion and other Bio-energy Applications

Molini and Irizarry (1983) proposed the use of bamboo as a fuel for power generation in Puerto Rico in preference to sugar cane, since its lower moisture content at harvest obviates the need for drying, but they provide few data in support of their case. Limited experience has been gained

using de-lignified bamboo pulp as a substrate for ethanolic fermentation (Ram and Seenayya, 1991). Early work on preparing a diesel-like fuel from bamboo culms (Piatti, 1947) is cited by Tewari (1992); the process appears to have been the pyrolysis of "black liquor" from bamboo pulping, but does not seem to have progressed beyond the laboratory scale (Piatti, 1947). The review by Scurlock et al. (2000) evaluates bamboo as a potential bio energy feedstock, and tackles some of the myths and facts surrounding it--its "prodigious" productivity, its "disastrous" flowering, its multiple uses, etc.

Bamboo Charcoal and Activated Carbon

Bamboo charcoal is traditionally used as a substitute for wood charcoal or mineral coal. Bamboo charcoal is a good air purifier as it has the property of absorbing odor, moisture and harmful gases. It is also a good water purifier as it filters and absorbs pollutants, chlorine, pesticides and poisonous materials. It has an extremely porous structure and is a better and eco-friendly option to wood charcoal. The domestic applications include charcoal pillows, mattresses and to preserve freshness in refrigerators, deodorizer in moist places. This charcoal has a number of potential applications in the agriculture activities, such as to change the soil structure, eliminate negative effects of pesticides on plants, increase soil temperature and amount of water content. The industrial applications are health-care, gas masks, absorbing radioactive xenon and krypton, safe disposal of water and waste gases. The calorific value of bamboo charcoal is almost half that of oil of the same weight. Activated bamboo charcoal can be used for cleaning the environment, absorbing excess moisture and producing medicines. China is a leader in its production. At present, Japan, the Republic of Korea and Taiwan Province of China are the main consumers, but its importation is rapidly expanding in Europe and North America. Production of bamboo charcoal does not require a very high level of infrastructural and machinery investment. Thus, the opportunity is open to micro, small as well as medium enterprises. Not only the export has a lot of scope, but the local marketplace also has a plenty of consumers for this product.

Similar to the Bamboo Charcoal, Activated Carbon (S. Bakshi et al., 2003) throws other vistas of opportunities. It is a black solid substance resembling granular or powdered charcoal. It is extremely porous with a large surface area, and typically produced from organic precursors such as bamboo, coconut shells, palm-kernel shells, wood chips, sawdust, corncob and seeds. The raw material is first heated in an inert environment to obtain the carbonaceous material, which is activated further to derive a highly porous final product. Activated carbon has several important uses including solution purification, removal of tastes and odours from domestic and industrial water supplies, vegetable and animal fats and oils, alcoholic beverages, chemicals and pharmaceuticals and in the waste water treatment. It also finds use in purification of gases, liquid phase recovery, separation processes and as catalyst and catalyst supports. The opportunity is particular of concern to bamboo as the wastage of bamboo industry can be efficiently utilized. The process of conversion of bamboo into mat boards, laminated boards, flooring tiles etc. generates a lot of waste material in dust & chip forms. Also about 30% of the culm length (top portion for reduced diameter & wall thickness and bottom part for semi-rigid construction with too many knots) cannot be converted into the aforesaid products. These bamboo wastes are thus best converted into activated carbon for a high value-addition. With a view to exploring the potential of bamboo based activated carbon on a commercial scale, the National Mission on Bamboo Applications (www.tifac.org.in) prepared a complete 'business opportunity' report altogether with the techno-economic evaluation, assessment of market demand and necessary investment for entrepreneurial actions. The report provides a road map for a viable project for producing activated carbon on a commercial scale. The Mission supports such projects in partnership with the industries.

Bamboo Housing

The bamboo species are widespread through the tropical, subtropical and temperate climates around the globe. The fibers of bamboo poles posses' high strength both in tension and compression. Its compressive strength is roughly twice the compressive strength of concrete and bamboo has roughly the same tensile strength to weight ratio as steel has. The hollow cross section and solid diaphragms at regular intervals contribute to the strength of the bamboo pole. It is a renewable plant with a very short rotation period. Bamboo grows to its full size for about a year. Another two or three years are required for the plant to gain its high strength. Bamboo production doesn't involve much energy consumption and therefore adoption of bamboo housing helps to preserve the environment. There are three main types of bamboo housing: (i) traditional houses, which use bamboo culms as a primary building material; (ii) traditional bahareque bamboo houses, in which a bamboo frame is plastered with cement or clay; and (iii) modern prefabricated houses made of bamboo laminated boards, veneers and panels. Experts estimate that over one billion people live in traditional bamboo houses. These buildings are usually cheaper than wooden houses, light, strong and earthquake resistant, unlike brick or cement constructions. New types of prefabricated houses made of engineered bamboo have certain advantages. They can be packed flat and transported long distances at a reasonable cost. They are better designed and environmentally friendly. Bamboo housing is being successful used around the globe and even in India, this is very popular in the north eastern states (Ramachandra Laha, 2000). Bamboo is being widely used in these states for the supporting posts, flooring, frames, partitions, ceilings, walls, thatching, doors, windows and tying.

Bamboo Flooring

Bamboo flooring is a quality product that can be used widely and has a large, global consumer market. It has certain advantages over wooden floors due to its

smoothness, brightness, stability, high resistance, insulation qualities and flexibility. Bamboo flooring has a soft natural luster and maintains the natural gloss and elegance of bamboo fibre. This flooring is attractive to the demanding markets in Europe, Japan and North America. The estimated annual production of bamboo flooring in China was 17.5 million m2 in 2004. Exports account for some 65 percent of total production (Customs General Administration of China, 2004).

Bamboo weaving products and crafts

Bamboo crafts and woven mats are traditional products in China, India, Malaysia, the Philippines and Thailand. The technique has been known for several thousand years. These diverse products have become an indispensable part of daily life, literature and art. There are nearly 20 categories of woven bamboo products in Asia, including fruit baskets, trays, bottles, jars, boxes, cases, bowls, fans, screens, curtains, cushions, lampshades and lanterns.

Bamboo Furniture

Traditional bamboo furniture uses natural round or split bamboo. A new type of 'pack-flat,' 'knockdown' furniture uses glue-laminated bamboo panels. Unlike the traditional design, this furniture may be shipped in compact flat packs, to be assembled on the spot. The new design overcomes many of the problems of traditional bamboo furniture, such as high labour and transportation costs, low productivity, instability, varying quality and susceptibility to insects and fungi. At the same time, it retains the distinct physical, mechanical, chemical, environmental and aesthetic features of bamboo. The bamboo furniture offers excellent durability and light weight characteristics at a much cheaper price. It is becoming popular, even in hotels and resorts. A number of micro and small scale industries are producing bamboo furniture in the north-east India and this is being supplied in the different parts of India. Export of laminated bamboo furniture is growing rapidly. However, trade statistics currently do not capture the value, owing to the absence of a special code for bamboo furniture. It is usually classified as wooden furniture.

Government of India Initiatives

In India, recently a re-discovery of the potential of bamboo for developing it as one of the sunrise industries resulted in launching of an integrated bamboo development programme by the Prime Minister on 05 June 1999 with a view to focus on the development of bamboo sector. Subsequently, the Planning Commission, Government of India prepared an Action Plan to give maximum emphasis for promotion and development of bamboo during the Tenth Plan. The Action Plan proposed creation of 8.6 million jobs in the bamboo based development programmes to enable 5.01 million families to escape poverty on a sustainable basis, upgradation of skills of crafts person, food and nutritional security through consumption of bamboo shoots, etc. for livelihood and nutritional security. The Action Plan also envisaged laying down a foundation of a modern bamboo economy with input from science and technology, people's participation, industrial application and strong linkage with market capable of meeting global competition. In addition to the paper pulp industries, the potential of bamboo on other large-scale industries like bamboo shoot processing, bamboo based boards, flooring boards, furniture, new uses in building and road construction, etc. was also emphasized. Following the Planning Commission's effort on bamboo sector development, the Minister of Science and Technology on Technology Day, 2002 established a National Mission on Bamboo Application (NMBA) under Technology, Information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology to focus on the commercialisation of value added applications in the bamboo sector. Different State Governments have also taken initiative to develop bamboo sector on a commercial basis.

Bamboo is a versatile and useful group of plants, capable of providing ecological, economic and livelihood security to people. As per estimates, 8.96 million ha forest area of the country contains bamboo amounting to 12.8 percent of the forest cover. India has the largest bamboo forests in the world. Two-third of the growing stock of the bamboo in India is available in the North-Eastern States. India ranks second in the world in bamboo diversity with 136 species, while China with 300 species is leading in genetic diversity of bamboo. Out of this, 58 species belonging to 10 genera are found in the North-Eastern region. In Asia, Bamboo is known as the poor man's timber/poor man's gold/green gold because growing, harvesting and processing are essential subsistence activities. It is mainly used for domestic consumption as a raw material for useful utensil and farm tools, as a building material for shelter, fences, bridges and even water pipes. There has been a growing awareness in recent years about the importance of bamboo being an important means of economic growth and of improving the socio-economic conditions of the rural poor. Bamboo as an industrial material can substitute wood and that too at low cost. Bamboo has been traditionally harvested from forest lands in India and the homesteads which may have a few clumps of one of the many species of bamboo for household use but very little intervention in terms of purposive planting has been done in the past. The demand for bamboo has increased, in recent years, within the country and abroad as a raw material for furniture making, as panel boards substituting wood, as agricultural implements, house/construction related uses and as a vegetable. China's focused intervention to harness bamboo's potential has led to increase in its productivity by more than 10 times since 1970 when it was 2-3 tonnes/ha/annum and today China's total export value of bamboo products is more than $ 550 million per annum. With a view to harness the potential of bamboo crop in the country through a multi-disciplinary approach, the Planning Commission brought out a report titled "National Mission on Bamboo Technology and Trade Development" (NMBTTD) in 2001-02. The report clearly brings out the country's future potential in bamboo for the next two decades.

Conclusion

Bamboo is a kind of fast- growing and renewable resource, which is cheap and widely available. It has unique characteristics and advantages in bringing ecological and social benefits. Bamboo based panels have similar properties to wood based panels. Since the utilization of bamboo will be well consistent with the sustainable development, bamboo based panels will become very competitive construction materials when an extensive factors are taken account of. At present, there is a large gap in the supply of pre-fabricated construction materials, and it is a very good opportunity for bamboo based panels to occupy the market, since they have so many merits compared with other building materials. However, a wide popularization of the utilization of bamboo needs to be done to make bamboo based panels better accepted by people around the world. If bamboo based panels can be well utilized in the construction industry, they will contribute a lot to the sustainable development of the prefabrication industry and the protection of environment. On the other hand, Bamboo has multiple applications in social growth and it has been utilized by the people for their cultural growth from ancient times. Most of the bamboo plantation in India are in Kerala and North-East states. In fact, the bamboo has a potential of sustainable development along with the cultural and social growth. Central government and state government have taken good initiatives for bamboo plantations and pushing the bamboo industry. The initiatives will certainly go a long way in truly evolving value-added application avenues for bamboo for catering to domestic and overseas markets through an indigenous technology route as well as entrepreneurial actions in MSMEs. Carlos J. Castro(2004), Sustainable Development: Mainstream and Critical Perspectives, Organization & Environment, Vol. 17 (2), pp. 195-225

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TECH-CHRONICLE
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Production of Enriched Compost from Water hyacinth (Eichorina crassipes)

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Abstract - Water hyacinth, an aquatic weed is known for causing a series of problems for aquatic life. It also has a few advantages to its recognition. If targeted properly, it can act as an extremely important alternative for meeting some of the most urgent needs of agriculture community. This study proposes and signifies that water hyacinth has remarkable nutritive properties that can be used for the production of nutrient enriched compost which not only result in healthy aquatic system but also add as a advantages on agriculture lands. The proximate analysis of different types of water hyacinth composts is observed. The results shown that various compost formed by using different amendments, an indicator for enriched water hyacinth composts.

Key words – water hyacinth, compost, amendments.

Introduction - Water hyacinth is one of the most productive plants on earth and considered as one of the world's worst invasive aquatic plants (Gopal, 1984; Malik, 2006). Water hyacinth is one of the worst weed in the world aquatic or terrestrial environment (Holm *et al.*, 1977). Compost is defined as the product resulting from the controlled biological decomposition of organic materials. Compost can be derived from a number of feed stocks including yard trimmings, bio solids (sewage sludge), wood by-products, animal manures, crop residues, biodegradable packing, and food scraps. Mature compost has little resemblance in physical form to the original biodegradable from which it is made. Compost is valued for its organic matter content, and it typically used as a soil amendment to enhance the chemical, physical and biological properties of soil. Compost is typically not a fertilizer, although when used at normal rates it can reduce the amount of required fertilizer. Compost can increase the water holding capacity of sandy textured soils, and can improve structure and water movement through heavier textured soils that are high in silt and clay content.

Compost has been considered as a valuable soil amendment for centuries. Most people are aware that using composts is an effective way to increase healthy plant production. It helps save money, reduces the use of chemical fertilizers, and conserves natural resources. Compost provides a stable organic matter that improves the physical, chemical, and biological properties of soils, thereby enhancing soil quality and crop production. When correctly applied, compost has the beneficial effects on soil properties, thus creating suitable conditions for root development and consequently promoting higher yield and higher quality of crops. (www.agritech.tnau.ac.in/org_farm/orgfarm_composting.html).

Composting process refers to the conversion of green waste into organic fertilizer with compost as an end product. Composting is the biological decomposition and stabilization of organic substance under condition that allows development of the thermophilic temperature as a result of biologically produced heat, with a final product sufficiently stable for storage and application to land without any adverse environmental effect (Haug, 1980). Composting is a biooxidative process in which the microorganism transform the more easily biodegradable organic matter into carbon dioxide, water, vapours, and other minerals (mineralisation process) or, with time, into more stable organic matter (humiliation process) called humic substances which are physically very similar to those present in soil. Composting is not a new idea. In the natural world, composting is what happens as leaves pile up on the forest floor and begin to decay. Eventually, nutrients from the rotting leaves are reclaimed by living roots. This completes nature's recycling process. As defined by Diaz *et al.* (1993).

The project will be beneficial for those cities where the problems of aquatic weeds are much that can be over come through removal of such weeds. Composting (S Ajay *et al*. 2011) as an alternative treatment has the advantage of producing a product that is easy to work into the soil compared with dried water hyacinth, because of the decomposed structure.

Much work has been carried out in different parts of the world to develop environmentally sound and appropriate methods for the management and control of water hyacinth. It recapitulated that the only means of utilization of water hyacinth which has proved economically viable across the world (Gajalakshmi *et al* 2001). In this background authors studied the utilization of water hyacinth as substituting bean straw with water hyacinth as animal feed (Tag El-Din *et al* 1992) feed for solid-phase fermentation raw material for making pulp, paper and paper board and the vermicomposting of water hyacinth (Gupta *et al* 2007) However, a novel technology with ecological sound and economically viable is urgently required to solve the problem of aquatic weed disposal and management. So this has been decided to prepare water hyacinth compost by using different amendment. In Bhopal there are many numbers of pond and small

lakes,river like Kaliasot. All are suffered by aquatic weeds like water hyacinth. Every year cities expenses big amount of money and use of machinery to remove water hyacinth from these ponds and lakes. There is no use of this removed weed, so this was the great ideacomes in mind that this can be utilized in best way by converting it into water hyacinth composting.

Hopefully this compost could be solving problems and utilized in our agriculture based country significantly.

With an aim to solve the problems associated with water hyacinth the project has been proposed to prepare compost by using water hyacinth to improve nutritional contents by incorporation of different amendments.

Materials and methods - This experiment was conducted at the form of Indian Institute of Soil Science Bhopal (geographical location 23^0 18" N latitude, 77^0 24" E longitude, altitude 485 m amsl). Water hyacinth as a source of waste material collected from Kaliasot river passing by Danish Kunj Bhopal.and Cow dung as a raw material collected from Lamba Kheda village near IISS Bhopal. Rock phosphate, lime, urea, microbial enriched compound and epigeic earth warm are the amendments arranged from Soil Biology Division ICAR, IISS Bhopal.

Water hyacinth was chopped manually at IISS Bhopal

The details of experiment set up are given below:

a. *Experimental setup:* There were seven pits for composting, dimension of each compost pits were length 6 to 7 feet. Width 3 feet and depth 2.5 feet. Fresh water hyacinth was chopped in small pieces and filled in each of those pits along with cow dung in the ratio of 2:1 as shown in fig 1

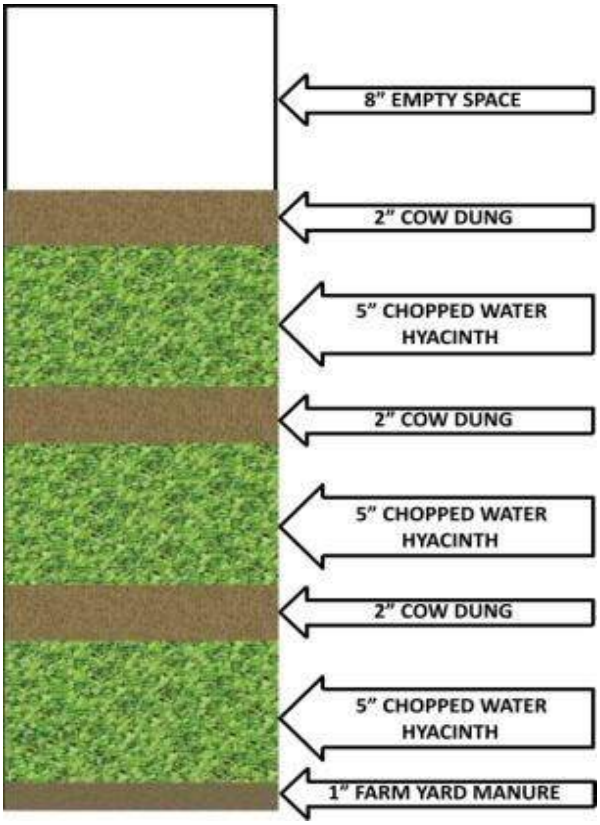

Fig. 1: Order of different layers of materials constituted for carrying out composting in pit

- The bottom of the pit filled with compost about 1 inch thick containing about 10 kgs of farm yard manure.
- The second layer above the manure compost's layer was of chopped fresh water hyacinth which was about 5 inch thick containing about 15.7 kgs of water hyacinth.
- The third layer above second layer was of fresh cow dung which was about 2 inch thick containing approx 13.33 kgs of cow dung.
- The fourth layer above the cow dung layer was of chopped fresh water hyacinth (~15.7 kgs) of 5 inch thickness.
- The fifth layer above fourth layer was of fresh cow dung (~13.33 kgs) of 2 inch thickness.
- The sixth layer above the fifth layer was of chopped fresh water hyacinth (~15.7 kgs) of 5 inch thickness.
- The seventh layer above sixth layer was of fresh cow dung (~13.33 kgs) of 2 inch thick Each pit remained empty by about 8 inch for turning and watering operation.

Fig 2: A&B. Filling of pits for composting, C. Pits were covered to facilitate composting, D. Turning for aeration

In each pit, different materials were used for composting fresh water hyacinth with cow dung. It was observed that after 21 days material in each pit was partially decomposed, and then in each pit various treatments were imposed as mentioned in table 1.0 Earthworms and microbial culture were inoculated after 32 days. Following treatments were applied in each of those prepared pits:

Table 1: Composition of different materials used for composting from water hyacinth

S.No.	Material	Quantity in Kg	Material %
1	Water hyacinth + Cow dung	77+40	15.7+13.3
2	Rock phosphate	2.925	2.5
3	Lime	2.34	2
4	Urea	0.06	0.5
5	Gypsum	11.7	10
6	Earth warm	2	-
7	Microbial culture	0.0585	-

As per the shown table above mentioned materials were applied in each pit.
Prepration of microbial culture and their sub cultures of fungai (*A. awamori, A hetromorphous and R. pusillus*) were prepared by using potato dextrose agar media.

Seven types of composts were developed by incorporating the materials in varied ratio as.

Different formulations of composts
T1 (control) = Water hyacinth + cow dung
T2 (Phospho Compost) = T1 + Rock Phophate
T3 (Phospho Compost with lime) = T2 + Lime
T4 (Phosphor Nitro Compost) = T3 + Urea
T5 (Phospho Sulpho Nitro Compost) = T2 + Gypsom + Urea
T6 (Vermi Compost) = T1 + Epigeic earth warm
T7 (Microbial Enriched Compost) = T1 + Microbial Culture

b. *Analytical Techniques:* Different parameters were analyzed for the characterization of both substrates (water hyacinth and cow dung) and products (water hyacinth compost) by dry ashing and wet oxidation method (Issac and Johson, 1975). Total Nitrogen (N) in substrates and composts were determined by (Kjeldahl, 1883), A suitable sample is digested with a strong acid so that it releases nitrogen which can be determined by a suitable titration technique. Substrates and composts samples for N determination were digested in sulphuric acid at a temperature between 360°C and 410°C. Total phosphorus (P) in substrates and composts (Jackson, 1967).Total Potassium (K) in substrates and composts (Jackson, 1967), the most common method for K determination is through flame photometer. The substrates and composts sample for K estimation can be digested in di-acid or in tri-acid. In addition digest obtained from dry ash is also taken for K determination.

Result and Discussion - Composting of water hyacinth biomass was completed in 7 – 8 weeks. The mature composts were black in colour, granular and fibrous with pleasant earthy smell compared with control mixture which was light brown in colour, coarse in appearance with a foul smell. The appearance of black colour is indicative of its maturity. Pandharipande *et al*. (2004)reported that the mature compost must be dark brown or black granular spongy in feel and smell normally shown in figure 3(a) and 3(b).

Water hyacinth and cow dung constituted the main ingredients in this study for the preparation of composts. Varied compositions of chemicals, earthworms and microbes have important role in the decomposition of substrates. The macronutrients substrates and composts (T1, T2, T3, T4, T5, T6 and T7) were determined.

Fig.3a: Matured composts (Control, Phosphocompost, Phospho compost with lime)

Fig.3b: Matured composts (Phospho Nitro compost, Phospho Sulpho Nitro compost, Vermi Compost, Microbial enriched compost)

Initial studies performed with S1 and S2 showed significant higher levels of nitrogen and Potassium in S1 in comparison to S2.

Table 2: Analysis of N, P, K parameters of water hyacinth and cow dung

S. No.	Parameter	Water Hyacinth (S1)	Cow dung (S2)
1	**TN (%)**	**2.06**	1.08
2	**TP_2O_5 (%)**	0.48	0.41
3	**TK (%)**	**1.85**	0.41

Table 3: Analysis of N, P, K parameters of Water hyacinth composts

S. No.	Parameters	Control	Phospho compost	Phospho compost (Lime)	Phospho Nitro compost	Phospho Sulpho Nitro compost	Vermi Compost	Microbial enriched compost
		T1	T2	T3	T4	T5	T6	T7
1	TN (%)	1.14	1.2	1.27	1.32	1.16	1.16	1.23
2	TP (%)	0.56	0.86	0.87	0.88	0.89	0.59	0.58
3	TK (%)	1.02	1.03	1.03	1.036	1.04	1.03	1.03

Table 3: provides the data on analysis of water hyacinth compost made with incorporation of different organic, mineral and microbial cultures. The general properties of composts and the nutrient compositions of composts varied depending on the amendments applied to the organic manure. With the addition of P through rock phosphate the phosphorous concentration increased in the compost.The N contents and K contents have also exceeded 1.00%.

According to above mentioned table 2 and 3 there are various comparisons between different contents of parameters of substrates and prepared composts

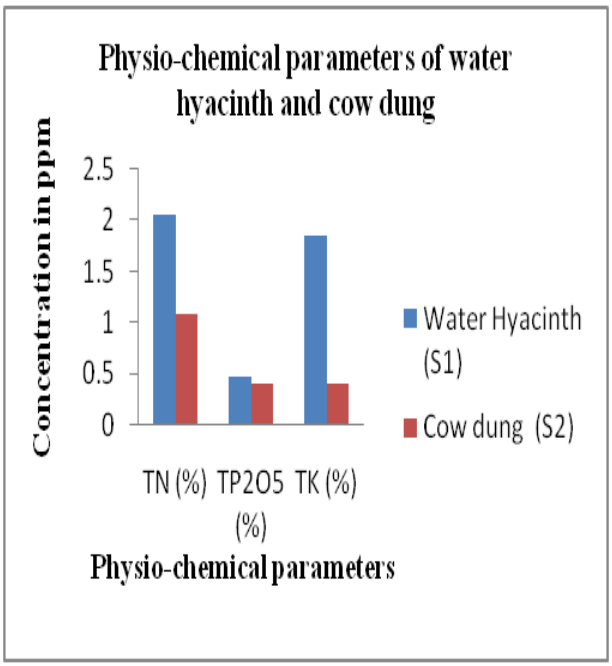

Fig.4: Physio-chemical parameters of water hyacinth and cow dung.

Total N: Total N content of compost depends on the initial N content present in the feed material and the degree of decomposition (Crawford, 1983). Presence of N rich weeds having lesser toxicity proved to be favourable for microbial mineralization of raw material. Decrease in pH, mineralization of proteinous organic material and conversion of ammonium nitrogen into nitrate may be responsible for addition of N in compost (Yadav and Garg, 2011). Total nitrogen (TN) content in the prepared composts was approximately equal to initial substrate (S2). The initial TN content of the substrates was 2.06 and 1.08 g kg-1 for S1 and S2, respectively. Whereas, TN content of treated composts was in the range of 1.16 to 1.23 g kg-1 after composting. Plaza *et al.* (2007) have reported that the nitrogen content of vermicomposts increase due to mineralization of C-rich materials and, nitrogen retention by compost which otherwise may be lost as ammonia at higher pH values. The difference in TN content of composts was different from each other.

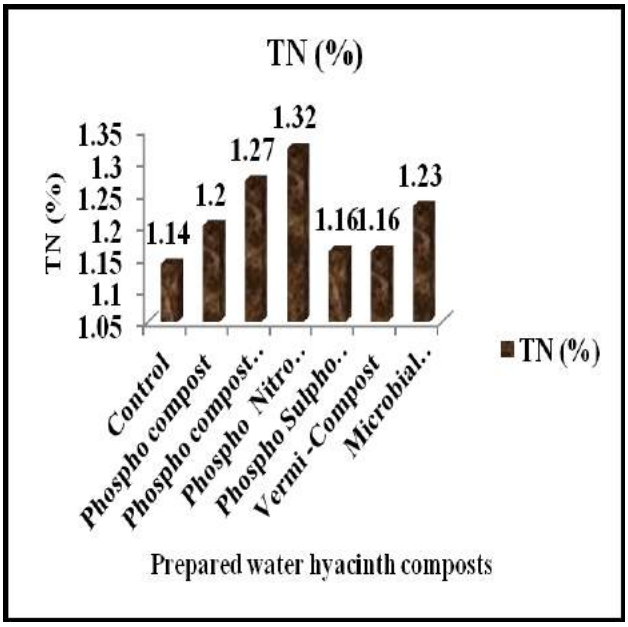

Fig. 5: Graphical comparison of Total Nitrogen content in different studies

Total Phosphorous: Phosphorous is also an essential element for plant growth which also increased on composting. This may be due to transformation of unavailable forms of phosphorus to easily available forms by microbial enzymes like alkaline and acid phosphatases etc. On composting, phosphorous content were enhanced

in all composts. Maximal increase was found in compost (T5) approx 58.90% followed by T4 (57.1%) and T3 (55.4%) composts. Acid phosphatases and alkaline phosphatases may be responsible for this transformation (Ghosh *et al*., 1999).

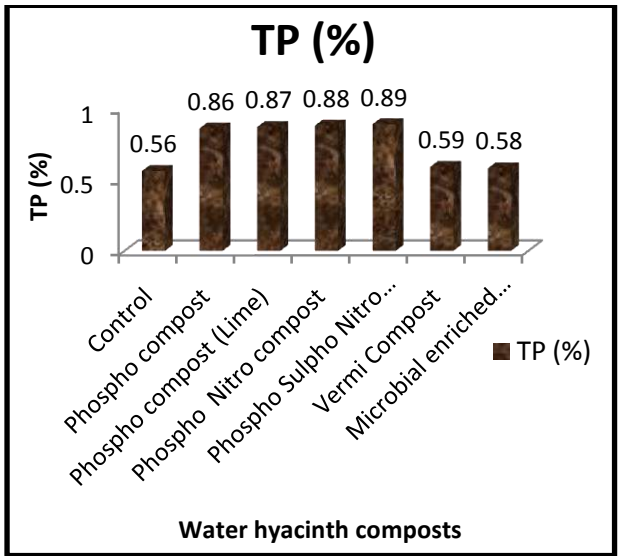

Fig6: Graphical comparison of total phosphorous content in different studies

After vermicomposting phosphorus content was highest in T4 and T5, and minimum in T1, CD + WH mixture Le Bayon and Binet (2006) have reported that some amount of phosphorus is converted to more available forms partly by earthworm gut enzymes, i.e., acid phosphatases and alkaline phosphatases. Actions of phosphorus-solubilizing microorganisms present in earthworm's casts may also be responsible for the release of phosphorus in vermicomposting (Prakash and Karmegam, 2010).

Total Potassium: The potassium (K) content was greater in all the composts than initial waste (S2) (Table3). The increase in potassium content was 1–2% in the composts as compared with K content in control. The differences in the results can be attributed to the differences in the chemical nature of the initial raw materials. Suthar (2008) has reported 104 - 160% increase in potassium content during vermicomposting. Sangwan *et al*. (2010) have also reported an increase in K in vermi composts after bioconversion of sugar industry waste.

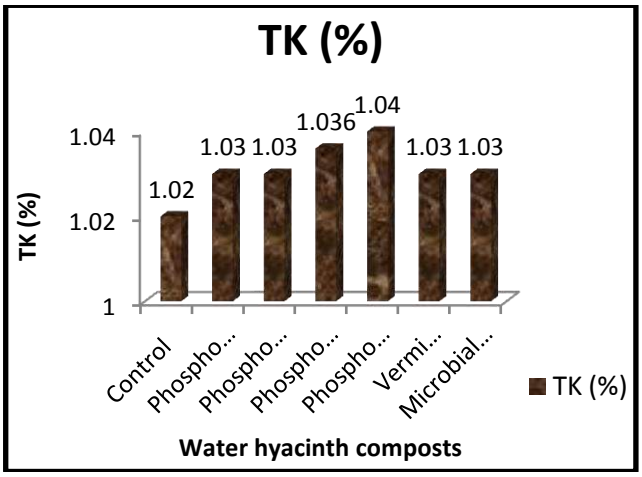

Fig.7: Graphical comparison of total potassium content in different studies

Conclusion - This study signifies that water hyacinth has remarkable nutritive properties that can be used for the production of nutrient enriched compost which not only result in healthy aquatic system but also add as an advantage on agricultural lands as soil amendments.

The result of the studies have shown that the water hyacinth composts prepared by combining different amendments such as rock phosphate, lime, urea, gypsum microbial cultures and earthworm inoculation and prepared different composts.. These are control, phospho compost, phospho compost with lime, phospho nitro compost, phospho sulpho nitro compost, vermicompost and microbial enriched compost. Among composts, the highest percentage of N was evaluated in phospho nitro compost and in phospho compost . The highest percentage of P and K were also recorded in phospho sulpho nitro compost (P 0.89and K 1.04) and the lowest percentage of P and K in control compost (P 0.56 and K 1.02).

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RESEARCH ON IN-VITRO CLONAL MULTIPLICATION PROTOCOL IN VARIOUS CULTIVARS OF *CHLOROPHYTUM.*

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Abstract:

*Chlorophytum co*mmonly known as 'Safed Musli' has become an endangered species due t o its over exploitation, used as tonic and aphrodisiac. Root of the plant contains steroidal sa ponin as secondary metabolite. It has a worldwide demand in ayurvedic and allopathic syst ems of medicine to cure general debility, fatigue, weakness and male sterility. Although thi s species has been brought under commercial cultivation but the systematic research on coll ection and evaluation of germplasm still in demands.A tissue culture method has been deve loped for its large scale multiplication and conservation. Micropropagation using stem disc as explant has been achieved on Murashige and Skoog (MS) medium containing 5.0 mg.L-1 BAP. Survival rate of these rooted plantlet in soil is about 80 %. A comparative studies h ave been carried out to compare the protocol in different cultivars of *Chlorophytum.*

Keywords- *Safed Musli, saponin, Micro propagation, Murashige and Skoog medium*

Introduction:

'Safed musli' is an endangered medicinal plant of Liliaceae family belonging to genus *Chlorophytum.* The tuberous roots of the plant are used in ayurvedic tonic and has aphrodisiac property due to the presence of saponin. Safed musli has wide distribution in India, mainly in the southern Rajasthan, Western MP and North Gujarat (Borodia *et.al.*).More than 175 species of *Chlorophytum* have been reported in world, about 13 species of genus are found in India out of which roots of species *C. borivillianum* and *C. tuberosum* only are used as safed musli in many ayurvedic preparations. It has a worldwide demand in ayurvedic and allopathic systems of medicine to cure general debility, fatigue, weakness and male sterility (Bhagat. *et.al*). In view of its day-to-day increasing demand not only by the user of our country but of abroad too, it may be a dollar-earning crop.

Population of the plant is dwindling at an alarming rate. In nature the plant is propagated by seeds and has become an endangered species due to low seed set, viability and germination, associated with over exploitation from the wild strands. The planting material/ tubers as well as seeds have dormancy for a certain period.

Owing to its enormous uses, its worldwide demand is estimated to be 35000 tons annually as compared to current annual production of 5000 tons. The immediate task is to conserve and multiply the plant in bulk amount required for its domestication to meet the present demand. In recent years a large-scale propagation of plant has been developed by use of the tissue culture technique and the number of plant species being enabled to multiply by this technique annually. Plant tissue culture has been successfully used to micro-propagate medicinal plants. Plantlet regeneration has been reported through apical meristem *in C. Comosum.* Plantlet regeneration and bulbil formation has been reported through leaf and stem explant in *Curculigo orchiodes* (Suri *et al*.1999).

In the present study, an efficient and rapid *In-vitro* micro propagation method of Safed musli (*Chlorophytum borivillianum)* has been established through optimization of medium and cytokinin and auxin ratio for shoot proliferation and root formation.

Material & Methods:

Leaf segment, root segment and stem disc of two different collection of *Chlorophytum borivillianum* (Fig-A, Fig.-B) were collected from mature plants as explants from the field and brought to the laboratory. The source tissues were kept under running tap water (5 mints) and washed with a 5 % laboline detergent for 5-10 mints. Different concentration and combination of sterilent tried for the surface sterilization of explants. After washing with detergent surface sterilization was done with 1 % bleaching powder solution with

0.1% amplicillin for 20 mints. After removing few scales and waste part, explants were washed three times with sterile water. After washing explants immersed in 0.2% mercuric chloride solution with few drops of tween 20 for 15 min. in laminar flow. Last treatment given by 70% ethanol for 60 seconds. Explants were inoculated after washing with sterile water and drying with sterile blotting paper.

The materials were cut into appropriate sizes (leaf- 1cm., root segment 1 cm, stem disc) and cultured on MS medium (Murashige and Skoog, 1962). The medium was used at different strengths. The medium was supplemented with 3 % sucrose and gelled with 0.8% agar. Basal medium was supplemented with different concentration of growth regulators (2,4-D, Kin, 2iP,NAA,BAP) either alone or in combination for shoot initiation as well as shoot multiplication. The pH of the medium was adjusted to 5.8 before autoclaving at a pressure of 15 lbs for 15 mints. The cultures were incubated at 25 +- 2^0C with 16/18 hours photoperiod under white fluorescent tubes. Experiments were set up in a completely randomized design. Minimum 6 explants were used for each treatment and all treatments were repeated twice. Data were presented in mean number of shoot. Plantlets were transferred to small pots containing soil and sand (1: 1) and subsequently to the field.

Result:

In this experiment most of the explants were contaminated with fungi and thus explants were sterilized with different concentration and combination of sterilent. Strong treatment has been given to explants to protect them for contamination. Shoot initiation was observed only in stem disc explant. No response has been seen in leaf as well as root segment. Growth regulators NAA, 2,4-D,BAP, 2iP and Kin. either alone or in combination tested in the present study (Table 1). Callus development has been seen on MS medium enriched

with 2,4-D(1-2.5mgL^{-1}) (Fig.-C). Cream coloured callus was not found suitable for shoot initiation as well as multiplication. Good response has been seen by Stem disc (crown) on the medium containing different concentration of BAP. BAP in higher amount is the best for shoot initiation in comparison to 2,4-D, Kin, 2iP. MS medium supplemented with 5.0 mgL^{-1} BAP was best for shoot initiation. Mean number of shoot initiated in MS medium supplemented with 5.0mgL^{-1} BAP is 7.8 in sample 1 and 6.6 in sample 2, which is highest among others (Fig.D,). More than 80% response has been seen in 5.0 mgL^{-1} BAP treatments. These cultured shoots were used for sub culturing. MS medium supplemented with 5.0 mgL^{-1} BAP used as a parent media. Different concentration and combination of growth regulators tried for multiple shoot formation. Auxin and Cytokinin ratio has given average response of 75% with 6-8 mean numbers of shoots. When sub culturing has been done on to the medium of same composition (5.0 mgL^{-1} BAP) resulted in an increase in size and extra ordinary response has been seen. 100% response with more than 15 mean number of shoots in sample 1 and 17 in sample 2 generated from the MS medium supplemented with 5.0 mgL^{-1} BAP (Fig.-E). 75 % response reported when BAP concentration increased after 5.0 mgL^{-1} BAP. (Table 2).

Healthy roots were found when shoots transferred to half strength MS medium supplemented with 500mgL^{-1} charcoal (Fig.-F.1,2). Plantlets developed through tissue culture were successfully transferred in soil and sand (1: 1) with high rate of survivability (80%) (Fig.-G).

Tissue culture has been used to accelerate plantation development, to shorten breeding cycle and to rapid multiplication. The best use of micro propagation technique is to

overcome dormancy problem. The plantlets obtained by this technique are expected to be pathogen free.

Discussion:

Due to large scale and indiscriminate collection of the wild material and insufficient attempts either to allow its replenishment or its cultivation *Chlorophytum* is rapidly disappearing from nature Growth regulators NAA, 2,4-D, BAP, 2iP and KIN either alone or in combination tested in the present study. Response has been recorded by Stem disc (crown) on the medium containing different concentrations of BAP. BAP in higher amount was found best for shoot initiation in comparison to 2,4-D, KIN, 2iP. MS medium supplemented with 5.0 mgL^{-1} BAP was best for shoot initiation. Mean number of shoot initiated in MS medium supplemented with 5.0 mgL^{-1} BAP is 7.8 in sample1 and 6.6 in sample 2. More than 80% response has been found in 5.0 mgL^{-1} BAP treatments. These cultured shoots were used for sub culturing. MS medium supplemented with 5.0mgL^{-1} BAP used as a parent media. Different concentrations and combinations of growth regulators tried for multiple shoot formation. Average response of 75% with 6-8 mean numbers of shoots was found in auxin and cytokinin ratio. When sub culturing was done on to the medium of same composition (5.0mgL^{-1} BAP) resulted in an increase in size and extra ordinary response was found. 100% response with more than 15 mean numbers of shoots in sample 1 and 17 in sample 2 generated from the MS medium supplemented with 5.0 mgL^{-1} BAP. 75 % response reported when BAP concentration increased more than 5.0 mgL^{-1} BAP. Healthy roots were found when shoots transferred to half strength MS medium supplemented with 500 mgL^{-1} charcoal. Plantlets developed through tissue culture were successfully transferred in soil and sand (1: 1) with high rate of survivability (80%) Arora

et al., (1999) developed an improved method for large-scale rapid multiplication of *C. borivillianum* through somatic embryogenesis. Somatic embryos were obtained on MS medium containing 2.25 micro molar 2,4-D and 1.5 micro molar kinetin. The technique developed is highly efficient to get miniature plantlets for field transfer in 2 months, starting from callus.

Tissue culture has been used to accelerate plantation development, to shorten breeding cycle and to rapid multiplication. The best use of micro propagation technique is to overcome dormancy problem. Plant tissue culture has been successfully used to micro-propagate medicinal plants. Plantlet regeneration has been reported through apical meristem in *C. comosum.* Plantlet regeneration and bulbil formation has been reported through leaf and stem explant in *Curculigo orchiodes* (Suri *et al*., 1999).

(Table 1)- Effect of different concentrations and combinations of phytohormones on shoot initiation

Hormone Concentration (mg/1)	Sample 1		Sample 2	
	% response	Mean no. of Shoots initiated	% response	Mean no. of shoots initiated
2,4 D				
0.5	25	2.0	25	1
1.0	20	2.0	20	1.5
1.5	50	3.5	50	4
2.0	25	2.0	25	2.5
2.5	25	1.0	25	1
2,4 D + KIN				
1.0+1.0	20	1.0	20	1
1.0+1.5	50	2.5	50	1
1.0+2.0	25	2.0	25	2.0
1.0+2.5	40	2.5	40	2.0
2iP				
0.5	20	4.0	20	0
1.0	33.3	5.5	33.3	1
1.5	40	2.0	40	0
2.0	40	1.0	40	2
KIN				
0.5	25	1.0	25	3
1.0	33.3	2.0	33.3	0
1.5	40	1.0	40	0
2.0	40	2.5	40	0
2.5	50	2.0	50	2.0
NAA+KIN				
1.0+1.0	40	1.5	40	1.5
1.0+1.5	20	1.0	20	3.5
1.0+2.0	25	2.0	25	2.5
1.0+2.5	40	2.5	40	2.5
BAP				
1.0	50	3.5	66.6	3.0
1.5	50	3.33	50	2.5
2.0	80	2.25	50	3.0
2.5	75	5.0	60	3.33
3.0	83.3	6.6	60	3.66
4.0	80	5.0	75	4.3
5.0	**83.3**	**7.8**	**83.3**	**6.6**
6.0	75	5.0	75	5.5
8.0	75	4.3	75	3.0
10.0	50	2.5	75	3.33

(Table 2) Effect of subculture media on multiple shoot formation.

Hormone Concentration (mg/1)	Sample 1		Sample 2	
	Mean no. of shoots initiated	% Response	Mean no. of shoots initiated	% Response
NAA+BAP				
1.0+0.5	6.66	75	6.0	50
1.5+1.0	3.33	75	6.0	33.3
1.0+2.0	4.00	50	3.5	66.6
1.0+2.5	3.33	75	3.5	66.6
NAA+KIN				

1.0+0.5	3.5	66.6	3.0	75
1.0+1.0	3.00	75	1.5	50
1.5+1.5	2.33	75	2.0	33.3
1.0+2.0	2.00	75	3.0	50
1.0+2.5	2.00	50	3.0	50
BAP				
0.5	6.66	75	2.0	25
1.0	8.00	75	3.5	66.6
1.5	7.5	66	3.0	66.6
2.0	6.00	75	2.0	66.6
2.5	6.0	66	2.5	33.3
3.0	6.5	50	7.0	75
4.0	6.6	75	7.6	75
5.0	**14.75**	**100**	**17.0**	**100**
6.0	8.6	75	9.0	75
7.0	8.33	75	9.3	75
8.0	9.00	75	6.6	75
10.0	5.00	75	9.3	75

Protocol for Multiplication of *Chlorophytum borivillianum*.

Explant (Stem disc)

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Surface sterilization

↓

Culture initiation (MS medium + 5.0 mg./l. BAP, 7.8 mean no. of shoots)

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Shoot Multiplication (MS medium + 5.0 mg./l. BAP, 15 mean no. of shoots)

↓

Rooted plantlets

↓

Field establishment

***In-vitro* regeneration potential of different *Chlorophytum* genotypes**

To study the *in-vitro* regeneration potential of different *Chlorophytum* genotypes, all the collected genotypes were cultured on the standardized medium. Among the three only two responded on the same standardized medium (Table 4.16). 50.0-percentage response with 2.55 mean numbers of shoots was recorded for M4 and 60.00 percent response with 3.33 mean numbers of shoots were recorded for M5. Genotype M3 not responded in the standardized medium (5.0 mg/l BAP). It has been concluded that *in-vitro* regeneration technology can be successfully employed for *Chlorophytum* plantlets, if careful selection of proper combination and concentrations of phytohormones for explants is made for specific genotype.

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Fig.-B

Fig.-E

Fig.-G