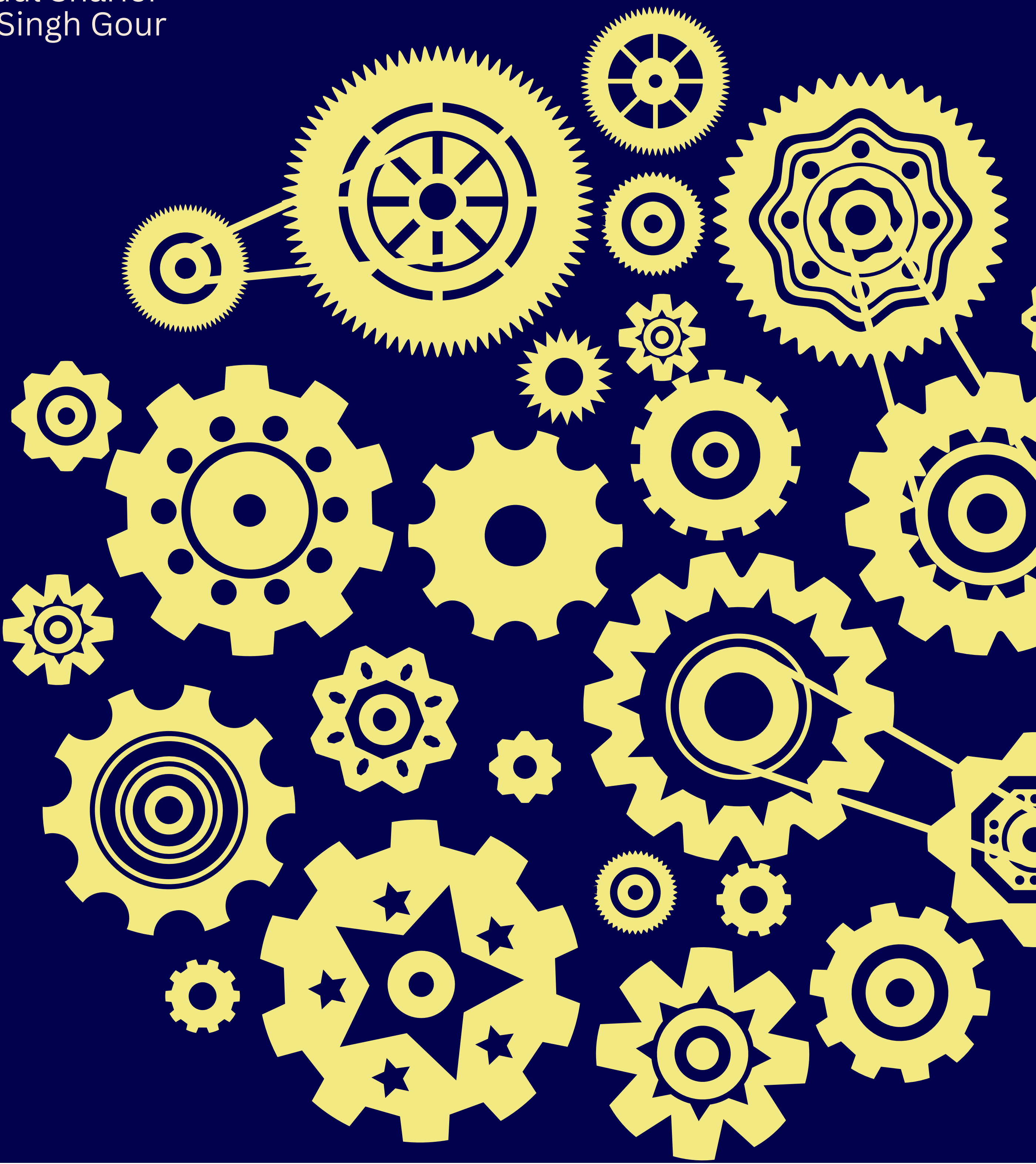
MECHANICAL ENGINEERING DESIGN

Kul Bhushan Anand
Dr. Abdul Sharief
Ashok Singh Gour



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CONTENTS

CHAPTER 1

DESIGN OF NEW BRAKING SYSTEM UTILIZING ELECTRO-MAGNETIC PROPERTIES FOR LOCKING MECHANISM

Kul Bhushan Anand, Assistant Professor
Department of Mechanical Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- anand_kb1980@rediffmail.com

ABSTRACT:

Over the past few decades, electromagnetic brakes have attracted significant attention in aerospace vehicles as useful actuator for controlling the motion of a mechanical system. The electromagnetic braking system was developed to improve stopping power, longer service life, and lower maintenance costs. This can be achieved by using permanent magnets as opposed to moving parts. Permanent magnets can produce more power at a much lower cost than conventional electromagnets. In addition, the field emission (emissions from the material, not the magnetic lines of force) character of the magnet also allows a reduction in the amount of iron powder or steel required in the rotor, further reducing weight and cost. This research mainly focused on the Design of an "Electro-Magnetic Brake' for a locking mechanism and design objectives are also verified from an experimental point of view. A simple nonlinear magnetics model analyzes the magnetic field variation at the break, which is performed during actuation conditions. A new working principle is proposed for electromagnetic brakes, which are potentially more energy-efficient and reliable than conventional solenoid-based brakes.

KEYWORDS:

Braking Torque, Electromagnetic Braking, Eddy Current, Locking Mechanism, and Flux Density.

1. INTRODUCTION

The development of the automotive industry is a very rapid process. Technology has been invented to be able to compete in this industry. In addition, automotive players currently aim for an environmentally friendly approach in the production of any model of vehicle [1]. As a result, automotive manufacturers are now competing to manufacture cars with various features such as great engine performance and safety, reliability, modern design, and speed. Electromagnetic brakes have found wide application in such heavy vehicles as a supplementary retarding device to regular friction brakes [2], [3]. The two major ways of converting kinetic energy into heat in road vehicles are friction brakes, which are used on all motor vehicles, and electromagnetic discs (which are used by high-speed engines). One is the frictional resistance offered by the wheels, which only generate heat during braking and require no power input [4], [5]. This is called 'frictional braking'. The second method is electromagnetic induction, which converts kinetic energy into electrical energy, which can then be stored in a battery or electrical capacitor and fed back as an electric current when braking is applied [6]. This method is called "Electromagnetic Braking" (EMB) or Electromagnetic retardation.

Eddy's current braking system is a contactless brake which could be an option to overcome this matter (Figure 1). Furthermore, it can reduce brake pad wear and vibration and is environmentally friendly [7]. Therefore, these advantages give us hope for a new exploration and invention of the green technology braking system. When a conductor moves through a stationary magnet, it induces eddy currents in the conductor [8]. These currents produce a drag force that slows down the motion. In addition, the eddy current braking system produces an induced magnetic field during acceleration and deceleration, which interacts with the moving conductor to create braking force [9]. In this braking system, a magnet will be energized and attracts the steel disc during the braking period. A brake disc is a disc-shaped component that is installed between the wheel hub and the brake assembly, or caliper. This component serves to slow how fast the wheels turn. Brake discs are used in vehicles with mechanical brakes such as automobiles, trucks, tractors, and motorcycles. The product is made of a high self-induction coil and magnetic core, which leads to a strong magnetic field. When the current is switched ON, the current flows through the wire, generating an electromotive force [10].

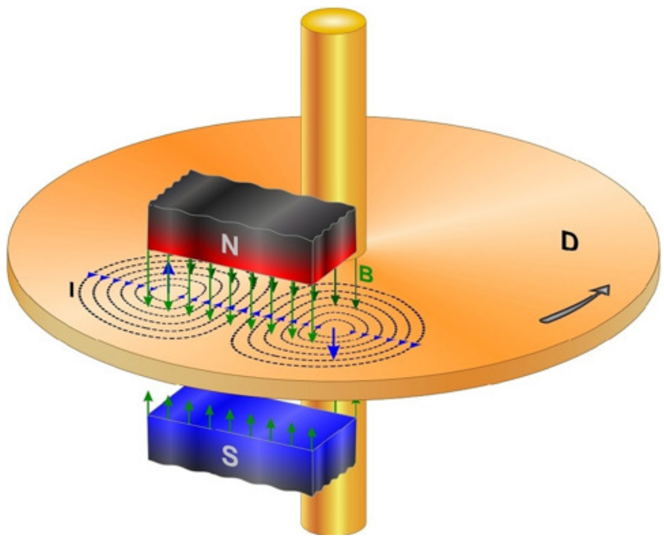

Figure 1: Illustrating the Working Mechanism of the "Eddy Current Braking System".

The magnetic field produced by the current and the internal magnetism attracts each other so that there is another force from which the magnetic core rotates. When the current is switched OFF or stops flowing, the rotation stops, and the magnetic field disappears; the core ceases to rotate. The current trend toward the development of energy-efficient automobiles has prompted the need for brake control systems that improve the vehicle's fuel economy. One such control scheme is the "Electro-Magnetic" (EM) brake [11].

A new efficient switching electromagnetic brake (EMB) configuration is proposed, which consists of an embedded permanent magnet and a back iron structure working together as an energy-storing device to improve the system's energy efficiency. The latch-type valves/brakes have been widely investigated and applied to speed control devices. The latch-type valves/brakes have been widely investigated and applied to speed control devices. However, the present configuration is different from theirs (i.e., there is no latching action). Thus, reducing the complexity of hardware and permanent magnet assembly. There are no complicated structures around the rotor unlike in conventional magnetic brakes. Nonlinear electromagnetic analysis has been carried out and validated by experiments performed on fabricated hardware.

2. LITERATURE REVIEW

Yogesh Kumar Yadav et al. [12] discussed electromagnetic braking. This study mainly focused on the application of electromagnetic power to stop the vehicle. According to the authors an electromagnetic brake structure employs magnetic power and what else will be current to connect the brakes, yet the power needed to apply the brakes is distributed through a current source. These brakes can be added as assist brakes in larger vehicles and autos. Electromagnetic brakes can be employed as a part of commercial automobiles by adjusting a given current to produce attractive growth. It could be employed as a component of upcoming cars with some adjustments to the brakes.

Purohit Harish Laljibhai et al. [13] discussed the "Electromagnetic Braking system". Although the extensive literature documenting all elements of MB is briefly examined, some of it directly applies to vertical magnetic braking systems, which is important to companies. One of the primary difficulties in building a vertical magnetic system is the detection of the magnetic flux. The transfer of magnetic flux causes "eddy currents" in the conductor. These currents consume energy in the conductor and create a drag force to reduce the velocity. Therefore, whenever the material of the track is changed along with the "air gap", a finite element model is created to investigate the processes of magnetic flux density. Verification shows that the estimated magnetic flux is now within reasonable limits with the observed value. The research will help in the design of EMB systems. The authors find that as mentioned about the limitations of drum brakes, braking systems, and pneumatic brakes electromagnetic brakes are a better and more reliable option. The electromagnetic brake control system is an electric switching system that provides better controllability.

Sudarshan T A et al. [14] detailed the design as well as Fabrication of the "Electromagnetic Braking System". According to the authors,accidents are also increasing due to poor braking mechanisms, it is clear that electromagnetic brakes are an important complement to the safe braking of large trucks. It tries to limit failed brakes preventing road accidents. It also reduces the maintenance of the braking system. One advantage of this system is that it can be used on any vehicle with simple adjustments to the transmission as well as the electrical systems. An electromagnetic braking system applies magnetic force to actuate the brakes, although the power required to apply the brakes is delivered manually. The disc is attached to the shaft and the electromagnet is installed on the frame. When power is supplied to the coil, a magnetic field is generated across the armature as current flows throughout the coil and attracts the armature towards the coil. As a result, it produces torque and eventually, the car comes to rest. These brakes can be incorporated into larger vehicles as auxiliary brakes. Electromagnetic brakes can be applied to commercial vehicles by regulating the current provided to create a magnetic flux. It can be used in future autos by making some changes in brakes.

Research Questions:

- How does electromagnetic braking improve the user experience?
- How to improve braking functionality and reduce environmental impact inclining?

3. METHODOLOGY

3.1. Design:

This research mainly focused on the Electro-magnetic brake for locking mechanism. The braking mechanism generates high holding force with low pull-in force and spring force. Producing high holding force against short travel length is utilized by applying strong air gap flux towards the armature core (i.e., increase magneto motive force). This increases the demagnetization factor of the armature winding, thereby increasing the equivalent impedance to be effectively reduced by decreasing the coil current. The brake is designed for a minimum gap length of one millimeter to ensure mechanical assembly feasibility. In the flux route, there are two air gaps.one before the test pole magnets and the other between the crown of the pole piece and the ferrite core. The flux is given in the below equation:

$$\phi_g=\frac{NI}{R_{g1}+R_{g2}}$$

$$F=\frac{\phi^2}{2\mu_0 A}$$

$$R_g=\frac{l}{\mu_0\mu_r A}$$

Where,

Φ_g =“RemnantFluxof Main Magnet”.

R_g =”Reluctance of Air Gap”.

A= Area of Air Gap.

NI= Number of Coil for Generating “magneto motive force”.

3.2. Instrument Used:

The coil produces a magnetic field around itself as electricity goes through it, and this is known as an electromagnet. Make a system that is capable of Brake for Locking Mechanism using the properties of electromagnetic braking. Figure 2 depicts the key component of this system.

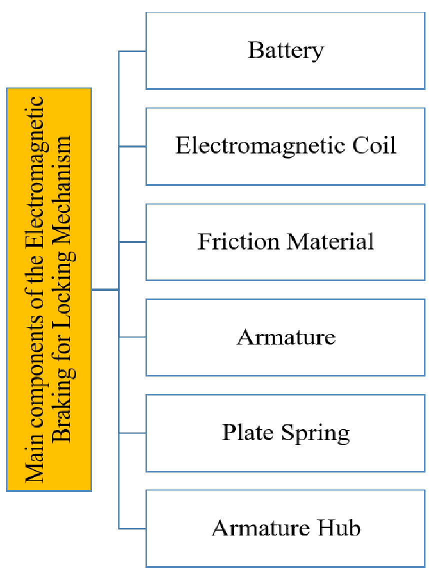

Figure 2: Illustration of the Components Used to Make the Electro-Magnetic Brake for the Locking Mechanism.

3.3. Data Collection:

To increase the energy efficiency of the system, a novel efficient switching “electromagnetic brake” (EMB) design has been developed, consisting of an integrated permanent magnet and a rear iron structure acting simultaneously as an energy storage device. Latch-type valves/brakes have received a lot of attention and have been used in a lot of speed control devices. The electromagnetic design brake's parameters are listed below in Table 1.

Table 1: Illustrating the Design Parameters of the Electromagnetic Brakes.

Sl. No.	Parameters	Value/Unit
1	Pull-Force	118N
2	Voltage	52V
3	Current	2.5A
4	Holding Force	87N

3.1.1 Braking Force:

Using Newton's Second Law, the total braking force required is easily computed.

$$V = \frac{\pi \mathrm{dN}}{60}$$

Where,

V=Velocity of Vehicle

d= Diameter of Disc Brake

N- Braking force applied on the Brake

3.1.2 Clamp Force:

Clamp force can be calculated as:

$$C = \frac{T}{\mu R_e}$$

Where:

C= Disk brake clamp load

T= Torque of the brake

Re= Effective Radius.

μ=Friction coefficient.

3.1.3 Brake power:

If the test speed is reduced to zero, the kinetic energy (K.E) is given by-

$$K.E. = 0.52mv^2$$

3.4. Data Analysis:
3.4.1. Break Torque Analysis:

The current level and speed of the disc play a vital role in limiting the braking torque (B) production and strain. This analysis focuses on the magnetic flux density generation and its relationship with the applied current. The iron core shape that has been used in this study consists of a round shape in diameter. The analysis of n, I, l_g, and μ_0 show the number of turns that are present in the electromagnet, applied current (Amp), air gap, and permeability of the air respectively.

$$B = \frac{\mu o\, ni}{l_g}$$

3.4.2. Wedge Angle analysis:

Brake torque and braking distance are crucial for the performance of the electronic management brake system (EMB). The EMB braking torque is an important design parameter that should be optimized to achieve better braking performance while maintaining the life of the friction material. The equation$\omega_n = \tau_m . \omega_t / R$ can calculate the wedge angle, ω_n is the frequency of revolutions, $\tau_m$is torque, ω_t is the angular velocity, and R is the wheel radius. To ensure braking regulation requirements, it's necessary to reduce braking distance.

4. RESULTS AND DISCUSSION

The simulation has been applied to the maximum braking torque and wedge angle at different speeds. The results show that the maximum braking torque decreases with increasing speed, and the wedge angle decreases with increasing speed, as shown in Figure 3. This analysis can be used to design a better emergency braking system in the future.

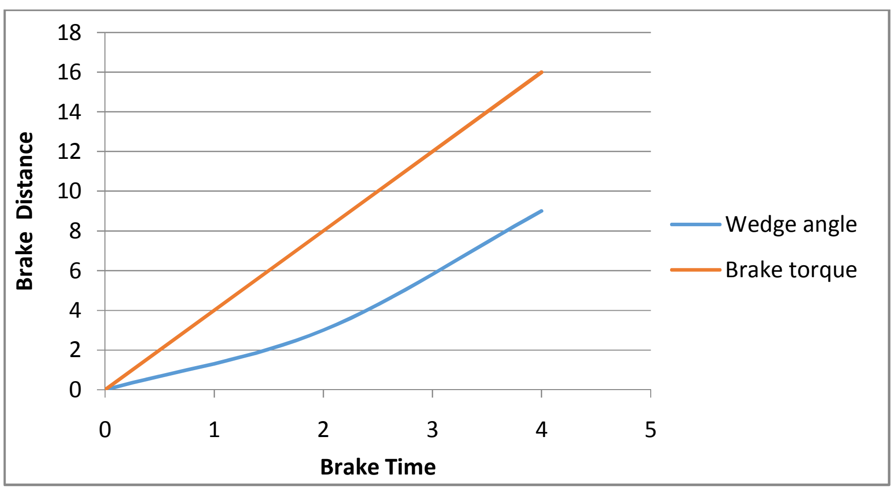

Figure 3: Illustrates the Braking torque curve in "Electromagnetic Braking".

4.1. Mode of operation for the Brake:
4.1.1. Holding Mode to engage mode:

When the power supply is turned on and the brake is OFF, magnet flux flows through the armature winding and suppresses current flow. When the armature winding is excited in the opposite polarity to change the holding mode of the brake to engaged mode, as illustrated in Figure 4 coil flux flows through the excitation circuit, and magnet flux is canceled to effect the armature reaction [15].

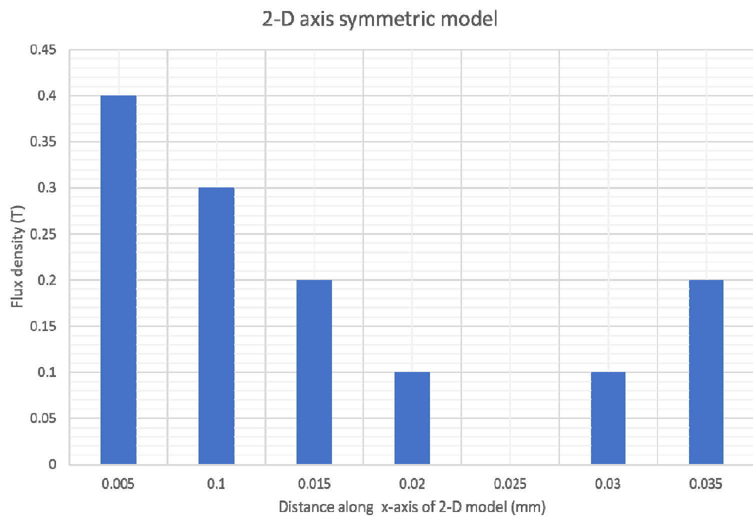

Figure 4: Illustrating the "Air Gap Flux Density" computing the Electromagnetic brake (Engage Mode).

4.1.2. Engage Mode:

In the flux density vector plot, as Figure 5 the amplitude of the signal near the air gap region is higher than that near the magnet. This is because a large amount of flux escapes from the core in this region, which provides a path to guide such flux away from the core surface.

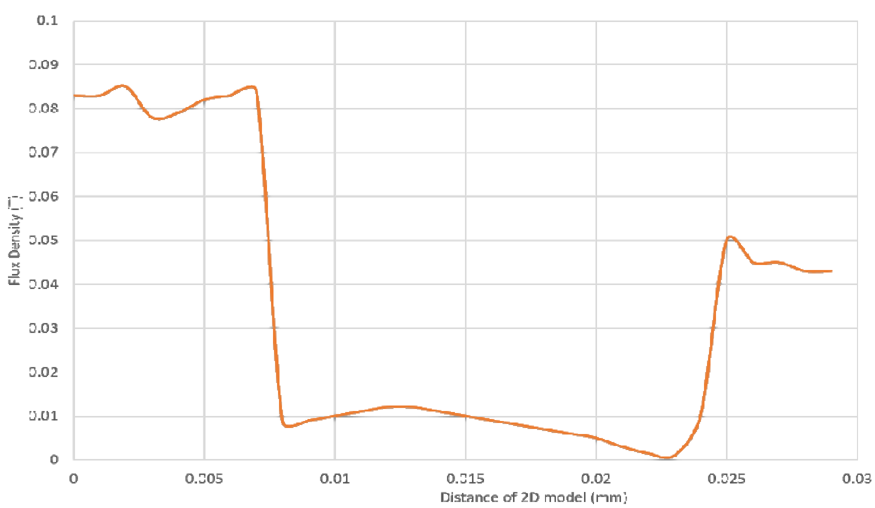

Figure 5: Graph Represent the "Air Gap Flux Density" Computation in Electromagnetic Brake (Hold Mode to Engage Mode).

5. CONCLUSION

The main function of the brake system is to stop the vehicle by efficiently converting kinetic energy into heat. The traditional break-by-wire system performs well after design and development, but it suffers from two main problems. One is that it cannot provide pure energy conversion because the lever force generated by the driver is supplemented by electromagnets and proportional servo valves to improve its sense, the second is that this system has limited torque capability at high temperatures because it relies on stop valves and solenoid valves with inherent hysteresis losses. The EMB system has been successfully implemented on commercial trucks and urban buses with a locking mechanism. In a break-by-wire system, the resistance between the electromagnet and the iron core varies with temperature. The braking force changes during braking as a result of the variation of electromagnetic resistance. When rapid braking causes a temperature increase or decrease, each thermoelectric experiences a decrease or increase in braking force, resulting in unstable performance and frequent wear and tear on tires, brake shoes, and other components.

When the motor mechanical backup system fails (due to a collision or breakdown), drivers may not be able to stop when necessary because they cannot use the electromagnetic brake or have limited control over the outcome, verified. The advantages of the proposed EMB system are as, First, the proposed EMB system has excellent braking performance; Secondly, it can be used as a type of DC (Direct Current) motor for front axle brake and rear axle brake and permanent magnet synchronous motor as control parameters. Theoretical formulas were prepared to describe the braking performance simulation results of an EMB system with different parameters. It has been proved that the braking performance is related to the geometry, frequency, and amplitude of the EMB and the un-sprung mass dynamics in this paper. However, other aspects of the rationality of the structure should be investigated in future research.

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CHAPTER 2

COMPARATIVE ANALYSIS OF TUBE TIRE AND TUBELESS TIRE FOR DIFFERENT ROAD CONDITIONS

Shri Bhagwan, Assistant Professor
Department of Mechanical Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- Shribhagwanme@gmail.com

ABSTRACT:

Tires and wheels are the main part of any vehicle. The movement of the vehicle is dependent on the wheel movement. The tires are mostly made of rubber so the composition of rubber makes it soft, thus new tires with different compositions are used nowadays. Various research was done by using various design software for different materials of the tire but the practically applicable research is less and so there is a need to do this study on the actual vehicle to understand the working of tires. The study is done to analyze the properties of tube tires and tubeless tires based on actual testing in different regions and different roads condition. Two bikes were tested on different types of load one with tube tire alignment and the other bike having tubeless tires. The result obtained for both types of tires are good in their field but most of the working bike is on smooth roads so tubeless tires are preferred. Thus it can be said that using a tubeless tire is the most efficient and economical for the user of a bike. The use of tubeless tires is increasing as the tubeless tire has more benefits one of which is there are fewer chances of puncture within it. In the next few years, the tubeless tire will be used in most vehicles and the new material tubes will be invented to avoid the punctures in tube tires as many types of research are to be performed.

KEYWORDS:

Automobile, Road, Spokes, Tube Tire, Tubeless Tire, Vehicle, Wheel.

1. INTRODUCTION

Transportation changed in history with the invention of the wheel, after which the use of the wheel became apparent to all transport systems [1]–[3]. The shape, size, and several wheel changes with the material used for the manufacturing wheels. Vehicles are used since the century of years as a mode of transportation having the number of wheels two to eight and so on. The tires are considered the main element or part of the automobile as the running or working is done by a wheel of a vehicle. The tires usually are made up of rubber having an air-filling cavity inside. The wheels are part of the main alignment of the vehicle and have main parts tube, tire, and spokes. Wheels carry the weight of all vehicle embodiment and the passengers within it while running on the road. The wheels of the vehicle also support the passenger within it on irregular roads and also help in reducing the noise of the vehicle to a certain level [4]–[8].

The wheel alignments are now modified based on the different wheel types available in the market which are depending on wheel design, tube presence, and spoke wheel alignment. The use of wheels is different for different vehicles based on their design and application. The tire of the wheel is observed in two types, they are available with tube and tubeless as well. All the tires of the vehicle are made from the same material, the peripheral design of the wheels changes according to the company design that is manufacturing the wheel tires for the vehicles. There are two types of tires in the market on which all vehicles run they are tube tires and tubeless tires. Tube tires are having a cavity that is used for putting the air-filled rubber tube inside the cavity of the tire. Tubeless tires are no-tube tires that are thick and hard and are used in most long-route running vehicles [9]–[12].

The tubed tire are used since history in the vehicle's wheel alignment. The tubed tire has one rubber tube placed within the tire and covered with a spokes rim over it having multiple metallic spokes.

There are cycles and bikes where spokes and wheel arrangement is seen mostly and are known examples of tube tires. The rims are used in the vehicle wheel whereas tubes are used in the tire alignment. Many bike models still have traditional looks and are on the list of costlier bikes like Avengers, Royal Enfield, etc., as well as classic models of old cars like Maruti have the wheel tire-tube arrangement as shown in Figure 1. The wheel embodiment is of the tube, tire, rim, and spokes, which are moving on the track with rolling friction to maintain the traction of the vehicle. The tubes are air-holding circular apparatus made of synthetic rubber placed inside the tire, to get the toughness in the wheel, which shape is shown in below Figure 1 [13]–[16].

Figure 1: Represent the Tube Tire Arrangement of the Wheel of Four-Wheeled Vehicle.

Tubeless tires are now used in vehicles that can sustain high load working depending on their application. The tubeless tires are hard than tube tires and there is no need for an air tube to install within them.

The spoke wheel is a metallic ring having metallic spoke alignment and is used for vehicles that are huge in weight to get less rolling resistance in smooth road conditions. The tubeless tire is hard than tube tires as there is no tube installed within it. The tubeless tire has low rolling resistance, as the air is directly placed within the tire and rim as shown in Figure 2 so there are no frictional losses, and the stability of the vehicle is maintained which is seen in a sports bike.

Figure 2: Represent the Tubeless Tire Wheel of a Two-Wheeled Vehicle [17]**.**

Different experts and researchers have done their research on tires having different designs and properties as the tire is the main part of the automobile system. The function of a tire is to maintain the stability of the vehicle while rolling on the road with minimum rolling resistance. There are two types of tires used in automobiles tube tires and tubeless tires. There is more research carried out that is comparing tube tires and tubeless tires, but there is very less research on the actual working of the tire, so it is needed and necessary to know all the hidden aspects of tires. Many conditions affect the working of a tire which creates an economic loss to the vehicle owner, so before buying any vehicle buyers should know the properties and work of tube and tubeless tires under different conditions. As the tire is the main part of the vehicle so it is necessary to know the working of the vehicle for both types of tire. So the research is carried out to make aware of which tire should be used in which road conditions.

2. LITERATURE REVIEW

N. K. Ospanovaet al. have studied different designs of tires used in automobiles, a tire is made of rubber where compressed air is entrapped. The tires get busted during running or driving while in working conditions so it is necessary to know the technology behind the designing of tires to avoid such accidents so the tubeless tires are used. Non Pneumatic tires give more safety advantages and have very less environmental impact. The different factors affecting vehicle performance, efficiency, and tire life such as drawbar pull, soil content, spokes structure, inflation pressure, slip, tire aspect ratio, etc. are studied in the study. Different types of tires such as “Resilient”, “Tweel”, and “Honeycomb” are studied. Modeling and analysis are carried out for non-pneumatic tires by using Solid works where Design and Modification are done in different parts of tires. Non-Pneumatic tires give more safety advantages and have a very less environmental impact, low stresses and higher ride quality which is seen in “honeycomb” spokes with a larger cell angle magnitude, which is beneficial for a fatigue-resistant spoke design.

Sandra R. Scagliusi et al. studied the mechanical and chemical properties of the Stability of inner tubes exposed to gamma radiation. The research was to study how the mechanical qualities of an inner tire used in trucks change after being exposed to gamma rays, to encourage more material recycling. Ionizing radiation was chosen because of its potential to change the structure and characteristics of materials, as well as its suitability for rubber recycling and recovery. The following tests were performed on non-irradiated and irradiated materials of the quantity of radiation stress and percentage of elongation, hardness, thermal aging, and elemental analysis which after 20 kGy, shows a deterioration in mechanical characteristics [18].

Prithviraj Kandekar et al. discussed that plastic was investigated as a substitute for an air package in a high-performance automobile. Tires that blow out cause more damage so the focus of the study was to find non-explosive alternatives for air holding or packing. Plastics are the primary material used in research because there is an oversupply of plastic on the planet so the focus is to make the plastic usable. The focus of the study was on a Formula One tire, which was designed in solid works in 2016, the design of the wheel was created according to the FIA's requirements, where the reaction forces, mass-energy conversions, and bending moments are the required calculations. ANSYS workbench was used for computer environment and structural analysis. The results of the air and plastic simulations were compared, and a converging graph was produced to validate the deformation outcomes with different element sizes. Thus, it can be said that plastics will soon use in place of rubber [19].

Solomon Wakolo et al. studied the effect of Variation in Tire Pressure on Power Generation from a Piezoelectric Element installed in the tire. In recent years, there has been a lot of research on power generation using piezoelectric elements. The research was done for a tire with components inserted in the inner tube as well as the tire to generate power using the piezoelectric sensors. The results have been compared to those of a tire with parts attached inside other than the inner tube. According to the results of the testing, both tires provide an increasingly better output when tire pressure is increased up to the full pressure beyond which production reduces for stimulation forces up to the maximum limit. The pressure built inside the tube tire was more than the pressure of the tubeless tire. Though the tubeless tire produced superior output at low loads, the tubed tire had the highest total output power and would be better suited for use in automobiles [20].

The research was carried out on the different fundamentals of tires used in various vehicles. The focus of every research was to bring the new properties and aspects of both types of tires i.e. tube tires and tubeless tires. There is various research on the material of the tube, physical properties of the tire, applications of the tire, and design of the tire. Very little research was carried out for analyzing the actual performance of tires by using them on actual roads which are necessary for study.

Research Questions:

- What are the different types of tires based on air tube orientation?
- What is the difference between tube tires and tubeless tires?
- What is the difference between road bikes and mountain bikes?

3. METHODOLOGY

3.1.Design:

The study is focused on analyzing the different properties of both the tubeless and tube tire under working conditions. The tire is the main part of any vehicle as the tires are used to move on the road while carrying all the load present in the vehicle. The tube tires are heavy as the external air-filled rubber tube is placed in-between the tire which is enclosed by the wheel rim as shown in Figure 3. The wheel rim has several spokes that are connected to the wheel alignment through the bearing. The tubeless tires are light in weight as the air-filled is placed in-between the tire which is enclosed by the wheel rim as shown in Figure 4. The tubeless tire is mostly used in vehicles that are working on smooth roads. The main function of the tire is to give more efficiency under any load condition and rolling resistance.

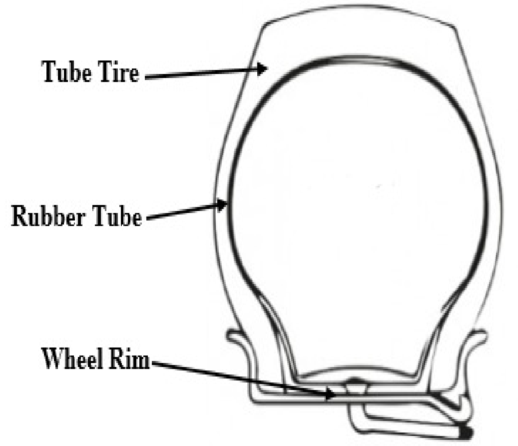

Figure 3: Illustrates the Tube Tire Arrangement of the Wheel Used on the Vehicle where the Tube is Completely Filled with Air or Vacuum.

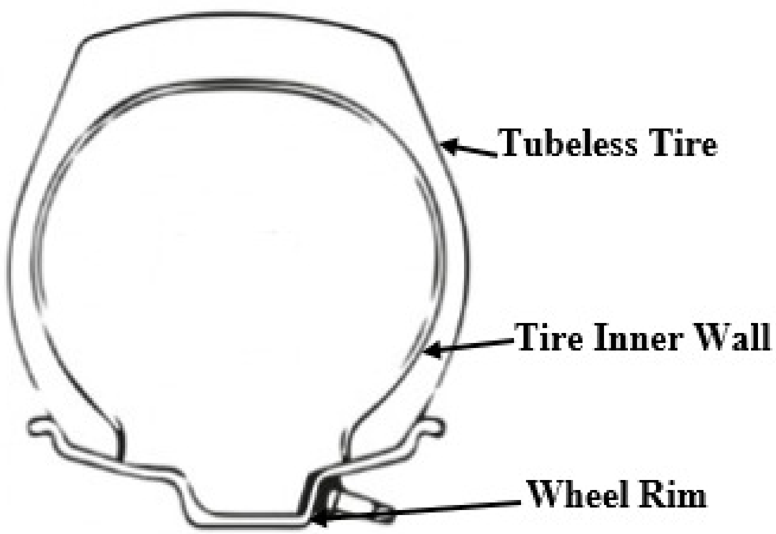

Figure 4: Illustrates the Tubeless Tire Arrangement of the Wheel Used on a Vehicle where Air is filled inside the Tire without Any Tube.

3.2.Sample:

Two bikes have tubeless and tube tires which are used for testing and analyzing the properties of tires. The radius (R) of a tire of the bike is 18 inches for both front (F) and rear (R) wheels. The bikes are tested at different places under road conditions with load and no-load conditions as shown in Table 1. There are many spokes on the rim of the wheel and tire of the passion pro bike while the Karizma bike has the metallic body of the spoke and rim together. The tire of the passion pro bike has a tube fitted within it and the tire is fitted with an air-filled tube having standard tire pressures as shown in table 1 with its physical orientation. The rear tires of Karizma bikes are broad than tube tire bikes to maintain high speed on the road.

Table 1: Illustrating the Details of Tires in the Wheel Alignment of the Bike where the Front and Rear Wheel Dimensions are mentioned with Standard Tire Pressure.

Sr. No.	Bike Name	Front-wheel	Rear-wheel	Type of Tire	Standard Tire Pressure
1.	"Hero Passion PRO"	2.75 Radius 18	3.00 Radius 18	Tube	F- 25PSI, R-29 PSI
2.	"Hero Karizma"	80/100 Radius 18	120/80 Radius 18	Tubeless	F- 29PSI, R-34 PSI

3.3.Data collection:

The comparison of tube tires and tubeless tires is based on, Tube application in the tire, Rolling resistance, Effect of Weight of the tire, Repairing of punctures in the tire, Damaging of the tire, Efficiency of the bike using the tire, Mileage of bike, Life Of Tire, Rim Design, Safety of rider, friction and Need Any Special Care While Using as shown in Table 2. The tube tires are mostly used for the vehicles which had the spoke rings in wheel alignment while the spoke wheel is used for tubeless tires as the tires are hard and difficult to fit the spoke wheel. The comparison is done to analyze the working of bikes using both types of tires in their embodiment which is mentioned in Table 2. Both types of tires have their market for different bike applications so their properties are compared with different design aspects as well as with their performances. The use of tires varies with the design of the bike and the workability of the bike.

Table 2: Illustrates the Comparison of Tube Tires and Tubeless Tires based on Properties, Working, and Performance.

Sr. No.	Comparison of Tires	Tube	Tubeless
1	Tube application in tire	The tube is filled with air	No tube air is directly filled in the tire
2	Rolling resistance	high	low
3	Effect of Weight of tire	Heavy when the tube is filled with air	Light in weight
4	Repairing of puncture in the tire	Easy to repair tire punctures.	As they are hard there are fewer chances of punctures
5	Damaging of tire	The tired are damaged easily due to uneven loading	The spokes may get bent on the uneven road.
6	The efficiency of the bike using the tire	Fuel efficiency is maintained if the air pressure is maintained as per the standard.	Fuel efficiency is maintained when the bike is running with low rolling resistance.
7	Mileage of bike	low	high

8	Life Of Tire	Long-life if the bike is operated by the same person	Long life and don't need special care.
9	Rim Design	Spoke rim	Rim wheel
10	Safety of rider	Due to friction on long routes, there are chances of the tire getting busted.	The tire does not get busted, the rider can ride with less air also up to the desired location.
11	Friction	High friction	Low friction
12	Need Any Special Care While Using	The air should be checked regularly to maintain the tire condition.	The tire should not get damaged on the side edge.

3.4.Data analysis:

There are two types of bikes tube tire and tubeless tire used for analysis, where observed that the tube tire bikes are good on uneven roads, desert sand, etc. while the tubeless tire has good mileage as there are less frictional losses as shown in Table 3. The passion pro and Karizma bikes are different in design and work with different engines were used in testing to analyze the working of their tires in different conditions as shown in Table 3. The conditions of the road should be considered while selecting a particular type of bike on which the bike is going to run. Road conditions play an important role in the life of the tire and the efficiency of the bike. So before selecting any type of bike, it is necessary to know all the technical aspects of the tires with which the bike is assembled. The bikes that are used in the analysis are belonging to the same company and have different engines, designs, and tire-wheel arrangements.

Table 3: Illustrates the Working of Bikes on Different Tracks Having Tubeless and Tube Tires.

Sr. No.	Types of Roads	Passion Pro Bike with Tube Tires	Karizma Bike with Tubeless Tires
1	City Roads	Good with low speed	Good with low speed
2	Highways	High speed creates friction in the tube and tire	High speed maintains the stability
3	Zigzag Roads	Slow speed	Slow speed
4	Uneven Land Road	Spokes rim maintains the balance of the bike without damage	The rim wheel may get damaged or bend if the land is very uneven
5	Desert Sand	Rims maintain the balance of the bike	Bike balance is not maintained and may get into problems due to sand.

4. RESULTS AND DISCUSSION

The chances of deflation in tubeless tires are slow and constant, providing the driver adequate taken to reach the nearby tire repair shop. A slow deflation also allows the driver to reduce the vehicle's speed. Tubeless tires provide minimal rolling resistance, making the bike seem lighter and providing enhanced stability and comfort. Tubeless tires are the final hope and are therefore more lasting than tube-type tires, thus most cars now have them removed. Repairing a tubeless tire is simple and painless, and the vehicle can travel a long distance if the rider continuously replaces the air. Tubeless tires provide better heat dissipation since the air is within the rim, resulting in longer tire life. Due to the lack of a tube and the slow rate of deflation, destruction to the tubeless tire is reduced in the event of a flat tire. The tubeless tires' minimal weight enhances the bike's fuel economy. When a sharp instrument rips a hole in a tubeless tire, the liquid sealant flows into the hole and dries, closing the leaking.

Running a bike with low air pressure can also cause damage to tires with tubes, but there is no such problem when there are tubeless tires. Tubeless tires are difficult to fit on the rim as they have to be airtight against the rim and a skilled person can fit a tubeless tire without getting the rim damaged. If there is a puncture in a flat tire, not everybody will be able to fix it as fixing tubeless-tire punctures require special equipment. The sidewall of the tubeless tire is a dangerous place to have a puncture and in a tube-type tire, the tube can be changed so the tubeless tire will need to be changed if its sidewall gets damaged or even if it's carelessly discarded. Tubeless tires are expensive compared to tubed tires due to the difference in components used for manufacturing. Thus, it can be said that tubeless tire has less maintenance but high initial cost while tube tires are less in price but are not as hard as tubeless tire so there are high chances of punctures and bursting due to occurring friction between tube and tire.

5. CONCLUSION

The tubed tire and tubeless tire are mostly used in an automobile but with change in time, the tube tires are replaced by tubeless tires due to their properties. The tubed tire has a rubber tube filled with air which makes it heavy while tubeless tires are directly fixed with a rim wheel with a special tool. The outcome obtained by using the bikes having different tire orientations is that both the tires are good in their working depending on the area where the bike rides. The tubeless tires are good on smooth roads as they cover the high distance in less time and a big wheel gives stability to the bike. The tube tires are good on uneven roads as the spoke rim arrangement adjusts the jerk obtained due to uneven track. Due to the hard material of tubeless tires, there are fewer chances of puncture and if the puncture is there it is easy to repair if it is on a flat surface but if there is a puncture on the side edge of the tire using such a tire should be avoided. The tubed tire is not much harder as there is a rubber tube placed inside the, there are many chances of puncture in the tire but the tube puncture should not be neglected. Thus, using tubeless tires is more convenient than tube tires if the work of the bike is on highway roads for long-running. There will be more use of tubeless tires in the next few years due to their hard nature and durability.

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CHAPTER 3

EXPLORATION OF THE STRENGTH OF CARBON COMPOUNDS USED IN INDUSTRIES

Arun Gupta, Assistant Professor
Department of Mechanical Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- engg.arun12@gmail.com

ABSTRACT:

Material strength is the ability of a material to resist force-driven forces when forces are acting on it. The properties of materials depend on many characteristics, including their composition, area of application, and composition. The focus of the study is to analyze and discuss the strengths of certain carbon-containing elements such as steel compounds and geopolymers, which are studied by various experts. Different experts focus on different aspects of the material by conducting various tests to get relevant results. The study states that carbon-containing compounds have high strength and are used for production in many industries. The study will help to improve the content of the discussed compounds to improve strength in such a way as to obtain high-strength materials with the required stresses and strains for the designed application. Thus, it can be said that the study of the strengths of different materials will improve and stress-strain should be considered when making any element compound.

KEYWORDS:

Geopolymer, Steel, Stress, Strain, Industries.

1. INTRODUCTION

The field of element strength often referred to as material mechanics, is related in several ways to the calculation of stress-strain for design features such as columns, shafts, and beams [1], [2]. Materials properties including “Yield Strength”, “Ultimate Tensile Strength”, “Young's modulus”, and “Poisson's ratio” are considered while predicting the behavior of the material under load and its susceptibility to various component failures. The mechanical component's geometrical properties, such as length, thickness, boundary limits, width, and abrupt changes in shape [3], [4]. The theory was developed by investigating the behavior with 1 and 2-dimensional objects, where perceived stress may be thought of as 2D and afterward projected into 3 dimensions to explain material behavior [5],[6]. In structural mechanics, the ability of a substance to sustain a weight without breaking or deforming is known as its strength.

The field of strength of the material is focused on the pressures acting on materials and the failure modes that happen when they do. When a load is given to a mechanical structure on a state basis, internal forces called stresses are created inside the member [7], [8]. Whenever a material's deflection is quantified on a unit basis, the phrase “strain” is used to characterize them [9], [10]. To estimate the member's maximum load, which is dictated by the object's shape and size, the stress-strain that develops together within the body must be computed. It is possible to apply radial or rotational loads. To evaluate the degree of tension strain at each point inside the member, systems, and materials of the loads and the player's composition can be employed. The individuals' energies, deformations, and stability may all be estimated if the condition of stress-strain inside the individual is understood. Given that the tensile modulus is the parameter that predicts extension in the components, depending on its microstructural properties and intended outcome, one may make intelligent decisions about how to increase the material's strength. The compression, tensile, and shear stress limit values that would cause a collapse are being used to show strength, as shown in Figure 1 [11].

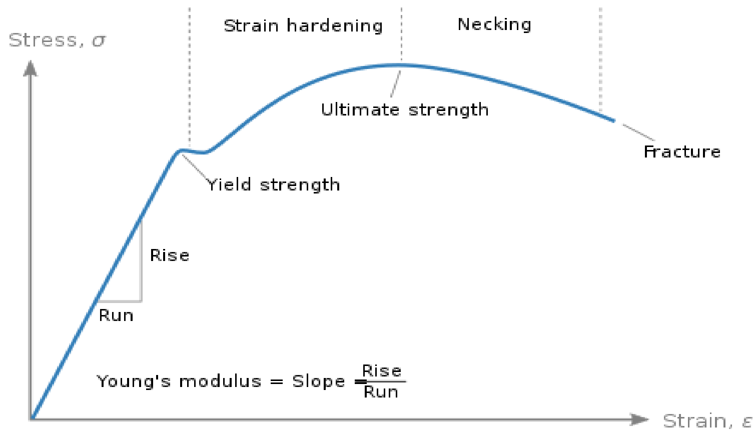

Figure 1: Illustrates the Stress-Strain Curve which is used for Analyzing the Properties of Metals.

The consequences of dynamic loading, particularly the problem of fatigue, are arguably the most essential practical aspect of material properties. Brittle fractures are commonly formed as a result of repeated stress, and they expand until they fail. At minimum stress points significantly lesser than the indicated for the material's strength, fractures invariably begin at stress concentrations, notable modifications in the inter-object, around holes and corners. Thus, there are many materials used in industries that are metal and non-metal having different properties, so it is necessary to study the different properties of such elements concerning their application in the industry.

2. LITERATURE REVIEW

Hafiz Tauqeer Ali et al. The use of "Fiber-Reinforced Polymer (FRP)" in bridge-building has been considered. This study provides a brief overview of the usage of FRP in construction design. The research is broken down into sections that include common FRP structure components, as well as various product and manufacturing techniques for maintaining and creating FRP bridges. Because FRPs are fragile and easily damaged, important components of bridges are constructed using a combination of FRPs and traditional materials. Despite the substantial study, further effort is required to better understandability to fulfill end-of-life recycling, develop expense and versatile production processes such as 3d modeling, and make composite materials to fully use FRPs [12].

Matteo Sambucci et al. advancement in Geopolymer Technology was reviewed. This paper investigates how major process parameters impact the mechanical, rheological, microstructural, and durability characteristics of geopolymer concrete materials. Finally, the paper highlights a few key points for future research, the concrete application effectively expanded in the civil-architecture areas, with possible trends of cementitious technologies in terms of marketing and large-scale dissemination [13]. A.K. Bhaduri et al. studied Bellows for the such nuclear sector are designed and manufactured. This study provides an overview of the nuclear industry's operational experience as well as the mechanical and neutronic characteristics of various materials bellows. Inconel alloys offer superior mechanical qualities over austenitic stainless steels, yet they suffer neutron embrittlement, according to this study. As a result, Inconel bellows are only suitable for situations with modest neutron fluence. Steels that have been precipitation hardened, such as AM350, have a good tensile property but a low ductility. Recommendations for the choice of materials bellows are drawn based on the current review work, fulfilling the selection criterion [14].

Yiliang Liu et al. researched Cementitious Materials, for example, which are low-strength materials. The use of metallurgical waste as “Supplementary Cementitious Material (SCM)” as a technique for decreasing greenhouses emission by decreasing types of cement manufacture has shown potential. As a result, this paper summarizes current research on using metallurgy trash leftovers as SCM to partly cement replacement, and also the use of potassium hydroxide metallic wastes as concrete mixtures to replace cement in the manufacturing process. This paper’s study and observations provide a fresh option for SCM development as well as a plan for addressing the environmental issues related to metallurgy waste processing.

Mehrab Nodehi et al. discussed the use of waste materials in construction as an example of recycling and reuse in action. In this context, the research looked at waste products as recycled products that, in some cases, might give a more customized property. The following review paper begins by giving a brief overview of the most often utilized waste materials, such as supplementary cementitious materials, construction and demolition ceramics, and the enormous array of plastic materials. Then, by examining a specific environmental effect, physicochemical qualities, endurance, and lastly mechanical properties, the limitations and future forecasts of modern waste products for use are discussed, as well as prospective future research in this field.

Y. Reda et al. discussed “Al-Zn alloy 7075” structure and physical attributes the purpose of this research is to look into the effects of retrogression, aging, and solution treatment for mechanical characteristics of “Al 7075”. Crystalline structure, toughness, and young’s modulus of materials were investigated. The optimum heat treatment values have been determined to be the condition, showing that triple artificial aging produces the peak value of UTS 690 MPa, as evidenced by the microstructure of each specimen.

Haocheng Jiang et al. studied The Fencing Blade was created using the following materials. They evaluated the usual elements used in the fencing blade and compare it with the outcome of the experiment with the theoretical proportions of a series of steels using 2 fencing swords made in Europe and China. Springs castings and matrix composite steels were found to be the most common metals utilized in fencing blades. The paper then gives a summary of these materials' elemental composition, thermal treatment procedures, microstructures, and mechanical characteristics. Finally, successful collaboration between producers and researchers is required to fulfill the varied fencing blade criteria to meet the expanding demand for fencing in China.

Long Yuan et al. did research on “Met-kaolin Fly Ash (MK-FA) Geopolymer” which underwent an orthogonal investigation and mechanisms of compressive strengths and microstructure. In this paper, “Orthogonal Experiments Design” (OED) was used to create 16 sets of samples to fulfill the sequence of contributions of three hypothesized effect elements in compressive strength increase. As the calcium cycle with fly ash interacted, test findings demonstrated that the calcium cycle was promoted significantly. The stimulation of gel formation with calcium successfully compensated for the demerit of lower-level reaction owing to partial hydrations of fly-ash in the later phases of the experiment.

The different industry experts and researchers studied the properties of materials used in the industry used in various applications. It is always better to know the physical proper of any compounds or materials that are to be used in particular applications to maintain the efficiency of the work. As the studies say different elements are combined with carbon to form a hard compound which may be metal or non-metal. The steel i.e. iron contained compound is used in the manufacturing most of machines and components. The studies made by different experts are useful for designing and developing components by studying the physical and mechanical properties by studying stress and strain. Thus, the study focuses on the new carbon compounds with metals and non-metals to analyze their properties, strengths, and areas of application.

3. DISCUSSION

Various components, combinations, and metals have unique qualities that distinguish them from one another. When employing a material for any use in industry, its qualities are critical. The point on the architectural stress-strain curve at which the material experiences irreversible deflections that result in permanent member deflection when the pressure is released is shown in Figure 2 which shows the effect of force acting on the bodies from different angles. The material's greatest strength relates to the maximum stress value obtained, whereas fracture toughness relates to the most recent yield stress recorded at the fracture yield point. The properties of metals are as shown in Table 1 which are brittleness, bulk modulus, friction coefficient, Poisson's ratio, coefficient of restitution, compressive strength, ductility, malleability, surface roughness, elasticity, flexural strength, fracture toughness, toughness, mass diffusivity, Plasticity, Shear modulus, Fatigue limit, Tensile strength, Shear strength, Stiffness, Viscosity, Hardness, Yield strength, Resilience, and Young's modulus.

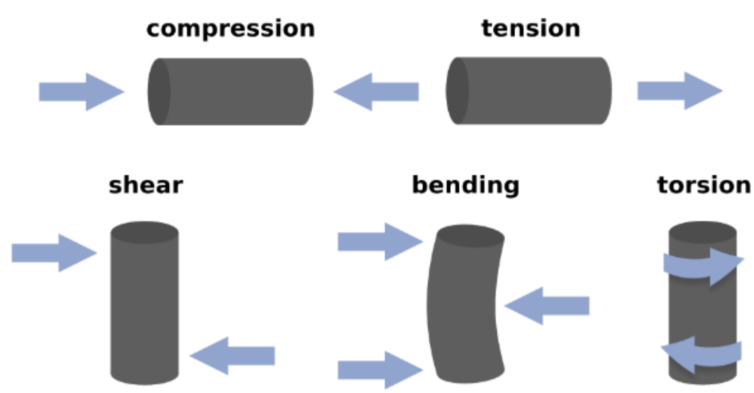

Figure 2: Illustrates the Effect of Forces Acting on the Body which Affects the Physical Properties of Elements [15]**.**

Table 1: Illustrates the Properties of Materials that are considered while making any Elemental Compositions for Different structures.

Sl.	**Properties**	**Definitions**
1	Brittleness	The property of a material that fractures when subjected to stress.
2	Bulk modulus	It is pressure-to-volumetric-compression.
3	Friction coefficient	The force opposing the relative displacement of surfaces in contact between material pairs is equivalent to the number of

		forces normal to a surface.
4	Poisson's ratio	It is the ratio of lateral to axial strains.
5	Coefficient of restitution	The ratio of two objects' final relative velocity to their starting relative velocity after they collide.
6	Compressive strength	The maximum stresses that materials could bear formerly fail compressively.
7	Ductility	When a substance is exposed to a tensile load, it can deform. A material's capacity to be drawn into lines by the tensile load is also known as tensile strength.
8	Malleability	The material's capacity to be squashed into thin strips under severe compressive pressures without cracking, whether by warm or cold work procedures.
9	Surface roughness	Deviance in the orientation of an actual surface's normal vector out of its purist form.
10	Elasticity	When a body is subjected to a distorting effect or stress, it has the potential to revert to its former size and shape after the tension is gone.
11	Flexural strength	The extreme bending stress that materials can take before failing.
12	Fracture toughness	The capacity of a substance to resist fracture in the presence of a crack.
13	Toughness	A material's capacity to store power and bend plastically without shattering.
14	Flexibility	An object's capacity to bend or deformed in reaction to pressure applied to it.
15	Mass diffusivity	A substance's capacity to disperse through another.
16	Plasticity	A material's capacity to withstand permanent deformations without cracking or rupturing.
17	Shear modulus	It is the ratio of stress to strain in shear.
18	Fatigue limit	The greatest amount of stress that a material can endure when subjected to repeated loading.
19	Tensile strength	The highest tensile stress that a material can bear before it fails.
20	Shear strength	The shear stress that materials can endure at its peak.
21	Stiffness	The capability of an item to withstand distortion when subjected to a force.
22	Viscosity	The resistance of a fluid to progressive deformation is caused by tension or shearing stress.

23	Hardness	Surfaces indent and scratch resistance, as measured by the “Brinell Hardness Number” (BHN).
24	Yield strength	The stress in the material after which it starts to deform plastically.
25	Resilience	When a substance is bent elastically, it has the potential to absorb energy.
26	Young's modulus	It is the ratio of stress to strain linearly.

3.1. Stress Parameters:

To depict material resistance, a variety of dynamic load characteristics can be employed. The word “material strength” is describing mechanical stress characteristics, which are parameters that have a consistent pressure-to-force ratio per unit surface size. Mostly as a consequence, the standard strength measuring unit in the SI System of Measurement is MPa, but in US metric system it is psi. Strength characteristics include yield point, tensile, wear resistance, fracture resistance, and some other aspects. The yield point is the minimum stress that causes a material to permanently distort. Because the limit of yielding in some materials, such as aluminum alloys, is difficult to determine, it is commonly compressive stress necessary to induce 0.2 percent plastic strain.

1. Compressive is a restricted condition of compressed stress crack formation in the form of brittle or ductile fracture.
2. Tensile strength, also known as UTS, is a restricted condition of tensile stress that results in tensile failure, either ductile or brittle. Stress can be used to describe tensile strength, although the actual load is the most prevalent.
3. Fatigue life seems to be a more complicated measure of a material’s strength that takes into account multiple load occurrences throughout an object’s service life and is typically more challenging to quantify than standing strength estimates.
4. Hardness value refers to a material’s ability to withstand a sudden load applied expressed in terms of energy. To assess this, the “Izod or Charpy impact tests”, which both analyze the force strength required to shatter a specimen, are often utilized. The impacting strength of the composite is influenced by its density, young's modulus, gravitational pull, and yield stress.

3.2. Ultimate-strengths:

Ultimate strength is expressed as the pressure applied per unit of area and is a property of a material rather than a specific specimen formed of the material with a unit of Newton per Square meter. The ultimate strength of a material is the highest stress it can bear before breaking or weakening. A design requirement that an engineering element or structure must meet is called a factor of safety. The proportion of UTS to imposed stress is known as the factor of safety.

3.3. Stress-strain relations:

After tension is lifted, elasticity refers to a material's capacity to achieve the proper. The relationship between applied stress and generated strain is exactly proportional in many materials, and a graph expressing those 2 values is a straight line. Plasticity, also known as plastic distortion, is the polar opposite of changeable deformations. Plastic deformation is described as a non-recoverable strain. After the applied force is released, plastic deformation is preserved. Plastic deformation is typically possible with most linear-elastic materials.

Material properties, such as porcelain, do not deform permanently and will shatter at minimum force, while ductile material, such as steel, copper, or resins, may flex much more plastically before shattering.

3.4. Material-failure theories:

The four failure theories are “Maximum Strain Energy Theory”, “Maximum Distortion Energy Theory”, “Maximum Shear Stress Theory”, and “Maximum Normal Stress Theory”. Only brittle materials would benefit from the “Maximum Normal Stress Theory”, whereas ductile materials would benefit from the other three theories. Out of the three, the distortion energy theory produces the most accurate results in the bulk of recommendations based. The “Strain Energy Theory" requires the value of the component material’s Poisson’s ratio, which is frequently unavailable. The hypothesis of maximum shear stress is conservative. All theories are comparable for simple directional applied stress, which implies they all produce the same outcome.

1. According to the “Highest Shear Stress Theory”, when the material's shear force intensity surpasses the object's shear capacity as assessed by uni-axial testing, failure occurs.
2. "Theory of Normal Maximum Stress" Failure happens when the maximum stress accumulation inside the component surpasses the UTS of the material as determined by the uniaxial test, according to theory. This idea only applies to fragile materials, the UTS divided by the factor of safety must be less than or equivalent to the maximum tensile stress. The final stress concentration reduced by the safety factor must be less than the size of the highest compressive stress.
3. Failure occurs whenever the strained energy per unit capacity or volume owing to dynamic loading in a component matches the quantity of Strain energy at the elastic limit in uniaxial testing, according to the “Maximum Strain Energy Theory”.
4. The energy of “Maximum Distortion Failure” occurs when the distorted amount of energy volume caused by applied loads in a part matches the deformation amount of energy at the ultimate tensile in uniaxial testing, according to theory. The entire changeable energy owing to strain is distributed into 2 types which first produce dimensional changes, and other cause a shape change. The energy required to modify the form is referred to as distortion energy.

The microstructure of a substance determines its strength. The microstructure of a material can be altered by the engineering operations it undergoes. Work hardened, crystalline reinforcing, precipitation hardening, and intergranular hardening are examples of restoration hardware that may be statistically and qualitatively described to change the strength of a material. To make the providing quality, strengthening processes come with the proviso that some other material properties of the substance may degrade. In intergranular strengthening, for example, while yield strength increases as grain size decreases, extremely tiny grain sizes eventually cause the material to become brittle. In general, a material’s yield point is an adequate predictor of its mechanical strength.

4. CONCLUSION

As the focus of the study was to analyze and discuss the strengths of certain carbon-containing elements such as steel compounds and geopolymers, which were recently studied by various experts. Different experts focus on different aspects of the material by conducting various tests to get relevant results. The study helps to improve the content of the compounds discussed to improve the strength to obtain high-strength materials with the required stresses and strains for the designed application. Stress and strain play an important role in studying the strength of a material. Nature consists of various elements with different properties, and the study of materials helps in analyzing the physical and mechanical properties of any given element. Destructive and non-destructive testing of elements is done to check the various properties of elements. It is the most common element used in the steel industry along with aluminum and copper. The use of new materials with new compositions is in research which will soon be marketed in industries to avoid any financial loss as any material is required to know the physical and chemical properties of the material. Thus, it can be said that the study of the strengths of different materials will improve and stress-strain should be considered when making any element compound.

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CHAPTER 4

ANALYSIS OF SPECIAL MATERIALS FOR HIGH-TEMPERATURE APPLICATIONS IN INDUSTRIAL APPLICATIONS

Sunil Kumar, Assistant Professor
Department of Mechanical Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- sunilgju123@gmail.com

ABSTRACT:

There are many branches of engineering that deal with the study of materials and properties. Many elements in nature have high thermal conductivity as well as resistance such as tungsten, nickel, titanium, molybdenum, and stainless steel. There is advancement in technologies and new methods, so many new and hybrid elements and compounds are found that have various characteristics. As the focus of the study is to analyze the various compounds that can be used for high-temperature applications it is found that the ceramics and carbon compounds like polymers can sustain at high temperatures also. Different experts studied the different compounds and properties as per their expertise, to find the compounds that should be used in industry for high-temperature applications. The Ultra-High-Temperature-Ceramics has a high melting point as compared to other compounds. The new methods and technologies are further discussed and developed which are useful for industries to use the compounds having high temperatures sustainability. Further study will help to develop new compounds for high-temperature applications for industry with improved properties.

KEYWORDS:

Ceramics, High Temperature, Industry, Melting Point, Polymer.

1. INTRODUCTION

Heat treatment is a series of thermal, industrial, and metallurgical procedures used to change a material's physical, and occasionally chemical, characteristics. The most typical use is in metallurgy. Many other materials, including glass, are made via heat treatments as well. Heat treatment uses heating or cooling typically to very high temperatures to harden or soften materials to obtain the desired outcome. Tempering, Quenching, Annealing, case hardening, precipitation strengthening, carburizing, and normalizing, are all heat treatment processes. Heating and cooling frequently happen unintentionally during some of those manufacturing techniques like hot forming or welding, even though the phrase "heat treatment" only refers to techniques when the air conditioning systems are done with the sole objective of purposefully changing attributes [1]–[3].

1.1. Factors Affecting Alloy Heat Resistances:

All alloys have unique characteristics which cause them to behave differently from other alloys when heated over an extended length of time. Before evaluating if an alloy is the "best match" for a certain operating environment, it is crucial to review the technical data that details its qualities. When choosing an alloy, many individuals frequently consider the operating temperature as the first and, in some cases, the only piece of information. This is the incorrect action to do. There are several additional factors to consider when choosing heat-resisting alloys, and the maximum operating temperature should not be the only criterion as shown in Figure 1 [4], [5].

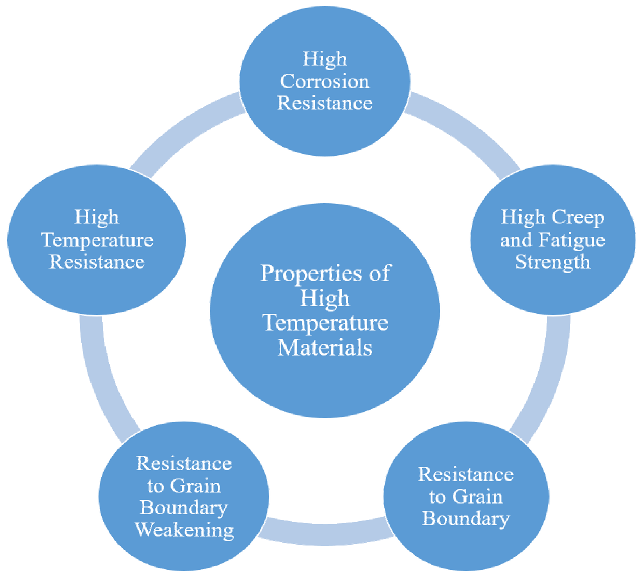

Figure 1: Illustrates the Properties of High-Temperature (HT) Materials Used In the Various Industries.

Heat-resistant alloys offer excellent high-temperature performance, which translates to great creep resistance and strength. Two physical characteristics of alloy structures and the tensile strengths of their interatomic bond confirm the alloys' degrees of heat resistance. By their basis, which might be beryllium, nickel, titanium, iron, or another metal, heat-resistant alloys are categorized as shown in Figure 2. According to their operating environment, a heat-resistant alloy may also be categorized into three groups: those that experience short-term, moderate-term, and long-term heat stress [6].

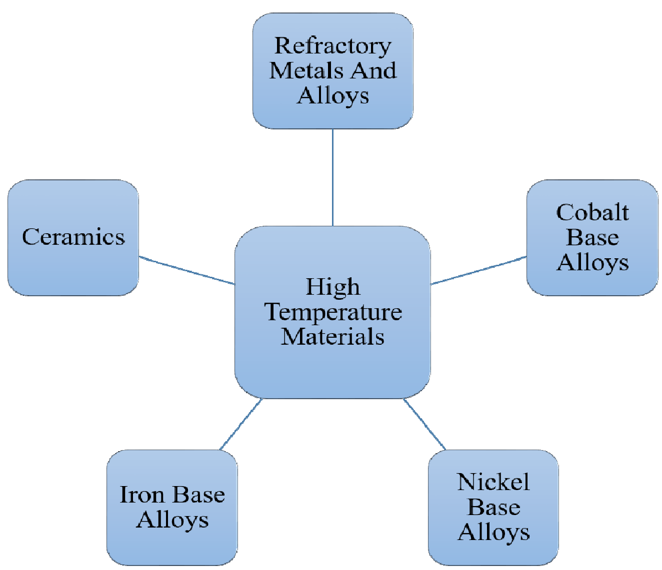

Figure 2: Illustrates the Different High-Temperature Materials with Their Base Metals in the Compound.

1.2. Element and Alloy that Sustain at High Temperature:

1.2.1. Titanium:

Silver in color, titanium is a beautiful transition metal. Titanium alloys can sustain temperatures as high as 600°C and have a + (HTS) to weight ratio, exceptional toughness, amazing resistance to corrosion, and good toughness. It is easily weldable, has high fabricability, and performs well in a variety of difficult industrial applications.

1.2.2. Tungsten:

A refractory metal with the color of silver or steel, tungsten is. Tungsten could be used as a reference element or as the foundation metal for an alloy. Great degrees of hardness, high heat resistance, and high thermal stability are all characteristics of tungsten. Ignition liners, industrial furnaces, turbine exhaust components, aircraft cabin warmers, and transition ducts, all often employ tungsten.

1.2.3. Stainless Steel:

Steel is an iron-based alloy that also contains additional metals including molybdenum and nickel, as well as a minimum of 10.5 percent or more of chromium. For usage within aerospace, automobile, and construction sectors with particular components such as steam turbines, boilers, piping systems, and pressure vessels, stainless steel alloys are renowned to maintain chemical stability.

1.2.4. Molybdenum:

As a refractory metal element, molybdenum may create strong, stable carbides that improve hardenability, strength, toughness, and corrosion- and wear-resistance. Molybdenum is extensively used in steel, CI, and super-alloys that withstand high temperatures in the military defense industry, as well as in semiconductors and special machines and workshops.

1.2.5. Nickel:

An inherently silver-white, glossy metal with a gold hint, it possesses exceptional strength and corrosion resistance, is malleable, and is ductile. Steel as well as other alloys commonly contain nickel to increase their strength. Power generation, aviation, special engineering, Gas turbines, and electronics all require nickel alloys.

1.2.6. Tantalum:

A lustrous, silver-white metal that is flexible when fresh. A little layer of oxidation on its surface provides it with almost complete corrosion resistance. Tantalum is very helpful in high-temperature applications in electronic devices and aircraft engines. Thus, various new compounds are developed from various base metals with different properties. Many fields in the industry are working on developing alloys that have high heat resistance. Heat resistance materials have one the important applications in the industry as the furnaces used are made of such materials. Using high-temperature materials it becomes easy to increase the high-temperature capacities of the materials. So it is necessary to know such compounds used in the industry that have high heat resistance.

2. LITERATURE REVIEW

François Gitzhofer et al. discussed that Molybdenum's (Mo) tested high-temperature corrosion resistance and proven anti-wetting properties have potential use in the aluminum industry. Using the Materials Studio and “Classical Molecular Dynamics” modeling of homogeneous Mo solids in contact with melted Aluminium at 1200 Kelvin, the actions of Mo in collision with molten Aluminium were simulated. The findings demonstrated that no atom reactions or cross-diffusion take place at Mo in solids Al in liquid-solid interfaces and that melted Al atoms align epitaxially with the exhibited solid Mo crystal shape. However, a 20 percent decrease in the Mo blocks occurred as a result of intergranular corrosion, not purest Mo reacting with the melted Aluminum-Magnesium alloys, in the ALCAN tests [7].

K. Derelizade et al. studied the two spray parameters that were used to deposit CrNiAlCY coatings using liquid-fueled “High-Velocity Oxy-Fuel” (HVOF) thermal sprays. The coatings were then examined for wear resistance. Investigations were done into how processing factors affected the coatings' mechanical and microstructural characteristics. As a result of the findings, coatings with reduced porosity and greater microhardness are only possible with higher oxygen flow rates. For dry sliding conditions sliding wear tests at lower temperatures (24 °C) and higher temperatures (900 °C) in a ball-on disc configuration, coatings with reduced porosity and greater hardness were chosen. Wear loss under 10 to 30 N was comparable to room ambient temperature despite thermal softening occurring at higher temperatures because of the preventative oxide layer that was established on the upper surface; even so, the oxidation reaction under 60 N was unable to withstand the load, began to crack, and ended up losing its protective ability .

Paweł Kołodziejczak et al. discussed 16Mo3 steel tubes that were coated with four protective coatings Stellite 6, Inconel 718, Alloy 33, also Inconel 625. Cold Metal Transfer (CMT) an improved Metal Active Gas (MAG) weldings technique, was used to deposit the coatings on the steel tubes. The base of the coating deposit was remelted using the Tungsten Inert Gas (TIG) welding techniques in the next stage. This demonstrated that the two test techniques employed had various wear processes. Alloy 33, as well as Inconel 718, exclusively demonstrated greater wear resistance than the base 16Mo3 steel in the dried sand/rubber wheels test. Furthermore, Stellite 6 coverings exhibited approximately 5times greater durability than other studied coatings, despite all coatings having stronger wear performance than 16Mo3 sheets of steel in abrasive blasting tests.

David Merino-Millan et al. researched Inconel 625 thermal-sprayed coatings that have been investigated as a potential replacement for receivers in concentrated solar power facilities. The coatings were applied to 2 substrates, ferritic steels of grading 22 as well as AISI 316 L austenitic steel alloy, using a limited compact plasmas spray system. For servicing or repairs, this method may be employed. The coatings underwent heat treatment at two distinct exposure durations and two different temperatures, 520 C and 800 C. The purpose of this study was to assess how this treatment affected the Inconel 625 coatings' adhesion and solar absorptivity. The findings demonstrated that improved adhesion and absorptivity are attained at extremely high temperatures and long residence durations.

Qiangang Fu et al. developed a method to construct Ceramics (Cs) with high strength and outstanding high-temperature stability, micro-multiscale reinforcing technologies had been implemented for Cs and the coating before 20 years. To create Cs that can withstand high temperatures of oxidation and ablation, this study will systematically summarise the most recent significant advances in some micro/nano multiresolution schemes, including nanomaterials, nanostructures, graphene, nanotubes, short fibers, hybrid micro/nanostructures, and ceramic fibers. A perspective for significant unresolved issues, obstacles to overcome, and recommendations for future study are provided for C/Cs with good complete mechanical-thermal performance.

Zhao Shen et al. discussed the several cutting-edge characterization approaches that have been used to analyze and evaluate the microstructures with microchemistry for an oxides scale at high temperature and pressure steaming at 600 °C for 1,500 hrs. It can be seen that Fe-21Cr-32Ni alloy is internally oxidized in the early stages of exposure by studying the oxides scales created at different phases of exposure and that under the inner oxidation zone, an exterior oxide scale and an internal chromium band later emerged. In contrast, for the whole trial period, Fe-17Cr-9Ni steel got inwardly oxidized along with exterior Fe-rich oxide scales. About the alloying and the development of the chromium layer, the implications of such structures on mass transport and reaction product generation were studied.

Naeem A. Basher and Ali Abdulkhabeer discussed the method for Oil emulsifiers that should be subdivided to prevent problems during oil handling and transportation. The presence of moisture in oil production is undesired and can cause pipeline damage and higher transportation costs due to water concentration and dissolving salt inside the aqueous solution of the emulsion. In this investigation, crude oil samples were utilized to examine the extraction of water from the emulsion by the manufactured rhodium borate (DF1) as well as the standardized demulsifiers seen in the same oil platform at a fixed temperature and even with different concentrations. When associated with the conventional demulsifier, the synthesized nano demulsifier had a high removal efficiency of up to (84.2 percent) (RP96BQ).

Dewei NI et al. studied that Ultra-High Temperature Ceramics (UHTC) have exceptionally good mechanical qualities, extremely high melting points, and high-temperature ablation resistance. Especially for leading edges, nozzles, and other structural materials in spacecraft and hypersonic vehicles, these special combinations of characteristics make them interesting materials. High-entropy UHTCs are gaining popularity as a starting to emerge path for UH thermostat materials recently due to their rapid development. The region of processing techniques, microstructure design, and UHTC attributes from composite counterparts to composite and coating are presented in this study, along with potential future developments.

There are various studies in the field of high-temperature materials and their alloys. The focus of the study was to make a material that has high-temperature resistance. Ceramics, polymers, and metal and carbon-based alloys have high heat resistance. The new studies developed are on the application and testing of new materials in the industry for various applications. Thus, UHTC has a high impact on industrial applications. Thus all these studies are helpful for the analysis of the different materials developed and used in the industries for various applications.

3. DISCUSSION

An alloy with the capacity to function at a high proportion of its melting point is referred to as a superalloy or high-performance alloy. Strong surface stability, Superior mechanical toughness, resistance to corrosions or oxidations, and resistance to thermal creeps deformations, are a few of a superalloy's major traits. Austenitic face-centered cubic (FCC) crystals are the most common kind. CMSX single crystal, Hastelloy, TMS alloys, Inconel, Waspaloy, Rene alloys, MP98T, and Incoloy, alloys are a few examples of these alloys. Chemical and technological advancements have been crucial for the creation of superalloys. Superalloys gain high-temperature strength by precipitating hardening using the second phase precipitates such as gamma prime and carbides and solid solution hardening. Elements like aluminum and chromium offer resistance to oxidation or corrosion. Although smaller papers may give strength at relatively low temperatures, they reduce creep resistance and are frequently cast as a crystalline solid in superalloys. Such alloys are primarily used in marine and aeronautical turbine engines. In gas turbine blades, creep is frequently the limiting factor for lifespan. Many advances in very high-temperature engineering technologies have been made feasible by exotic alloys.

UHTCs are being researched as potential materials for “Thermal Protection Systems (TPSs)”, layers for items exposed to high temperatures, and composite material for heating components because of their exceptional stability at temperatures above 2000 °C. UHTCs are essentially early transition metal oxides, borides, carbides, and nitrides. Thorium dioxide (ThO2), Hafnium nitride (HfN), titanium nitrides (TiN), titanium carbides (TiC), tantalum carbide (TaC), zirconium nitride (ZrN), and their associated composites are additional UHTCs under inquiry for TPS applications. Existing works focus on the heavy, initial transition metals like boron including hafnium diborides (HfB2) and zirconium diboride (ZrB2).

The 2 main compounds created in Manlabs, HfB2, and ZrB2 have been the subject of most studies over the past 20 years. However, extensive effort has been done to characterize the nitrides, carbides, and oxides, of groups 4 and 5 elements. The diborides often exhibit better thermal conductivity compared to carbide and nitride but for lower melting temperatures; this trade-off results in strong thermal shock tolerance and make them perfect for several superior temperature applications. Table 1 displays the melting temperature of several UHTCs. Pure UHTCs have high melting points, but because of their great sensitivity to oxidation at high temperatures, they are inappropriate for many difficult applications.

Table 1: Illustrates the Compounds of Ceramics for High-Temperature Applications in the Industry.

Sr. No.	**Material and their Formula**	**Crystal structure**	**Lattice parameter (Å) a**	**Lattice parameter (Å) b**	**Lattice parameter (Å) c**	**Density in (g/cm^3)**	**Melting point (^0C)**
1.	Titanium nitride (TiN)	FCC	4.24	4.24	4.24	5.4	2950
2.	Vanadium nitride (VN)	Cubic	-	-	-	6.13	2050 unstable
3.	Silicon carbide (SiC)	Polymorphic	–	Various	–	3.21	2545
4.	Tantalum boride (TaB_2)	Hexagonal	3.10	–	3.23	12.54	3040
5.	Hafnium carbide (HfC)	FCC	4.64	4.64	4.64	12.76	3958
6.	Zirconium boride	Hexagonal	3.17	–	3.53	6.10	3245

	(ZrB_2)						
7.	Zirconium carbide (ZrC)	Cubic	4.69	4.69	4.69	6.56	3400
8.	Niobium nitride (NbN)	Cubic	-	-	-	8.470	2573
9.	Zirconium nitride (ZrN)	FCC	4.58	4.58	4.58	7.29	2950
10.	Niobium boride (NbB_2)	Hexagonal	3.09	-	3.31	6.97	
11.	Hafnium nitride (HfN)	FCC	4.53	4.53	4.53	13.9	3385
12.	Tantalum carbide (TaC)	Cubic	4.46	4.46	4.46	14.50	3768
13.	Tantalum nitride (TaN)	Cubic	4.33	4.33	4.33	14.30	2700
14.	Niobium carbide (NBC)	Cubic	-	-	-	7.820	3490
15.	Titanium boride (TiB_2)	Hexagonal	3.03	–	3.23	4.52	3225
16.	Hafnium boride (HfB_2)	Hexagonal	3.14	–	3.48	11.19	3380
17.	Vanadium carbide (VC)	Cubic	-	-	-	5.77	2810 unstable
18	Titanium carbide (TiC)	Cubic	4.33	4.33	4.33	4.94	3100

Those are all materials that are used over 540°C. HT h materials are classified as construction solids refractory metals, stainless steel (limited), ceramic composites and ceramic, graphitic composites austenitic super alloys, and metal-matrix composites. While steel structures serve only marginally beyond 540°C and resistive metals are typically confined to non-oxidizing air conditions, the very first 3 types are well-proven in industrial applications. The other classes are being studied extensively over the world to see if they may be used to replace and improve the capability of iron alloys that are the basis of high-temperature services. High-temperature materials are most commonly used in nuclear reactors, aircraft jet engines, and industrial gas turbines. Many furnaces, ducts, and electrical and lighting systems, on the other hand, function at such extreme temperatures. The materials should have two fundamental features to function well and inexpensively at high temperatures it must be hard since temperature increases tend to loss of strength, and they must be resistant towards their surroundings, as corrosions and oxidations also rise with temperatures.

Because of the increasing need to provide civilization with energy and transportation, high-temperature materials have grown in importance. Machinery that generates electricity or another form of power out of a source of heat follows a set of thermodynamic cycles, such as the basic Brayton cycle and the Carnot cycle, in which the performance of the device is determined by the distinction between its highest and lowest operating temperatures. As a result, the bigger the difference, the further efficient the device, providing significant impetus to the development of materials that work at extremely high temperatures. There are various compounds of different elements used in industries that have high resistances. The compound containing carbons, ceramics, and polymers has a high range of applications. The composites that are used in the industries have their characteristics which are made by the combination of different elements where the mixture of different elements affects the properties of compound elements. Thus it is necessary to know the important compounds of metals and other elements that have high-temperature applications. Different applications are developed on high-temperature materials for domestic as well as industrial purposes.

4. CONCLUSION

There are many branches of engineering that deal with the study of materials and properties. Many elements in nature have high thermal conductivity as well as resistance which are tungsten, nickel, titanium, molybdenum, and stainless steel. As the focus of the study is to analyze the various compounds that can be used for high-temperature applications it is found that the ceramics and carbon compounds like polymers can sustain at high temperatures also. The UHTC has a high melting point as compared to other compounds. Thus, different experts studied the different compounds and properties as per their expertise, to find the compounds that should be used in industry for high-temperature applications. Further study will help to develop new compounds for high-temperature applications for industry with improved properties.

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CHAPTER 5

ANALYSIS OF DIFFERENT GRASS-CUTTING MACHINES USING MODERN TECHNOLOGY

Sunil Kumar Gaur, Assistant Professor
Department of Mechanical Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- sonusingh.gour.2301@gmail.com

ABSTRACT:

Lawns and gardens are the beauty of the house where green grass is used within it. The grass is grown on the lawn at the same speed as the grass has grown and has the possibility of getting insects or reptiles that cause human life, so it is necessary to cut the grass in the same and uniform size so that it is beautiful and safe. A manual mower is time-consuming and very hectic to perform this type of operation on large lawns. So there are machines in the market which are working automatically and with different power sources. The author focuses on finding machines that use a photovoltaic cell as a power source for working. Different machines are developed by different experts and researchers with different working principles. Hence the use of solar energy as a power source is very useful and devices have been developed which can work without the user with the help of the Internet of Things (IoT) and Artificial Intelligence (AI).

KEYWORDS:

Garden, Grass-Cutting, Lawn Mower, Machine, Photovoltaic Cell, Solar Energy.

1. INTRODUCTION

Undoubtedly, a lawn mower is a piece of machinery that employs one or more revolving blades to trim grass at a uniform height. The mower's design may predetermine the pitch of the mowed grass, but the operator may frequently adjust it using either a nut or bolt and lever, from each of the vehicle's wheels. The device may have had an electric motor or rechargeable battery, or the blades may have been physically fastened to the wheels and activated by pushing the lawnmower ahead [1],[2]. While move mowers are self-propelled and only require a human to walk behind and control them, smaller mowers usually really had no propulsions at all and must be driven over the ground by a person [3],[4]. Larger lawnmowers are typically either ride-on types, which allow the operator to sit on top of the mower and drive it, or walk-behind variants, which are self-propelled. Robotic lawnmowers are designed to operate entirely on their own or, less commonly, with the help of a remotely controlled operator [5].

In lawnmowers, there are two primary blade types. The term rotary mower refers to a lawn mower with a single blade rotating about a vertical line axis. The term cylinder mower refers to a mower with multiple blades rotating about a solitary horizontal axis [6],[7]. In some versions, however, the snipping bar seems to be the only cutter, and the spinning assembly is made up of flat metal parts that push the grass blades up against the sharp edge bar. Mowers come in a variety of designs, each adapted to a certain scale and use. For tiny residential lawns and gardens, non-powered push mowers are the smallest variety. Although there is some overlap, push mowers with electrical or piston engine power are employed for larger residential lawns. Although industrial riding lawn-mowers like “0” lawnmowers could be “stand-on” types and frequently bear no relation to residential garden tractors, of been intended to mow huge regions at a great velocity in the smallest period, they can be bigger than push lawnmowers and are appropriate for big lawns (Figure 1). The biggest multi-gang multi-blade mower is installed on tractors and is intended for grassy areas with a lot of space, including golf courses and city parks, but they struggle on terrain with a lot of variation [8].

Figure 1: Illustrates the Manually Heavy Grass Cutting Machine operated by the Person.

An autonomous robot that is used to cut grass on lawns is a robotic lawn mower. A common robotic lawn mower, especially older generation versions, needs a boundary wire placed up around the grass to indicate the area that has to be mowed. This wire is used by the robot to identify the perimeter of the area that has to be trimmed and, in certain situations, to identify a dock for charging. Automated lawnmowers are becoming more advanced, some have self-docking capabilities, and some, if required, have rain sensors, all of which almost eliminate human contact. By the end of 2005, robotic lawn mowers were the second-most popular category of household robots. Sales of robotic lawn mowers increased 15 times faster in 2012 than those of traditional models. Since smartphones have become more common, several robotic lawn mowers have integrated functions into unique applications that allow users to change settings, plan cutting times and frequency, and manually operate the mower via a digital joystick. Specialized sensors may be found in contemporary robotic lawn mowers, enabling them to autonomously mow around obstructions or even turn off when it starts raining. Most robotic lawn mowers approach the job by using a “random” mowing mechanism.

The machine essentially bounces about on the grass until it runs into the wire defining the operating area, at which point it switches direction and bounces around some more. This could take quite a long time depending on the size of the grass, thus the machine must essentially run continuously. One exception is Bosch “Indigo” robotic lawn mower, which maps out the user’s landscape before proceeding methodically, much like the more advanced robotic vacuum cleaners. Thus, the study is necessary for analyzing the importance of solar energy as an important alternative fuel source for various applications to avoid the use of external power sources which may cause damage to the environment.

2. LITERATURE REVIEW

M. Pita and P. B. Sob developed a design for grass trimmer that uses solar power. Common grass-cutting equipment is powered by pricey fuel and electricity that requires a lot of maintenance. In that research, a solar-powered lawn trimmer has been developed to maintain environmental cleanliness and minimize fuel use. The power going into the battery is managed by a 20A solar charge controller. The mower cuts the grass using blades made of sheet metal. When completely charged so there is no sunlight, it can operate for about two hours. If the batteries are flat or completely charged, it is simple to know [9].

A. Sri Tarun et al. developed a robotic all-terrain sprayer and mower powered by solar energy. Their design calls for a flexible, adaptable, distantly, semi-automated spraying robot with such a degree of freedom (DoF) in positional movement, as well as a separate tool for trimming plants. Because the robot can administer pesticide/insecticide precisely where it is needed, there are fewer chemicals wastage and overspray, which makes the technique both cost-effective and ecologically friendly. With an effective spraying area of 0.98 square meters as well as an effective mowing surface of 0.3 square meters by the mower, the robot is designed to transport at a speed of 1.4 meters per second while it is stationary. Under modest demand, the prototypes can function for 7.2 hours on rechargeable batteries [10].

According to the authors, Milufarzana et al. a solar-powered sprayer and grasscutter were created, which sprayed and chopped grasses using solar energy. The solar-powered sprayer and grasscutter's manufacturing cost amounted to Tk 12550. Cut performance was 79 percent, since no fuel is used, the solar-powered sprayer/grasscutter emits no pollution. The machine is less expensive than similar ones that are sold in the market [11].

Dhiventhra S et al. stated a validation of an experimental system for using solar grass cutters today to cover lawns. The automatic lawn mower mechanism is provided by the intelligent grass-cutting system. The robotic vehicle has a grass-cutting blade that enables cutting grass at high Revolutions per minute (RPMs). The device includes clever functionality that enables it to completely cover a yard or garden by employing an ultrasonic sensor to identify corners and move in a zigzag pattern to cover the whole area. To perform 180-degree revolutions and cover the whole lawn and garden, the device additionally employs a gyro sensor. Thus, they get the conclusion that it uses non-renewable energy sources like gasoline and diesel. They employ solar energy, a sustainable source of energy, to conserve power and lessen our reliance on human labor. [12].

Krunal Mudafale et al. developed a smart Crop Cutter Powered by Solar. The design goal was to create a lawnmower that is lightweight, robust, and simple to use. Additionally, a self-propelled lawn mower powered by electricity is planned. The device's brain is a battery-operated dc electric motor. The design is distinctive in that it uses foldable blades instead of an engine and incorporates an alternator to charge the batteries. In a performance test, the cutting effectiveness was 89.55 % using a 0.24kN human effort. This machine is therefore recognized as being quite effective and versatile in terms of cutting situations.

Balakrishna K and Rajesh N, developed an IoT (Internet of Things) based, remotely supervised solar-powered grasscutter bot with avoiding obstacles. The Grasscutter was created using IoT technology, and it can be operated remotely using the Bluetooth-enabled Blynk app. The developed model is Arduino-programmed to manage the grasscutter's operations. The model's head is equipped with an ultrasonic sensor that prevents the system from hitting objects while it is moving.

Muhammad Waqas Jabbar et al. developed a grass Cutter with Solar Power for Home Uses. In that study, a solar-powered grass cutter's construction and operation are described. The development of a solar-powered lawnmower, that has reduced air pollution and labor costs while saving energy. Cutting iron was employed in the previous design. This new invention is an Arduino UNO-powered remotely operated lawn mower that utilizes current technologies.

A smartphone is used to control the Intelligent Solar tracker using Bluetooth. When the battery is fully charged, the Smart Solar Mower can operate for even more than two hours.

The above study shows that the Design of a grass trimmer that uses solar power, and common grass-cutting equipment is powered by pricey fuel and electricity that requires a lot of maintenance. And also Design an Internet of Things-based, remotely supervised solar-powered grass cutter bot with avoiding obstacles. In this study, the author discusses the photovoltaic cells technology-based machine and components of the mower.

3. DISCUSSION

Edwin Budding created the first lawnmower in 1830 at Thrupp, a little town west of Stroud, Gloucestershire, England. As a good option for the scythe, Budding's mower was created particularly to mow the lawn on the grounds and in large gardens. It was given a British patent dated August 31, 1830. The original budding machine had a 480 mm broad wrought iron frame. From behind, the lawnmower was propelled [13]. The rear roller could drive the blades on the cutter cylinder thanks to the cast-iron gear wheels, which delivered energy out from the back rollers to the cutting cylinder at a 16:1 ratio. Between both the cutter cylinder and the primary roller, which could be elevated or lowered to change the cut height, was another roller. The grassy clippings have been flung forward into a receptacle that resembled a tray. It didn't take long to understand that the machine needed a front handle as well. Overall, these devices were amazing and resembled current lawnmowers. Because of the equipment, modern-style fields, athletic fields, and grass courts may be prepared. Modern regulations for several sports, including baseball, tennis, football, and cricket, were codified as a result.

3.1. Up-driven Push Mowers Cutting Machine:

There are several mower kinds, each suited to a certain scale and function. Up-driven push mowers are the smallest variety and are best for small lawns and gardens in homes. Large residential lawns are cut by push mowers, which come in electric or piston-engine versions. A permanent, horizontal cutting blade is mounted on a cylinder’s lawnmower or reel mower at the specified cut height. A reel of blades that spins quickly above this pushes the grasses past a mowing bar. The set of rotating blades depicts a cylinder because each blade in the blade's cylinder twists helically around the reel axis. A correctly set cylinder mower, out of all the cutters, gives the grass the cleanest cut, allowing the grass to recuperate most rapidly. A correctly adjusted cylinder mower creates a cut that is clean and exact, similar to that of scissors. This clean-cut results in the growth of a thicker, healthier, and stronger grassland that is resistant to illness, weeds, and parasites. The discoloration of a lawn caused by leaf shredding is much less likely to be yellow, white, or brown when it is mowed using a cylinder mower. Even though the cutting motion is sometimes compared to those of scissors, this is not essential for the spinning cylinder's blades to make contact with the lateral cutting bar. A perfect cutting can still be performed if the distance between both blades is smaller than the size of the grass blades. But if there are enough, the grass will get through. Additionally, reel mowers had much trouble cutting over rough terrain.

A rotary mower uses impacts to cut grass while rotating around a vertical plane with a fast-spinning blade. This usually leads to a harsher cut, bruises, and tears in the grass leaf, causing the ends of the leaf to become brown as the torn area dies. This is especially common when the blades are dull or blocked. Most rotational lawnmowers have to be set a little higher than their cylinder counterparts to minimize combing and gouging of somewhat uneven lawns, even if some contemporary rotaries are fitted with a back roller to provide a more formal striped cut. Additionally, these machines typically remove 13 mm less material than just a normal four-wheel rotary cutter.

3.2. Photovoltaic Cells Technology-Based Machine:

The way the panels are arranged in a solar grass cutter's operating system allows it to directly accept high-intensity solar radiation from the sun. Solar energy is transformed into electrical energy by the solar panel. By utilizing a solar charger, this electricity is put into batteries for storage. The solar charger's primary job is to boost the panel's current output while the batteries are charging. Through connecting cables between such mechanical circuit breakers, the motor is connected to the batteries. The motor is started and stopped using the breaker switch. Power is transferred from the motor to the mechanism, causing the blades to spin the shafts and mow the grass. Internal combustion engines are the primary source of power for rotary push mowers. These engines often burn fuel (petrol) or even other liquid fuels and are four-stroke engines because of their increased torque and cleaner combustion. Typically, lawn mower internal combustion engines have a single cylinder. In general, 4 to 7 horsepower is the power range. The engines typically also have a carburetor and required a physical pull crank to activate them, however, some models especially big riding and commercial mowers also come with automatic starters. The operator of certain mowers may change the engine speed using a throttle position on the handlebar. There is a constant, pre-set engine speed on other mowers. Each one has a governor that may be used to increase the throttle as necessary to maintain the pre-set speed when the force required to cut thicker or higher grass is present.

A variable number of 12-80 volt rechargeable batteries power cordless electric mowers. More batteries often equate to longer run times and/or more power. The lawnmower's batteries might be found inside or outside. The exhausted batteries may be simply replaced with recharged ones if they are outdoors. Mowers with cords are more costly and offer fewer models than cordless mowers, which are more maneuverable than gasoline-powered mowers and more environmentally friendly. Additionally, certain cordless mower engines tended to become less efficient than fuel motors of the same total weight, and disposing of used batteries can be a hassle. Mowers powered by gasoline have a longer range and more powerful motors than those powered by electricity. Due to combustion inside the engine, they do produce a large quantity of pollution, and their engines need routine maintenance like updating the engine oil and cleaning or replacing the sparking plug and air filter. Small gas engines are known to contribute to air pollution, which has led to state-level regulations encouraging customers to select equipment with alternative power sources. California enacted AB1346, an air pollution management measure, on October 9, 2021, it will phase out gasoline-powered small off-road engines like lawnmowers on January 1, 2024.

The two types of electric mowers are corded and cordless versions. Although a fuel lawn mower could be 95 dB or louder, both are normally or less 75 decibels in volume. Due to their trailing power cords, corded electric mowers have a shorter range and may not be suitable for lawns that are farther beyond 100–150 feet from the next power outlet. With these devices, there is also the extra risk of accidentally cutting through the power wire, which pauses the mower and it may put others in danger of receiving a potentially harmful electric shock. A residual-current sensor just on the outlet might lessen the chance of a shock. A border wire that surrounds the lawn and delimits the area that has to be mowed keeps a robotic mower in its place. This wire is used by the robot to identify the perimeter of the area that has to be trimmed and, in certain situations, to identify a dock for charging. Robotic mowers can keep up nearly 5 acres of grass in good condition. Autonomous lawnmowers are becoming more advanced, are frequently self-docking, and include rain sensors, all of which almost eliminate the need for human contact when cutting the grass. An even wider area may be mowed with multiple robotic lawnmowers.

Powerful rotating push lawnmowers called hover mowers employ an impeller just above rotating blades to pump air downward, producing air cushions that raise the lawnmower off the ground. The mower will then glide over the grass, making it simple for the operator to maneuver. To accomplish the air cushions, hover mowers must be light, therefore they often feature plastic bodies with an electrical motor. The rising air cushions are damaged by large gaps between both the frame and the ground, making them difficult to use in rocky terrain or along grass margins. This is the biggest drawback. Golf course groundskeepers and professional landscapers frequently utilize hover mowers since they are designed to work on steep terrain, waterfronts, and high-weeded regions. Although frequently offered, grass collecting might be subpar in some models. If the air cushion pushes the grass away from the blade, the quality of the cut may suffer.

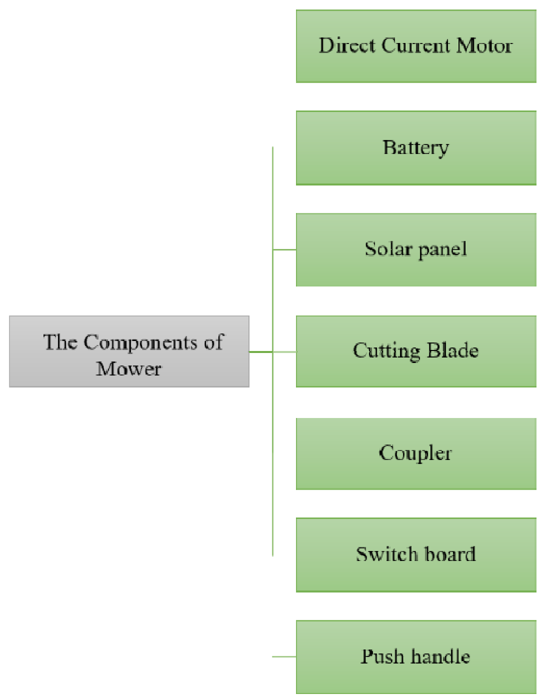

Figure 2: Illustrates the several components of the solar-powered lawn mower.

1.1.Types of Electric Mowers:

There are several types of drives for these mowers. A manual gearbox is the most typical transmission for tractors. Hydrostatic transmission, a type of continuous variable, is the second most used transmission type. These transmissions come in a variety of shapes and sizes, ranging from pumps driving independent motors with gear reductions to completely integrated systems with a gear reduction, pump, and motor. Although hydrostatics transmissions cost more than mechanical transmissions, they are simpler to use and have a higher torque capacity than a standard mechanical gearbox. Electric drives are the most costly and least prevalent form of driving. Rotary mowers can employ specific mulching blades that are made to circulate the grass clippings beneath the mower until they are very finely chopped. There are some designs in which the clippings are mulched into tiny bits by twin blades. The benefits of this function include avoiding the extra labor of gathering and discarding grass cuttings and minimizing lawn waste in a method that also produces handy composting for the lawn, saving money, and avoiding the negative environmental effects of fertilizer. Thus, there are various grass-cutting machines in the market but using solar energy is more convenient to operate such machines which saves energy. Use of solar energy is useful and fuel-saving and is a good optional source for replacing other power sources in various applications.

1.2. Components of Mower:

The Solar powered lawn mower consists of the following components which are categorized in Figure 2:

1.2.1. D.C. motor:

A mechanically commutated electric motor operated by direct current is known as a direct current (D.C.) motor. By convention, the stator and its current are immobile in space. The commentator changes the current flowing through the rotor such that it is also stationary throughout space. The DC motor's velocity altering the field current or perhaps the voltage delivered to the armature would control its motor. It served as the brains behind the creation of the lawn mower, D.C. The cutting blade's rotation was powered by a motor. With the use of a coupler, the motor shaft was attached to the blade shaft. We utilized a 12-volt, 400 watts D.C. motor to remove the grass following the necessary force motor.

1.2.2. Battery:

Energy is stored by batteries, the motor was powered by the battery's energy. Depending on the size of the motor being utilized, the battery size was chosen to be 12 volts. The motor's rotation was powered by a 26 AH rechargeable battery.

1.2.3. Solar panel:

A solar panel is a collection of electrically linked photovoltaic modules that are installed on a base. A bundled, linked arrangement of solar cells is known as a photovoltaic module. The solar panel may produce and supply power for use in the home and commercial applications as part of a larger photovoltaic system. By using the photovoltaic concept, solar panels transform solar energy into electrical energy, which is then utilized to charge batteries. The solar panel's ability to generate power is determined by the portion of the panel that receives sunlight.

1.2.4. Cutting Blade:

Both the force needed to cut the lawn mower and the force acting here on the blade were taken into account while constructing the cutting blade. Any sharp item must contact the grass with a force greater than 10 Newton’s to make an impact. Additionally, it depends on the object's elevation, density, and surface area. Therefore, the force necessary for efficient mowing should be larger than 10 Newton when constructing the blade of the solar-powered lawn mower.

1.2.5. Coupler:

Couplers, a type of holding mechanism, were used to join the motor shaft and blade shaft. The coupler had two ends: one joined to the drive shaft and another to the blade shaft. The mechanical tool called a coupling is used to keep two spinning shafts together. Unlike a clutch, which may be withdrawn at the operator's command, it has a permanent joint. It can connect two shafts that are crossing, collinear, or parallel using couplings (with a small distance).

1.2.6. Switchboard:

It features two different sorts of switches: an on/off switch for starting and stopping the motor and a toggle switch for rotating the blade in a clockwise and counterclockwise motion.

1.2.7. Push handle:

The handle is properly positioned on the main frame. There was a mechanism in place to alter the handle's height following the operator's elevation.

2. CONCLUSION

When green grass is used inside a home, the lawns and gardens are what make it beautiful. Since the grass on the lawn grows at the same rate as it could contain insects or reptiles that might endanger human life, it must be trimmed to an even height to keep the area both attractive and secure. On large lawns, using a piece of manual grass-cutting equipment takes a lot of time and is stressful. Therefore, there are devices on the market that operate automatically and with various power sources. The goal of the research is to identify the machines that utilize solar cells as their main source of electricity. Different professionals and researchers with various working philosophies create various machines. As a result, employing solar energy as a power source is quite beneficial. Additionally, thanks to the Internet of Things and artificial intelligence, gadgets are becoming increasingly autonomous. It suggests that utilizing fossil fuels is an outmoded practice nowadays, as people become more conscious of solar energy when a lawn cutter is propelled by human effort. Elderly people and younger people both find it difficult to cut the lawn. Because although electric solar grass cutters are more environmentally friendly, trying to move with an engine produces noise pollution because of the loud engine and local air pollutants because of the combustion in the engine. Additionally, a motor power engine needs regular maintenance, like changing the same engine oil. Therefore, it is also much more appropriate for cutting grass. Because there is a capability to charge those batteries in daylight, the very same thing may be used at night as well.

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CHAPTER 6

EXPLORING THE APPLICATION OF LATHE MACHINES AND ITS DEVELOPMENT IN DESIGNING

Rohit Kumar Singh Gautam, Assistant Professor
Department of Mechanical Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- rohitsingh200873@gmail.com

ABSTRACT:

The lathe machine is the main machine used in the industry for various machining processes. The various operations like facing, shaping, turning, knurling, etc. are done using a lathe machine. Various types of lathe machines are used for different materials and purposes. The focus of the study is to discuss the various applications of lathe machines that are used in industries. The different machines are used for different purposes like the bench lathe is an old machine while Computer Numeric Control (CNC) is an advanced machine that is used for high production. The different designs are developed by different researchers and have different characteristics and working principles. Thus after studying the different kinds of literature it can be said that the CNC is the most advanced lathe machine which is used for high-scale productions. In the next few years, CNC machines will be used in industries as all are focused on high-scale production to increase profits.

KEYWORDS:

CNC, Feed, Lathe Machine, Spindle, Workpiece.

1. INTRODUCTION

A broad family of lathes known as metal lathes or metalworking lathes is used for precisely milling relatively hard materials. Although they were first made to work with metals, they are now utilized for a wide variety of applications and materials because of their innate adaptability and the development of plastic products. They are typically just referred to as lathes in manufacturing terminology, where the greater context is already recognized, or else by more precise subclass names. Through the motions of different blade tools, such as drill bits and tool bits, these stiff mechanical components undergo degradation from a spinning workpiece. Depending on the desired use, lathe designs can vary significantly; nonetheless, most varieties have certain fundamental characteristics. A carriage, bed, tailstock, and headstock make up these machines. Better machines are well-built, have wide bearings for stability, and are quite precisely crafted. This makes it possible to verify that the components made by the machinery can adhere to the necessary tolerances and reproducibility [1]–[3].

As seen in Figure 1, the headstock (H1) holds the one of main spindles (H4), gear change (H10), and speed control (H2, H3). Because of the material removal pressures involved, which might deform a light-built housing and cause harmonics vibration that will carry through to the product, lowering the performance of the completed product, the headstock must be designed as sturdy as possible. Long bars can typically reach through the main spindle and into the work area. As a result, less material needs to be prepared and wasted. The spindle is equipped with a way to connect work-holding tools like chucks or faceplates and runs in precise bearings. The tailstocks and carriages may be shifted parallel to the spindle's axis thanks to the bed, a sturdy platform that attaches to the headstock. Hardcore and grounded ways that confine the carriages and rear axle to a predetermined track make this easier. The rack and pinion mechanism is used to move the carriage. A gearbox powered by the headstock drives the precise pitch leadscrew, which in turn drives the carriage housing the cutting tool. Inverse "V" shape beds, plain beds, and combined "V" shaped and plain beds are among the several types of beds. For precise and light-duty work, "V" shaped and combined beds are employed, whereas plain platforms are used for intensive work [4], [5].

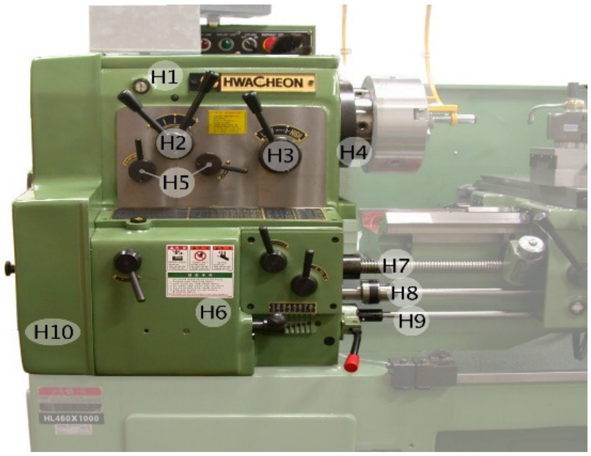

Figure 1: Illustrates the Working Model of the Lathe Machine with its Assembly Nomenclature of Headstock.

A long driveshaft known as the feedscrew (H8) enables a set of gear-drive to different carriage mechanics. These gears are situated in the carriage's apron. As indicated in Figure 1, the shift gearing or an intermediary transmission known as rapidly changing gearing (H6) or Norton gearboxes are used to power using both feedscrew and leadscrew (H7). The appropriate ratio and direction may be established for slashing thread or worm gear using these intermediate gears. A quadrant plate and tumbler gears (controlled by H5) are placed between both the spindles and geared train to allow the introduction of a gear train with the appropriate ratio and angle. As a result, there is a continuous link between the spindle's number of turns and the leadscrew's number of turns. This ratio makes it possible to cut screwthreads directly onto the workpiece without using a die. On some lathes, a single lead screw is used for all carriage-moving operations. For effective power feeds, a lock connects with a latching mechanism cut into the leadscrew to move a pinion across a rack that is positioned along the lathe bed. A half nuts are engaged to be powered either by leadscrew's threads for screw cutting [6],[7].

In its most basic configuration, the carriage carries the workpiece and rotates or faces it perpendicularly as the user directs. As indicated in Figure 2, the operator can move the carriage manually using the handwheel (5a) or mechanically by connecting the feed shaft to the carriage for the feeding mechanism (5c). The operator will feel some relaxation as the carriage will now move with power assistance. Three handwheels (2a, 5a, and 3b) on the carriages and their associated slides are often calibrated for user convenience and to aid in producing repeatable cuts. The saddle and apron are normally the top and side castings of the carriage, respectively (5). A feedscrew on the cross-slide (3), which is mounted on the frame of carriages and moves at a right angle to the primary spindle axis, is used. This enables the cutting depth to be altered as well as face operations. The feedscrew could be connected to a feeding shaft (before mentioned feed shaft) by a gear train to give automatic "power feed" movements to the cross-slide. Over most lathe machines, only one direction may be engaged at once because a second gearbox interlock will switch it off. A grade representing 0.001 inches of diameter equates to 0.0005 inches of cross-slide mobility since cross-slide handwheels are often indicated in respect of the part's diameter [8],[9].

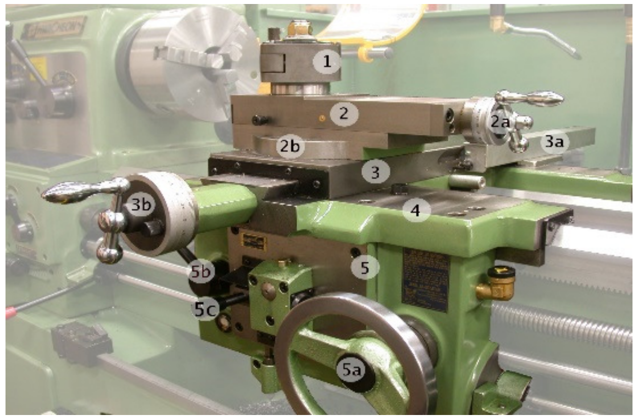

Figure 2: Illustrates the Assembly Parts of the Carriage in the Lathe Machine.

The tool post is often installed on the compound rest (also known as the top slide). Through a different feedscrew, it offers less movement along its axis (than the cross-slide). The cross-slide or carriage cannot be moved while the composite resting axis is being adjusted. It can be used to spin tapers, regulate the cut depth during precision facing or screw-cutting, or get finer feeds (under human control) than the feeding shaft allows. The compound rest often features a tape measure marked inside its base (2b), allowing the user to precisely change the axis. The tool bit is fixed to the toolpost, which can be in the form of an American lantern, a conventional four-sided square, or an instant type like the multi-fix setup in the image. Instead of being constrained to one tool with the lantern style or 4 tools with the 4 types, a rapid change setup enables the use of an unlimited number of tools. All tools may be fixed to a constant center height using interchangeable tool holders, even if the holder is taken out of the machine.

Opposite the headstock is a tool and centermounting called the tailstock. Leadscrew and handwheel motion cause the spindle (T5) to move longitudinally rather than rotating (T1). To retain drill bits, centers, and other tools, the spindle has a taper. According to the requirements of the workpiece, the tailstock could be adjusted all along the bed and secured (T6) into place. When turning minor tapers or realigning the tailstock towards the bed's axis, it is also possible to deflect the tailstock (T4) from the spindle's axis. Between both the spindles and handwheel, wherein heavy drills may require added leverage, the illustration depicts gear reduction boxes (T2). Typically, HSS, cobalt steel, or carbide are used to make the tool bit [10].

Since cutting metal generates powerful pressures that tend to bend or even deform the workpiece, long workpieces frequently have to be stabilized in the middle. This is because cutting tools might press the specimen beyond where the centers can hold it. Consistent rest can offer this added assistance. It holds the object at the center of the rest, usually with 3 contact points spaced 120 degrees apart, and it stands still from a strong attachment to the bed. The following rest is equivalent, and it is affixed to the carriages instead of the bed, so it “follows along” with the tool bit as it travels. Follower rests can offer assistance that immediately counteracts the tool bit's springing force in the area of a workpiece that is now being cut. They resemble a box tool in this regard. Any rest will cause certain workpiece geometry defects to be transferred from the base to the processing surface. The rest design will determine this. Correcting rests are utilized for minimum transfer rates. Rest rollers frequently add to the operating surface's geometrical problems.

There is various type of lathe machines in the market which are used in different industries. Lathe machines are used in industries for the production of various components throughout history. There is a great impact of lathe machine in the field of production, there are different types of lathe that works for special purposes or multi-purpose. The CNC is the most advanced machine which works on code programming. These programs are preinstalled in the controlling system of the machine where users need to set the program codes in the pattern to start the working of the machine continuously. The capstan turret lathe is another type that is used in small industries or startups.

2. LITERATURE REVIEW

Y. Sai Diwakar et al. created a 3-Axis CNC machine from scratch. Making portable, affordable, and small three-axis CNC machines are motivated by the growing need for these types of devices as production processes become more automated using CNC machining. CNC automation lessens the likelihood of mistakes and gives CNC operators more time to complete other jobs without wasting any material. This method uses enhanced techniques to decrease control mistakes on three-axis CNCs without sacrificing overall effectiveness. The entire structure was constructed utilizing 3D-printed components. By utilizing 3d printing technology for components, any CNC machine's overall cost may be decreased, providing a cheap machine at a low price.

Jonathan A. Enokela and Ocheinu Anfofun made a milling machine with computerized numerical control (CNC). The placement of elements on printed circuit boards (PCBs) that has been carefully plotted out is crucial to the creation of a PCB board. This work presents the design and building of an automated drilling machine for drilling PCBs point to point. The machine uses a lead screw mechanism to determine the corresponding coordinates. The lead screw mechanism is powered by an A4988 stepper motor driver, which is managed by an Arduino Garble controller. Using the graphics program Inkscape, the PCB sketch, which is saved as an image, is transformed into G-code. The construction of a 3-axis device was accomplished. The machine interprets the PC's G-code commands before watching the motor move to create the necessary traces. The goal of etching the picture onto the PCB was accomplished. The machine's inexpensive construction cost and simplicity of use make it ideal for small-scale producers and amateurs.

Dr. S Ganesh Kumar et al. developed a compact CNC milling machine of machining that uses computerized controls and spinning multi-point cutting machines to gradually remove material from a workpiece to produce an element with a bespoke design. CNC is programmable code that describes a means to automatically turn a virtual thing into a real one and provides instructions for precise control within the machinery to carry out the activities. Compared to humans, automated robots are more precise and efficient. A CNC machine may be used to create components using a variety of labor processes using its cutting tools [11].

Nitin Sawarkar et al. studied and developed the 360° adjustable drill machine experimentation. Due to a small gap between the drilling bits and the bed, some items cannot be drilled with fixed drills. In these situations, hand drills are necessary, although they have alignment issues when drilling. So the author suggests 360-degree versatile drilling which can be placed on a tabletop or wall and then used to drill a hole in any direction. Thus, even complex pieces and surfaces may be easily drilled in thanks to this. Therefore, they design and construct a small 360-degree drill with spinning hinges and connections, a motorized mounting, and a supporting framework for simple drilling operations [12].

H. Niranjan Kumar et al. constructed a portable wooden lathe machinery that is effective and useful. Their study evaluates and combines the various potential design concepts and solutions. We will analyze each machine part to find the best size for the given loads and stresses. The initial investment in machining may be decreased by using the micro lathe machine, which also lowers labor costs. Due to its portability and mobility, the system might be simple to manage and maintain. Since it is portable and compact, it will use less energy than traditional lathes while still being easy to operate [13].

Musonda Christopher and Moses Kaleji designed and constructed a low-cost, three-axis miniature CNC milling machine. Commercial CNCs are costly and quite large. This project was undertaken to develop a low-cost, three-axis mini-CNC machine. The design and construction of a three-axis milling CNC machine will be discussed in this study. The Arduino-based microcontroller will be used to generate pulse-width modulation (PWM) outputs, which will be utilized to drive the stepper motors. The CNC controller reads the dxf file that is fed to the machines, extracts the shapes from the file, and then creates orders to manipulate the CNC machining axis to enable the machining of these shapes [14].

Wasis Nugroho created CNC Milling Machines for startups. Their major goal is to explore the creation of three-axis CNC machines that include a spindle drill and a microcontroller as the main controller. This device's primary use is for cutting and carving low-hard materials like wood and acrylic. The three-axis CNC machine created has a cut and etching accuracy of 98.5 percent and a depth consistency of 100 percent for wooden and other materials, according to tests done on the items generated by the machine. The largest size of an item that can be carved with this machinery is (30 × 30) cm in both 2D and 3D [15].

Siti Aina Mardhia Binti Dol Haji, discussed the use of the X, Y, and Z axes of a CNC milling machine, which can move in three directions. The G-code enabling machining cutting assembly testing for this project was produced using Master CAM software. In this project, a computer and a CNC machine are developed. The purpose of the project is to create a portable, inexpensive CNC milling machine. It is manageable, easy to transport, and appropriate for small-scale industries. To move the axes X, Y, and Z, a stepper motor uses an AC power source that is first passed to a noise filter to decrease signal interference. The Direct current stepper motor controls the movement of the CNC machine frame [16].

There are different studies on the application and construction of lathe machines which are still being studied and developed by different experts in various parts of the world. The lathe machine is important in the industry as all the basic operations of an industry can be performed by the lathe machine. It is now advancement in the CNC machines which are multi-functioned lathe machines that follows the programs and run on the codes which should be studied to know their importance in the industry.

3. DISCUSSION

The words engine lathe, bench lathe, and "center lathe", all refer to a fundamental kind of lathe, which may be thought of as the archetypical category of metallurgical lathes most frequently employed by the ordinary machinist or machining enthusiast. Bench lathe alludes to a model of this kind that is compact enough to be put on a workbench. The design of a center lathe is described above, although even these lathes can differ significantly across models based on the year of manufacturing, size, price range, or desired features. In contrast to early lathes, which have been used using custom tooling, or hand tools with manual feed only, engine lathes are standard late-19th- or 20th-century lathes with automated feeding to the cutting-edge tool.

The word “engine” is used in this context to refer to a mechanical device rather than a primary mover, like the steam engines that were the norm for many years as an industrial power source. One sizable steam engine would be used at the plant, and a belted line shaft system would be used to power each machine. Earlier engine lathes were therefore often “coneheads”, though the spindle typically had a multi-step pulley termed a cone pulley attached to it that was made to receive a flat belt. By adjusting the flat belt's stride on the cone pulley, varied spindle speeds may be achieved. Typically, cone-head lathes included a countershaft on the rear side of the cone that could be deployed to deliver a lower range of rate of speed than was possible with a straight belt drive. They were referred to as back gears. A further lesser range of speeds might be provided by shifting the two-speed rear gears on heavier lathes.

3.1. Toolroom Lathe:

A lathe that is designed for toolroom work is a toolroom lathe. It is essentially simply a top-tier center lathe with all the greatest extra features that might not be included in less-priced versions, such as a collet closure or taper attachment. A toolroom lathe's bed is often bigger than a regular center lathe's. Throughout the years, there has been an implication of selected assembling and further fitting, with great care being given in the construction of a toolroom system to make it the most exact and smoothly functioning replica of the machinery that can be created as shown in Figure 3. The difference in quality between a standard model and its matching toolroom model, however, within the same brand varies on the builder and, in certain instances, has been somewhat influenced by marketing psychology.

Figure 3: Represents the Tool Room Lathe Machine Which is Mostly Used in the Industries

There's not generally a shortage of excellence in the base model for name-brand power tool manufacturers that exclusively produced high-quality tools, preventing the “luxury model” from being improved upon. In other situations, particularly when comparing various manufacturers, the quality difference between a toolroom lathe intended to compete purely on performance but not on price and an entry-level center lathe constructed to compete on price may be objectively proved by monitoring TIR, vibration, etc. In any event, toolroom lathes are much more priced than entry-level center lathes due to their fully checked-off option list and greater quality.

3.2.Turret and Capstan lathe:

Capstan and Turret lathes are two examples of a type of lathe used to produce identical parts repeatedly as shown in Figure 4 and Figure 5 respectively. With the relation of a turret, an indexable component placement that enables multi-cutting processes to be carried out each with various cutting tools in simple, quick succession without the need for the operator to complete configure tasks in between or manage the toolpath it evolved from previous lathes. Turret and capstan lathe models come in a huge diversity, which reflects the range of tasks that they accomplish.

Figure 4: Represents Capstan Lathe Machines Used in the Industry for Different Machining Processes [17]**.**

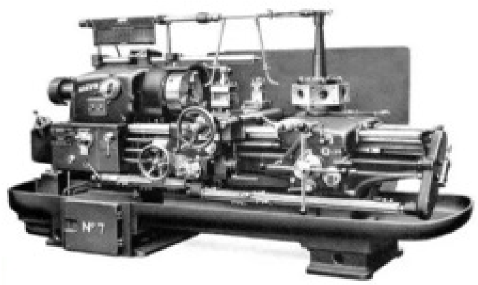

Figure 5: Represents Turret Lathe Machines Used in the Industry for Different Machining Processes [17]**.**

The cross-slide of a lathe is a long, flat surface that resembles the table of a milling machine and is where a row of tools is arranged. Similar to turret lathes, the objective is to set up several tools and then conveniently index them for each cycle of part-cutting. The indexable tool grouping has a linear design rather than rotating like a turret. Multiple spindles and automated control are features of multispindle lathes. They constitute production tools with a focus on big-volume manufacturing. The bigger variations are typically referred to as chuckers, while the smaller varieties are typically known as screw machines. In contrast to chuckers, which autonomously chuck up actual blanks out of a magazine, screw machines typically work from bar stock. Due to the lengthy setup time, the typical minimum profitable manufacturing lot size for a screws machine is in the thousands of components. A screw device can quickly and effectively create thousands of pieces continuously with high precision, short cycle times, and minimal human interaction once it is set up.

Due to their simplicity in setup, operation, repeatability, and precision, CNC lathes machines are quickly replacing the more traditional manufacturing lathes. A piece of equipment that is computer controlled is a turning lathe. It enables the execution of fundamental machining operations like turning and drilling on a traditional lathe. They are made to fully use contemporary methods and advanced carbide tooling. Once established and tested, the device will start to generate parts while sometimes being supervised by an operator. The component may be created as well as the tool paths may be programmed physically by the programmer or via the CAD/CAM process. A computer menu-style interface is used to electrically manage the machine. The program may be changed and shown on the device, including a projected view of a process. The technique requires a high degree of ability from the setter or operator. In contrast to the previous manufacturing machines, when intimate familiarity with each machine was seen as necessary, the level of expertise is now more expansive. These machines are frequently set up and controlled by the same individual, who will also oversee a few other devices.

Utilizing horizontally arranged lathes, machining centers, boring mills, or boring machines, CNC linear machining is carried out. Typically, the machinery consists of spinning cylindrical cutters that move vertically along five axes. On a three-dimensional component, these machines can create a wide range of forms, slots, holes, and features. Cylindrical cutters on either a vertical spindle plane are used on CNC machines that are vertically oriented to produce plunge cuts, drilled holes, as well as unique forms, slots, and features on 3-d items. Lateral lathes, vertical machining centers, and 5-axis machines are among the pieces of machinery utilized in this sort of milling.

A particular type of lathe with extremely high precision is known as a Swiss-style lathe. A spindle and a guided bushing are used in a Swiss-style lathe to hold the workpiece in place. The tools are held fixed on the Z-axis with the collet positioned behind the guiding bushing and in front of it. The tools will go in and the materials will travel back and forward along the Z direction to cut longitudinally along the portion. This makes them perfect for working on narrow workpieces as the component is held securely with minimal danger of bending or vibrations happening, allowing all jobs to be completed on the material close to the guide bushings where it is stiffer. This kind of lathe is frequently utilized with CNC control.

A secondary spindle, often known as a “sub-spindle”, is a common feature of Swiss lathes, as is “live tooling”. Rotating cutting tools known as “live tools” is propelled by a tiny motor separate from the spindle motor. The complexity of components that may be produced by the Swiss lathe increases with the use of live tools. For instance, it is extremely cost-effective to automatically produce a component with a hole that is drilled perpendicular to a major axis whereas it is similarly uneconomical to do so as a subsequent operation after the Swiss lathe has finished its machining. A "secondary operation" is a machining process that needs to secure a partially finished object in a different machine to finish the production process.

Drilling or milling processes are included in the design of a combination lathe, sometimes referred to as a 3-in-1 machine. These machines use the top slide and carriage as that of the X and Y - axis for such milling column, which rises just above the lathe bed. The idea of needing a turning, pillar drill, and milling machines all in one reasonably priced machine tool inspired the moniker “3-in-1”. These are only available inside the MRO and hobbyist sectors since to stay economical, they invariably incur size, feature, stiffness, and accuracy sacrifices. However, they do a good job of satisfying the needs of their particular specialty and, with enough practice and expertise, are capable of great precision. It might well be encountered in smaller, less machine-focused firms when the occasional tiny item has to be machined, especially when the pricey toolroom machines' fine tolerances would've been excessive for the application from such an engineering standpoint in addition to being overpriced.

A general-purpose center lathe is a larger version of the mini- and micro-lathes. They generally only handle projects with a diameter between 3-7 inches. They are compact and reasonably priced lathes for a home workshop or an MRO facility. These devices have the same benefits and disadvantages as previously discussed 3-in-1 machines. Thus, there are various designs of lathe machines in the market which are used in various applications of manufacturing in the industry. The wood lathe, CNC, and other lathe machines are productive and had particular functions. The study will further help in analyzing the working of different types of lathe machines used in the industry.

4. CONCLUSION

The lathe machine is the main machine used in the industry for various machining processes. The various operations like facing, shaping, turning, knurling, etc. are done using a lathe machine. Various types of lathe machines are used for different materials and purposes. The different machines are used for different purposes the bench lathe is an old machine while CNC is an advanced machine that is used for high production, and the mini and micro lathes are used for small objects. The different designs are developed by different researchers and have different characteristics and working principles. Thus after studying the different kinds of literature, it can be said that the CNC is the most advanced lathe machine which is used for high-scale productions. In the next few years, CNC machines will be used in industries as all are focused on high-scale production to increase profits.

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CHAPTER 7

DESIGN AND FABRICATION OF A BELT ABRASIVE GRINDING MACHINE FOR IMPROVED FINISHING OF A METAL

Himansh Kumar, Assistant Professor
Department of Mechanical Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- himansh.rmu@gmail.com

ABSTRACT:

A grinding wheel is the cutting tool used in the abrasive machining process of grinding. For grinding, a wide range of machinery is employed. Even abrasive belts for belt grinders offer more cutting power than grinding wheels do. The key goal of this study is to build an abrasive belt grinding machine that can grind a variety of materials, including metal, glass, ceramics, stone, and other materials, with improved tolerance and surface polish. The use of an aluminum oxide belt with a high stock removal rate for cleaning and polishing while grinding with an acerbic belt can effectively condense the accuracy and exterior irregularity of work components. In terms of efficiency and parameter range, abrasive belt grinding is more effective than wheel grinding. It is concluded that the hardness of the aluminum oxide belt creates it adequate for use as an acerbic and then as a substantial part of wounding implements. A vertical grinding machine has been developed for abrasive belts with more benefits than a wheel grinder.

KEYWORDS:

Abrasive Belt, Grinding Machine, Metal, Grinding Wheel, Polishing.

1. INTRODUCTION

The grinding system is a long machining operation with many factors. The grinding system includes the ore features served keen on the track (or toughness, grain extent, elemental arrangement, or speed of stream), the stream speed of water served hooked on the circles, and the changes in the storm feed ore [1]. Crushing is a major non-linear, heavily coupled, and moment-important manufacturing procedure. It is tough to accomplish ideal power outcomes using the conventional control method [2]. Many advanced control techniques for machining operations have been developed by scholars both at home and abroad. In the metallic and furniture-making industries, acerbic belt grinding is a popular production process [3]. Covered acerbic belts are used at the same rate of speed as connected wheels, but they are typically not clothed when the acerbic becomes gloomy.

Acerbic belt grinding is a type of grinding instrument with a distinctive design that requires a strain-hardening device and moving rollers to strain and move the erosive belt at high speed, except under certain pressure, the interaction between the acerbic belt and the workpiece surface can help to realize the whole grinding and machining process. Wood and many materials can be grind by a belt grinding process. A belt runs continuously over the surface of rough material to achieve a specific smoothness with the help of pulleys [4].

A base is provided to support the pulley and belt. One pulley is attached to the motor and the other pulley is attached with a wooden or metallic base. Grinding paper is attached to the pulley [5]. The grinder is designed by using a base frame, acerbic belt, and coupling motor along with pulleys. The grinding process is used to give shape to the material without putting more effort, by grinding process a material achieves a good surface finish as compared to other machining processes. By using a belt grinder we get a large area as compared to a wheel grinder during the grinding of any material [6]. Crushing is an acerbic machining procedure that uses a crushing surface as a cutting implement. While the mini belt grinding system has better-cutting efficiency as compared to wheel grinding [7].

Nowadays mostly used grinding process is wheel grinding. To remove the sharp edge, sharpen the cutting edge of any cutting tool at different angles wheel grinding is generally used in workshops. A major problem in wheel grinding is lesser contact surface area, due to lesser area time consumption in the grinding process is more [8]. To overcome this problem people adopt a new solution mini belt grinder. Mini belt grinders have a larger surface contact area than wheel grinders. So, the grinding time for the same operation is very in a mini belt grinder as compared to a wheel grinder.

Exterior texture effectiveness for a multipart shape part in industrialized operations such as polishing and grinding is primarily determined by two factors i.e. first, the situation of the belt grinding method and second, the arrangement of operational limits such as spindle rapidity, pressure, flow speed, polymer roller toughness, and abrasives size. Observing the situation of the belt crushing tool is essential since undetected tool degradation will influence the material removal method and, finally, the surface properties of the machined surface. Furthermore, the grinding process parameters must be flexible and adaptive during the process of manufacturing predicated on certain situations or circumstances also including, the curves structure of the work material, adjustments in acerbic instrument wear circumstances, the toughness of the work material, which is commonly not entirely homogeneous, and the extent of the work material actuality designed and produced, e.g., by the corners towards the center part [9]. This research involves estimating belt grinding instrument conditions from new to decent utilizing special manufacturing parameters as shown in Figure 1.

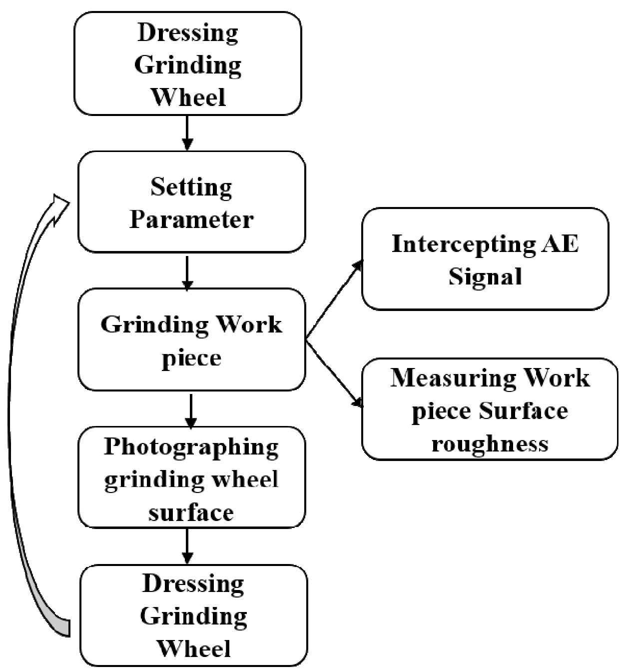

Figure 1: Demonstrate the life cycle time of a grinding tool.

1.1 Advantages and Disadvantages of Abrasive Belt Grinding:

Abrasive belt grinding is a special type of grinding tool with different shapes of abrasive straps which need starting device and driving wheel to make the abrasive belt stress move at high speed under certain pressure.

1. Acerbic papers on abrasive straps are high-pitched and produce a lot of critical output. Wide acerbic belts have a huge grinding area and have a productivity that is between five and twenty times that of grinding wheels [10].
2. Low amounts of energy are used during grinding. The interaction wheel and prestressing wheel are compact, the abrasive belt is lightweight, and there is minimal energy loss because of the low inertia of the high-speed rotary motion [11].
3. Grinding with an abrasive belt gives an excellent fit best. It doesn't require trimming, generates less heat, and can provide continuous speed operation. Additionally, the cleanliness of its acerbic grains than the effective cooling of the acerbic belt may ensure excellent precision and minimal surface roughness values [9].
4. An abrasive belt is useful for grinding a variety of surfaces with complex shapes since it is soft and may adhere to the forming surface.
5. The abrasive belt turning process has a straightforward structure that guarantees safety and reliability [12].

2. LITERATURE REVIEW

P. Z. Liu et al. conducted a study on the abrasive machining process that used a grinding wheel in their study for smoothing the surface. In their study, they find limitations of grinding wheels in the material removal process. After that, they focused on a mini belt grinding system to overcome the limitation of the crushing roll. The core objective of their paper is to project a perpendicular belt crushing mechanism to attain an improved exterior texture for numerous materials such as rock, ceramic, glass, metal, and specified materials. Abrasive grinding by the belt can affect the accuracy and surface roughness of the work material. In the meantime belt of aluminum oxide with great stock removal polishing and cleaning is effective. They conclude aluminum oxide belt is best for use as an acerbic and as a component in cutting tools [13].

Y. Fu et al. conducted a study on tool dress-checking terminology that arranged the acerbic belt grinding process by consuming force significance and trembling on a convolutional neural system. Due to the random location of acerbic papers on the belt, a belt has a good option for the course and fine substantial elimination. Due to a critical occurrence known as degradation the quality of work material affects. Their work focused on identifying and study of vibrational signals and force took from sensors that assign to the axis of work material [12].

J. S. Wanget al. conducted a study on the grinding process. In their study of the grinding process, they mainly focused on the non-linear multivariable process of classic complex materials with powerful connections and a very bulky time gap. The integrated modeling of the intelligent control method of data driving modeling theory in crushing procedure is supported in their study, which establishes a connection between soft-sensors of technique index and economic model. After that point, a controller approach of crushing procedure depends on cognitive as well as self-tuning PID (Proportional–Integral–Derivative) de-coupling controller is optimized. Lastly, they used PID (Proportional–Integral–Derivative) terminology to control the grinding process [14].

H. D. Yuet al. researched the final stage of the grinding process used in industries. There is no further process in any industry to remove material in abrasive papers without opting grinding process. For attaining high surface smoothness industries use the grinding process in terms of wheel drive as well as a belt drive. Grinding wheel with belt type tool is used for different accuracy uses such as perfecting, deburring ion foundries, cut off grinding as well as engraving. This paper highlights on latest improvements in numerous power tools such as pneumatic and electrical power tools, and also execution in robotics systems [9].

W. Caesarendraet al. carried out a study on the material removal process from materials like wood and metal during the conventional marching process. They find the grinding process is the best option to remove material in terms of abrasive papers. In their paper first, they suggest a grinding wheel, but after knowing the limitation of the grinding wheel they turn their study towards belt drive grinding wheel. In their experiment they rotate the grinding wheel through a motor and two pulleys, to support the moving mechanism a base is also used. They also use variable frequency drive (VFD) for varying the rotating speed of the belt. They conclude that due to its hardness aluminum oxide belt is best suitable for making belt grinding cutting tools with a substantial percentage [15].

3. METHODOLOGY

3.1 Design:

The abrasive belt grinding process employs an abrasive product, normally a rotating belt conveyed into the controlled work area. The grinding wheel is poised of abrasive grains and papers joined together in a binding material. The abrasive grinding belt rotates about the rotating wheel to come into contact with the working area. The grinding process is adjustable by certain parameters such as belt speed, grinding process, feed speed of the grinding belt, dimension of the contact area, and the type of abrasive grains that are used during the design and manufacturing of the abrasive belt.

3.1.1 Technical Demonstration of Grinding Procedure:

The goal of polishing, which occurs after the ore rolling process, is to produce meaningful ore elements to accomplish all or maximum of the monomer segregation while preventing consumption occurrence and obtaining the required atom size for sorted processes. Figure 2 depicts a conventional grinding and classifying procedure. Polishing any material is a very intricate process. Many points affect the polishing process such as the feed velocity of milling U1, the release ratio of milling Y1, the granularity of milling Y2, feed speed of thrust U2, the volume of water feed ore A, new mineral feed B, excess deliberation C, classifier current E and milling current D. Sand return and water supply characterizes as V1 and V2 respectively.

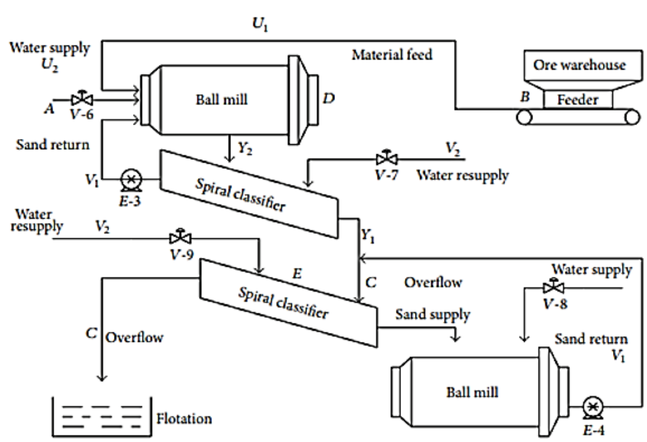

Figure 2: Demonstrate the technique of the grinding process [Source: Google].

3.1.2 Controlled Intelligent Strategy for Grinding Process:

Figure 3 depicts the block illustration of the information combined simulation and adaptive controller design for the polishing. The dynamic wavelet neural system's easy approach to industrial and procedure indicators, the optimal process set-point exemplary using specific instance rationalization advanced technologies, and the auto-tuning PID (Proportional–Integral–Derivative) disentangling control system centered scheduled the IFLA (International Federation of Library Associations and Institutions) are all components of the combined modeling and intellectual controller system of the polishing. First, the soft-sensor model's predicted milling resolution and discharge ratio are recognized as the set-point model's input parameters. The milling ore input relation and the freshwater feed speed of the impel lake are then improved using specific instance reasoning.

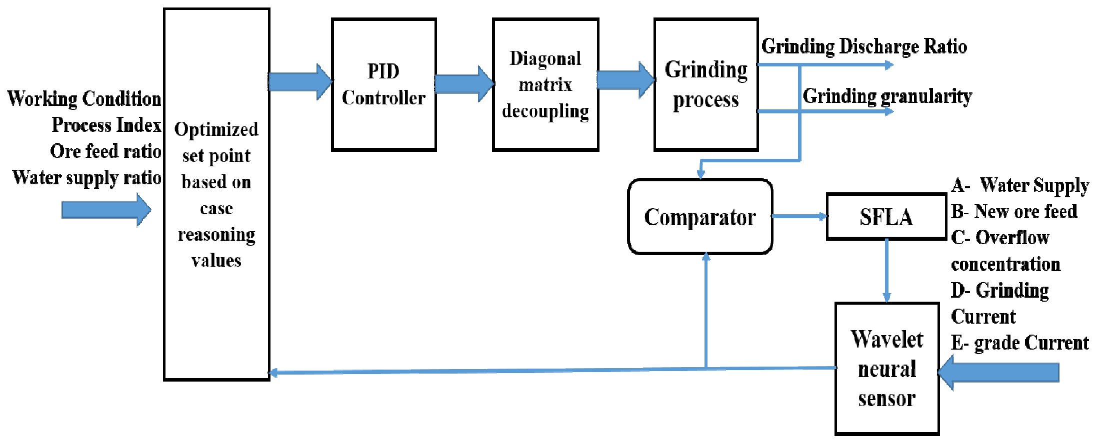

Figure 3: Demonstrate the block diagram of information integrated simulation.

3.2 Instrument:

This proposed design of the mini belt grinder model has been developed and simulated by utilization of CATIA V5. And the other factor is measured and worked out by various tools and arrangements. The machining process is necessary to maintain the base of the grinder. The pulleys of the grinder are ground by the wheel grinder to maintain specific friction between the belt and pulleys. The effectiveness of the belt grinder is measured by a lot of sample pieces. The rotation speed of the grinder belt is measured by Tachometer.

3.2.1 Components of Acerbic Belt Grinding Mechanism:

Belt grinding is an abrasive machining process used on metals, alot of non-metals, and many more materials. The grinding process is typically used for the finishing process in workshops and industries. A belt coated in abrasive material is run over the surface to be processed to remove the material or produce the desired finish and smoothness of the desired surface. Belt grinding is a multipurpose process that is comfortable for different applications. Figure 4 demonstrates the components of the abrasive belt grinder. There are various applications of the belt grinding technology and some components used in such technology are illustrated below:

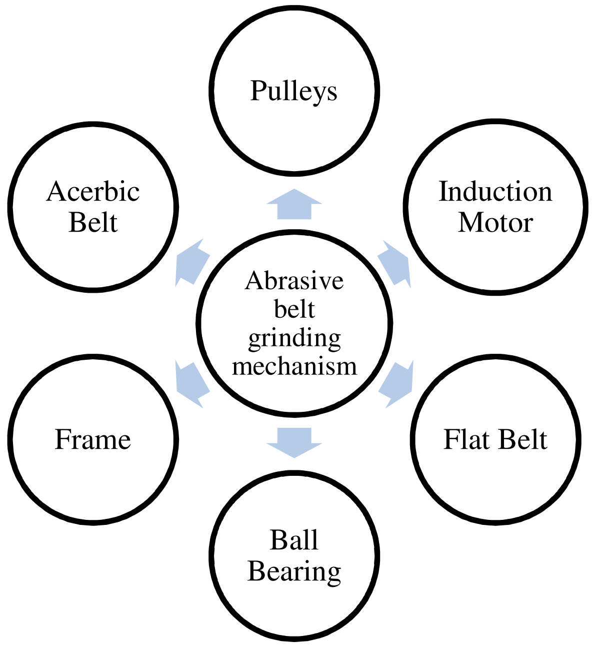

Figure 4: Demonstrate the components of the abrasive belt grinder.

Pulleys: In power transmission with flat belt drives, flat belt pulleys are employed. The flat pulleys used in manufacturing are frequently top speed, lower power consumption, and are utilized for a variety of industrial applications. Flat belt drive pulleys provide the belt with speed. The grub screw, keyways, or key is used to secure the pulley wheels to the shaft.

Induction Motor: The roller shaft, which is fixed to the end of the frame structure, is found to be driven by it. The motor's massive pulley, around which the belt runs, is located at the free end of the shaft; the other motor characteristics are discussed in the design section. Since it only has one source of alternating current. The only conceivable output of a solo phase is motorized is an irregular pitch. Single that appeals primarily in a unique way and ultimately the reverse as the field's split reverses.

Flat Belt: Flat belts are generally built of rubber, leather, and cotton. Leather belts have such a high coefficient of friction, making them suitable for flat belts. The bulk of the load carried by belt drives is transmitted through the inner lining. Which is formed of canvas fabric or other material and is designed for light-duty transmitting power and high-performance transportation. They work best when using small pulleys and a large central distance. Flat belts get both interior and exterior connections. Pulleys can come in both endless and joint construction.

Ball Bearing: This allows the roller to revolve and wear the load securely and smoothly. There will inevitably be friction between the rotating part and the continuing to support component for rotations. Between the wheels, and bearings are two elements. The bearing acts as a friction-reducing and allows easy rotations. This lowered the amount of utilization of energy. The bearings are load-removing and reduce the effort required.

Frame: This is constructed of mild steel. The entire component is installed on this frame construction in the proper configuration. To ensure that the bearings are properly aligned during assembly, the bearing size and open box are bored in one setting. The entire assembly is covered by the requirements. This indicates that while parts can move with one another within a machine, they cannot move with one another within such a frame.

Abrasive Belt: An abrasive machining technology used on metallic materials is belt grinding. In industry, it is extensively employed as a finishing step. To remove the material or achieve the desired polish, an abrasive-coated belt is run over the surface to be treated. This abrasive belt is produced in different grades in response to the market, needs, and expectations. We determined the grades based on the materials we were grinding. An abrasive belt is manufactured up of a backing comprised of a sponge and textile film structure with abrasive grains put to it. Abrasive belts are used in applications like surface polishing and grinding and are attached to rotating wheels or pulleys.

3.3 Data Collection:

The grinding wheels or belts are created using a variety of abrasives as shown in Table 1 and Table 2. Abrasive materials are utilized generally in wheels and belts, but sometimes they are not. Today, however, numerous different abrasives belts can be purchased or created to complete the grinding job. The fundamental advantages of belts over wheels have already been discussed. The varieties of abrasive belts used in belt grinding machines with various dimensions produced for various uses are shown in the following tables:

Table 1: Demonstrate the specifications and applications of nylon and ceramic belt.

Material	**Nylon and Ceramic**
Size	2.5 cm in width
Various Applications	Rubber products, Stone metal, Metal processing industry

Table 2: Demonstrate the specifications and applications of the aluminum oxide abrasive belt.

Material	**Aluminum Oxide**
Brand	Drillpro
Size	3 cm in width
Various Applications	Wood, Steel, Furniture, and Grinding of metal

3.4 Data Analysis:

Considering the major goal of grinding seems to be accurately predicting a large number of materials that can be used in the production of abrasive belt grinding as shown in Table 3. There have been performed experiments with many materials, some material gives poor surface finish as compared to wheel drive. After analyzing all collections of material, we find aluminum oxide is the best material for the abrasive belt. Aluminum oxide gives an appropriate surface finish, and aluminum oxide abrasive belt has a specific life cycle.

Table 3: Demonstrate the surface speed of the belt with different materials.

Material	**Surface Speed (meter per minute)**
Acrylic	300-800

Glass, ceramic, and stone	500-800
Lacquers and varnishes	500-850
Hard and hardened steel	500-850
Plastic and rubber	600-1150
Titanium and titanium alloy	600-1600
Wood	900-1600
Aluminum and zinc	1100-1800
Stainless steel, tool steel & high-speed steel	1100-1800
Copper and brass	1500-2000
Cast iron and carbon steel	1500-2000

4. RESULTS AND DISCUSSION

This study is focused on a belt abrasive grinding machine instead of a wheel drive grinding machine. During the study, the belt abrasive grinding machine is found much better as compared to the wheel drive grinding machine. After that, it is focused on some parameters which affect the grinding tool like grinding wheel diameter, machining time, and lifetime of a grinding tool. After some experiments, desired results are achieved which results as shown in the graphs. Figure 5 shows the relationship between grinding wheel diameter and machining time. As can be seen in Figure 5 machining time of any wheel is inversely proportional to the diameter of the wheel. If increase the diameter of a wheel the machining time of any, material will decrease.

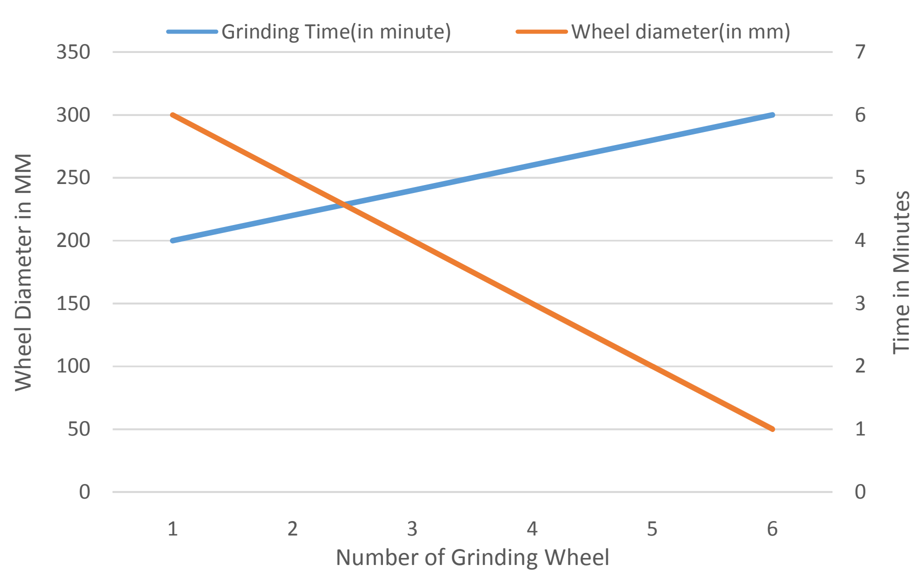

Figure 5: Demonstrate the relation between grinding wheel diameter and machining time.

Figure 6 demonstrates the relationship between the grinding roll diameter and the lifetime of the grinding roll. As can be seen in Figure 6 wheel diameter and lifetime of a wheel is directly proportional to each other. If increase the diameter of a wheel the lifetime of the wheel also increases. Figure 6 demonstrates that if the diameter of the wheel increases the life span of the grinding wheel also increases in the same proportion. Because with an increase in diameter, the friction between the workpiece and the grinding wheel decreases due to which the amount of heat energy produced during the grinding process is decreased. Due to a decrease in heat energy, the grain papers of the abrasive belt cannot extinguish easily. So the life of the abrasive grinding papers increases, as the life of the grinding wheel also increases.

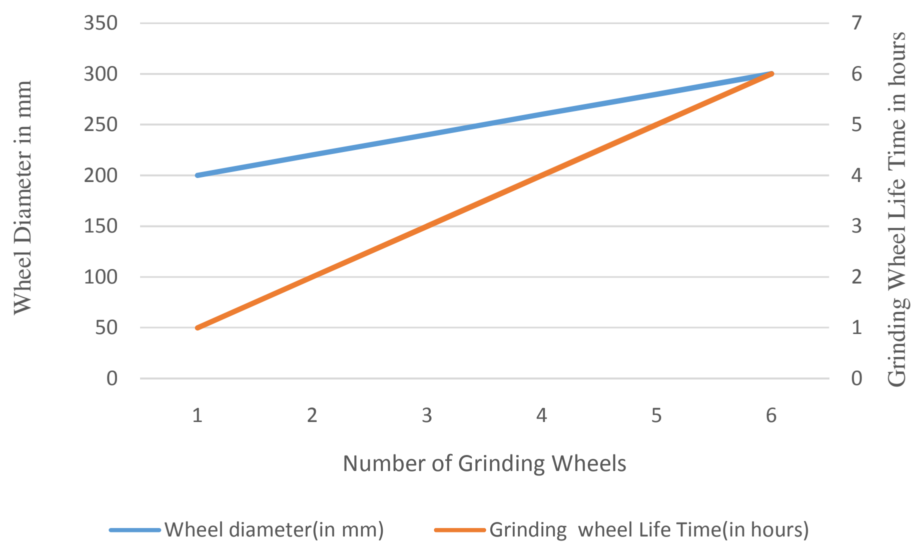

Figure 6: Demonstrate the relationship between the grinding roll diameter and the lifetime of the grinding roll.

5. CONCLUSION

A grinding wheel is the cutting tool used in the abrasion machining process of grinding. For grinding, a wide range of machinery is employed. Even abrasive belts for tiny belt grinders offer more cutting power than grinding wheels do. However, wheel grinding has several drawbacks in terms of the amount of time needed to finish the surface, the rate at which material is removed, the quality of the finished surface, etc. Utilizing CATIA v5 software, a vertical abrasion belt grinding machine was established to solve these drawbacks of wheel grinding equipment. Using abrasive belts that are mounted on this specially designed machine, this machine also helps to polish or finish the surface. Given the increasing area of the abrasive belt that is in contact with the workpiece as a response to this, compared to a wheel grinding machine, the rate of material removal or surface polish is higher in a shorter amount of time. In future, there exists a modification in the rotating mechanism of the abrasive belt, if the length of the rotating mechanism is decreased then the material removal rate with the increase in the feed of the abrasive belt also increases.

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CHAPTER 8

DESIGN OF MULTI-POINT DRILLING MACHINE TO INCREASE DRILLING EFFICIENCY AND REDUCING DRILLING TIME

Shreshta Bandhu Rastogi, Assistant Professor
Department of Mechanical Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
Email Id- Shreshtha.polytechnic@tmu.ac.in

ABSTRACT:

For many sectors, drilling is an essential machining technique. Among the industries that create millions of holes, the automotive and aerospace sectors rely heavily on the efficiency, reliability, and precision of the holes they drill. The needed dimensional precision and surface roughness can only be achieved by using the right machine tools, equipment, cutting tools, and parameters. This subsequently aids organizations in prospering and lengthens the lifespan of their products. This study gives a basic overview of the drilling procedure used in manufacturing, which serves to increase the effectiveness and efficiency of exploratory drilling on metallic materials. It explains the benefits of employing multi-spindle heads to increase drilling productivity and hole quality. As the study performed earlier, the main disadvantage of these studies is surface roughness. A multi-spindle drilling machine can reduce drilling time as well as cost. As we discussed earlier about reducing time and cost, this system is more efficient to increase the efficiency of operation and surface finish.

KEYWORDS:

Cutting Speed, Drilling, Feed, Holes, Speed.

1. INTRODUCTION

Companies are looking for new and more effective techniques to create and research their products to gain the production's economic benefits in the past due to the quick development of new technology and rising consumer expectations [1]. High production efficiency is anticipated to be achieved by the deployment of specialized solutions and innovations, which enable manufacturing organizations to quickly enhance current practices and methods. Drilling is one such important technological procedure as shown in Figure 1 [2]. Drilling deep holes can be done in several different ways, including using a rotating workpiece, a rotating tool, or a tool that rotates in tandem with the spinning workpiece [3]. The foundations of drilling, as well as the proper selection of cutting speed and feed rate, are unaffected by the drilling technique. In general, the most significant elements that influence the effectiveness of drilled holes are successful chip production and its extraction from the sharp end without injuring the tool or workpiece. Deeper drill with the Single Tube System (STS) technology produces small-diameter holes [4]. The ejector system is a substitute for STS technology in situations when a small manufacturing series is being drilled without the use of special equipment. Modern carbide monolithic tool development has made it possible to create a hole with smaller paper sizes using carbide screw augers with length-to-diameter ratios within a range of 30 mm [5]. Figure 1 shows the Flow Chart of Drilling techniques Used during the Drilling Process.

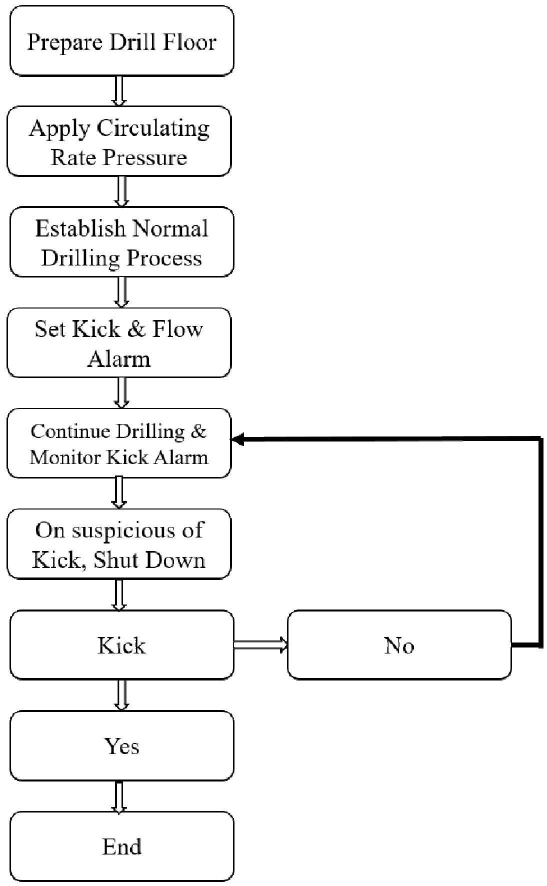

Figure 1: Illustrates the Flow Chart of Drilling techniques Used during the Drilling Process.

Deep-drilling (gun-drill tool) technology has advanced in terms of design, materials, and coating. The most current remedy involves creating gun-drill tool bodies with interchangeable cutting plates and guide surfaces, which allow for greater dimension adjustability using various washer widths [6]. The application of appropriate cutting fluid pressure to dissipate heat, remove chips, and lubricate the cutting process remains one of the most crucial requirements for maintaining a stable operation, even when using the newest auger design. Other factors that affect the process include the stability and accuracy of the machine, the characteristics of the material being machined, the technological parameters, and the use of an appropriate tool [7]. The topic of deep drilling is covered by several significant authors from the global scientific community. A combination of force, torque, and vibration data are combined and retrieved from a designated segment to form the basis of the suggested monitoring approach, which is based on something like a Gaussian regression process (GRS) [8]. The findings demonstrate that the suggested method, which performs noticeably better than competing approaches, can increase the precision of such cutting tools estimate. Examples include support vector regression and linear regression [9].

The most frequent machining activity in the manufacturing and services sectors is drilling. To enhance efficiency and profitability, it is essential to analyze and develop this process, and numerous previous research has discussed its optimization and advancement. Numerous machines, milling machines, and machining centers, including lathes and special determination machines, can execute drilling tasks [10]. The drilling procedure is widely and frequently employed in industries, and it is responsible for a sizable amount of the total time and expense associated with machining. As a result, drilling plays a large economic role in the industrial sector, where it significantly advances the production of numerous industrial components. Numerous research efforts have been focused on hole-making procedures utilizing drilling activities, where a great deal of advancement and improvement has been accomplished [11]. The effectiveness and quality of this crucial function, which is at the center of operations in many sectors, must be improved, but as technology has advanced and novel equipment and tools have been introduced, more research is required [12]. For instance, within a range, around 16,000 holes in one converter for coupling with refrigeration tubes are needed for the heat transfer of nuclear energy control points. Other instances include the automobile sector, where drilling accounts for within a range of 40% of all heat energy extracted, or the aviation sector, where the combining of numerous aircraft fuselage sections requires the drilling of millions of holes [13].

1.1 Classification of Drilling:

1.1.1 *Spot Drilling:* Drilling a test hole that will serve as a guide for the larger hole is the goal of spot drilling. The hole is only partially bored through into the object because its main purpose is to serve as a preliminary step for further drilling operations.

1.1.2 *Centre drilling:* A center drill is a double-fluted tool used to drill countersunk center holes in an object that will be positioned between centers for grinding or turning. It consists of a twist drill with a 60° countersink.

1.1.3 *Deep Hole Drilling:* Drilling a hole deeper than ten times its diameter is referred to as deep hole drilling. To keep the holes straight and within tolerance, specific equipment is needed. Surface polish and roundness are other factors [14].

1.1.4 *Gun Drilling:* A gun drill, which was invented to remove gun barrels, is frequently used to create deep, shallow holes of a smaller diameter. The ratio of depth to diameter may even exceed 300:1. The bits used in cannon drilling must be self-centering to produce such deep, precise holes.

1.1.5 *Trepanning:* Trepanning is frequently used to maintain large dimension holes (within a range of 91.5 cm (36 inches)), where it would be neither convenient nor cost-effective to use a regular drill bit. Trepanning, which functions similarly to a drafting compass, eliminates the necessary diameter by cutting away a solid disc. Trepanning is done on flat items, such as I-beams, granite (curling stone), sheet metal, and granite (curling stone). Trepanning can be used to create grooves for O-rings and other types of seals [14].

2. LITERATURE REVIEW

Sergio Alexandre Gehrke et al conducts a study on drill machine design to improve the temperature control of the drill bit temperature to improve the proficiency of the drill bit. By reducing the temperature of the drill bit they try to increase the tool's lifetime. They used three blocks of synthetic cortical to perform osteotomy procedures. In the first group, they used many drilling systems with a predictable external procedure and named control group 1. The second group is known as control group 2, where a single new drill bit with the predictable external procedure is used in a new irrigation procedure. And the last group is known as the test group, in which a new single bit is used with the irrigation procedure. A thermocouple is used at each step to measure the temperate of the drill bit [15].

Martin Pollak et al conducted a study on parameters that affect the life of a drill tool as Feed rate, RPM, Cutting chip length, and temperature of the drill bit. The drilling process in the real-life manufacturing industry is a major tool to create a hole in any material, the length of holes varies with demands. The aim of these study to determine the better conditions for a drill bit to create a deep hole and they also try to determine the better cutting process and degree of output requirements like angle, feed rate, and ratio of uncut chip to cut chip. Based on the analytical test perform during these studies the result of the study was statistically calculated and well-enhanced.

Yu-Gang Ren et al performs research on process parameters of drill bits for no load conditions. The need for precise study of deep sea-technical research, and drilling terminologies by comparing the operative improvement is considered one of the best suitable methods for deep-sea bedrock drilling. In these studies cutting models and separate material simulation, as well as well-organized drilling as design considerations. The exceptional process of that terminology is the bit load created by the drill pressure generally up to a range of 100 to 400N, although recommended load for a drill bit is more than 1 to 3 KN. To demonstrate the viability of electromechanical deep-sea drilling technology, it is thus imperative to find drill bits that really can drill in exceptionally tough formations with little load and appropriate rates of penetration and rotational speed [16].

3. METHODOLOGY

3.1 Design:

Three spindles are used in a multi-axis drilling machine to simultaneously drill three holes. By physically turning the handle, which also turns the bevel gears, power is conveyed to the leadscrew with the aid of the rack and pinion gear as shown in Figure 2. The lead-screw mechanism, which uses bevel gears to power lead screws, governs the radial movement of a spindle. We employ a limit switch, which regulates the ON/OFF function of the drill machine, to control the depth of the opening. This limit switch is frequently adjusted radially depending on the required hole depth, allowing us to drill holes with greater accuracy. Drill machines are installed on stands, thus by adjusting the height of the stand, we may regulate the drill spindle's vertical movement. As a result, we are prepared to change the distance between the holes in the base as well as the angle between them.

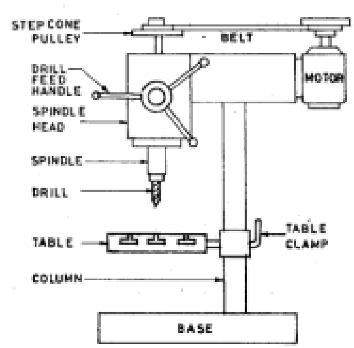

Figure 2: Illustrates the Working Model and Parts of the Drilling Machine [17].

3.2 Instrument:

The proposed model of the drilling machine has been developed and simulated by utilizing the Creo. After that, the efficiency of the drilling machine is calculated by using different parameters like Machining Time, Spindle Speed, and feed rate. The spindle speed of the grinding wheel is measured by using Tachometer. Other parts of the drilling machine like a tool, and base may be manufactured by different machining processes. Sharping of the drilling tool is done with the help of the grinding process.

3.2.1 Components of Drilling Machine:

1. A power source (May be AC or DC)
2. Motor (May be AC or DC)
3. Rack and Pinion gear
4. Base
5. DPDT Switches
6. Channels
7. Sliders

3.3 Data Collection:

A drill bit is a cylindrical instrument that revolves against such a material to make holes during the drilling process, which can be seen in Figure 3. There are 3 stages to the drilling operation process: the opening and concentrating phase, the complete drilling phase, and the breakout phase. First, the precise location of the hole must be determined. Next, the drill bit must be fully engaged. Finally, the procedure must be completed by passing the drill through the underside of the working material. As seen in Figure 4, there are many different ways to make a hole during the drilling process, including blind and through holes. Blind holes are drilled to a specific depth, whereas throughholes are when the cutting tool enters the material on one side of the workpiece and exits the other. Twist drills typically operate at a thickness-to-diameter ratio of 5:1 or more; however, when using slightly elevated twist drills with through-tool coolant systems, this ratio can be doubled.

When utilizing specialized deep-hole drilling tools with through-tool coolant systems, this ratio can be raised to about 20:1. Although the focus of this chapter is on the usage of twist drills, it is important to note that gun drill bits with through-tool lubrication systems can achieve a depth to diameters of 100:1 or more. Gun-drilling machines, in contrast to typical drilling operations, rotate the cutting tool and the workpiece in different directions and at various rotational rates, greatly enhancing the alignment of the resulting deep hole.

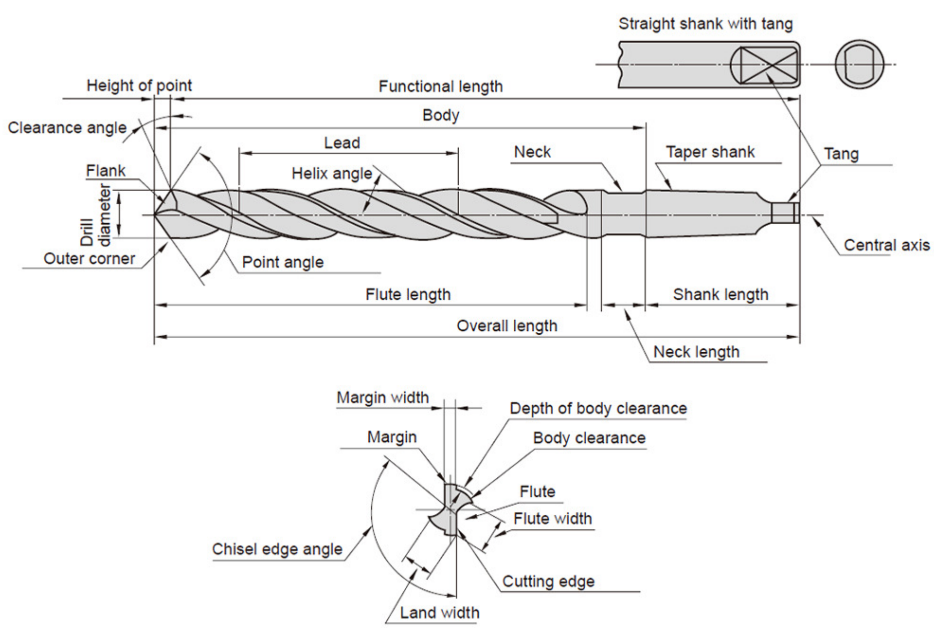

Figure 3: Illustrates the Nomenclature of a Drill Tool [13]**.**

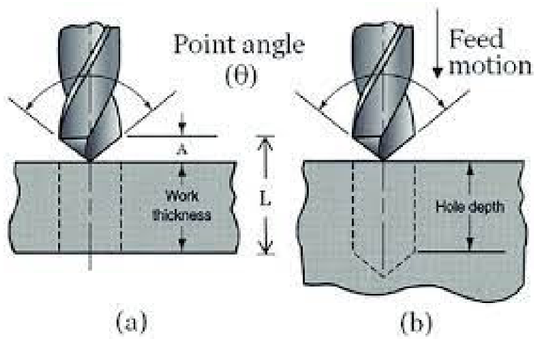

Figure 4: Illustrates the (a) Through Holes and (b) Blind Holes.

3.4 Data Analysis:

The success of every drilling process is largely determined by the cutting conditions. Feed and feed rate, Material removal rate, Cutting speed, and machining time are some fundamental cutting conditions that are covered in the section below:

3.4.1 Feed rate and feed: The feed rate for a drilling operation is defined in mm/rev, whenever the feed is multiplied by the spindle speed, the feed rate. Which is the linear travel rate in mm/min can be changed by a practical system. Thus, the feed rate can be calculated as:

$$F_{r = f \times n} \quad (1)$$

Where,

f represents feed in mm/rev

F_r represents feed rate in mm/min

n represents the speed of the spindle in rev/min.

3.4.2 Material Removal Rate (MRR): The rate of material removal can be used as a gauge to assess how effectively a machining process is working. The removal of material during drilling is accomplished via:

$$M_{rr} = \frac{\pi}{4} d^2 F_r \quad (2)$$

Where,

Mrr represents the material removal rate in mm3

d represents the diameter of the drill bit in mm

F_r represents the feed rate in mm/min.

3.4.3 Cutting Speed: During the drilling process, a tachometer is used to compute the spindle speed, which is the rotating speed measured in rev/min. The distance that each cutting edge travels on the workpiece surface when cutting material is calculated using the spindle speed. Consequently, the calculation of cutting speed in a drilling process is:

$$V=\frac{\pi dn}{1000} \quad (3)$$

Where,

V represents cutting speed in m/min

Pie = 3.14

d represents the diameter of the cutting tool in mm

n represents spindle speed in rev/min

3.4.4 Machining Time/Grinding Time: Drilling time is the amount of time a tool is used for continuous machining from the start of stone creation to the finish. This period does not include any scheduled or unplanned breaks during the process. Through hole drill time in minutes can be calculated using the:

$$T_m = \frac{L}{Fr} \quad (4)$$

Where,

Tm represents drilling time in minutes

L represents the distance traveled by the cutting tool in mm

F_r represents the feed rate in mm/min.

The drill bit should move the length L (see Figure 4), which comprises the desired hole depth plus a deduction for the tools impact angle, A, determined by:

$$A= \frac{d}{2}\tan\left(90 - \frac{Ø}{2}\right) \quad (5)$$

Where,

A represents allowance in mm

d represents the diameter of the drill in mm

Ø represents the tool point angle in degrees

4. RESULT AND DISCUSSION

To reduce the machining time in the current study to increase productivity. For a lack of machining time, we must condemn several procedures at once. We have a design that allows us to "drill three holes at a time." There are numerous methods for drilling multiple holes, but most of them aren't prepared to drill on lateral surfaces or at different angles. The majority of those tools can only drill holes in one plane, and we aren't equipped to change the height of the hole peak utilizing these tools. Spindle speed is inversely proportional to the number of drilled holes as shown in Figure 5. With the increase in spindle speed life of the tool decreased, due to the generation of excess amount of heat. Heat generation may be controlled by a suitable lubricant for a particular limit after that heat decreases the life of the tool.

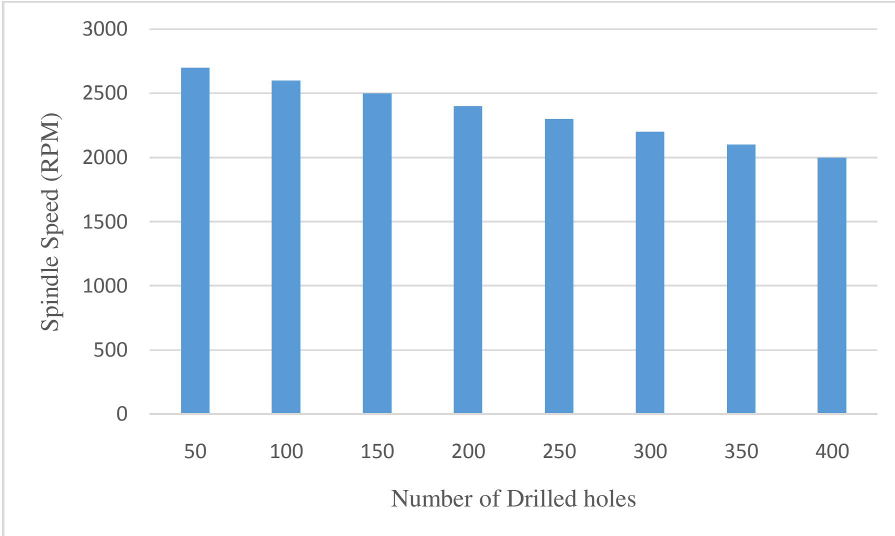

Figure 5: Illustrates the Relation between Spindle Speed and the Number of Drilled Holes

Figure 6, demonstrates the relation between service life depending upon spindle speed and drilling time depending upon spindle speedas shownin the graphwith the increase in spindle speed drilling time decrease, because drilling time is inversely proportional to spindle speed in a direct proportion. But as shown in the graph service life is also inversely proportional to spindle speed but for some intense with the increase in spindle speed service time increase.

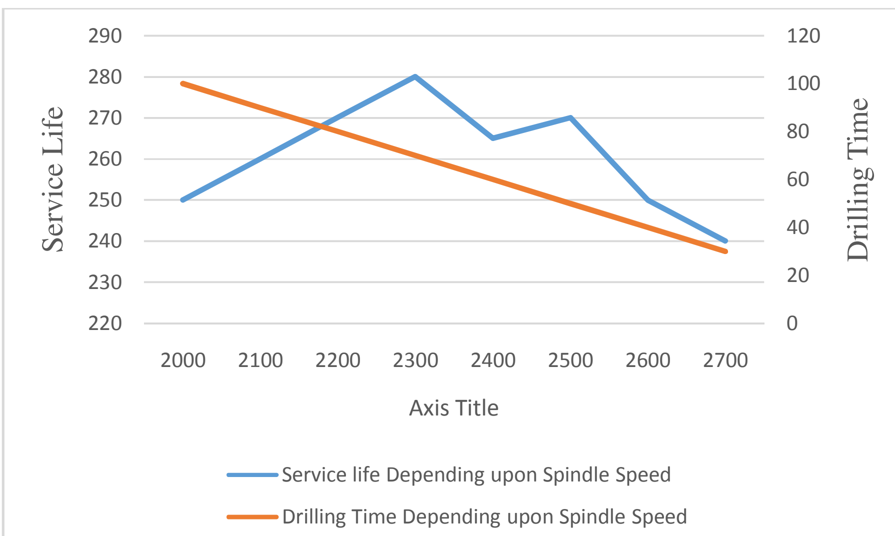

Figure 6: Illustrates the Relation between Service Life Depending upon Spindle Speed and Drilling Time Depending upon Spindle Speed

5. CONCLUSION

The productivity will increase by using a 3-axis drilling head. Because the current procedure generates one hole at a time, which takes 12 seconds for each component, 2400 components are created in 8 hours. Since each hole is drilled individually, the possibility of a hole going missing is eliminated. The price per unit is decreased. By the newly proposed model three holes can be created at one time so, the manufacturing rate of holes increases thrice. As well as the manufacturing rate increases the cost of production decreased in the same manner.

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CHAPTER 9

ANALYSIS OF A NEW GEAR FINISHING TECHNIQUE FOR HIGHLY LOADED GEARS

Dr.Abdul Sharief , Professor,
Department of Mechanical Engineering, School of Engineering, , Presidency University, Bangalore, India,
Email Id-abdul.sharief@presidencyuniversity.in

ABSTRACT:

Gaining the necessary gearbox lifespan, durability, and performance requires attaining irregularity criteria on the cog edges of extremely overloaded gears and producing their non-directional exterior touch. Technical literature lists and describes a variety of finishing procedures, containing gear cog ultimate honing, super finishing, shaving, and grinding to produce the required exterior state. Inappropriately, everywhere is still a need for a straightforward concluding technique that may be used on heavily overloaded gears during production to reduce waste and costs. The results of a non-chemical, very effective abrasive procedure to eliminate a sizable quantity of measurable off-gear cog flanks are presented in this paper. The technology being studied is known as Stream Finishing (SF). To compare the surface's qualities during the appropriate SF process parameters definition, the surface condition was examined. Determining the appropriate manufacturing process application is helpful for transmission groups in achieving the requisite gearbox lifetime at the lowest possible part cost. The definition of the process parameters must be made specifically for each application and tested.

KEYWORDS:

Bearing, Cog, Finishing, Flanks, Gears, Machineries, Tooth.

1. INTRODUCTION

Since human history, power transmission or movements at the appropriate speed has always depended heavily on the use of gears. These are very significant buildings that have taken years to establish and are held to strict standards based on the kind of tools and systems for which they are used. Gears are utilized to give the precise speed required for proper operating circumstances as well as to transport energy from the motor or rotor to the working equipment. Gears can also have one flanged helical cog, dual helical cog, and straight teeth contingent on the category of claim [1]. By using such a solution, axial forces are reduced. When it is important to convey the torque without altering the orientation of the speed, pieces of machinery might be built as dual axial wheels. However, bevel pieces of machinery with orthogonal axes can also be employed as necessary. Gears may be exposed to modest torque multiplication as in the heavy marine, automotive, aviation industries, and food sectors, and to significant forces dependent on the form of claim. In the farming area, apparatus functions under particular circumstances that include contaminated water, dustiness from sand or soil, and heavy pollution [1].

The gear used in aviation buildings, according to their requirements, has a relatively small limit value and is susceptible to misalignment. In aviation, unanticipated in-flight occurrences are seen as a danger to good equipment design [2]. Gears with high rotating speeds need immaculate coatings on their tooth sides to maintain the required service life, which can be accomplished by utilizing specialized cutting-edge super-finishing techniques. Compared to the lubricants used in the automotive industry, lubricated oils are thinner and operate under pressure. Lubricant layer breaking is less dangerous and less probable in automotive applications than it is in aircraft transmissions. The planetary system is a different kind of gearbox, in which the sun'stypes of machinery powers the planet'stypes of machinery[3].

Now, the hollow types of machinery serve as the power-receiving component, and the sun pieces of machinery serve as the input gear. Planetary gears have large gear ratios while transferring great power. The planet gear is still relatively simple to design (several design guides help to generate the correct constructions backed by 3D software), but it is technologically complex enough for high-quality commercial applications as shown in Figure 1 [4]. In arrears to working circumstances (extraordinary speeds, transmitted power, unforeseen events, vibrations, a particular lubricating oil technique, and coolant, moving relative velocity concerns, micro pitting, as well as scuffing in high movable speed parts) then misalignments in operating circumstances, gear scheme also befits very complexly in the flying manufacturing [5]. This results in an accurate assessment of interaction relation and repercussion, comprehension of lattice toughness fluctuation, and impact of manufacturing errors. Additionally, the increased bending stress level that aviation gears function under necessitates meticulous finishing of the gear's top lands and break edges from their faces. The right surface topography must be achieved to prevent scuffing and pitting. This general consent lay, surface roughness along gear teeth, and roughness.

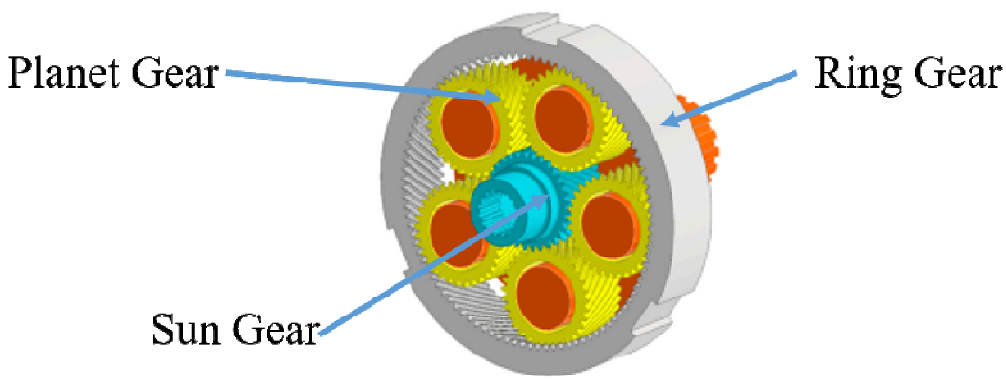

Figure 1: The Above Figure Demonstrates the Computer-Generated 3D Model of the usual Planetary Gearbox.

1.1 Problem Definition:

Although some manufacturers don't make any single-stage units at all, one-step reducers are only made in one-stage housings. Different axis heights pose a unique difficulty since they required different mounting techniques, different methods for determining maximum load and gear ratio, and different methods for choosing the right materials to make gear reducers, especially at lesser heights. Gear reducer manufacturers develop their conceptual solutions by using various techniques to set their products apart from those of their rivals or to achieve greater performance [6]. By carefully choosing the right shape and distributing the weight of the gearbox housing, manufacturers try to increase the strength and durability of the whole apparatus unit. Individual of the crucial aspects of gear reduction is their axis height since it influences the weight ability and gear relationship values and occasionally leads to alternative conceptual designs. Universal gear reducer axes must be no higher than the usual row R20.

Given how thick this row is, the majority of manufacturers create reducers using an R10 standard row for the axis height. To enhance gear ratio, however, they rapidly increased axis heights, and today reducers remain manufactured with an axis altitude in a typical commotion R20/2 [6].

Some industrialists make alleged medium gears through both shaft altitudes with row R20 in the region of the most popular gearbox sizes. In recent years, gear reducer manufacturers have worked to reach the same axis lengths to increase the interchangeability of various gear units [7]. That is crucial for lesser producers since it allows them to compete with larger producers' products. Additionally, this means that they must share the same mounting specifications, such as the size and placement of the base screw holes on the feet or flange [8].

Axis Altitudes of one-step Gear Reduction for Various Producers are shown in Table 1. It can be inferred from the axis heights shown in this table that all single-stage gear reducer manufacturers offer an axis height range: of 63 to 112 millimeters. Additionally, some models offer different heights, as is evident, no manufacturer adheres to the rows R10 or R20/2 entirely instead, they add new heights to the supposedly intermediate sizes [9]. For instance, since axis lengths of 90, 100, and 112 mm are frequently demanded, large manufacturers create gear units in the row R20 with these axis heights. Only Bonfiglioli S and Lenze Somer produces one step reduction with the smallest axis length of 50 millimeters. SEW and Siemens-Flender produce one-step reduction with the smallest length of 140 millimeters and 160 mm respectively [10].

Table 1: The Below Table Demonstrates the Axis Length of One Step Gear Reduction for Various Producers.

Manufacturer Name	50	56	63	71	80	90	100	112	125	140	160
Lenze GST	Yes		Yes		Yes		Yes		Yes		
Bonifiglioli S	Yes	Yes	Yes	Yes	Yes						
Leroy Somer				Yes	Yes	Yes		Yes		Yes	Yes
SEW			Yes		Yes	Yes	Yes	Yes		Yes	
Nord-UNICASE		Yes		Yes		Yes	Yes	Yes			
Siemens-Flender		Yes				Yes	Yes	Yes		Yes	Yes

2. LITERATURE REVIEW

Wieslaw Budzisz et al conducts a study on loaded gears tooth flanks roughness parameters for creating their non-directional surface finish for acquired suitable gearbox lifetime, efficiency, and stability. Before that many surface finishing terminology are addressed which include honing, super finishing, shaving, and gear tooth grinding to maintain proper surface finishing conditions. But, there is still a deficiency of simple methods in manufacturing simple finishing highly loaded gears to obtain time, waste, and cost. That study presents without any chemical course, a very operational method to eliminate a huge quantity of substance from equipment tooth flanks. This terminology is known as Stream Smoothening.

It is useful to describe the correct industrial procedure for obtainingthe proper essential gearbox and enhanced cost.

Peng Wang et al conducts a study on the fault-finding characteristics of a gear. In these studies, they focused on interesting an excessive contract of consideration from investigators to minimize the fault in gear. Typically, when a gearbox is faulty some proper terminology like side-band to use to detect the situation of the mechanical apparatus. Though the side-band terminology of smashed gear is regularly disturbed by durable jams in contextual noise. In this paper, a new terminology with fusion- a signal dispensation process is used which is built on an ethereal deduction (SS) denoising procedure combined with an experiential wavelength transform [11].

Milan Rackov et al conducts a study on strategy explanations summary of one-step general gear. In these studies, they mainly focused on the presence of general gear. Earlier studies not assumed so much consideration on the appearance of the gear surface, but nowadays shape, graphic design, and color of gear are very interesting solutions. It ought to may need in concentration the general gear reduce their complex structure when compare with some superior gear reduction. Principally, it should be noticed that nowadays demand for one-step gear reduction is increasing in universal gear. Single stage-reducer isa very simple and useful product nowadays so, there is a large quantity of manufacturing for such an invention [12].

3. METHODOLOGY

3.1 *Design:*

Designing a gear reducer should be done so that the axial force is applied to just one bearing on the output shaft. The output shaft's two bearings will cost less, mounting and demounting will be considerably easier, and the shaft will be able to expand appropriately when heated. Positioning the helical gear between the bearings will improve shaft stiffness. To ensure as even contact as possible between the two gear flanks, it is best to place the gear in the center of the bearings. If it can't be done, the gear should indeed be positioned to guarantee even contact between the two flanks. Only two conceptual solutions are feasible when analyzing the typical made process of single-stage uniform gear units: when the output gear is overhung as displayed in Figure 2(a), then the output gear is situated among the bearings as displayed in Figure 2(b).

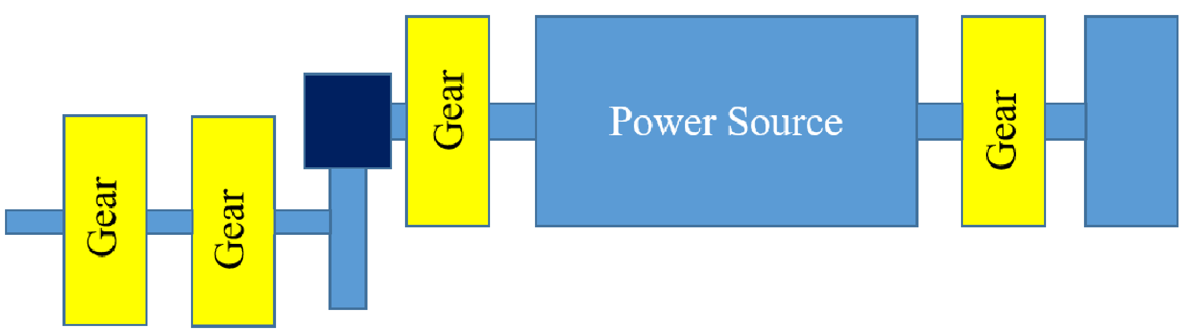

Figure 2(a): The Above Figure Demonstrates the Design of Possible intangible resolutions of One Step General Gear Reduction through Superior Gear Motorized in the Case of Outer Gear is Overhanging.

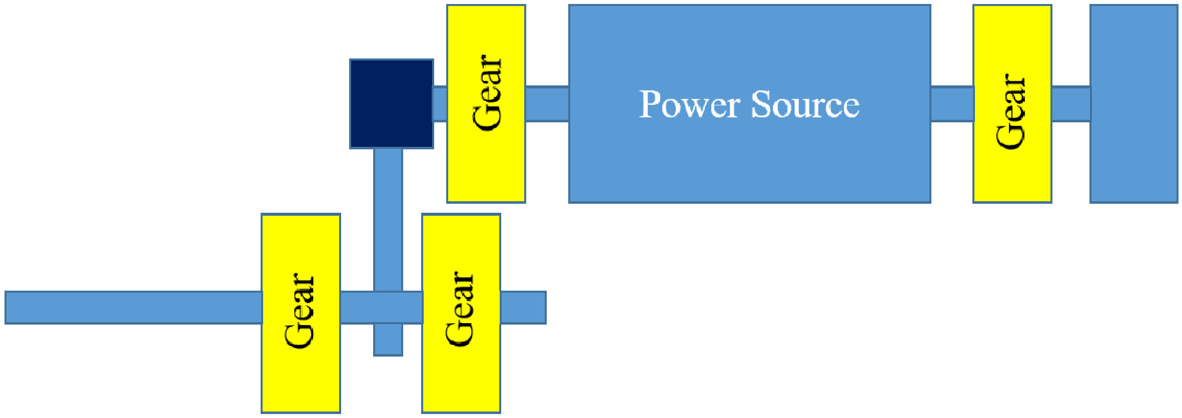

Figure 2(b): The Above Figure Demonstrates the Design of Possible intangible resolutions of Step General Gear Reduction through Superior Gear Motorized in the Case of Outer Gear between the Bearings.

3.2 Instrument:

This proposed enhanced model has been developed and simulated by utilizing the CATIA V5 version embedded within a computing ANSYS comprising the succeeding system arrangement. CATIA V5 and ANSYS are one of the most suitable software packages nowadays for complex computational works, simulation as well as modeling, and many more. This software package is constantly becoming one of the most suitable choices for researchers for designing novel models in a fast manner because of its adaptable nature and easy-to-use handling. Further, the design and simulation of the suggested model have been done with more accuracy as well as precision for eliminating the chance of computational errors for the pragmatic outcome.

3.3 Data Collection:

The study's focus was on gears with a 5-inch pitch diameter that were built of carburizing steel, which has high case hot hardness, high surface hardness, abrasion resistance, and superior tempering resistance. Before the Stream Finishing (SF) procedure, the original surface was machined to an average Ra of 0.27 m. To make the manufacturing process more efficient in comparison to other processes available on the market for gear manufacture, there were three workpieces, each of which was subjected to a distinct SF process parameter at the ideal time. The optimal surface, a representation of the optimized SF process parameters, was defined as among the three work parts. Potential developments must contain arithmetical inquiry of the components to track changes in the rate of substantial removal out from involute (part-by-part dissimilarity). In contrast to the involute tolerance in heavily stressed aviation gears, the inclined cog-to-cog shape distinctions for workpieces are inside a narrow assortment. It implies that the SF procedure can be rather easily repeated.

The faces of the gear surface of the tooth can be finished using a wide variety of technological techniques. The last tooth-grinding operation utilizing a contouring or circular approach is the first well-known procedure. CBN or ceramic discs can be used as the grinding wheel. A honing procedure is utilized for gear surfaces that are submitted to great power and speed to minimize machining marks left over from tooth grinding, generate the necessary morphology of the tooth flanks, and achieve the desired roughness. When honing is used, it has a very positive impact on gear effectiveness and gearbox lifeline. Honing is insufficient for very heavy load gears since it still produces excessively high roughness levels. As a result, more accurate machining is needed, which offers roughly half the surface roughness of honing. Superfinishing is single of the approaches in the marketplace. With isotropic topography, this method produces an exterior that is appropriate for greatly overloaded gears. Though, it can occasionally be challenging to put into practice, too multifaceted for certain types of machinery, and challenging to attain the exceptionally great superiority of product inside supplies. But in the additional influence, this approach offers an excellent surface condition that guarantees strong gearbox performance.

3.4 Data Analysis:

3.4.1 *Gear Ratio*: Gear ratio is defined as the ratio of the number of teeth in driver gear to the number of teeth in driven gear. A colon is used to represent the gear ratio = Number of teeth in driver gear: Number of teeth in driven gear. For example, for one complete rotation of 60 teeth gear, 20 tooth gear must rotate 3 times. The formula for the calculation of the gear ratio is given below:

$$I = \frac{Ze}{Zs} \quad (1)$$

Where,
I represent the gear ratio
Ze represents the number of teeth in the driver's gear
Zs represents the number of teeth in the driven gear

3.4.2 *Speed Ratio:* The spacing between adjacent teeth and the width t of each gear tooth are both distributed evenly beside the pitch circle. The space among identical places on together cog in the pitch circle, or the gear's pitch p is equal to twice the width of a tooth:

$$P = 2t \quad (2)$$

Gear pitch G_A may be calculated with the quantity of tooth N_A and the diameter D_A of its pitch circle:

$$P = \frac{2 \times 3.14 \times D_a}{2N_A} \quad (3)$$

Webbing efficiently double gears G_A and G_B necessity have the similar size cog and so they essential need the equal pitch *p*:

$$P = \frac{2 \times 3.14 \times D_a}{2N_A} = \frac{2\pi r_b}{N_B} \quad (4)$$

This calculation demonstrates that the share of the periphery, the distances, and the radius of binary engaging gear are equivalent to the share of their amount of tooth:

$$\frac{r_B}{r_A} = \frac{N_A}{N_B} \quad (5)$$

The velocity ratio of binary gear progressing lacking sliding on own pitch of circles is calculated as:

$$R = \frac{w_A}{w_B} = \frac{r_B}{r_A} \quad (6)$$

i.e.

$$R = \frac{w_A}{w_B} = \frac{N_A}{N_B} \quad (7)$$

3.4.3 *Torque Ratio:* The rotation force ratio of a gear train, which would be the share of its outer rotation force to its input rotation force, may be calculated using the theory of virtual work to demonstrate that it is equivalent to the gear train, speed ratio, and gear ratio. This indicates that the ratio exists between the intake rotational force T_A delivered to the intake gear G_A and the outer torque T_B on the outer gear G_B:

$$R = \frac{T_B}{T_A} \quad (8)$$

Where,

R represents gear to share.

Torque share is also calculated by:

$$MA = \frac{T_B}{T_A} \quad (9)$$

4. RESULT AND DISCUSSION

The gear's ability to resist the sides of the gear teeth from pitting and scuffing depends on its tribological qualities. Additionally, there are exceptionally large bending loads placed on the teeth. Gear teeth of highly loaded gears need to be topographically correct. In addition to the roughness parameter, other factors to consider include the isotropy properties of the exterior, the form of exterior indiscretions, the standards of the higher points and lower point of roughness described by other unevenness factors, and the profile of the involute relative to unevenness and main outline. The characteristics discussed here have an impact on the transmission assembly, mechanical tightness, impact lubrication, and friction and wear of the contact objects. Table 2 shows the Computer-Generated 3D Model of the usual Planetary Gearbox.

Table 2: Demonstrates the Computer-Generated 3D Model of the usual Planetary Gearbox.

Factor	Ground Surface	Enhanced SF	Non-Enhanced SF
Mean Roughness (Ra)	0.270	0.090	0.090
Root mean roughness (Rq)	0.410	0.120	0.110
Max. Height (Rz)	2.600	0.590	0.600
Total length (Rt)	6.070	1.080	0.780
Maximum profile length (Rp)	1.660	0.270	0.340
Highest depth (Rv)	1.070	0.370	0.280
Arithmetic mean waviness (Wa)	0.350	0.360	0.740
Root mean squared waviness (Wq)	0.410	0.420	0.860
Total height of waviness (Wt)	1.950	0.950	4.400
Maximum waviness peak (Wp)	0.480	0.430	0.910
Maximum waviness valley (Wv)	0.540	0.440	1.020
Primary profile of arithmetic (Pa)	0.410	0.420	0.750
Primary profile of root mean (Rq)	0.540	0.490	0.810
Primary profile total length (Pt)	6.630	2.550	4.520
Primary profile maximum depth (Pv)	1.310	0.760	1.150

To find the least amount of involute curliness and unevenness on the gear cog flanks, the enhanced Stream Finishing (SF) procedure on behalf of the workpieces needs the elementary assortment of the right utilized in order, the shaft slant modification, the extent of the middle of the vessel, the workpiece space from the vessel boundary, by way of the assortment of the procedure technique (wet dying and dry dying). Table 2 shows ground surface-related gear tooth characteristics beforehand and afterward an enhanced SF procedure willpower. Mahr's standard roughness inspection equipment with a 5 m stylus tip radius served as the measuring system's instrument. In 25% and 75% face-width sections, it assessed regions close to sliding velocities.

Waviness and principal profile characteristics were outside of the incoming range due to non-optimized process settings (numbers in red). This occurred when the teeth flanks were subjected to a strong media flow that was too tiny. The amount of material removed from the surface was not uniform or efficient; rather, it simply monitored the sharp crests of curliness created during the crushing procedure. This exterior quality is insufficient to prevent gear harm. The suitable range of values was established by the optimized process (values in green). Gears suffer from the poor visibility of unidirectional grinding scratches. Numerous variables would be impacted by the involute's waviness.

Unique of them is the inequitable weight dissemination sideways the involute since a stable, computational level, which results in limited absorptions of interaction strains and affects the threats of exhaustion, such as opposing, micro pitting, and coarse garb or limited garb, which ultimately results in the gear's destruction. Another illustration is the increase in bending stress caused by the cog twisting powers functional to a particular top of the involute irregularity at the tooth fillet radius area. Unwanted gearbox vibrations brought on by transmission mistakes are another issue. These vibrations run the risk of rupturing the oil film, which would result in transmission failure through scuffing and localized abrasive wear. Figure 3 represents the gear cog flank circumstance already the SF optimization. Everywhere is around the prominence of the lasting lines after the grinding procedure, as well as the waviness design.

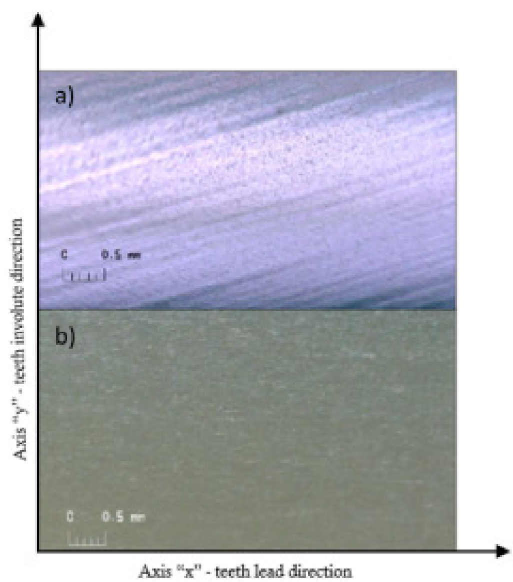

Figure 3: The Above Figure Demonstrates the (a) Gear Tooth Flanks Conception Before Abrasive Process Parameters and (b) Gear Tooth Flanks Conception After Abrasive Process Parameters.

5. CONCLUSION

In a market for gear manufacture that is correctly optimized, the SF technique designated in this study might be used as a supplementary way of gear cog dying on heavily overloaded gears in addition to shaving, honing, and super finishing. Consequences of the gear tooth side condition from grinding operation to after the Stream Finishing (SF) procedure are quite precise. Additionally, non-directional process media flow, involute waviness reduction, and the isotropic tooth flank condition were all accomplished. The key to implementing the process described in this study to the manufacturing process is its simplicity and ease of process parameter control. The waste-reducing, environmentally friendly application is another crucial element that further improve in the future by some modification in waste reduction.

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CHAPTER 10

ANALYZING THE APPLICATIONS OF INJECTION MOLDING IN THE MANUFACTURING OF VARIOUS COMPONENTS USING DIFFERENT MATERIALS

Dr. Madhusudhan M, Assistant Professor,
Department of Mechanical Engineering, School of Engineering, , Presidency University, Bangalore, India,
Email Id-madhusudhan@presidencyuniversity.in

ABSTRACT:

There are many processes of manufacturing including casting and molding. There are different types of molding and castings available in the industry for the production of different components. There are many methods to increase production in manufacturing using molding which is injection molding. Hence the author focuses to explore injection molding which is carried out in industries where bulk manufacturing is required. In this paper,the author discusses the various methods developed to improve the efficiency in the injection molding process which are developed and studied by different experts. It concludes that many new methods are more useful and effective in increasing the production of industries in bulk production than the methods used before in the market. In the future, it will help in analyzing and comparing different production methods to increase the productivity of industries.

KEYWORDS:

Casting, Injection Molding, Mold, Manufacturing, Production, Polymer.

1. INTRODUCTION

By pumping molten material through a mold, a manufacturing process known as injection molding creates objects. Injection molding may be done using a wide range of materials, comprising confectioneries, glassware, metallurgy, elastomers, and most commonly thermoplastic and thermoplastic elastomers. Ingredients for the component are combined in a heated barrel, injected together into a mold cavity, and allowed to cool & crystallize to suit the cavity's shape. Ever since a plan has been manufactured, often by industry designers or architects, a professional mold maker makes a metal mold from metal, frequently either steel or aluminum and precisely processes them to form the features of the needed part. Injection molding is widely used to make a variety of parts, ranging in size from the smallest components to whole vehicle body panels in Figure 1. Using photopolymers that don't melt when some lower-temperature thermoplastics are injected into molds, advances in 3D printing technology may be leveraged to create some straightforward injection mold [1][2].

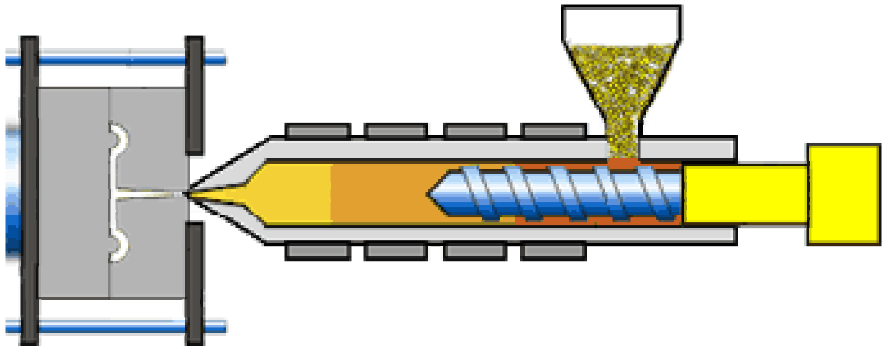

Figure 1: Illustrates that Injection molding is widely used to make a variety of parts, ranging in size from the smallest components to whole vehicle body panels.

The three parts of the particular machine utilized in injection molding are indeed the injection unit, manufacturing mold, and the clamp in Figure 2. Whenever designing components that are to be injection-molded, it is necessary to take into account the component's material, desired form, features, the material of a mold, as well as the properties of the molding machine. Because of the range of design possibilities and issues, injection molding is much more versatile. Most polymers, sometimes referred to as resins, can be used, which include all thermoplastic materials, certain thermosets, as well as some elastomers. In 1995, there were approximately 18,000 suitable materials. Since then, 750 new materials have become available during the injection molding process every year. To discover the material with the best possible mix of properties, product designers can pick from a broad variety of materials. Alloys and mixtures of previously created materials are available [3][4][5].

Figure 2: Illustrates the three-phase injection molding machine.

The strength and functionality needed for the finished component, as well as the cost, are the main factors to consider when choosing a material. However, each material has various molding requirements that must also be taken into account. Other aspects to consider when choosing an injection molding material are heat distortion, water absorption, as well as the degree to which a material may be twisted without incurring damage. The thermoplastics include materials like nylon, polypropylene, and polyurethane, meanwhile, the thermosetting plastics include epoxy and phenol. Plastic springs were not feasible until very recently, but improvements in polymer characteristics have made them presently quite feasible. Applications for buckles include securing and releasing webbing for outdoor equipment [6][7].

An injection molding machine consists of a material container, an injection drive or screw-type plunger, as well as a heating element. They support the molds in which the component are formed and are also referred to as platens. The clamping power that a press is capable of producing is expressed by its tonnage rating. In the course of the injection process, this force maintains the mold closed. Tonnage ranges from less than 5-9,000 tonnes, with the highest numbers being employed in just a small number of manufacturing processes. The anticipated area of the component being molded determines the overall clamp force required. For every square centimeter of the planned regions, a clamping force ranging from 1.8 to 7.2 tonnes is compounded. For the majority of products, 4 or 5 tons/in2 may be used. Greater injection pressure is required to fill the mold if somehow the plastic is very stiff, and more clamp tonnage is required to hold the mold closed [8].

The required force can also be influenced by the component's size and the kind of material employed. For bigger parts, more clamping pressures are required. The tools used to mold plastic components were usually referred to as "molds" or "dies." Due to the expensive expense of producing them, molds were frequently only used in mass production, wherein tens of thousands of components were produced. Aluminum, pre-hardened steel, beryllium-copper alloy, hardened steel, and these materials are used to make standard molds. Cost is the primary factor to be taken into account when selecting a mold's materials for construction; while steel molds are normally more expensive to build initially, their longer lifespan allows for the production of more components before they need to be replaced.

Pre-hardened steel molds are often used for larger components or lesser volume requirements because they are less wear-resistant and possess a steel toughness of 38 to 45 here on the Rockwell-C scale. Heat-treating hardened steel molds after machining results in a substantial improvement in wear resistance and durability. Aluminum molds can be made and produced utilizing modern computerized technology at a cost-effective rate for molding tens of thousands and perhaps even hundreds of thousands of pieces. Beryllium copper is used in areas of a mold where rapid heat removal is required or even where shear temperature increase is highest. The molds may be created using both CNC machining but also electrical discharge machining methods.

In the injection molding process, molten plastic or rubber is pushed into a mold cavity using a ram or screw-type plunger, where everything cools and takes on the shape of the mold. It is primarily typically used to process both thermoplastic and thermoplastic elastomers, with the quantity used for the former typically notably larger. Thermoplastics are frequently utilized due to their advantages for injection molding, such as their ease of recycling, versatility for a variety of applications, and their ability to soften but also flow while heated. Thermoplastics also offer a higher level of safety than thermosets; when the thermosetting polymer is not quickly removed from the insertion barrels, copolymerization might occur, potentially harming the injection molding process by enabling the screws including check valves completely freeze.

Under intense pressure, raw ingredients are injected into a mold during the process of injection molding, which shapes the polymer into the required shape. Several single-cavity and multi-cavity molds are available. In a multiple cavities mold, the individual cavity may either generate many different geometries when they are distinct or it can manufacture identical components when they are identical. Molds are frequently made of tool steel, but there are some uses for stainless steel and aluminum molds. Aluminum molds are generally not appropriate for high-volume production or parts with narrow dimensionally accurate due to their inferior mechanical characteristics and increased susceptibility to accessorize serious harm, and deformation even during injection and clamping cycle; nevertheless, in low-volume applications, within which mold fabrication expenses and time are significantly lower, aluminum materials seem to be cost-effective. Some steel molds can be expensive to construct and are designed to generate well over a million parts over their lifetime.

2. LITERATURE REVIEW

Prof. Quirico Semeraro et al. In terms of process optimization based on simple-to-measure variables, while simultaneously taking defect generation into account during the method, the current technique has significant industrial importance. To take into consideration the process' unpredictability and create a restricted optimality zone, the suggested solution makes use of the bootstrap technique and the data depth approach. Utilizing a utility function, the best level of the process parameters was chosen. Increased variability of the key process parameter, Tmelt, and Phold, as a result of this unique technique, results in increased variability of the micro-injection molding process without running the risk of manufacturing waste components.

Cátia Araújo et al. Established be possible to use in-cavity pressure industrialization for failure diagnostics & injection molding process improvement. The pressure profile identification technique is a useful tool for improving efficiency, ensuring flawless production, and controlling the quality of processes and components. It could be used to track and identify processing errors, such as burn marks with short shots, throughout an injection molding process. The correlation between the findings and the theoretical profile curve allows for the extraction of process and molding tool-related information. Additionally, there was a correlation between the measured outcomes that were produced and the processing circumstances that were researched.

Nan-Yang Zhao et al. Over the past few decades, much work has been put into optimizing process variables to reduce product warpage and shrinkage deformations. In this examination, we first go through the shrinkage deformations caused by the manufacturing method in PIM on the warfare page. The method by which process factors, which include injection pressure, mold temperatures, time and temperature, injection rate, holding pressure, as well as cooling duration, have an impact on those faults is next covered. Then, they cover four cutting-edge strategies for maximizing processing parameters to lower warpage and shrinking deformation, as well as the most recent advancements in experimental setup.

Puria Esfandiari et al. The manufacturing of two tape-like thermoplastic pre-impregnated materials is examined in this study, one of which is created using brand-new prototype machinery we built in our labs. The creation of tape is addressed, and the prepregs displayed here underwent two different processing techniques: pultrusions and hot compression molding. Composite materials were produced using this rather simple process. The mechanical testing of both the pultrusion bars and composite laminates was then used to determine the degrees of concentration of the completed material. A microscope was used to assess the composite's void content, dispersion of fibers and polymer, and other factors.

Chanun Suwanpreecha and Anchalee Manonukul the metals MEX method is similar to the conventional metal injection molding (MIM) approach in that it uses layer-by-layer 3D printing (metal MEX) or injection (MIM) to create green elements, depending to get rid of the binders, and sintering to create the consolidated metallic components. Because metal MEX has developed so quickly recently, it is crucial to review recent research on the subject to better understand the crucial process variables and the metal MEX parts' associated physical and mechanical properties that are important for future research and practical applications. The material that is currently accessible is methodically summarized in this study and concluded feedstock, printing, debinding, and sintering.

Marko Bek et al. In this study, we discuss a thermoplastic polymer combination that contains large quantities of inorganic fillers, up to 60% by volume. Four different spherical materials steel, aluminum alloys, titanium alloy, and glass were considered in the current investigation. Furthermore, it was shown that processing-induced differences in paper form and size cause composite materials to behave unexpectedly rheologically, as seen by composites overloaded with glass beads that shattered at high content [9].

3. DISCUSSION

About 85,000 commercialized plastic material alternatives and 45 polymer families comprise the numerous polymers that may be utilized for injection molding. These polymers can be broadly split into the thermosets and thermoplastics groups. The two most commonly used types of plastic are low-density polyethylene (LDPE) and high-density polyethylene (HDPE) (LDPE). A few advantages that polyethylene offers include high degrees of ductility, outstanding tensile strength, strong impact contact resistance, resistant to moisture absorption peaks, and recyclability.

3.1. Different Plastic Material on Injection Molding:

There are hundreds of plastic materials for injection molding. Different plastic resins impart different end-use properties, such as tensile strength and impact resistance. Injection-molded plastics also have specific processing requirements, such as melt temperature and molding pressure. There are also different grades of the same plastic material, including resin types with fillers such as glass or fiberglass.

3.1.1. Acrylonitrile Butadiene Styrene (ABS):

In many industries, this robust, impact-resistant plastic is employed. ABS has strong structural stability, low shrinkage ratios, and good resistance to bases and acids.

3.1.2. Polycarbonate (PC):

Low shrinkage and exceptional dimensional stability are characteristics of this robust, impact-resistant plastic. PC, an optically clear plastic that seems to be transparent and available in several grades, may provide a high-end polish and robust heat resistance.

3.1.3. Aliphatic Polyamides (PPA):

PPA (or nylons) come in a variety of forms, each of which provides unique benefits. In general, nylons offer excellent strength, high-temperature resistance, and chemical resistance except for strong acids and bases. Some nylons have stiffness, impact strength, and good hardness while being abrasion resistant.

3.1.4. Polyoxymethylene (POM):

This plastic, also known as acetal, is highly hard, stiff, strong, and robust. It is also lubricious and resistant to organic and hydrocarbon solvents. For some applications, good elasticity and slippiness are also benefits.

3.1.5. Polymethyl Methacrylate (PMMA):

PMMA, sometimes known as acrylic, has good optical properties, a high gloss, and is resistant to scratching. For geometries with thin and thought sections, it also provides minimal shrinkage and a little sink.

3.1.6. Polypropylene (PP):

In some grades, this low-cost resin material has good impact resistance, although it can become brittle in colder climates. While PP is likewise wear-resistant, flexible, and able to deliver extremely high elongation in addition to being resistant to acids and bases, copolymers provide superior impact resistance.

3.1.7. Polybutylene Terephthalate (PBT):

The usage of PBT has significant advantages for both automobile electrical operations and power component functions. According to the glass fill, the hardness of glassware can range from moderate to high, with unfilled types being robust and versatile. In addition, PBT exhibits a variety of fuels, oils, and fats, as well as solvents, and it also does not absorb smells.

3.1.8. Polyphenylsulfone (PPSU):

Excellent toughness, temperatures, and heat resistance, in addition to resistance to ultraviolet sterilization, alkaline solutions, including mild acids, are all characteristics of PPSU. It is dimensionally stable as well.

3.1.9. Polyether Ether Ketone (PEEK):

Strong chemical fire resistance, dimensional stability, remarkable strength and heat tolerance, and flame retardancy are all features of this high-temperature, high-performance resin.

3.1.10. Polyetherimide (PEI):

PEI (or Ultem) has great strength, dimensional stability, and chemical resistance, as well as strong temperature resistance and flame retardancy.

The main advantage of injection molding is the capacity to scale up manufacturing to produce numerous components. Once upfront expenses of the design, as well as the molds, have been played for, the cost of production is fairly low. Production prices go down when more components are made. Compared to more traditional manufacturing methods like CNC machining, which eliminates superfluous material, injection molding produces less waste. In despite of this, injection molding still generates some waste, typically in the form of runners, sprue, gate locations, and any excess material that leaks out of component cavities. The last advantage of injection molding is its ability to make several identical parts, which permits part uniformity and reliability in high-volume manufacturing.

While there are certain benefits to injection molding, there are also some drawbacks to the technique. When it comes to tooling, injection molding might have expensive upfront expenses. A prototype part must be made before any pieces may be produced. Once this is completed, a prototype mold tool has to be created and tested. The entire process can be costly, time-consuming, and expensive. The production of big pieces in a single piece via injection molding is likewise not recommended. This is a result of the mold tools' and injection mold machines' size restrictions. Items that are too big to be produced by an injection molding machine must be produced in many sections and assembled afterward.

3.2. Components of an Injection Mold:

The base, including the hopper, the barrels, as well as the clamping unit are the four basic parts of an injection molding machine. The split mold, clamping unit, injection unit, but also hydraulic unit were examples of smaller parts. There are other smaller parts like the nozzle and ejection pins. The machine's electronics and other components are stored in the base. A variety of heaters, hydraulic systems, sensors, as well as injection pressure must be controlled by the device's circuitry.

3.2.1. Hopper:

Even before the injection molding process could start, the plastic material is placed into the hopper. To keep moisture away out from plastic material, each hopper often has a drier unit. Additionally, it could be equipped with tiny magnets to keep any dangerous metallic papers out of the device. The plastic material will be next transferred from the hopper into the barrel, the largest component that follows.

3.2.2. Barrel:

To allow the plastic to stream through the barrel, the barrel or even the material tubing and barrel must be heated until the plastic melts. The clamping unit's inside screw injects plastic through molds or cavities. To keep the right temperatures for various types of plastic materials, the temperature within the barrel must be properly controlled. That before plastic enters the injection mold, its cylinder's job is to move, compact, dissolve, agitate, and press it.

3.2.3. Screw Motion or Reciprocating Screw:

Midway through the 1950s, reciprocating screws were developed, and by 1960, they had begun to rapidly replace the earlier designs. The reciprocating screw design has the benefit of assisting in controlling the temperature of the molten plastic. Plastic is fed through the barrel by the screw. Initially, the screw is turned as the pellets were fed from either the hopper into the barrel, moving the material ahead as additional pellets are introduced. The flights also offer a constant mixing motion that uniformly disperses heat throughout the pile. Additionally, this mixing aids in clearing the injection molding machine's mechanism of various materials as well as any colors left over from prior manufacturing runs.

3.2.4. Heaters:

Different kinds of heaters can be used in an injection molding machine to maintain the temperature within conduits and nozzles as well as to heat molds and steel plates. The molding materials throughout the hopper can be melted and turned into a liquid substance by attaching a heating source to the barrel. Band radiators, coil/nozzle heating systems, cartridge & strip heating systems, and insulated fabric heating jackets are a few of the several kinds of injection molding heaters.

3.2.5. Nozzle:

The machine's ejector software's bottom section houses the nozzle, an injection molding component. It forces the liquid plastic through into the mold from the barrel. The sprue bushings and locating ring, a feature on the mold, with which the nozzle sits helps position the nozzle upon that mold. Today, nozzles may perform several tasks, including filtering, mixing, and stopping the flow of melt. Nozzle filters can reduce the amount of foreign material or contaminants in the melt stream that clogs gates and hot runner tips. Mixing nozzles can improve additive dispersion and mixing, which enhances the quality of composite structures while lowering the additive volume and cost. In injection molding processes where the press often disengages from either the mold, for instance in several two-shot molding situations, shut-off nozzles help decrease drool.

3.2.6. Extraction Pins or Ejector Pins:

Ejector pins are essential while making components. They are a crucial part of the ejection mechanism in molds, which controls how goods turn out when injection molding is done. Both the A and B sides make up the two portions of the metal injection mold. Both sections are separated to extract the solid plastic when the molten material throughout the mold has cooled. When an injection mold is removed, the A-side half is removed, leaving the produced portion and the B-side behind. On the B-side of an injection mold, there are extraction pins that are used to extract the produced part from the mold (or extract it). This pin mark is frequently left as a dent on completed goods. Ejector pins come in a variety of designs. Ejector pins that are throughhard are heat-treated to maintain uniformity in the hardness throughout the pin's diameter. A case-hardened ejector pin is appropriate for die-casting ejection systems since it is substantially tougher than through-hardened pins. Black surface treatment applied to an ejector pin makes it self-lubricating and capable of withstanding temperatures ranging from 1000°C.

3.2.7. Split Molds:

A parting line during injection molding is the place where two mold halves converge when the mold is closed, particularly on a split mold. The line between the two molds along which the plastic product produced by the injection mold is separated into two sections is known as the "parting line." Split molds were a kind of injection mold in which the plastic material is formed by the jaws. Whenever the mold opens with both a pull tab, the jaws are first injected diagonally somewhat on the nozzle side and then transferred diagonally onto the outside. The injection-molded component is then let go. The ejector side can also be used to guide the jaws. They are therefore moved, either while the mold is being opened or afterward, mostly using hydraulic cylinders or manually, utilizing springs or air.

3.2.8. Clamping Unit:

The clamping unit's functions include opening and closing an injection mold and ejecting the items that have been injection molded. The hydraulic and toggle designs are the two primary types of clamping mechanisms. Whereas the toggle clamp system uses several links, the hydraulic clamp system uses one or even more hydraulic presses. The clamping mechanism holds the injection mold using two sizable clamping plates. Two steel components are fastened to every one of the substantial plates upon that clamping unit to form a mold. The clamping device closes the two separate plates whenever the machine is prepared to inject plastic into the mold or cavity. Building the component, allows the plastic to flow into the hollow. The plastic part is then solidified by cooling. The clamping device opens the injection mold after the plastic has cooled sufficiently, and the item drops out of the mold halves and is collected in a container.

3.2.9. Injection Unit:

The injection unit, which would be made up of various pieces, is a crucial part of injection molding equipment. The raw material is to be melted and directed into the mold by the injection equipment. The hopper, barrel, and screw make up the injection unit. The coloring pigment or even other reinforcing ingredients are combined with the dried as well as placed in the hopper polymer grains. The granules were heated, combined, and driven toward the mold by that of the screw action as they are fed into the barrel. To assist increase the pressure to the proper levels and melt molten material, the screw and barrel are identical in shape.

3.2.10. Hydraulic Unit:

For machinery used in plastic injection molding, a hydraulic system or component is essential. The system may run nonstop during manufacturing cycles. There are a lot of motion-activated sub-circuits needed for nozzle approaches, injection of a plunge screw, extrusion screw rotations, and mold closure. When flowing into the mold even during screw rotation and plunging phase, granular plastic material needs to travel through the warmed plastic-looking state smoothly, requiring a very steady motion. Any inconsistencies in the hydraulic movements might affect the injection molded product's quality. To prevent the mold from opening and to maintain the position of the nozzles along the filament of the injection mold, force control sub-circuits are also necessary. These processes are essential for injection molding. The electromechanical pressure is adjusted and monitored by the hydraulic pressure.

4. CONCLUSION

There are several manufacturing processes, including molding and casting. For the manufacturing of various components, the industry offers a variety of molding and casting kinds. There are several ways to boost production in manufacturing that uses injection molding. Examining injection molding, which is used in sectors where mass production is necessary, is the study's main objective. Different specialists have devised and researched several strategies to increase the effectiveness of the injection molding process. According to the study, several new techniques are superior to those previously employed in the market in terms of helping enterprises produce more in large quantities. The study will also aid in the analysis and comparison of various manufacturing methods to boost industry productivity. As equipment grows more effective and materials like thermosetting polymers can survive high temperatures and conditions, injection molding is becoming more ecologically friendly. Injection molding produces some material waste, however, it is less than many other production techniques. Of course, the specific materials chosen also have an impact on the environment because of their durability, ability to be recycled, and disposal methods. The carbon footprint of items across their whole life cycles, including during manufacturing, is also taken into account.

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CHAPTER 11

ANALYSIS OF VIBRATIONS OCCURRED IN VARIOUS MACHINES USING THEORY OF MACHINES

Dr.Yuvaraja Naik, Assistant Professor,
Department of Mechanical Engineering, School of Engineering, , Presidency University, Bangalore, India,
Email Id-yuvarajanaik@presidencyuniversity.in

ABSTRACT:

As manufacturing depends on machinery, machines are a component of the industry. The machine does not fully use the power input because of friction losses, which manifest as vibrations or component heating. Therefore, employing numerous theories of machines, the study's main goal is to identify the variables that lead to each of these vibrations in the machine. On the theory of motors with friction, which encompasses heating and vibrations of machines and devices, many studies and investigations are conducted. In this paper, the author elaborates that there are several techniques used to lessen machine vibrations to increase productivity and efficiency. The results show that computer analysis is needed in the industry and increases output by limiting or lowering vibrations. Assessing the key characteristics would aid in enhancing productivity, according to the research. In this paper, after many literature review studies the author concludes that vibration plays a major role in the machine architecture and its modeling for the enhancement of the machinery one can use many ways to overcome the vibrations in the machine. The future potential of this paper is the theory of machines can be understood fully in an effective way.

KEYWORDS:

Motors, Machines, Manufacturing, Misalignment, Vibration.

1. INTRODUCTION

Vibration is the oscillation of the displacement, speed, and acceleration of the operational parts of an agrochemical system. The transplanter's continuous high frequency and high amplitude oscillations may harm the beam, which might reduce how long it lasts. Lowering the mechanical structure's vibration level has become more and more crucial in the design and optimization of mechanical items. A movement wheel, turning equipment, and power device are examples of large-scale machinery that might improve the system's overall performance, according to the current mechatronics trend. These gadgets might also be sources of vibration, which would certainly lower their operational quality. Farmers are becoming pickier about the quality and comfort of agricultural machinery as a result of the advancements in contemporary agricultural equipment technology [1].

Vibration, noise, and harshness are the most obvious auditory markers of the manufacturing quality of agricultural equipment. Noise, vibration, and comfort are becoming more and more important to people. About one-third of all vehicle breakdowns were due to the NVH issue with agricultural machines. More than 20% of the total R&D costs for the equipment are spent on NVH resolution for agricultural gear. As a result, research on vibration isolation management is very important and has broad implications. Vibration control is important to recognize that machining is a volatile process. Complex vibration processes, such as the lathe-workpiece-lathe-tool process, happen while turning is being done. Turning causes a complicated, undesired process called vibration [2]–[6].

As a result, attempts have been undertaken to reduce vibration as much as feasible. It is an arrangement of malleable and material entities that may be put together in various ways and, while vibrating, interact with one another. They oscillate to varying degrees with a wide variety of unique vibrations at pertinent unique frequencies. Sometimes the vibration that happens while turning is so little that it has no negative impact. Additionally, there are instances when turning causes a lot of vibration. The lathe machine generates an odd sound with these vibrations, or the tool makes a regular ringing sound. When cutting materials, high vibrations may have negative impacts on the completed surface quality, tool wear, and machine wear. Examining the source of vibrations on the lathe's significant impact is the primary goal of the experimental experiments. Figure 1 discloses the equilibrium line and the mass position in the period.

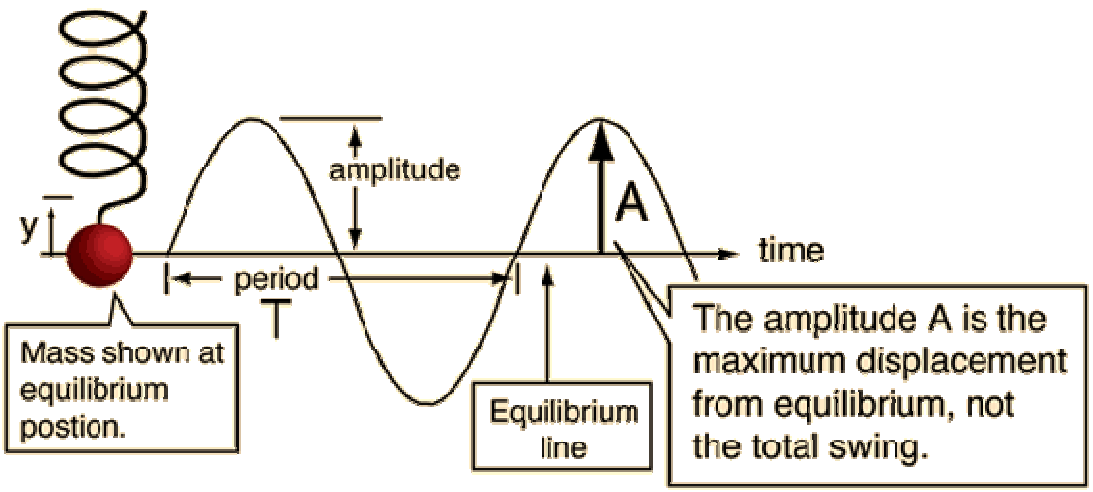

Figure 1: Discloses the equilibrium line and the mass position in the period [7], [8]**.**

Two different types of sensors “contact and contactless and a stainless workpiece with a 20 mm diameter” were employed to conduct these experiments. The outcomes of the two approaches' measured values were then contrasted and assessed. The technical “parameters spindle speed and the material removal without removal and removal of 0.5 mm” were altered while the trials were being conducted. Bushings constitute one of the most prevalent machine components and are crucial for almost all rotating machinery, not only for flipping technical equipment. One of the reasons for the machine's decreased dependability and service life is its failure. For forty years, several scholars have focused on the investigations and assessments of bearing wear [9], [10].

Due to the shifting distribution of their load, bearings are regarded as a cause of vibrations and fall under the category of distributed and local faults. The manufacturing process, assembly, improper lubrication, or poor operating conditions might all be to blame for this behavior. They may also wear out or exhaust the machine or the tools, in addition to producing vibrations. A reliable way of identifying a failure might be found using clearly defined vibrations that occur when a bearing starts up. Figure 2 discloses the "High frequency and low frequency with the effective" period.

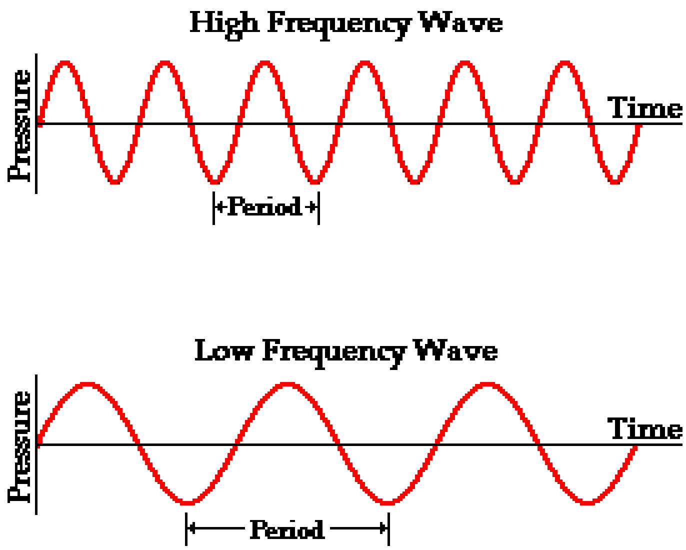

Figure 2: Discloses the High frequency and low frequency with the effective period [11]**.**

Recent years have seen a rise in the need for innovative green transportation methods, and tribology has had a significant impact on their development. Traditional propulsion systems' oil-lubricated bearings harm the environment. In the maritime industry, water-lubricated stern bearings have largely taken their place. The rubber stern bearing made its debut in the combat of the Midway Archipelagos and has subsequently proved superior in a variety of situations because of its exceptional fracture toughness, great vibration suppression efficacy, and high shock resistance. Figure 3 embellishes the parallel misalignment and angular misalignment.

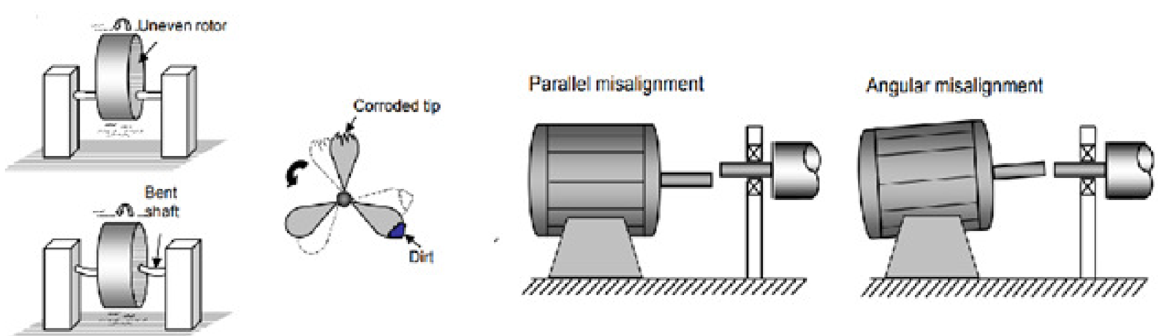

Figure 3: Embellish the parallel misalignment and angular misalignment [12]**.**

Rubber stern bearings that are water-lubricated nevertheless have several issues. For example, the specified "pressure is only 1/3 of what an oil-lubricated bearing would experience under the same circumstances because the water film that forms seen between moving pairs is only 1/8 the thickness of the oil film. Water is less suited to dynamical lubricants, made by mixing lubrication, or border lubrication circumstances" because it has a lesser load-bearing capacity than oil. When solvent stern bearings are started or stopped under severe strain, dry friction conditions will develop. Under these circumstances, frictional movement and noise are also readily produced, which seriously impairs the vessel's capacity to survive and may expose sophisticated electronic detecting equipment to risk. “Stick-slip phenomena and other harmful outcomes for mechanical systems including wear, deformation, and fatigue failure” may result from self-excited oscillations.

In this paper the author elaborates the frictional vibration's mechanism is quite intricate it includes interdisciplinary expertise in tribology, materials science, vibration, and movement stability. Analytical approaches, different procedures, and finite difference methods may be used to generally categorize the existing research on this topic. To evaluate system dynamics concerns like the stick-slip mechanism, the resistance correlations speed negative slope mechanism, or challenges related to modal interaction theory, analytical approaches often assume basic, single-degree-of-freedom system models. However, owing “to the deformation of the rubber material and the intrinsic properties of friction force, the solutions do not accurately explain the behavior of fictitious resonance in water-lubricated rubber stern” bearings. Hence, the motion equations for these systems may be successfully solved.

2. LITERATURE REVIEW

Gao et al. in their study embellish that an effective method for evaluating the dependability and effectiveness of motion control applications is vibration-based monitoring. In this paper, a new “multimodal micro-electromechanical system (MEMS)-based low-power wide-area network (LPWAN) incorporating LoRa with NB-IoT is introduced to satisfy the requirements of long-range, low cost”, low power, and slightly elevated “synchronous acquisition in the Internet of Things (IoT)-based vibration condition monitoring. This method builds the LPWAN for machine vibration measurement in plants using a bidirectional LoRa and NB-IoT gateway and several wireless MEMS-based LoRa nodes”. Additionally, the Google Cloud server and computer system can support remote IoT-based communication [13].

KIEW et al. in their study illustrate that when the tool applies forces to the workpiece during the machining processes, “tool wear becomes a significant problem. To decrease tool wear and extend tool life”, technologists just choose the best values for machining settings and circumstances. Tool wear is greatly influenced by many variables, including machine vibration. Due to the intricate structures between both tool wear and machine vibration signals, fractal theory is being used in this study to determine their relationship. In this study, we examine the relationship among both tool wear and computer vibratory signal in several tests where the feed rate, depth of cut, and spindle speed vary. The acquired findings demonstrated a relationship between “wear and machine noise signal” in several trials where changes in depth of incision as well as feed rate occur, where both fractal patterns get more complicated as these machining parameters increase [14].

Huang et al. in their study embellish that an essential strategy to guarantee the dependability of industrial machinery is vibration-based condition monitoring. On the one hand, conventional wired monitoring systems have certain drawbacks in some scenarios. WSNs, on the other hand, offer a great deal of potential to get around these limitations. High sample rate and synchronous collection are two issues that have yet to be resolved, nevertheless. A machine measurement and control algorithm that relies on WSNs was already created and described in the current work. In the beginning, a wireless sensor node with a dual-processor architecture is created to strike a compromise between cost, power use, and performance. After that, a unique approach based on equipment cross-layer design is used to increase the precision of asynchronous acquisition. Finally, the proposed node is subjected to testing, and the usefulness of the suggested machine motion-tracking system is confirmed [15].

In this paper, the author elaborates that in order “to meet the demands of long-range, low cost, low power, and slightly elevated synchronous acquisition in the Internet of Things (IoT)-based vibration condition monitoring, a new "multimodal micro-electromechanical system (MEMS)-based low-power wide-area network (LPWAN) incorporating LoRa with NB-IoT is introduced in this paper. Using a bidirectional LoRa and NB-IoT gateway, many wireless MEMS-based LoRa nodes, and an LPWAN for machine vibration monitoring in plants. The Google Cloud” system and server can also handle remote IoT-based communication.

3. DISCUSSION

The FSF control is shown to have the maximum theoretical achievement when non-linear stabilizers are used. In comparison to the hypothetical passive scenario, the RMS values of the dynamic and accelerated tire forces are reduced by 38percent in terms and 20%, respectively. Only when the gain enhancement factor is included in the control loop can this optimum state be achieved. It is necessary to ignore the following two shortcomings of standard vibration isolation technology: First, only when the number of turns of heavy machinery is modest, which is required to ensure the passive energy dissipation effect, the passive energy dissipation device's efficacy is poor and the durability is unstable. Second, the genuine passive energy dissipation effect of the vibrational reliever is diminished in the high-frequency region over several hundred hertz by the standing wave impact [16]. To significantly improve the vibration isolation effect of mechanical equipment while avoiding the disadvantages of the single-layer vibration isolation system and extending the vibration isolation frequency range, the philosophy of the double- "layer passive energy dissipation systems is proposed and practically applied. A double-layer vibration isolation system is often used in the suspension movement frame structure of automobiles and engines. Due to outside influences, the double-layer vibration isolation device will vibrate. In car engines, a double-layer vibration isolation" device is often utilized.

By adopting a double-layer vibration isolation system, which can also change the "stiffness of the original system and the recurrence of the overall resonance" frequency, the peak power spectral density may be enhanced. This function may be utilized to improve the mechanical equipment's vibration characteristics and avoid resonance occurrences.A "double-layer vibration isolation system" provides better low-frequency vibration control than it does high-frequency control. Figure 4 discloses the wave displacement and the Cosine wave in the time.

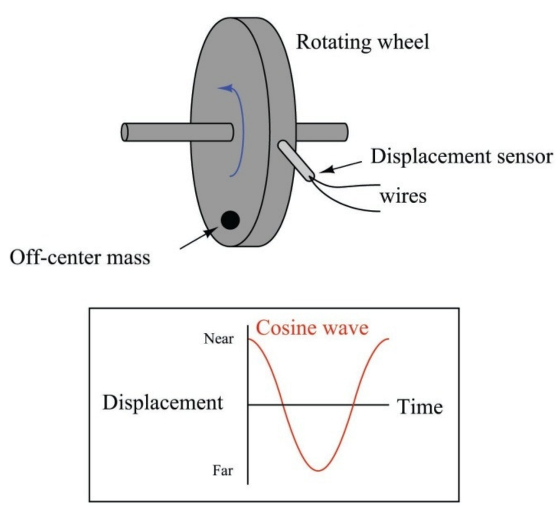

Figure 4: Discloses the wave displacement and the Cosine wave in time [17]**.**

It is obvious from the relationship between the velocity bandwidth utilization of the separator and powertrain speed that the double-layer suspension system featuring ideal stiffness has a considerable impact on vibration isolation. The optimum vibration transmission rate is decreased by 42.3%. It complies with realistic technical criteria and shows the effectiveness of the two-layer isolation technology in reducing vibration caused by the transplanter's engine.The mechanical equipment that has to be separated from vibrations and elastically attached to the medium is connected by a device of double-layer noise control. The quality of the moderate resonance depends on the substrate. The double-layer passive energy dissipation system has the benefit of having a strong passive energy dissipation effect in the high-frequency zone since the majority of the vibration generated by agro-chemical operation is high-frequency vibration [18].

Waves are often used to represent signals the received signal density of a wavelength is multiplied by the appropriate coefficient to provide the power transmitted by each unit frequency, and this quantity is referred to as the power spectral density (PSD). Watts per Hertz (W/Hz), the standard unit of power spectrum density, is used to represent this quantity. Random vibration analysis often uses power spectrum density. Only the probability distribution function, or the probabilities matching to a horizontal reaction, can adequately characterize the persistent response of the system. It shows the market share of the stochastic process's statistical parameters' mean values throughout the frequency range. In other words, the vibrational energy's probability distribution for each frequency domain [19]. Thus, the frequency band may be used to determine the average densities of the resonance present in vibrational disturbances with various natural frequencies, preventing or enhancing vibration excitation and so reducing vibration damage. Figure 5 embellishes the “static unbalance and Coupled unbalance”.

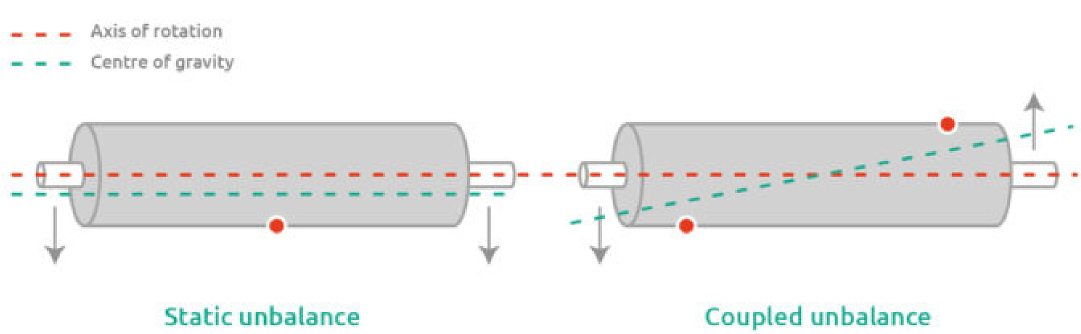

Figure 5: Embellish the static unbalance and Coupled unbalance [20]**.**

By inserting an intermediate-mass between heavy machinery that decouples pulses and the elastic foundation, the single-layer acoustic emission shear wall provides a framework for the rigid quintuple acoustic emission energy dissipation, which replaces the pliable single-layer vibration isolation system. Figure 6 embellish the graph of the different machine in the system.

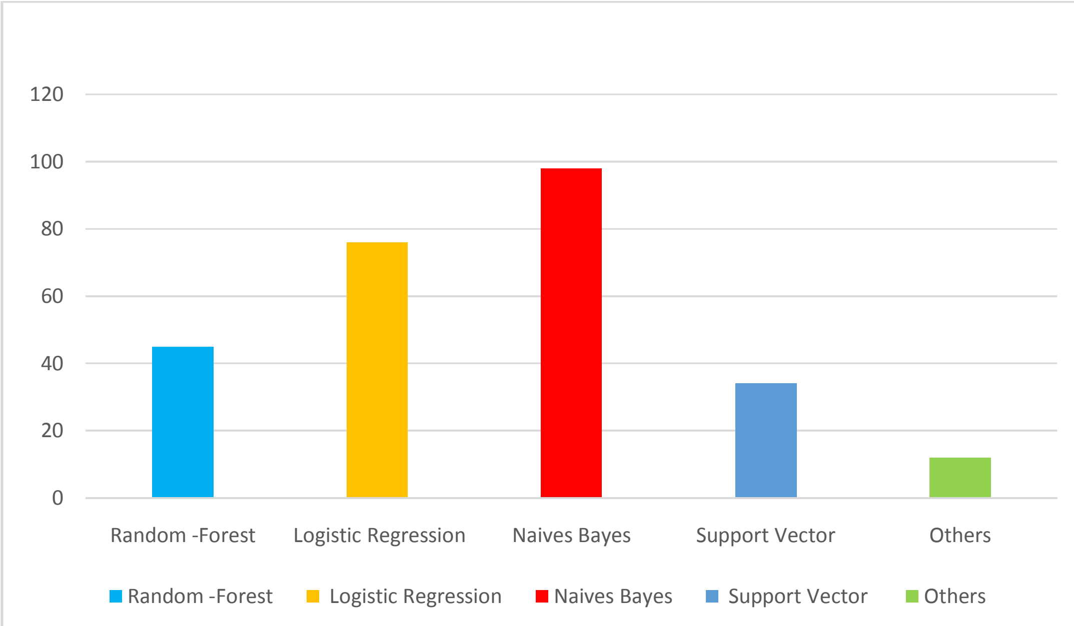

Figure 6: Embellish the graph of the different machines in the system.

By widening the vibration isolate range and overcoming the disadvantage of the single-layer passive energy dissipation system's poor stability, the system may provide a stronger effect of vibration isolation. The method's application to agricultural input vibration reduction research might improve machine performance, extend its usable life, and provide theoretical support for the development of modern agricultural equipment technology.

4. CONCLUSION

The purpose of the work was to add to the findings of earlier studies in the area of measuring the amplitude of mechanical vibration during the turning of materials. The findings show that further study is required. Further research into this matter may focus on a more in-depth determination of local frequencies. One method for cutting materials at the moment is turning technology. Despite its benefits, this technology is not without its drawbacks. There has been much study on the creation of technologies to remove some of the problems. The concerns relating to the technical input elements and the resultant vibration parameters are clarified in part by this study.

Vibration signal analysis demonstrates how the lathe cutting force "and the number of chips taken from the material affect the characteristics of the monitored signal. The impact was felt on the vibrational characteristics like RMS and Peak to Peak. Significant amplitude increases in the low-frequency spectrum were" seen in the frequency analysis example. The vibrations were measured using a laser interferometer, and the results were contrasted with those obtained from a "piezoelectric accelerometer. It's been demonstrated that the contactless measuring technique is not simply more accurate but also allows us to precisely capture the vibrations produced on the" item being examined. This conclusion is crucial because it enables us to track vibrations and find flaws that are invisible to the human eye. Additionally, it aids in the early diagnosis of defects and the reduction of machine damage. Lathe-bearing housing wear may be identified utilizing the data acquired during the vibration analysis procedure. The frequency band amplitude changed as the spindle speed was changed; this may be used to detect machine flaws.

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CHAPTER 12

CONSTRUCTION OF A HYBRID ARC WELDING MACHINE USING INVERTERS

Dr.Aravinda T, Assistant Professor,
Department of Mechanical Engineering, School of Engineering, , Presidency University, Bangalore, India,
Email Id-aravinda@presidencyuniversity.in

ABSTRACT:

Arc welding is a sort of joining technique that melts and joins metals by employing an electric arc to create heat. Direct current or alternating current from a power foundation generates an electronic arc between a disposable or non-disposable rod and the base material. Grid frequency transformers are used in conventional welding equipment to lower the arc voltage, and a chopper circuit is then utilized to control the welding current. But compared to high-frequency transformers, grid frequency transformers are larger and heavier. Therefore, the portability of traditional welding machines is a drawback. An inverter circuit was also created to address the weight and size issues with traditional arc welding equipment. Generators used in welder circuits could operate at a frequency significantly higher than 50Hz to 60Hz. In this study, a complete inverter portion for an arc welding machine together with the required high-frequency step-up transformer has been provided. The goal of designing the inverter for an arc welding machine is to lay the groundwork for designing welding equipment based on other existing techniques, such as Tig, CO2, etc. The sole design considerations are the operating frequency, output voltage, and current.

KEYWORDS:

Alternating Current,Circuit, Direct current, Inverter, Transformer.

1. INTRODUCTION

A fabrication technique called welding uses melting to combine materials, typically metals or thermoplastic elastomers. In general, welding is preferable for joining the most common steels that can be welded [1]. The main industrial method for connecting metals is welding. But it can also release harmful vapors that could be harmful to the welder's health. Currently, 2% to 3% of employees from diverse professions are exposed to welding fumes and gas action. Because poisonous fumes and gasses can be substantially more intense and possibly exceed the appropriate limits for dangerous substances in confined areas, welding can be fatal [2]. Metals with joints can also be sliced or separated using this method, the welding process as shown in Figure 1. In the early or prehistoric days, welding was mostly accomplished by heating two solid strips to reddish until they were nearly molten, and then hammering the strips or plates together [2]. Power plants on construction sites, pipes in pipes, and housing appliances can all be joined together by welding. The arc welding machine is a specific kind that uses electricity as its input [3]. Electricity is delivered through the main winding and is then inducted into the secondary winding, where it may be utilized to perform welding tasks by attaching welding cables to the output terminal [4].

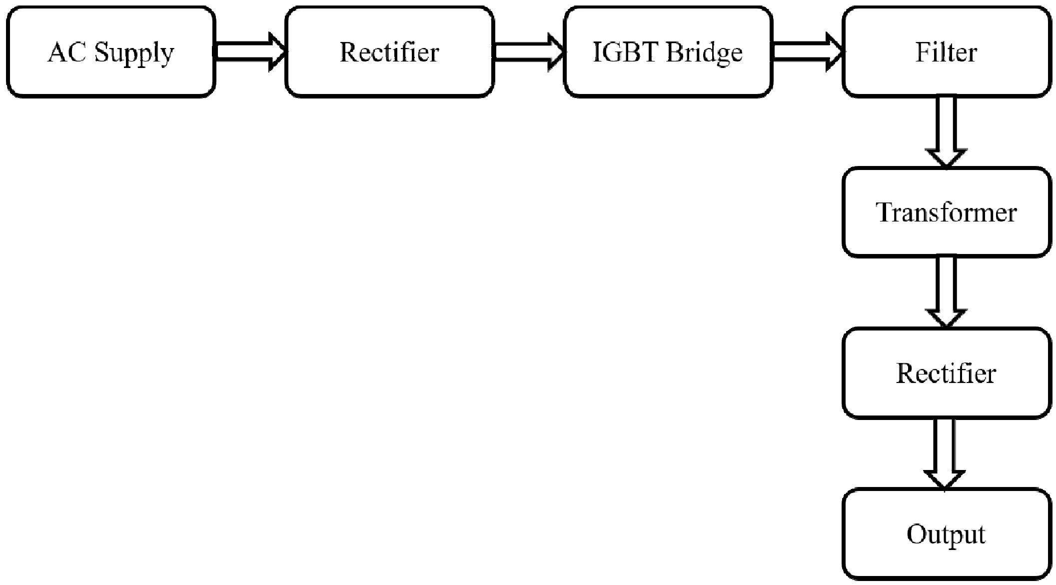

Figure 1: Demonstrate the Flow Diagram of the Arc Welding Process.

A transformer is used by all welding power sources to convert relatively high voltage, high current welding output, and low current input power to lower voltage. In the past, the transformer was powered directly by incoming [5] Alternating Current (AC) within the range of around 50 to 60 Hz. The transformer must be rather big and heavy since at these frequencies it generates a lot of heat. Additionally, the maximum number of control signals that can be sent per second at 60 Hz by a transformer is around 120 [6]. Direct current (DC) and then alternating current inverters were originally used in welding power supply, as shown in Figure 2. In some of these power sources, input 50 to 60 Hz alternating current power is rectified to direct current power and then supplied into the inverter portion. Whereas solid-state controllers turn it on and off at rates as much as around 20000 Hz, essentially transforming it back to high-frequency alternating current [7].

The primary power transformer subsequently converts such pulsed into high-frequency alternating current into low-voltage and high-current, 20,000 Hz alternating current appropriate for welding. To obtain direct current welding current, it is then sent through a filtering and rectifying circuit [8]. Solid-state controllers adjust the switching rate of the switching transistors to control output. The power transformer is significantly more effective than one that operates at 60 Hz because it operates around 20 kilohertz. This allows for a considerably smaller and lighter transformer, which in turn allows for a lighter power supply [9]. Direct current Gas Tungsten Arc Welding (GTAW) power sources using inverters typically weigh between 35 and 60 pounds. On 240 V single-phase electricity some of these power sources draw 30 amps at 205 amps. Although inverter power supply cost savings are frequently exaggerated, annual power supply savings typically amount to 10% of the power supply purchase price [10]. The incoming alternating current is additionally chopped up very finely by inverter power supplies, producing a consistent direct current alone without typical 60 Hz fluctuation and a steady welding arc [11].

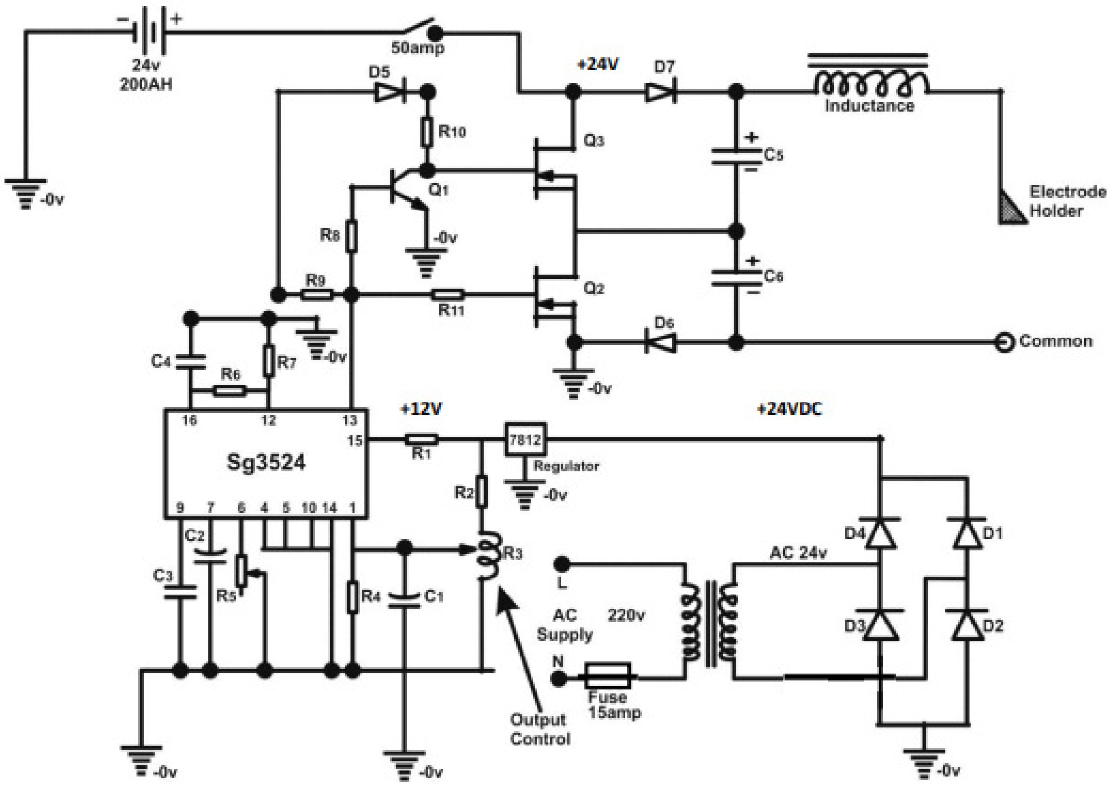

Figure 2: Demonstrate the Circuit Diagram of the Arc Welding Process.

1.1 Categorization of Welding:

According to American Welding Society (AWS) has recognized more than fifty dissimilar kinds of welding procedures. Few of them are same widespread amongst the productions such as the Plastic Process and Fusion Process. The plastic process is further classified as Forge Welding and Resistance Welding, whereas the Fusion process is further classified as Thermostat, Arc, and Gas Welding. And further classification of the welding process is shown below in Figure 3:

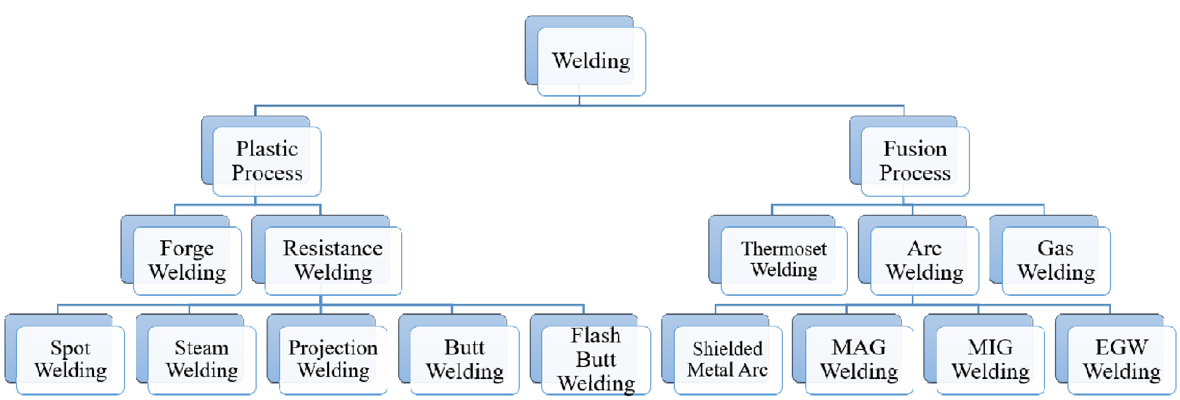

Figure 3: Illustrate the classification of the welding process.

2. LITERATURE REVIEW

Man Alhaji Sulaiman et al conducts a study onthe design and construction of a hybrid arc welding machine. In this study, they mainly focused on hybrid components. The hybrid electric arc equipment is designed to function with an input current of 40- 50 amps from the mains power supply and a 100AH 24VDC battery. The primary side, which supplies voltage to the machine, has 220 turns of 2.38mm wire with an equivalent wires gauge of 13 copper coils. The secondary side is linked to a 24-turn 3.09mm rectifier with a comparable type of cable measurement of 8 copper coils. Both turns are wound on a laminated core limb. Induction transfers voltage from primary to secondary turns. When the resistor knob is turned clockwise, the magnetic flux leakage and inductive impedance are reduced, causing the soldering current to increase. A power converter circuit was also designed for the direct current battery power supply. The inverter is linked to a resonant frequency to provide a regularity of 50Hz for the welding machine. Pliers, soldering iron, Filling machine, Screwdriver Copper wire, Lead sucker Tester bending machine, and multi-meter are among the materials and tools used [10].

Engr. Ovbiagele U et al conducts a study on inverter-type welding machines. Welding is used for many purposes across many domains. Welding in business and industry includes equipment and machinery fabrication, pipeline and multifarious welding, functional welding, offshore welding, and ornamental welding. Welding hardware has become one of the most powerful tools that a manufacturer can have, necessitating the need to design and build an arcwelding machine. The authors used locally available materials to design and build a 3KVA, 50 Hz, single-phase arc weld bead machine in this paper. A power converter circuit was also designed to address the weight and size issues of conventional arc welding machines. The inverter provides a much greater frequency than a welding transformer's 50Hz or 60Hz.

Dr. A. M. Haque et al conducts a study onthe design and construction of three phases inverter-based arc welding machine. To best serve users including construction workers and industrial users, this project focuses on building a power supply for an inverter-based welding machine with the desired output current and utilizing an efficient method. The goal of this project is to create an affordable machine that will produce a superior version of a market product while using DSP to manage output voltage and current. This performs better than standard welding equipment. With the aid of several timers and interrupts, the fixed power flow and power output are obtained. DSP allows for simple temperature and other parameter control. The welding machine is more conventionally inexpensive and efficient thanks to the inverter than standard welding equipment. More than 88 percent of the system is efficient [12].

3. METHODOLOGY

3.1 Design:

The approach of this design is appreciated through the planning and building of a direct current inputs control module and alternating current input control unit to provide a step-down output. After the controller system, the yield system is connected through a conductor material intended toward the weld metal is welded. This component relates to the steps and processes used to accomplish the work goal and objectives. Alternating current and direct current power supplies are used at this stage. The inverter, which includes a power amplifier and converter circuit, receives the appropriate voltage from the batteries. In this design, the circuit is powered by a 24V battery while employing a mains-powered direct current supply. Regarding the alternating current power source, the transformer receives 240V before stepping it down to 24V. It also provides the oscillators and rectification circuits with power so they can produce a useful output through an impedance. A range of dissimilar power stores may be utilized to provide the electrical energy required for arc welding procedures. Constant voltage power supply is the most typical category in this design. Figure 4 shows the Design of a Hybrid Arc Welding Machine Using Inverters.

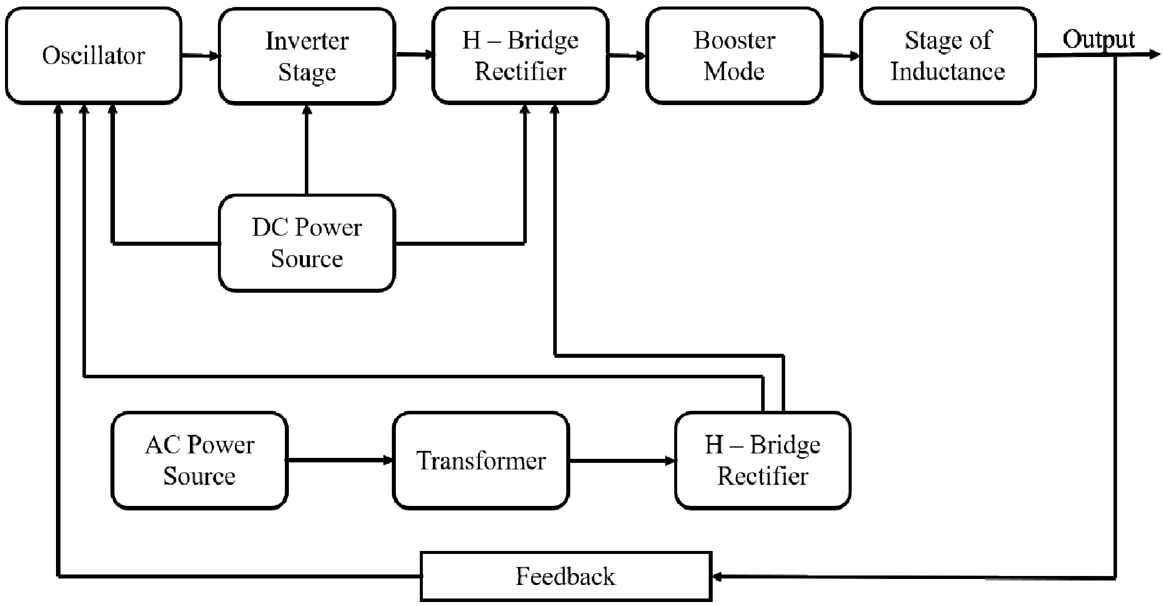

Figure 4: Demonstrate the Design of a Hybrid Arc Welding Machine Using Inverters.

3.2 Instrument:

The proposed model of a hybrid arc welding machine using inverters has been developed and simulated by utilizing the Creo. After that, the efficiency of the arc machine is calculated by welding different materials. Steel alloy and Iron Alloy. Other parts of the arc welding machines like the tip of the tool, base may be manufactured by different machining processes. The efficiency of some other parts like the Inverter, H-Bridge Rectifier, Transformer, and Booster Mode was also measured by using different terminologies.

3.2.1 The instrument used During Are Welding:

- *Welding Machine:* Either an alternating current or a direct current welding machine can be used. The step-down transformer on the alternating current welding equipment lowers the input voltage from within a range of 220-440V to 80-100V. The alternating current motorizedgenerator setup, diesel, and gasoline engine-generator setup and transformer-rectifier joining set make up the direct current welding machine. Alternating current machines typically require a power supply with a frequency of 50 or 60 Hz. The alternating current welding transformer has an efficiency range of 85% to 90%. For alternating current welding, a kilogram of dropped metallic requires 3.0 to 4.0 kWh of energy, but a kilogram requires 6.0 to 10.0 kWh for direct current soldering. The control feature of an alternating current welding mechanism is typically between 0.30 and 0.40, but a D.C. soldering machine motor has a controlling factor between 0.60 and 0.70.
- *Lead or Cables:* Cables and leads have the purpose of transferring current after the machine to the effort. These remain constructed of elastic aluminum and copper. The

wires are constructed from 1000–2100 extremely tiny wires that are twisted together to increase flexibility. The wires are further insulated by a strong rubber coating on top of a reinforced fiber covering and a rubber covering.

- *Electrode Holder:* The job of the electrode holder is to grasp the conductor in the chosen position. These come in a variety of sizes depending on the ampere rating, which ranges from 50 A to 500 A.
- *Transformer:*The low current and high voltage electric current from the effectiveness mains is transformed into a low voltage and high current using a transformer-style welding power supply. To produce direct current output, alternating current is converted into direct current using a rectifier. The output current can be changed by sliding an electromagnetic push in and obtainable of the modifier core. The production voltage from several blows on the second curving of the transformer is managed by a series reactor to the secondary. Although it is less expensive, this power source is big. To prevent unnecessary shunt currents, low-frequency transformers need to have a high magnetizing conductance.
- *Inverter:*Inverters now also conceivable to construct a switched-mode power source accomplished trying to cope with the greater loads of arc soldering, thanks to the development of high-powered semiconductors like shielded gate field-influence transistors, also called Metallic Oxide Semiconductor device field-influence Transistors (MOSFETs). Inverter welding machines are created using these designs. Utility alternating current power is rectified first to create direct current power, which is then switched at high frequency into a decreased power transformer to provide the anticipated welding current or voltage. Typically, the switching frequency ranges from 20 KHz to 100 KHz. The step-down transformer bulk is significantly reduced by the high substituting regularity. As the operational frequency rises, the mass of the magnetic components (conductors and transformer) decreases quickly. Power regulation and overload protection are two other capabilities that the conversion circulatory can offer. Compared to conventional welding machines, this form of inverter-based welding equipment is added effective and offers well controller of changeable efficient limitations. In an inverter-based machine, the IGFETs are controlled by a microcontroller, allowing software to alter the electrical properties of the welding power.

3.3 Data Collection:

The heat necessary to melt the metal is produced during the arc welding process by an arc welder between the base material and a conductor. At what time two electrodes are attached and then removed by a minuscule gap of 0.2 to 0.4 cm, allowing the current to continue flowing over the air, an electronic arc is created. The electronic arc produces temperatures within a range of 4000°C to 6000°C. The filler metallic is abounding by a metal conductor. The electrodes may be bare or flux coated. If the electrode is bare, additional flux material is given. Arc welding can be done with either direct current or alternating current. A decrease transformer provides the direct current output used for the arc. The modifier steps down the main supplies within a range of 220 to 440 volt current to the necessary voltage, which is within a range of around 80 to 100 volts. The generator used to produce the alternating current for an arc is often powered by a diesel engine, electric motor, or gas engine. In the case of direct current welding, an open circuit voltage ranges within 60-80 volts, whereas a closed-loop voltage ranges from 15-25 volts.

In general, welding machines have two types of regulations: continuous power and continuous current. The current in constant current manner machines affects the melting rate or rate significant of the conductor, regardless of whether it is a wrapped conductor or a wire conductor. The speedier the electrode melts or the quicker the melting rate, the higher the current level. The power controls the duration of the soldering arc, as well as the eventual results thickness and capacity of the arc cone, in constant power mode machines. The arc distance grows longer as the voltage rises.

3.4 Data Analysis:

Analog circuits were used in older machines for this purpose, but digital methods are more advantageous and faster. The filters now clean the output of the Insulated Gate Bipolar Transistor (IGBT) Bridge for improved efficiency and provide it to the transformer. Because of the high cycle per second, the step-down transformer brings the voltage of the alternating current output from the IGBT and the IGBT delivers the high frequency which can be in input waveform or sine wave but higher frequency ensures cut more flux in the minuscule quantity of copper and reduces the voltage nearly sixth of the main supply to get desired current in the second winding.

The modifier outputs a low voltage, high current supply while remaining in alternating current mode. The transformer has a high turn ratio and delivers a low voltage, but the power is always constant on both sides, so the voltage is low but the current rises, resulting in a high current output from the transformer. The power diode rectifier is powered by a high-current alternating current supply. These power diodes have a high breakdown voltage and are designed to withstand high-power applications without damage. These rectifiers provide a direct current supply but with a low voltage range of around 25-27 volts and a high current range of around 200 amperes or more depending on the output requirement.

The heat sinks are intended to speed up the component cooling process. When exposure conditions in any component, it results in a loss. Heat can also cause reduced efficiency. The components may be permanently damaged. Calculating the heat sink size is necessary to avoid using a random size because a larger size will start making the circuit bulkier unnecessarily. One special component in the circuit or the entire project is known as a low-voltage power supply. This lower voltage supply is powered by a direct line alternating current supply. We can obtain various types of direct current supplies for voltage levels for the power source of the microcontroller, the power source for the fan and display, and smaller other components that require an extra direct current supply using various types of ICs and transformers. This low-voltage procurement circuit obtains all of the required supplies.

4. RESULT AND DISCUSSION

We created a Creo Simulink model for the welding inverter, as well as separate modeling of the DC-to-DC Power converter section with parameters close to the practical desired values. This project simulated an inverter and a full bridge rectifier circuit. The filter circuit, as well as the Snubber circuit, were implemented in hardware, and the inverter section, as well as the SG3525 IC, were used in this work. Table 1 shows the parameters and their values used in this study. The method for developing a power supply for an inverter machine is a closed loop method that controls a full bridge inverter with the Space vector pulse width modulation (SVPWM) method for high efficiency with a low-cost product that is more reliable and flexible than a conventional welding machine, and the digital control of the machine provides easy control and flexibility in the machine's output range. Conventional welding pieces of machinery are inefficient and heavy, which is why we should use an inverter method when designing the machine.

Table 1: Demonstrate the Values Parameters Adopted for Arc Welding.

Parameters	Remarks
V_{IN}	13 V
I_O	2.5 A
C	10.930 uH
F	200khz
C_T	0.10 F
Load Resistance	16 Ohm
L	9.85
D	0.350
R_D	100 Ohm

As shown in Figure 5, the Arc welding process is most useful during the manufacturing process in industries. The overall percentage ratio in all welding processes of arc welding is about 40 percent. So the design and construction of inverter welding for arc welding are very useful in day-to-day life as well as manufacturing industries.

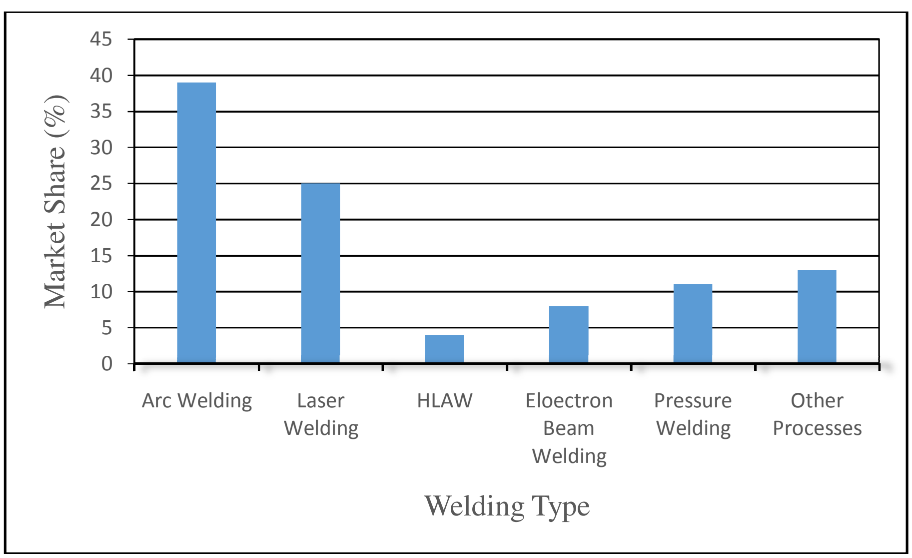

Figure 5: Demonstrate the Percentage of Various Welding Processes in the Manufacturing Process.

5. CONCLUSION

By creating this inverter circuit, we hope to include it in a user-portable welding machine and design a cost-effective product that will give the necessary task work to the user regardless of the location or accessibility of a power source. However, because the circuit is a direct current-operated one, regular maintenance of the stated battery is required. A 48v 100Ah battery is one of the suggested dc sources that may be utilized for the machine and is capable of supporting welds for a respectable duration of time. But that depends on their availability. In summary, the suggested inverter circuit for use with an arc welding machine will prove advantageous and beneficial to its user. To safeguard the circuit power components an isolator circuit such as an optocoupler can be introduced. The devices can be equipped with LCDs in the future for user convenience as well as for spotting and tracking systemic errors.

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CHAPTER 13

DESIGN AND CONSTRUCTION OF A DOUBLE HACKSAW MACHINE WITH AUTOMATIC COOLING POWER FOR MULTIPLE APPLICATIONS

Ms. Priyanka S Umerji, Assistant Professor,
Department of Mechanical Engineering, School of Engineering, , Presidency University, Bangalore, India,
Email Id-priyankasumarji@presidencyuniversity.in

ABSTARCT:

In this study, a developed double hacksaw with automated cooling power hacksaw machines and a manual refrigerating hacksaw machine in a nearby sawmill where the refrigerant is applied continuously by the operator are compared and contrasted. These machines can precisely cut rods of various materials at a very fast rate, but they can only cut rods of one substance at a time, which means they cannot cut dissimilar materials at the same time. To meet mass production requirements, metal bars must now be cut at a very high rate. As a result, there is a need to develop new technology that allows us to mass produce in less time and with less energy. It is impossible to rely on a traditional hack saw machine. Using this two-way hack saw machine, two metal bars, pipes or rods can be cut at the same time to achieve a high cutting rate and mass production for optimum results in manufacturing industries. It is suitable for use in assembly lines and industries due to its low cost, small size, and high efficiency. This study focuses on the creation and idea of a two-way hacksaw removing machine, which is primarily conveyed for creation-based ventures. Businesses are profoundly implied for the production of valuable goods and ventures at low production, machinery, and stock costs. Today in this world, every errand has been made quicker and more efficient because of technological advancement; however, this advancement also necessitates massive speculation and consumption; each industry wishes to achieve high-efficiency rates while maintaining the quality and benchmark of the item at a low normal cost. A prototype model that is efficient and capable of performing multiple cutting operations is created. These types of machinery can be used in remote areas where power is not normally available. It is designed to be a versatile tool that can be used for cutting in a variety of locations. It can be used to work on materials such as thin metals and wood.

KEYWORD:

Blade, Cooling Power, Coolant, Hacksaw, Tool.

1. INTRODUCTION

It is impossible to overstate the value of a manual hacksaw as a straightforward hand-operated tool for cutting both metals and non-metals, but operating one by hand may be very taxing and tiresome when cutting a lot of thick and wide materials. This may have inspired the notion to add power to saws, which were originally made to do various cutting tasks that called for the use of basic hand tools [1]. Any machine's initial design or any design modifications made afterward must take power transmission at the proper speed and torque into account before adding power driving mechanisms. But as the name suggests, a power hacksaw uses an electric motor that runs at a low speed [2]. As a result, it occasionally needs to be slowed down from its typical speed to one that can still operate the sawing machine components. Power hacksaws are frequently used in tasks requiring the cutting of materials with enormous dimensions such as glassware, metal, plastic, and wood, as shown in Figure 1 [3]. The sawing of solid rods or rods with a radius greater than 40 mm thickness is a very challenging process to accomplish with a standard hand-held hacksaw, which is where the motorized hacksaw machinery comes into play [4].

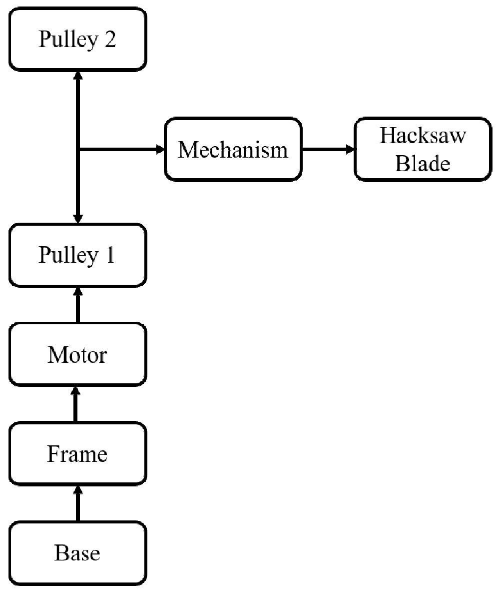

Figure 1: Demonstrate the Power Hacksaw with Manual Cooling Power.

The double hacksaw device with automated cooling power is a piece of machinery made to cut materials to the necessary lengths and shapes simplifying the cutting speed for the machine driver by effectively reducing time, energy, and material waste [5]. In other words, a power sawing machine is used to produce precise angular cuts as well as square or measured cutting on a workpiece and is faster, easier, and more precise in terms of precise cutting than a hand saw. The two most popular sawing machines are the 1. Power saw and 2. Bandsaw, operate on the same principles. A certain workpiece is driven through a blade with a set of teeth on it to create a small aperture [6]. As materials wider than the ideal blade width can reduce the cutting precision and rigidity of the blade resulting in blade deflection, the saw blade is chosen based on the thickness of the plate intended for having cut with special attention to the structure of the teeth spacing, clearance, and saw blade. Sideways arm movement, Sporadic dullness, non-vertical blades, Flexible arms and Material hard patches etc. are all causes of blade deflection. Dry cutting machines, also known as Ecological Machining, are used for some sawing machine activities because they are not intended for use with fluid coolants [7].

Because of this, the machine operators occasionally interrupt operation for a short period to cool the sawing blade. Depending on the length of the interruption, this usually results in downtime. Blue, brown, or burned chips during cutting operations, on the other hand, may indicate an inadequate cooling, coolant shortage, improper coolant input, or any of these. The heat produced during cutting may raise the blade temperature and decrease its mechanical strength, leading to plastic deformation in the cutting blade shear zone and potential failures including saw blade braking, curved cutting, teeth braking, blunt impacts, etc [8]. For instance, Danielson and Schajer examined the lateral movement and gradient of saw blade temperature on a circular gang edger operating in a sawmill. According to the results, saw blade over-tensioning, saw heating as a result of insufficient guide cooling, and guide movement during sawing are the three primary factors that cause rising blade temperatures and unwelcome vibration throughout the wood-cutting process [8].

The importance of applying coolant to the cutting blade is to prevent excessive heat, reduce thermal conductivity, reduce friction between the workpiece and the blade, reduce thermal expansion of the blade during the operating condition, energy, increase blade life, and most importantly protect breakage and excessive wear prevent chip-clogged teeth save time and last reduce material waste. For these devices, emulsions made of water and soluble oil-based coolant or water-soluble synthetic coolant are utilized [9]. For sawing operations where cooling is crucial, this kind of coolant has shown to be quite satisfying. To avoid corrosion brought on by the coolant water component, the majority of makers of water oil and water refrigerants add a rust blocker to the solution. Numerous investigations on the powered hacksaw machine have been conducted as part of research and development. For instance, Raj Ruturaj examined the design and construction of a four-powered adjustable stroke hacksaw and discovered that increasing the motor power and eccentric cam size can speed up the pace of sawing a given size of material [10]. The evaluation also mentioned the use of hydraulic pistons and cylinders to provide an automatic lifting mechanism for frameworks during cutting operations. Sreejith and colleagues created a pedal-driven hacksaw machine and tested its functionality [11].

2. LITERATURE REVIEW

Hemant Singh Raghuwanshi conducts a study onthe design and analysis of a multi-point cutting automatic hacksaw. A hacksaw is a good saw that is commonly used to cut metal. Hacksaws can also be used to cut various materials such as metal, plastic, and wood. There are two types of hacksaws, 1. Hand saw shapes and 2. Stoking variants. Almost all of the hacksaws are hand bandsaw blades with a C-formed edge that is held under strain with the construction screw. Such hacksaws have a handle, typically made of wood with pins for attaching a limited expendable hacksaw sharp edge. A saw's bleeding edge is either serrated or sharp like teethes. The housings have additionally been designed to accommodate sharp edges of various lengths [12].

Raj Ruturaj perform a study onan Automated hacksaw machine. In these studies, they use a spindle and slotted lever type method used in two pairs in an automatic hacksaw machine and it is arranged with a hacksaw. The entire mechanism is linked to a microcontroller, that will cut the specimen in several cycles based on the width of the workpiece material and will automatically stop after cutting. This hacksaw equipment has four hacksaws that cut four workpieces in a single pass and with an exact number of cycles. As a result, it will help to increase productivity because it will save time stopping and restarting it, and it will require less human effort. In addition, we are attempting to attach a fully automated small compressed air feeding system to this machine to reduce the cost of the workpiece [13].

Tanuj Joshi conducts a study onan Automated double-cutter side hacksaw. In the study, many electrically operated tools are used for metal cutting in different industries. To meet mass production requirements, metal bars must now be cut at a very high rate. As a result, there is a need to develop new technology that allows us to mass produce in less time and with less energy. It is impossible to rely on a traditional hack saw machine. Using this two-way hack saw machine, two metal bars, pipes, or rods can be cut at the same time to achieve a cutting speed rate and mass manufacturing for optimum results in manufacturing industries. This machine eliminates the disadvantages and limitations of the single-block hack saw machine.

It is suitable for use in production lines and industries due to its low cost, small size, and high efficiency [14].

3. METHODOLOGY

3.1 Design:

A hacksaw is a great saw with a side under stress in a casing that is used to cut materials such as metal. Hand-held hacksaws are made up of a metal edge with a grip and sticks for connecting a thin disposable cutting edge. A rivet or other system is used to apply pressure to the thin cutting edge. A power hacksaw is a hacksaw powered by an electric motor. Although most power hacksaws are static machines, there are some useful models available. Stationary models typically include a framework to lift the saw's sharp blade on the entry stroke, as well as a refrigerant pump to keep the saw's cutting-edge technology from overheating. Figure 2 represents the model of a proposed hacksaw.

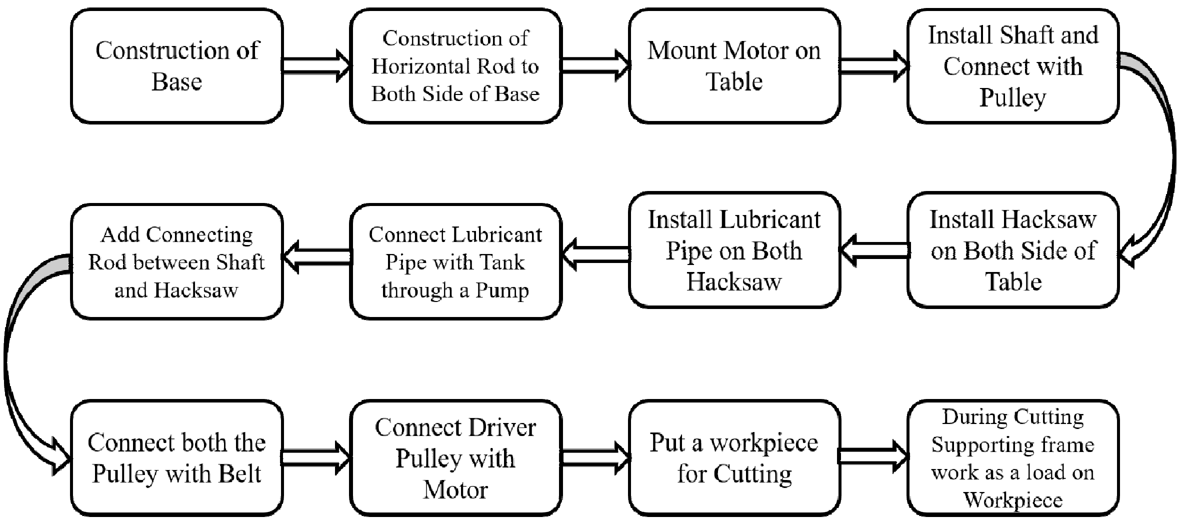

Figure 2: Demonstrate the Design of a Double Hacksaw Machine with Automatic Cooling Power.

The base of the hacksaw is used to hold all the other parts of the machine. In the concept plan, various parts have been composed for example, the base table and material utilized is gentle steel, the center arm material utilized is gentle steel, is utilized as an interconnect join for hacksaws and arms, and material utilized is gentle steel, the motor is appended under the base table, upper arm is found to be correlated with the back arm and material. Rough sketch is shown in Figure 3.

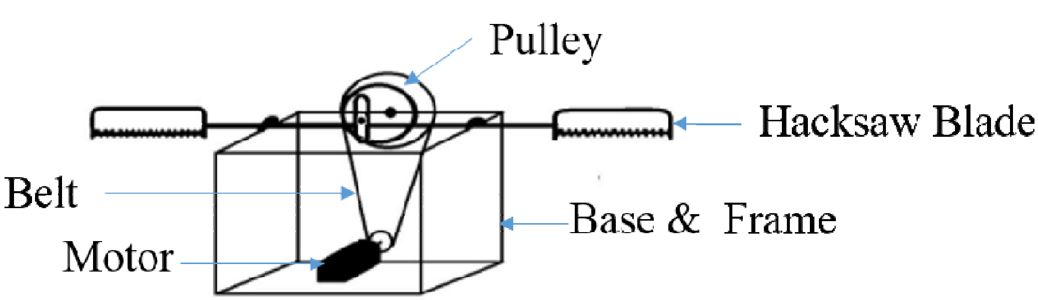

Figure 3: Demonstrate the Rough Sketch of the Double Hacksaw Machine with Automatic Cooling Power.

3.2 Instrument:

The proposed model of design and construction of a double hacksaw machine with automatic cooling power for multiple applications has been developed and simulated by utilizing the Creo. After that, the efficiency of the hacksaw machine is calculated by using different materials like Metal, Wood, and some other alloy. RPM of the motor is measured by using Tachometer. Other parts of the hacksaw machine like the tool and the base may be manufactured by different machining processes. Sharping of the blade is done with the help of the grinding process.

3.2.1 Component of Hacksaw:

i. Blade

ii. Motor

iii. Base and Frame

iv. Blade Pins

v. Connecting Rod

vi. Pulley

vii. Belt

3.3 Data Collection:

The electricity hacksaw has been transformed to include a cooling mechanism. The electricity hack saw has a motor at its base that is connected to a shaft that houses the gear train driving gear via a pulley drive. The gear is meshing with a driven gear three times its dimensions to increase torque while decreasing speed for better control. The saw handle is attached to the larger gear. The hold has been extended to form an extra-long arm. Two vertical rods fastened to the blade allow for this connection. A bearing between the two perpendicular guides is welded to the gear. The hardware is allowed to receive motion from the motor and rotate 360 degrees, resulting in the hack saw blade oscillating. This causes the machine blade on the other end to cut anything in its path. The extra weight adds force to the cutting operation and guarantees that the saw blade doesn't change its cutting direction. The cooling mechanism consists of a small fuel tank with very low suction pressure. The fuel tank is attached to the gear's static frame cover. The piston is attached to the reciprocating blade's framework. The cylinder is made up of two low-pressure valves one of which is linked to the refrigerant tank or reservoir. Table 1 shows the details of materials with their configurations.

Table 1: Illustrate the details of materials with their configurations.

Consideration	Detail	Material
Power requirement	Low speed, Single phase electric motor, and a 3 Pin plug.	Grey cast iron
Pulley and belt	The motor shaft rotates a belt mostly on the driving pulley, while another end of the belt	Polyester cable and Rubber cushion

	is fastened towards the driven pulley groove, which transfers the motor's rotating motion to the gear through a shaft.	
Shaft	The shaft is a rotating bar that connectsthe motor and other parts.	Carbon Steel
Frame	A rigid part that supports all other parts of the hacksaw.	Mild Steel Bar
Blade	A 12-inch flat piece of metal with teeth designed for cutting of workpiece.	High-speed tungsten steel
Coolant	A moderate heavy-duty coolant of synthetic property is used. It also consists of good oil-rejecting quality.	Water soluble coolant

3.4 Data Analysis:

Using wood and metal of various sizes evaluations of the performance were made for both the manual single hacksaw and automatically cooling double hacksaw machines. The time needed to chop each mass of lumber was calculated using a stopwatch. The computation of Relative Mechanical Energy using the energy equation. The double hacksaw with an automated coolant and the identical machine in the next sawmill in which the coolant is supplied manually both use the same equation to determine all parameters like shaft speed, length of the belt, the tension in the tight side of the belt, etc.

3.4.1 Pulley and Belt:

The belt in this application is a soft and flexible machine component that is typically connectedto a pulley with a motor and utilized in transporting systems and for power transmission across a sizable distance. The v-belt drive is used in this design to transmit power from an electric motor to a pulley and one pulley to another pulley, as shown in Figure 4. A V-belt is made out of an infinite, flexible belt that contacts and grips the pulleys to transfer power.

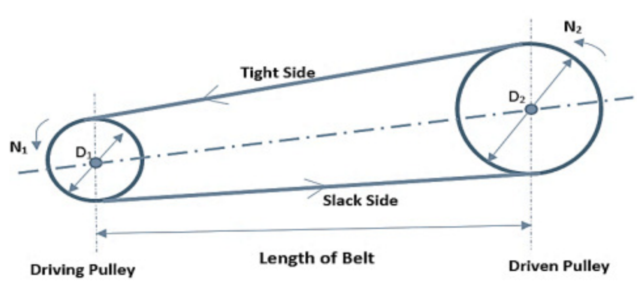

Figure 4: Demonstrate the Connection Between Two Pulleys through a Belt.

3.4.2 Shaft Speed:

Figure 4 illustrates the transmission system, which consists of V-belt power transmission through a pulley. Thus, the generic formula provided in Equation 1 can be used to determine the pulley speed.

$$\frac{D1}{D2} = \frac{N1}{N2} \qquad (1)$$

Where,

D1 = Diameter of the driver

D2 = diameter of the driven

N1 = speed of the driver

N2 = speed of the driven

$$N2 = \frac{D1}{D2} N1 \qquad (2)$$

3.4.3 Length of Belt:

The equation provides the formula for calculating the belt drive's length 3.

$$L = 2C + 1.57(D2 + D1)\,\frac{(D2-D1)^2}{4C} \qquad (3)$$

3.4.4 Contact Angle of Belt:

Equation 4 yields the contact angle for the belt.

$$\sin\beta = \frac{R-r}{C} \qquad (4)$$

Where,
R = radius of the large pulley
r = radius of the smaller pulley
C = Centre distance

$$\beta = \sin-^{1}\frac{R-r}{C} \qquad (5)$$

3.4.5 Calculation of Tension on the Tight Side of the Belt:

T1 = Cross-sectional area of belt × maximum stress in belt

Cross-sectional area = width x thickness = b x t

The factor of safety of 2.5

3.4.6 Calculation of Tension in Slack Side of Belt:

$$\frac{(T1-mv)^2}{(T2-mv)^2} = e\ (\mu\theta\ \sin\beta) \qquad (6)$$

Where T1 is the tension in the tight side of the belt

T2 is the tension in the slack side of the belt

m is the mass per unit length of the belt

V denotes the linear velocity of the belt

θ is the groove angle

μ is the coefficient of friction

4 RESULT AND DISCUSSION

The ability to accurately refrigeratethe saws machine in this investigation is more efficient and effective in saving time than the mechanical refrigerating hacksaw equipment in a regional sawmill. This means that if the cutting process takes less time, more energy will be saved for longer-term operations. Operations and maintenance time and SME of the mechanical cooling power hacksaw machine were significantly higher than those of the fully automated cooling power hacksaw machine showed that the proposed. As shown in Figure 5, the cutting speed of the automatic refrigerating hacksaw machine was slightly faster than that of the manual cooling power hacksaw machine.

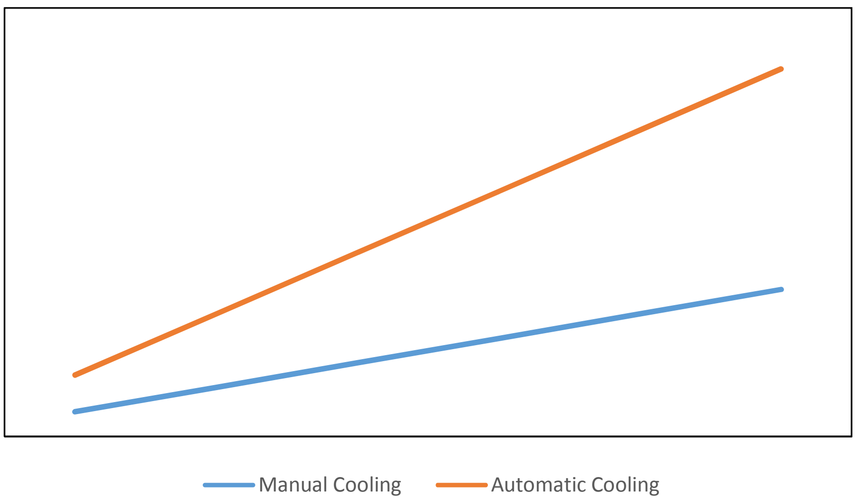

Figure 5: Demonstrate the Relation Between Cutting Speed of Manual Cooling and Automatic Cooling.

To increase the cutting velocity of the power saw, trade-offs in input power to the motorized and output power from the motor may be required. As a result, maintaining a constant voltage can only increase the current, and expanding the current can only increase the torque (and thus the total power supplied to the system), whereas increasing the voltage can cause an increase in the motor speed, which is then translated to the reciprocating speed of the power saws machine. Figure 6 represents the relation between RPM and Life cycle manual cooling hacksaw and automatic cooling hacksaw with the double blade. Conclusively, it was discovered that when the belt was positioned on the relatively small pulley roller of the motor the cutting speed dramatically increased whereas placing the belt on the bigger pulley wheel (driven) resulted in a decreased cutting speed.

It is impossible to overstate the importance of power hacksaw machines to production and industrial sectors given the necessity of cutting wood, metals, and other materials for practically every task. However, as compared to manual cooling hacksaw machines with double hacksaw automatic cooling machines offer more benefits (in terms of decreased cutting time and proper mechanical energy of the machine). In comparison to powered hacksaw machines in nearby sawmills without coolant, those equipped with coolant compartments with double hacksaws produced improved efficiency (in terms of cutting) in less time. In addition to cutting time reduction,the double hacksaw machines offered significant labor energy and downtime reduction savings. In comparison to the blade used in the nearby sawmill, the cutting efficiency of the blade used in the automated refrigerating hacksaw machines was higher and generated less heat. Blade lifetime and the number of cut pieces through one blade also increase due to coolant. Because coolant removes the excess heat from the blade and the blade can not be heated up through a specific limit of temperature. So, wear and tear of the blade is reduced. In the future four hacksaw machine with coolant is to be considered.

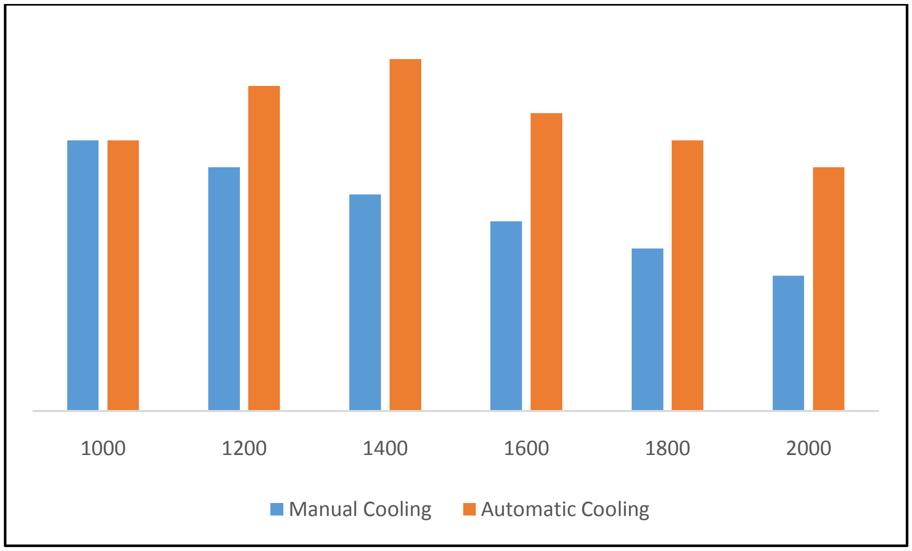

Figure 6: Demonstrate the Relation Between RPM and Life Time of Manual Cooling and Automatic Cooling Hacksaw.

5 CONCLUSION

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CHAPTER 14

PROSPECTIVE INSPECTION OF ELECTROMAGNETIC BRAKING SYSTEM

Dr. Surendra Kumar A M, Professor,
Department of Mechanical Engineering, School of Engineering, Presidency University, Bangalore, India,
Email Id-surendrakumar@presidencyuniversity.in

ABSTRACT:

Electromagnetic brakes are a new technique produced in automobile industries. It can be set up in both light and heavy motors. Vehicles like buses, jeeps, cars, etc. are set up and connected with electromagnetic brakes. The electromagnetic brakes system is run on the concepts of an electro-mechanical system. This system is developed due to the number of accidents is extremely gone to peaks due to a failure in the braking system, so it is required for the vehicle to have a good position, and easy to handle the braking system. The electromagnetic system is a very good outcome in the braking system because it creates good support to vehicles and gave super specialty in giving the vehicle to move freely and when the break is required it gives the best output in the situation. Electrometric brakes are used widely in the world. In the future, all vehicles will carry a major system in the braking system all new vehicles will carry electromagnetic brakes in their structure.

KEYWORDS:

Electro-Mechanical Brakes, Electromagnetic Braking System, Eddy Current, Hysteresis Brakes, Power Brakes.

1. INTRODUCTION

Electro-mechanical brakes, or EM brakes, are several other names for electromagnetic brakes. They use electromagnetic force to cause mechanical confrontation, or friction, which slows down or stops motion. The magnetic field produced by an electrical current running through a braking coil is robust enough to move an armature on or off a magnetic expression. On large vehicles, electromagnetic brakes have been implemented in addition to the traditional friction brakes as the special capacity for retardation. The mechanism and features of electromagnetic brakes are then explained. The conversion of kinetic energy into thermal energy is the basic braking concept for motorized vehicles (heat). When using the brakes, the driver commands a stopping force that is several times stronger than the force that moves the vehicle forward again and releases kinetic energy in the form of heat. No issue how rapid the speed is, brakes must be capable of rapidly limiting the speed of a vehicle [1].

Vehicle safety improvements are one area of the vehicle market that is growing increasingly important as time passes. The stability of trucks on the road is heavily reliant on continual advancements in braking technology. Automotive manufacturers are now investing in developing EMB to improve braking functionality while minimizing ecological impact (Electromechanical braking systems). These braking systems are unusual in that (Electromechanical braking systems) [2].

With the rapid rate of technology breakthroughs and implementations, the automobile industry is a continually evolving business. With the emergence of new and powerful machines, there is also a need to halt these machines. Emerges. Not to stop, but to maximize efficiency to minimize energy losses to a minimum. In general, friction braking or exhaust braking is employed in cars. The system includes mechanisms for converting the Kinetic energy of the body into Heat energy, resulting in the motion to pause The stopping force produced by a braking system is more than the energy produced by the system [3]. Because of the increased power of engines and the increased demand for safety, a system to reduce the risks of accidents. Because of the extra performance of engines and the increased necessity for safety, a method to limit hazards was developed. Vehicle safety enhancement is one area of the vehicle business that is becoming increasingly important as time passes. The stability of automobiles on that road is heavily reliant on continuing advancements in braking technology. Automotive manufacturers are now investing in developing EMB to increase braking functionality while minimizing environmental impact (Electromechanical braking systems).

Kinetic energy is converted into heat as part of the braking mechanism. A stopping force that is multiple times as strong as the force that propels the auto or vehicle into motion is generated when the brakes are applied, and this force releases the kinetic energy it contains as heat. No matter how quickly the car is moving, the brakes quickly reduce speed. An electromagnetic brake transmits torque hydraulically but utilizes an electric actuation. The coil is engaged when the brake receives power or current, generating a magnetic field. The coil will become an electromagnet that creates magnetic lines of flux when this field is maintained. The armature is attracted to the magnetic flow. Typically, the hub and armature are placed on the rotational shaft. The shaft eventually reaches a halt due to the coil's attraction to the armature and hub. The armature also may rotate with the shaft after the brake is no longer accepting electricity. When power is removed from the plurality of electromagnetic brake types, springs keep the armature away from the braking surface, producing a small water gap [4].

The electromechanical brakes or rotors of the generator and the primary motor are mechanically coupled to the electromechanical brake described in a clutch. The electromagnetic power of the generator is then directly measured by determining the voltage at the generator's terminals and the power flow through into the generator stator, and the result is compared to the value of the electromagnetic power before the application of the disruption [5].

While an electromagnetic brake relies on magnetism to swing a physical lever against the wheel shaft to stop a vehicle, eddy current brakes solely use the strength of two opposite magnetic fields to stop. As the name suggests, these brakes rely on an eddy current, which is formed when a conductor passes through a magnetic field. The conductor then creates its opposite magnetic field, which reacts with the original field to stop the moving conductor’s movement. Eddy current brakes use electromagnets rather than permanent magnets since the power of the magnetic field can then be better controlled by electricity [6]. Electromagnetic brakes may develop negative power that is approximately double that of a standard engine's maximum power output and at least three times that of an exhaust brake. When compared to other retarders, the performance of electromagnetic brakes makes them a far more competitive alternative for alternative retardation equipment.

The electromagnetic brake excitation system is best supplied by the power plant's supply Then if the protective generator has a brush excitation, A thermistor rectifier is required to provide the brake's excitation winding in the system. If the generator incorporates an It is a brushless excitation system controlled by a thermistor. Converter (another example is the vapor-gas apparatus) This converter can be used to power the electromagnetic brake's excitation windings.The power plant's supply is suitable for supplying the electromagnetic brake excitation system. If the protective generator is aroused by a brush, a thermistor rectifier is essential to provide the brake's excitation winding in the system. If the generator has a brushless excitation system that is regulated by a thermistor. converter (another example is the vapor-gas apparatus) This converter can be used to power the excitation windings of the electromagnetic brake.Figure 1. Demonstrates the structure of electromagnetic brakes [7].

Electromagnetic brakes are simply mechanical brakes that end up causing retardation by applying electromagnetic induction in the disc brake in the direction opposite to the rotation of the actual disc, i.e. if the vehicle is moving forward, the rotation of the disc will be clockwise (frame of reference is from the left side of the vehicle) and the magnetic field will be counterclockwise. The brakes slow the motion of the brake in this manner, despite the lack of physical contact in any circumstance. This is a flooring idea. As either a response or electrical energy from the proper power source is employed to achieve the goal [8].

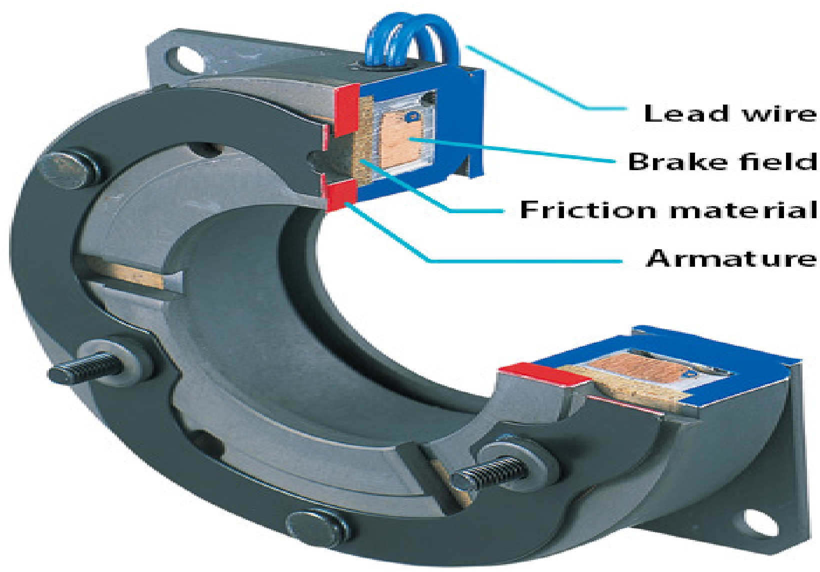

Figure 1: Demonstrates the structure of electromagnetic brakes [9].

1.1 Types of electromagnetic brakes:

There are numerous types of electromagnetic brakes three main types are enlisted as follows:

1.1.1 Single faced brake

Single-face brakes utilize friction from a single plate surface to connect the clutch's input and output elements. Single-face electromagnetic brakes comprise over 80percent of the overall all power applied brakes.

1.1.2 Power brakes

When electrical power is disconnected, either mistakenly or purposefully, power-off brakes halt or hold a load. They are usually located near or on an electric motor. They may employ numerous discs to improve torque without extending the diameter of the brake.

1.1.3 Hysteresis brakes

The torque range of electrical hysteresis units is extensive. They may indeed be remotely controlled, making them excellent for test stand applications involving changing torque. Because drag torque is low, these brakes have a broader torque range. When electricity is delivered to the field, an internal magnetic flux is formed, which is subsequently transmitted into a hysteresis disc. The braking shaft is connected to the hysteresis disks. A magnetic drag on the hysteresis disc causes the output shaft to drag or even freeze. Once the electricity is withdrawn, the hysteresis disc is free to revolve, and no relative force is communicated between either component. The only torque between the input and output is the bearing drag. The electromagnetic brakes absorb Magnetic paper clutches and brakes are endlessly adjustable, making them very effective in tensioning and positioning applications requiring continual speed changes. These clutches and brakes are suitable for synchronous and other heat-inducing slip operations due to their low wear. Figure 2 illustrates the single-face and hysteresis breaks [10].

Figure 2: illustrates the single-face and hysteresis breaks [11]**.**

2. LITERATURE REVIEW

In a review [12], The author Zhuan Zhang et al. discussed in his study" A narrative review: The electromagnetic field arrangement and the "braking" effect of electromagnetic brake technique in slab continuous casting" that The major purpose of his study is to offer a clear picture of the EMBr approach in terms of magnet configuration, as well as their "Braking "effect to aid decision-making. In terms of magnet arrangement, the EMBr system is divided into three types the Local type, the Ruler type, and the Multi-mode type. Each type's pros and downsides have been examined. Unforeseen challenges are also addressed. But this technique diagnosed lots of problems in many ways.

In a review [13], The author Zhongming Lei et al. discussed in their study "New Study and Development on Electromagnetic Field Technology in Metallurgical Processes" that To respond to the needs of complex states in high-quality steel continuous casting, flow field control utilizing an electromagnetic field is still used. A new principle of applying high thermal electromagnetic force is proposed in the field of static magnetic field control solidification structure, and it is presented that the development of electromagnetic metallurgy technology needs to combine the artificial intelligence of big data to play a better role.

In a study [14], The author Antipova et al. discussed in their study "The use of an electromagnetic brake to improve the dynamic stability of a power system" that An electromagnetic brake construction example for application in power systems is presented. The conclusions of an examination into the function of the electromagnetic brake on the dynamic stability of the simplest system are illustrated, and the company should implement electromagnetic brake parameters are proposed.

In a study [15], The author Sagar Mahakode et al. discussed in his study "Electromagnetic Braking System in Automobile" that The braking system can generate more friction, which produces heated wear and strain on the brake elements and eventually affects the braking overall system performance. As a solution, an Electromagnetic Braking System is used, which is an efficient method of braking with a high power-to-torque ratio and low friction.

In a study [16], The author Krunal Vibhandik et al. discussed in his study "Electromagnetic Braking System" that When control is connected to the twist, an appealing field is formed over the armature as a result of the current that flows over the circle, enabling the armature to be drawn in towards the twist. Because of the attraction between the magnets in the tape measure and the moving circle, a torque is created that restricts the movement of the rotor and, in the long run, creates the vehicle to stop. Furthermore, a whirlpool current is produced on the plate when an exceptionally high-quality magnet is placed close to the moving circle. Swirl currents generated in the plate generate their attractive field, which is opposed to the associated attractive field.

In a study [17], The author R.Siva Sundar et al. discussed in the study "Design and development of electromagnetic braking system" that When the driver carries out the necessary to the brake pedal, the severity of the braking is detected by a pressure transducer, which sends output actuating signals to the microprocessor. This controller gives a signal to the capacitor, and the capacitor transmits a pulsing D.C. current to the power pack. To decrease the car, a proportionate torque is created based on the driver's requirements.

In a study [18], The author Rui Jun et al. discussed in their study "Structure design and coordinated control of electromagnetic and frictional braking system based on a hub motor" that The coordinated control method for the electromagnetic and frictional braking system was designed using fuzzy control theory. In comparison to lower and moderate braking strength, the slip ratio of high braking strength remained close to 0.15. It efficiently prevented the wheel from sticking and generated fairly substantial braking torque during the deceleration phase. The integrated system employing a fuzzy control method may help minimize braking time while maintaining braking safety.

3. DISCUSSIONS

The Electromagnetic braking system is avoiding the boost converter principle employed in regenerative braking. To examine the duty cycle in a PWM (period cycle in minutes) period, the inductor current must fulfill the inductor volt-second balance, and the capacitor must match the capacitor ampere-second balance. As a result, the smaller the duty cycle, the lower the discharge of the capacitor. As a result, the capacitor is charged more. To preserve the advantages of the reverse magnetic field whereas the motor coil is driven to a reverse magnetic field when braking, the capacitor must charge more than it discharges.

The braking system eligible for the support of Magnetic paper brakes offers a wide range of available working torque. Torque may be adjusted extremely precisely with a magnetic power brake (within the unit's operational RPM range). These machines are therefore suitable for tension control applications including wire winding, foil, film, and tape tension control. Their quick reaction is particularly useful in high-cycle applications like magnetic card readers, sorting machines, and tagging equipment.

A vehicle's magnetic stopping system. a braking sensor for detecting whether a brake pedal is applied; a wheel speed sensor for detecting wheel speed; a magnetic polarity sensor for detecting the magnetic polarity of the brake storage card solenoids; and a control unit for controlling the brake pad solenoids using signals from the braking sensor The magnetic polarity sensor and the wheel speed sensor This invention pertains to a fishing reel, more specifically to an improved kind of reel with compensating magnetic brake mechanisms for minimizing spool backlash or overrunning and the reciprocal of the electromagnetic power brake is diagonally be optimized and use for the security purpose respectively.

An output disc (connected to the output shaft) rests undisturbed inside a housing in magnetic paper brakes. The remaining space within the housing is filled with magnetic shavings or powder, which remain free-flowing until acted on by a magnetic field emanating from a stationary coil embedded within the housing. When dc power is applied to the coil, the powder solidifies into chains along magnetic field lines, binding the disc to the housing and arresting the load. Only a few common materials, such as iron, nickel, and chromium, have enough magnetism to achieve this effect. The stainless steel powder fills an empty section here between a cup-shaped input rotor and an output shaft armature in less common magnetic paper clutches. A dc-energized coil in the housing magnetically excites the powder between these input and output devices; the current generated in the rotor controls magnetic field strength and paper bonding, which determines the amount of torque transmitted.

In hysteresis brakes, The Pure hysteresis brakes provide torque only through a magnetic air gap, with no magnetic papers or friction components employed. This braking method would have far superior operating characteristics (smoother torque, longer life, superior repeatability, a high degree of controllability, and less maintenance and downtime), which make it the preferred choice for precise tension control during the processing of nearly any material, web, or a strand.

In friction brakes, an electromagnetic friction brake is comprised of two primary parts: an armature and a magnet. The armature is a rotating steel plate or disc that mounts to the machine's shaft and is the component that is restrained during braking. It is typically segmented to prevent warping while also allowing wornpapers and heat to evaporate.

In eddy, current clutches brakes, eddy current clutches are extremely similar in composition to hysteresis clutches. The output discs that rotate through induced magnetic fields, on the other hand, are constructed of nonferrous materialsand excellent conductors that are only moderately magnetic. Repulsive diamagnetic alumina, weakly appealing paramagnetic copper, and brass are examples of materials. When exposed to a fluctuating magnetic field, they generally display strong conduction and more significantly good eddy current flow.

Eddy current brakes are widely utilized in operations that need large inertia masses to be immediately stopped; electric tramways and testing loading motors are two examples. Eddy currents cause I2R heating in the rotor, diminishing its utility. These clutches and brakes are best suited for drive applications wherein rotor and stator synchronization is permitted and electrical output torque is desired; they are commonly used in speedometers and tachometers. Tach generators are available as an alternative to provide linear speed indications to a controller for precise, closed-loop control braking.

After friction brake, the most popular type of friction brake is an electric spring-set friction brake; dc electricity recompresses springs to release a friction plate attached to the shaft, enabling it to revolve. Permanent magnet friction brakes that have been electrically released are also employed. Permanent magnets on the steel shell of an electromagnetic friction brake bind the unit's halves together to stop and retain loads. When dc electricity is applied to the coil, a balance magnetic field of opposite polarity is created, which decreases magnetic attraction at the friction faces and allows the armature to release and spin freely. An adjustable power supply sustains the equilibrium of the two opposing magnetic fields.Figure 3 demonstrates the overall mechanism of electromagnetic brakes.

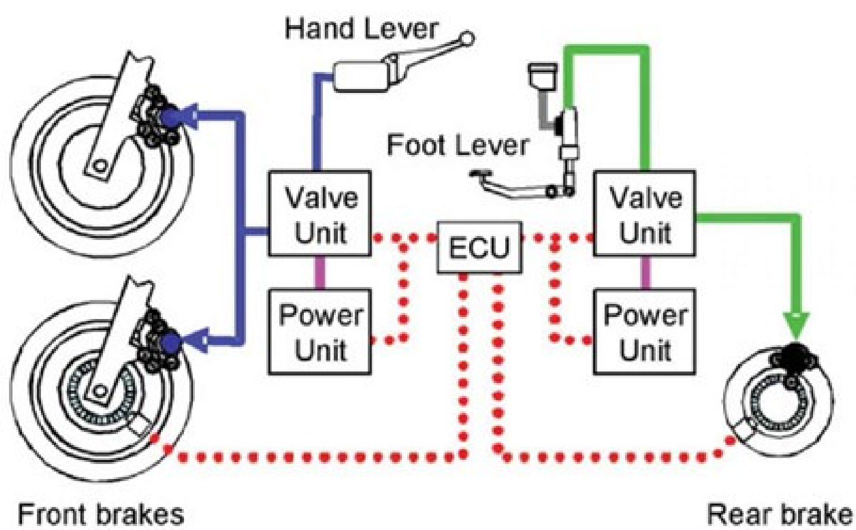

Figure 3demonstrates the overall mechanism of electromagnetic brakes[3].

The retarder is actuated by a hand control located on the vehicle's steering column. The first position is 'off,' while the following four positions increase the braking power in order. This manual system can be replaced by an automated system that operates mechanically via the brake pedal. The contacts are turned on sequentially over the slack movement of the brake pedal in this situation. To avoid the energization of the retarder when the vehicle is stationary and the driver maintains pressure on the brake pedal, the use of automation must be combined with a cut-off system working at extraordinarily low vehicle speed.

The wear of electromagnetic brakes is an important element when they are used since it is related to their lifespan. Most systems involve excellent cooling and heat dissipation. Wearing, like the coefficient of friction, is influenced by several variables, namely temperature, pressure sliding speed, and the chemistry between the friction couple structure and the environment. There is currently no linear relationship that may represent wear in response to distance or duration of brake application. Every material performs differently based on how it is used. For example, an airplane brake can last a lifetime if well maintained, whereas it can only last a short time if improperly maintained. Automobiles may well have similar results.

4. CONCLUSION

In Conclusion, an Electromagnetic or electro-mechanical braking system is found to be more eligible than a previous and simple braking system. In an oil or small braking system even at one step of the procedure if found leaks, the braking system acquires failures at that moment So by electromagnetic braking system it is found that these brakes can perform well to the previous one and will take a lot of time to get failed and it can help in the safety of the passengers also...Although four disc plates, coils, and firing circuits are mounted independently to each wheel in an electromagnetic braking system, even if one coil fails, the brake does not fail because the remaining three coils operate well. And this technique requires relatively minimal upkeep. Furthermore, it has been determined that electromagnetic brakes account for about 70% of all power-applied brake applications. Electromagnetic brakes, in addition to traditional friction brakes, have been utilized as extra retardation equipment on big vehicles. Friction brakes may be operated less often and so just about never reach high temperatures. The brake linings would last much longer before needing service, and the possible "brake fade" issue would be avoided. This improved braking mechanism not only aids in effective braking but also in ensuring safety and lowering the incidence of accidents to a bare minimum. Furthermore, electromagnetic brakes eliminate the dangers that just might occur from using brakes for an extended period that exceeds their ability to evacuate heat. In the future, electromagnetic brakes can help the automobile industry in their sales also because everyone, when they are supposed to b u automobile, will ensure the first thing kept in the customer's mind that it is safe for riding or not, so electromechanical or electromagnetic brakes are indulging of this factor safety.

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CHAPTER 15

ASSORTMENT AND EVALUATION OF SOLENOID ENGINE WITH ENERGY SYSTEM

Mr.Neeraj, Assistant Professor,
Department of Mechanical Engineering, School of Engineering, , Presidency University, Bangalore, India,
Email Id-neeraj@presidencyuniversity.in

ABSTRACT:

A solenoid is a device in engineering that transfers electrical energy to mechanical energy by utilizing an electromagnet produced from a wire coil. The technology produces a magnetic field from electric current and leverages it to produce linear motion. The major purpose of our study is to address the drawbacks of a conventional IC engine by replacing it with a Solenoid engine. The replacement of I.C engine is replaced by a solenoid engine because of the correct construction of actuators, a considerably larger actuator would be necessary to drive the valves. So for this, this reason solenoid engine is developed to give high function ability to the valves of the engine to bring more output and energy to the engine system. In the future, every Automobile should be working on the solenoid system and the engine will vanish for its drawbacks.

KEYWORDS:

Accurate, Energy System, CI Engines, Solenoid Engines, Sprinkler System.

1. INTRODUCTION

The solenoid ignition engine is based on the law of electromagnetic attraction. In the basic “A solenoid engine is an engine that functions by delivering electricity via coils that cause the pistons to head back and forth owing to electromagnetism”. The plunger is pulled by coil magnetism, and a spark distributor is utilized to induce the electromagnet to move following the height of the piston without the need for sensors or microcontrollers. When an electric current is applied to the conductor, it creates a magnetic field at its surface. This magnetic field acts similarly to an electromagnet. The electromagnetic force created is proportional to the current running through to the coils and the number of turns in the coils. When the solenoid is holding, it requires electrical energy. Nevertheless, it generates no output. All of the electrical energy is then transferred to heat by reacting with the coil's resistance. As a corollary, its efficiency is nil. The fundamental idea of an electric motor and a solenoid is the same [1].A solenoid is a term generally for a wire coil used as an electromagnet. It also refers to any device that uses a solenoid to transform electrical energy into mechanical energy. The technology makes a magnetic field from electric current and utilizes it to generate linear motion. Solenoids are typically used to power a switch, such as a starter in a vehicle, or a valve, such as in a sprinkler system [2].

Vibration isolation in the engine compartment is a challenging design competition for all types of transportation. Designed for the car business to increase ride comfort, road handling, and engine life. The sources of engine excitation might well be split into two categories: 1) base excitation imposed by the road pattern and vehicle acceleration, and 2) force excitation within the engine. Many applications benefit from solenoids' flexibility in handling intricate activities. There may be thousands of them just within a car: a couple in the transmission used to shift gears, a few in the door locks, another in the ignition circuit, and so on. In actuality, essentially every industry uses a solenoid at some time during its history: Pick-and-place robots in manufacturing process lines use solenoids to open and close clamps to handle products; pneumatic or hydraulic cylinders drive gates at storage silos; and some health monitoring systems in emergency rooms use solenoids to displace critical fluids into patients' bodies, such as blood or medicines. As a result, constructing and maintaining an appropriate engine mount is always a multi-objective issue. A solenoid is a term generally for a wire coil used as an electromagnet. It also refers to any device that uses a solenoid to transform electrical energy into mechanical energy. The technology makes a magnetic field from electric current and utilizes it to generate linear motion. Solenoids are typically used to power a switch, such as a starter in a vehicle, or a valve, such as in a sprinkler system [3].

A solenoid is constituted of a coil and a rotating metal rod known as an armature or plunger. Because solenoids function by transforming electrical energy into mechanical energy, they are classified as electromechanical actuators. Typically, the coil is a copper wire coiled at a fine pitch and enclosed in a metal (iron-based material) container termed a C-frame. The C-frame is a structural component that contributes to the magnetic field created by the coil. When an electric current is sent through a solenoid coil, it creates a magnetic field or flux with intensity proportional to the current [4]. In Figure 1 shown the overall procedure of the solenoid engine.

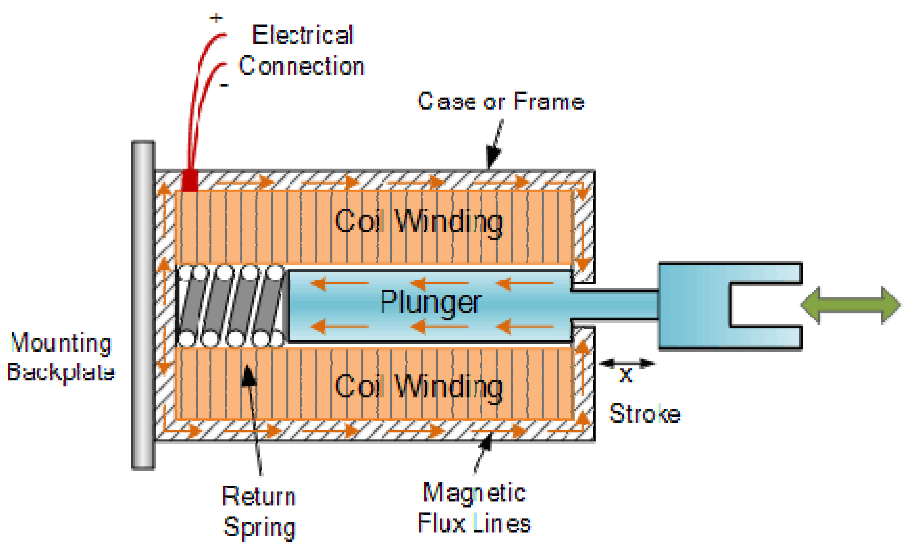

Figure 1: Describes the overall procedure of the solenoid engine [5]**.**

The plunger is dragged in by the magnetic field. Because the magnetic field can only attract the plunger (armature) of the solenoid, the solenoid can only produce force in one direction. Normally, when the solenoid is at rest, a spring keeps the plunger aside from the coil. However, in engine mount applications, a solenoid has been employed as a servo actuator replaced with a solenoid plunger with a permanent magnet and inserted inside an active engine bushing. It allows them to attract and repel the actuator as well as generate a sinusoidal motion with it [6].

Magnetic shielding safety components are included within the engine to protect people and other electronic components from large rare earth magnets and electromagnets. The Left-

Hand Rules specify that a straight current-carrying conductor develops a circular magnetic field around itself at all places along its length and that the direction of rotation of this magnetic field depends on the direction of current flow through the conductor. The force that creates the magnetic field is dependent on the number of turns on the coil along with the quantity of the current flowing [7].

The Solenoid Engine is a machine that provides mechanical motion. It accomplishes this by varying the applied and every metal with an electric current, making it move in an up-and-down or circular motion. The Solenoid Engine offers various advantages over standard engines since it does not require fuel, pollutes the environment with pollutants, or uses dangerous substances.Figure 2shown the making of a solenoid engine [8].

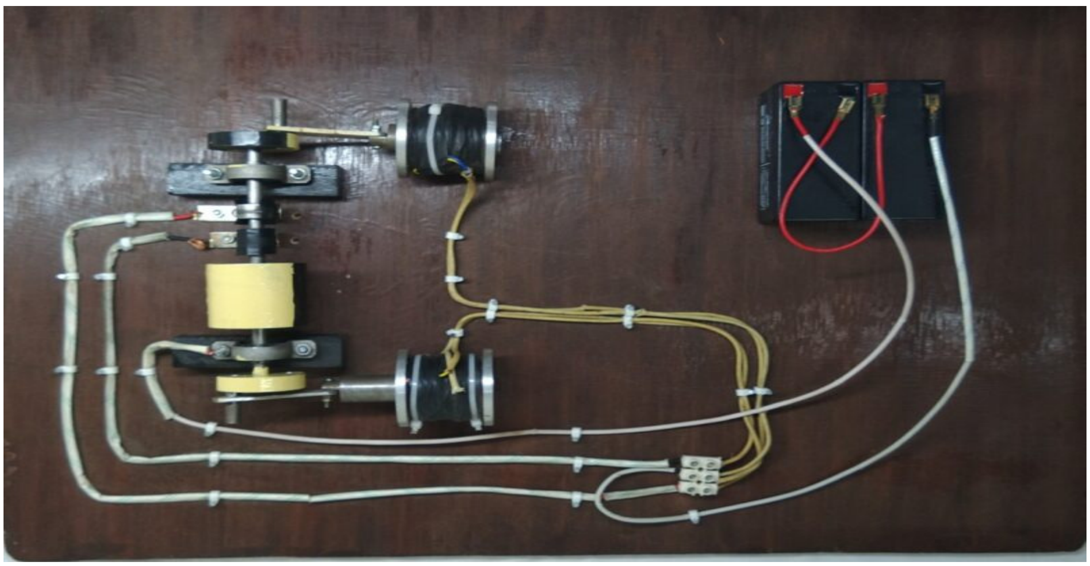

Figure 2: Illustrate the making of a solenoid engine [9].

Solenoid engines are based on electromagnetic induction. When a conductor moves through a magnetic field or a current flows through it, it generates an electromotive force (emf). The armature and stator are the two major components of the solenoid engine. The stator is stationary, whereas the armature is a metal rod that travels up and down or in circles. A magnetic field is produced when electricity travels through the armature. This attracts the stator by MA magnetizing the armature. When the current is turned out, the magnetization decreases, and the armature collapse [10].

2. LITERATURE REVIEW

In a study [11], The author Chang Woo Lee et al. discussed in his study" Design of a solenoid actuator with a magnetic plunger for miniaturized segment robots" that A multi-segmented robot's rectilinear and twisting motions are provided by a solenoid engine actuator with a magnetized plunger. Each segment of the miniature robot is actuated by a pair of solenoids, and the linear and turning motions are created by in and out-of-phase pulses of the solenoid pair.

In a study [12], The author Tamir Crevecoeu et al. discussed in his study "Bayesian Convolutional Neural Networks for RUL Prognostics of Solenoid Valves with Uncertainty Estimations" that solenoid valves are major elements of industrial systems, they are frequently utilized. Because of their high failure rates in the field, fault forecasting of these assets is critical for improving their maintenance and dependability. By training them on the valve's current signatures, Bayesian convolutional neural networks are considered in this research to estimate the remaining life span of solenoid valves.

In a study [13], The author Abdelhadi Taleb et al. discussed In his study “Design and modeling of solenoid inductor integrated with FeNiCo in high frequency” that The function of solenoid inductor shape on inductance and quality factor is investigated using MATLAB simulation. The turn number, magnetic core length, magnetic core width, spacing between turns, magnetic core thickness, coil thickness, and solenoid inductor oxide thickness are the solenoid inductor geometry characteristics evaluated. The recommended solenoid inductor integrated which is compared to conventional solenoid inductors in regards to performance.

In a study [14], The author M.Konieczny et al .discussed in his study “ Why do antifreeze proteins require a solenoid?” that The presence of the protein creates an ordering of water molecules that hinders the creation of ice crystals. This conclusion is supported by an examination of the ordering of hydrophobic and hydrophilic residues in antifreeze proteins, which reveals large different running the gamut from perfect adherence to the fuzzy oil drop model to structures sorely missing a clearly defined hydrophobic core to a linear arrangement of alternating local minima and maxima propagating along the principal axis of the solenoid.

In a study [15], The author Abdallah Amrane et al. discussed in their study “Monitoring of solenoid parameters based on neural networks and optical fiber squeezer for solenoid valves diagnosis” that solenoid technology utilizes an artificial neural network algorithm paired with an optical ber polarisation squeezer based on EMS for polarization scrambling to monitor the electrical and mechanical parameters as they change over time. To begin, The outcome of this simulation is utilized to train the neural network, and then a simulation is proposed using the neural net testing toolbox to find the solenoid parameters from the coefficients of the transfer function, which are determined from the model step response.

In a study [16], The author Taehun Ha et al . Discussed in his study “Off-axis magnetic fields of a circular loop and a solenoid for the electromagnetic induction of a magnetic pendulum” that When = 0, the resultant analytic equations reduce to a well-known magnetic field expression concerning the circular loop's vertical axis and the solenoid. Furthermore, we explored two forms of B inside the approximating circumstances using Wolfram Mathematica simulation. The generated analytic functions may be used to calculate the magnetic field B(r,) around a circular loop and a solenoid at arbitrary places with big r and small r. They are useful for studying the electromagnetic induction generated by a magnet swinging over a coil or a solenoid.

In a study , The author Peter H. Murray et al. discussed in his study “Magnetic manipulation in directed energy deposition using a programmable solenoid” that In certain positions, a solenoid fixed to a specific spot along the toolpath was utilized to increase the cross-sectional area of tracks by up to 65%. To better understand the mechanics of powder integration, the positioning of magnetic fields in the deposition zone was widely analyzed. Magnetic manipulation of magnetic feedstocks in DED should thus be explored as an adaptive control approach whenever higher track dimension control or improved feed control is required.

3. DISCUSSIONS

The solenoid coil is having great load carrying potential and low cost compared to electric engines, solenoid coil automobiles based on the induction principle will be an obvious alternative for diesel cars in the future. This research applies new sophisticated automobile cum electrical technology to regenerate a new advanced electric engine without employing a motor, and it is conceivable to entirely remove the motor from the car, which we called a high torque coil engine. It functions engine is the primary energy source in automotive, where combustion occurs and heat is produced, which is then converted into mechanical energy. Though we know that internal combustion engines are utilized in buses and airplanes, incomplete combustion releases certain toxic gases, which is a major pollutants in the air. Many beneficial steps have been made in pollution control by modern science and technology. Using CNG and LPG instead of gasoline and diesel, for example. Electric bikes, scooters, and automobiles are now available thanks to advances in technology. The battery of an electric car may be charged similarly to a mobile phone. They have lower operating costs and produce no emissions. However, they have a relatively low weight carrying capability and are not appropriate for prolonged runs. So, in speaking, we must favor engines with better power and running capacity similarly to a traditional gasoline engine, but the power source is now a battery, which is absolutely pollution-free and ecologically sound.

Ordinary engines contain a cylinder, piston (without piston rings), connecting rod, and crankshaft. There is no entrance or exhaust stroke or ports, nor is there a spark plug. Two solenoids will be employed in this system, one at the top dead center and one at the bottom dead center. When electricity is applied to a solenoid, it behaves like a magnet. As an outcome, the piston will indeed be reciprocating by these two solenoids. Figure 3 describes the overall procedure of the solenoid engine.

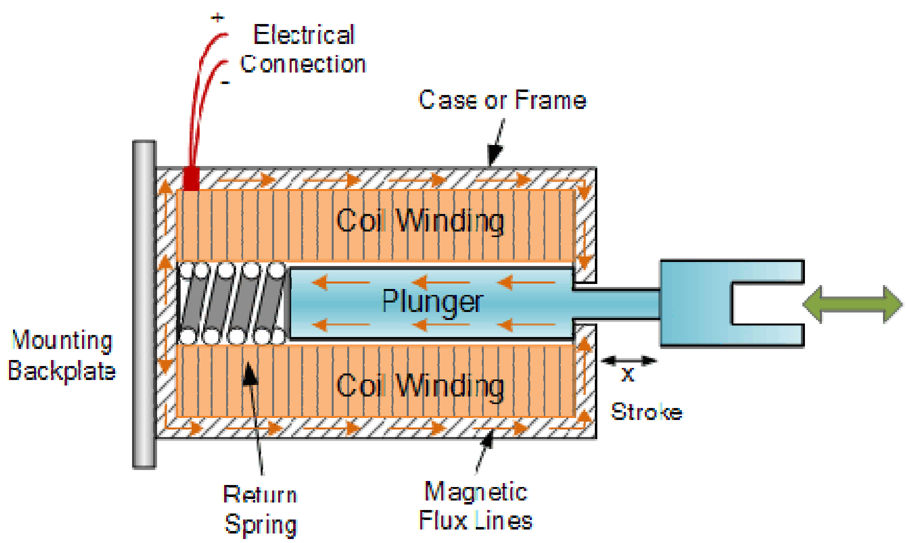

Figure 3: Describes the overall procedure of the solenoid engine [17]**.**

When electrons are sent through the coil, electromagnetism produces a magnetic field surrounding it. Guess it depends on the direction of the current, the rod within is repelled or attracted. The attraction may use a simple distributor rather than an Arduino and the microcontroller continues providing movement from one plunger or piston to another. This operates similarly to a spark distributor on a combustion engine, only it supplies the power to operate the solenoids so instead of simply an ignition spark.

A solenoid is a corkscrew-shaped cords coil, often manufactured of steel. When the electricity goes through a wire, it creates a magnetic field, just like every other electromagnet. Electromagnets are more efficient than permanent magnets because they can be changed on and off by adding or removing electrical energy, making them useful as switches and valves and allowing them to function automatically. Figure 4 shown the solenoid coil structure.

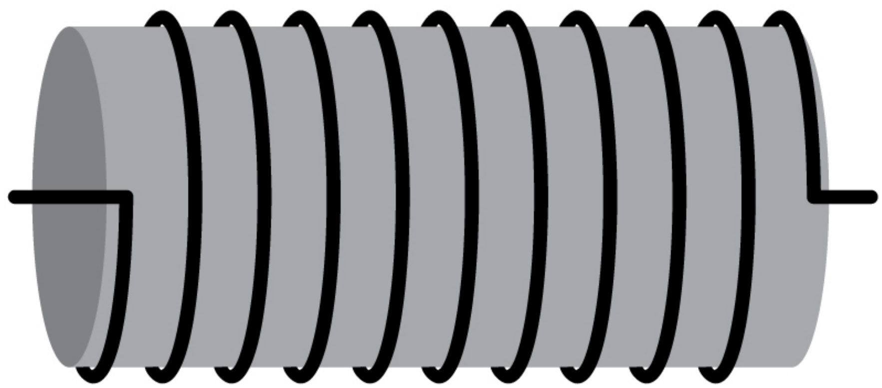

Figure 4: Illustrates the solenoid coil structure [18]**.**

A magnetic field is created when the electric current surpasses the capacity of the solenoid coils. The number of turns mostly on the solenoid's coil influences the strength and amplitude of the magnetic field. Because the rotor of a solenoid is movable when the voltage surpasses the coil, the armature moves to increase the magnetic flux connection. This is accomplished by sealing the air gap between the two cores. When the solenoid is de-energized, the moveable iron core or armature is loaded in the spring and restored to its former stance.Figure 3 depicts the movement of the electric current in the solenoid engine. Figure 5 depicts the movement of the electric current in the solenoid engine.

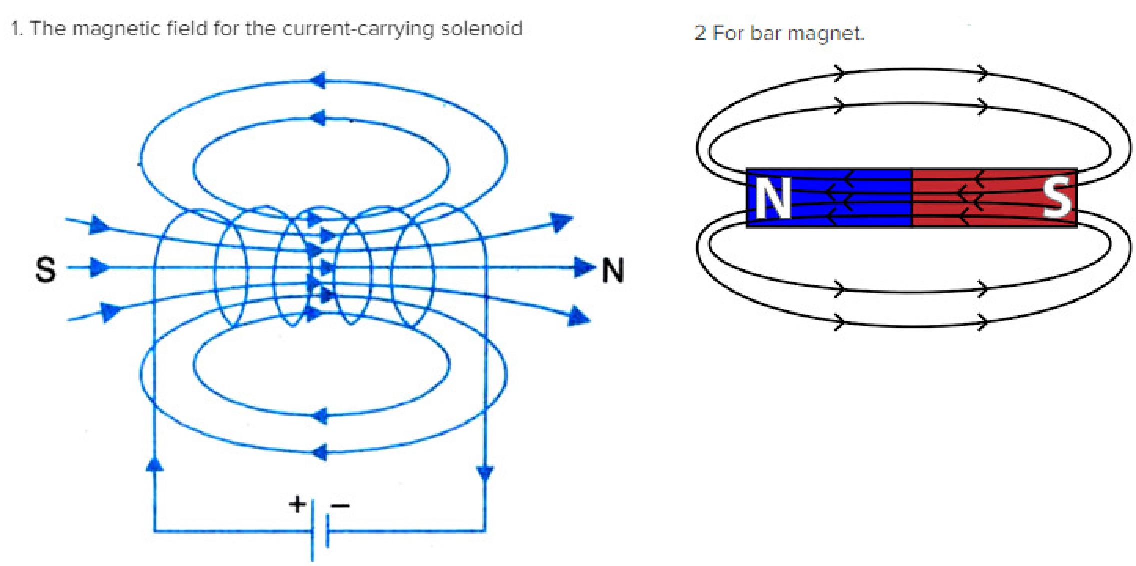

Figure 5: depicts the movement of the electric current in the solenoid engine [19]**.**

3.1 Application of solenoid engines

- Solenoids are primarily utilized as a global distribution component.

- They are employed in inductive loads, valves, transmitters, and a multitude of other components. Its applications include medicines, industrial applications, security systems, vehicles, and so forth.
- They are used to electrically manage the valve.
- They are appropriate for use with a certain sort of lock system for doors. Because electromagnets are used, these lock systems are extremely secure.
- They are commonly found in computer printers.
- Solenoids are utilized in automobiles system for fuel injection.
- The starting solenoid is an electromagnet that activates the internal combustion engine launcher. It's frequently actually connected to the starting motor that drives it.

3.2 Advantages of Solenoid valve / Solenoid engines:

- There is no air pollution in autos that use the solenoid engine.
- The solenoid engine can function properly with minimal torque.
- When exposed to electricity, solenoids react swiftly.
- Rather than employing fossil fuels, solenoid engines can be utilized.
-

3.3 Disadvantages of solenoid valves/solenoid engine:

- Most probable, the coil is going to be repaired over its lifetime.
- The need that a control signal to remain in situ through the operation.
- Voltage fluctuation or change sensitivity
- If the magnetic field is not adequately controlled, the valve might collapse inadvertently.

4. CONCLUSION

In conclusion, a Solenoid device is a medium that transfers electrical into mechanical energy, The engine's power cannot be comparable to the power of an electric car because these vehicles employ an electric motor to power the engine. Nevertheless, the power of the solenoid engine can be increased to the same extent as the power obtained through the electric motor by increasing the number of turns in the solenoid coil. Doing so would increase the force applied to the piston, thus increasing the power, and studying the effect of other parameters and improving them would also increase the power. There will be no pollution to the environment by using a solenoid engine. To end the usage of fossil fuels. It is smaller in weight and requires less maintenance than an internal combustion engine. Because the global temperature has indeed been rising over the decades, employing a solenoid engine will result in no air pollution. The solenoid engine will be an effective replacement for the I.C engine because in the IC engine there is a need for a perfect and large actuator in an engine that a solenoid engine can provide. In the future, A Solenoid Powered Engine could save a significant amount of cash while also reducing pollutants. It may help the user for more riding and safety toward oil considerations.

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CHAPTER 16

POSSIBILITY AND INVESTIGATION OF MECHANICAL WIRE ARC ADDITIVE MANUFACTURING

Dr.Ashish Srivatsava, Assistant Professor,
Department of Mechanical Engineering, School of Engineering, Presidency University, Bangalore, India,
Email Id-ashishsrivastava@presidencyuniversity.in

ABSTRACT:

Wire Arc Additive Manufacturing (WAAM) is a metal element 3D manufacturing and repair technology. It is an Additive Manufacturing method that comes to the Direct Energy Deposition (DED) family. WAAM(Wire arc additive manufacturing) is accomplished by depositing layers of metal on top of one another until a desired 3D shape is produced. Wire arc additive manufacturing is developed to identify the components and arrangement designs demonstrated by today's modified technology of manufacturing processes and it can also support the process of additive manufacturing to be more improved. Wire arc additive manufacturing supports fast manufacturing and creates a manufacturing process comfortable to finish. In the future, wire arc additive manufacturing will focus on making cost reductions in the overall manufacturing process by reducing the wastage of material and providing less time for the manufacturing of the finished product.

KEYWORDS:

Additive Manufacturing, Manufacturing Process, Wire Arc Additive Manufacturing, WAAM.

1. INTRODUCTION

Wire arc additive manufacturing (WAAM) is a wire-based technology that melted wire feedstock and implants a portion preform layer by layer that used an electrical arc as a source of fusion. WAAM is a directed energy deposition technology (DED) that uses a welding technique that is required of arc to print 3D metallic components. The procedure is instructed by a robotic arm which gives shape to the welding process and the welding process is built upon a substrate material that helps the structure of the part to cut when needed when the process is finished. When the wire is melted, it is extruded as pellets on the substrates. As the beads adhere to one another, they form a coating of a metal substance. Afterward, the procedure is repeated layer by layer until the metal section is completed [1].

An important feature of the WAAM process is the low capital money required, as the elements of WAAM equipment may be derived from open source equipment acquired from a variety of providers in the mature building construction sector. The processing capabilities of the WAAM mechanism may also make it superior to other fusion sources. WAAM, for example, does not require a vacuum condition to work, as electron beam-based techniques do. Because of its capability to harness the benefits of additive manufacturing for the fabrication of large components with medium geometric complexity, Wire Arc Additive Manufacturing (WAAM) is gaining major interest in business and academics. WAAM is unique in that it combines the use of wire and electric arc as fusion sources to manufacture materials layer by layer, both of which can give considerable cost reductions when compared to powder as well as other fusion sources, such as laser and electron beam, respectively [2].

A high deposition rate is supplied, which is necessary for producing such components, while also allowing for reporting capabilities savings as compared to conventional operation processes. However, high-quality production in a wide range of materials is hampered by high amounts of heat input, which presents several material processing problems in WAAM. This work thoroughly outlines the materials' technical challenges, which include the generation of large residual stresses, undesired microstructures, and solute segregation and phase transitions during solidification. Another problem is the heat profile during development, which results in heterogeneous and anisotropic material properties [3].

WAAM systems have a wide range of possible applications, although most fall into one of two main categories: robotic or machine tool-based. Commercial machine tools and robotic WAAM systems are available at the time of writing; these are dominating the market for integrated systems and include some incredibly advanced manipulation systems and CAD/CAM software. For medium-to-large engineering components of medium complexity, arc-based AM possesses significant cost and lead time reduction potential. Careful arc-based AM design can offer partial topological optimization, and careful wire feedstock selection can enable extra material optimization and multi-material components. When additive manufacturing is combined with a machining platform, previously inaccessible shapes become accessible [4].

An entry-level WAAM system, however, may be built using virtually any three-axis manipulator or robot arm and an arc welding battery pack. Similarly, numerous types of power sources are available, and the material in use will influence the arc deposition method used to some extent. Titanium alloys, for example, are often deposited using a more stable TIG or plasma transferred arc, meanwhile, the preponderance of other materials are deposited using MIG/MAG equipment [5].

Machine tool-based systems with integrated deposition equipment have the extra capacity to enable the layer-by-layer integration of AM and subtractive/cutting (SM) processes, allowing features to be produced and finished machined that would not otherwise be achievable. There are laser/powder-based hybrid AM/SM machines available; the development of hybrid WAAM/SM systems is underway, and a system will be available very soon [6].

Wire Arc Additive Manufacturing method is a new approach for metal element additive manufacturing. According to regulations, the process parameters are determined based on the evolution of the microstructure and the mechanical characteristics of the final samples acquired by sequential deposition weld beads of ER70S-6 steel. The feed rate and heat input during the deposition of the weld beads were modified to better understand how the temperature obtained by the samples affects the mechanical characteristics of the finished product.

WAAM is currently not a net-shape or completely automated process; until fully capable commercial AMCAD/CAM software is available, the part model must be understood and the production process manually prepared, necessitating some operator expertise for efficient part manufacture. WAAM's surface finish (waviness) generally indicates that the component must be finish-machined to meet mathematical or surface finish standards. The envelope of material to be removed, on the other hand, can be as narrow because this does not grow with component size, material efficiency improves as components get greater. Figure 1 illustrates the process of Wire arc manufacturing process [7].

Scientific innovations in processing capabilities enabled by constituents and interlayer/interlayer processes may be able to modify grain size and solidification mode throughout the part, paving the way for functionally graded materials in large-scale components. On-machine material property development offers a significant possibility to reduce total post-processing time and expense for WAAM components. Knowledge of on-machine material property development will also help in feature addition or repair of WAAM applications when heat treatment is not available.

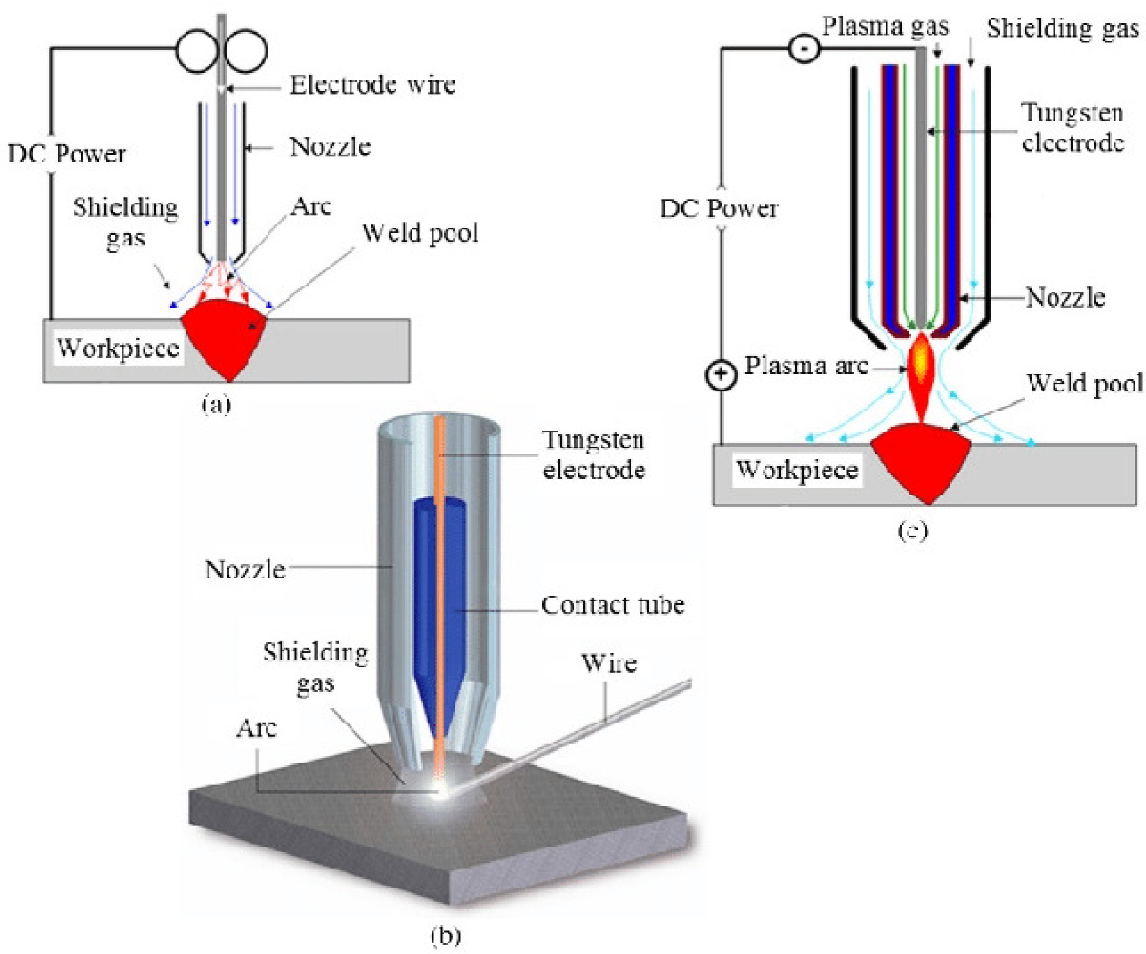

Figure 1: Illustrates the process of Wire arc manufacturing process [8]**.**

2. LITERATURE REVIEW

In a study [9], The author Dingjian Hua et al. discussed in his study "Arc interference behavior during twin wire gas metal arc welding process" That Interference characteristic of arcs The synchronous acquisition system was designed during the twin wire gas metal arc welding process to gather immediate access to information on the arc profile, including dynamic arc length change as well as relative voltage and current signals. The results show that if a trailing arc (T-arc) is added to a middle arc (M-arc) in a stable welding process, the current of the M arc remains constant while the agitation increases; the voltage of the M arc increases noticeably; the shape of the M arc changes, with increasing width, length, and area; the transfer frequency of the M arc droplet increases, and the droplet itself becomes smaller. Twin arc welding provides a shorter wire extension length than single arc welding.

In a study [10], The author Degala Venkata Cho et al. discussed in their study "Arc interaction and molten pool behavior in the three wire submerged arc welding process" That They demonstrate the good the equations of mass, momentum, and energy conservation, as well as the volume of fluid methodology. To follow the geometry of the free surface, the volume of fluid approach is utilized. A physical model is also created to determine the arc middle displacement. When compared to the sine waveforms, connecting the leading electrode with direct current electrode positive polarity, the medium and trailing electrodes with trapezoidal alternating current waveform produced deeper weld pools for a given welding environment. Weld width is primarily controlled by the leading arc in the range of welding parameters addressed in this work, whereas penetration is influenced by the medium and trailing arcs.

In a study [11], The author Anantha Neelakandan et al. discussed in their study" A study on process characteristics and performance of hot wire gas tungsten arc welding process for high-temperature materials" That The temperature sensor gas tungsten arc welding procedure involves preheating the filler wire to near melting temperature before feeding it into the arc. The impact of materials parameters including laser welding, hot wire current, and wire feed rate on heat input, voltage-current (V-I) characteristics, and weld bead characteristics such as bead weight and form when welding of super ASS 304H stainless steel tubes studied examined.

In a study [12], The author Omer Atalay et al. discussed in his study "EVALUATION OF OVERHANG ANGLE IN TIG WELDING-BASED WIRE ARC ADDITIVE MANUFACTURING PROCESS" That WAAM (Wire Arc Additive Manufacturing) is a fairly recent manufacturing technique. It is a unique technology for layer-by-layer construction of net-shaped or near-net-shaped metallic components using metal wire and a heat source such as laser light, electromagnetic radiation, or electric arc. WAAM technology is preferred to traditional manufacturing processes, especially for complicated features and large volume solid part fabrication, and it is notably utilized for aeronautical structural parts, die/mold manufacture, and repair.

In a study [13], The author Chunyang et al. reviewed in their study "A review on wire arc additive manufacturing: Monitoring, control and a framework of the automated system" That In several manufacturing industries, wire arc additive manufacturing (WAAM) has emerged as a highly promising alternative to high-value large metal components. Because of the WAAM system's prolonged process cycle time and arc-based deposition, defect monitoring, process stability, and control are essential for its usage in the industry. Despite significant advancements in the design process, path slicing and programming, and material analysis, a full process monitoring, and control system are still lacking. The purpose of this study is to give an in-depth analysis of sensing and control design for a WAAM system, covering technologies established for the generalized Arc Welding process, Wire Arc Additive Manufacturing, and laser Additive Manufacturing.

In a study [14], The author Amagoia Álvarez et al. discussed in their study "Study on Arc Welding Processes for High Deposition Rate Additive Manufacturing" That Although the prevalence of additive manufacturing is expanding, industrial sectors are seeking greater made parts, which most extended techniques, such as Selective Laser Melting (SLM) or Laser Metal Deposition (LMD), cannot provide. In this regard, Wire-Arc Additive Manufacture (WAAM) provides high deposition rates and quality with size limitations, making it the greatest solution for manufacturing processes of medium-large size components with high mechanical requirements, such as structural elements in the aerospace sector. WAAM technology incorporates material in the form of wire and used an arc welding operation that melts both the cable and the substrates.

3. DISCUSSIONS

WAAM is a common AM technique seen in DED technologies. In general, energy sources such as lasers, electromagnetic flame, and electromagnetic waves are required in DED to melt the input material, which can be powder or solid metal wire. The use of the welding technique would direct the heat energy of the operation to the metal to be dissolved effectively. Wire Arc Additive Manufacturing is a technique of welding that involves melting and depositing metal layers additively to obtain the finished shape and size of the product (WAAM). WAAM usually employs any of the oxy-acetylene process's power sources, along with opportunists for automation, to deposit 3D structured metal components. CAD/CAM-based software's commonly used for manipulating. Automatic welding equipment is appropriate for WAAM since it is simple to obtain the requisite form of automation/manipulation. The form of the element was made is attained by carefully designing the deposition route. The most popular feed material for this procedure is solid wire. This solid wire is melted by an electric arc and then travels along predetermined routes to distribute the metal component in the prescribed manner.

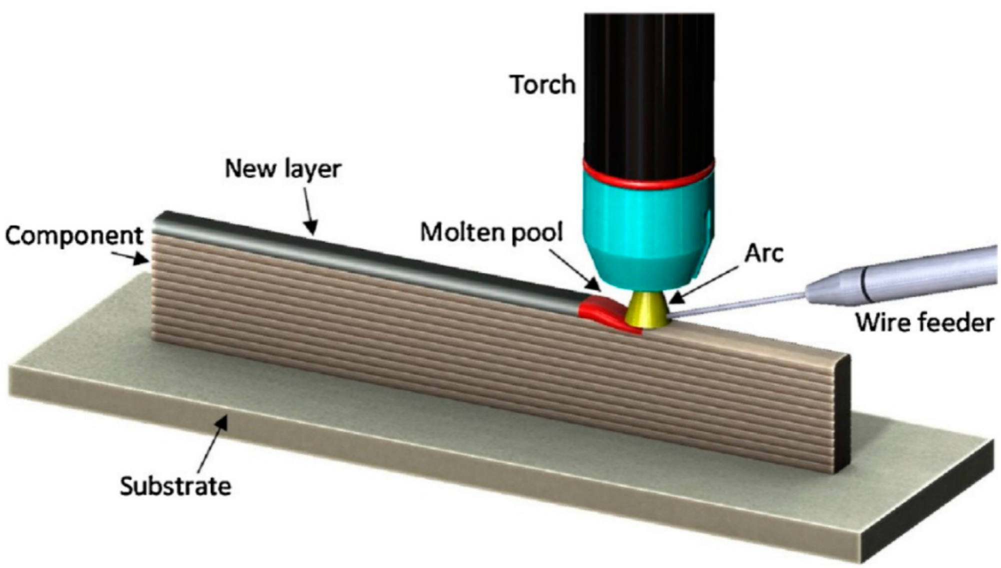

Figure 2: Demonstrates the procedure of the wire arc welding process and their component.

Machine tool-based systems containing integrated deposition equipment have the extra ability to allow the layer-by-layer combination of AM and subtractive (cutting) (SM) processes, allowing features to be created and finished machined that would not otherwise be possible. There are laser/powder-based combined AM/SM machines available; the development of arc-based systems is underway, and a system will be available very soon. WAAM is a pure heavy steel component production method in which the arc created in any of the arc spot weldings is redirected to the wire mesh entering out of the distributor and the arc melting the insulated wire, culminating in deposition over a substrate. As a result, the number of needed deposition layers might be augmented to achieve the desired form size of both components. Figure 2 demonstrates the procedure of the wire arc welding process and their component**.**

An electricity supply, an automatic wire-feed system, a computer numerical control work table, or a robotic system, and some accessories comprise the WAAM system (e.g. shielding gas, preheating, or cooling system). A typical robotic WAAM setup is as follows programmer To program the programmable procedure and gather the experimental results, a computer interface is used. Both the robot motions and the welding operations are coordinated by the robot controller. To manage the welding process, a programmable welding power source is employed. In a gas metal arc welding or gas tungsten arc, plasma is moved by an industrial robot manipulator for metal deposition.

The WAAM crystallization characteristics determine the significant performance metrics for a given area and the quality in situ by combining the heat gradient and nucleation rate inside the weld pool. Because the thermal gradient affects the final performance measures of the layers beneath, until the reheat effect has no metallurgical impact, and sets the thermal boundary conditions for the following layers of deposition, this aspect controls the heterogeneity and quality that can be expected within the final as-built part. WAAM sensing and control are still in their beginning phases, without single-bead wall construction being a popular example study. The primary goal is to maintain or manage the breadth and height of the wall through the use of numerous sensors and control techniques. For the welding area, active visual sensing utilizes laser or structural light as light sources. The primary issue is to combat the welding arc's technology changes in scene brightness.

A single fiber-optic connection transports laser energy to the welding spot. A xenon flash lamp was also utilized as a powerful pulsed light source. For a brief moment, the laser light reflected from the location is significantly brighter than the welding arc's direct or reflected light The procedure utilizes this condition by observing the welding site with a special-purpose video camera equipped with a CCD video sensor and a very high-speed electronic shutter that is coordinated with the laser flash and video sensor framing. A limited-band To further reduce light from the laser, an optical filter with the same wavelength as the laser is also employed as a welding arc.

Material removal processes are the primary method to access elements that have been encased by the end of the construction on an interlayer basis. Interlayer CNC machining provides a chance to reduce non-value adding time using the WAAM process by machining during the time allotted to cooling to the interphases temperature very little is documented about the machinability of WAAM components and the practicality of machining at high temperatures, although material weakening may improve machinability. Other benefits that may be examined include the removal of oxides on the surface of the WAAM deposit.

Although visual sensing has been increasingly investigated for monitoring the weld area throughout a standard (i.e. non-AM) arc welding process, there is limited literature describing a reliable measure of the weld pool during the WAAM process. Increasingly powerful types of sensors and imaging methodological approaches are necessary to generate good pictures of the WAAM process. This essential consideration is because surfaces close to the weld pool in WAAM are not as regular or predictable as workpiece surfaces in traditional single-pass fabrication welding.Figure 3 demonstrates the wire arc welding of additive manufacturing.

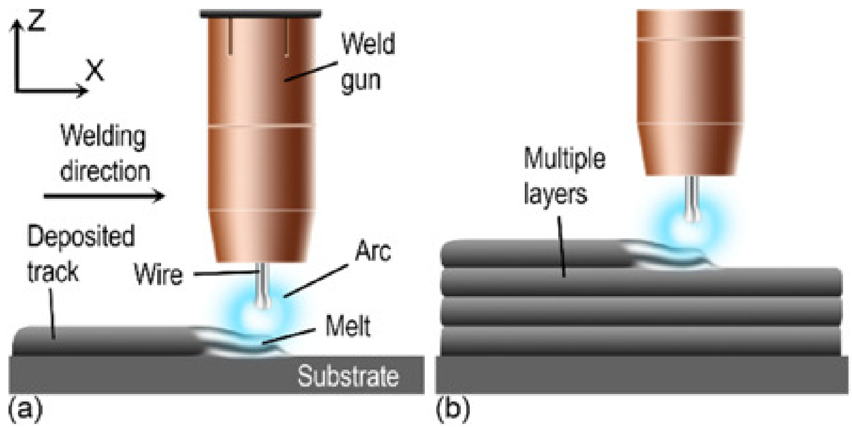

Figure 3: demonstrates the laser wire arc welding of additive manufacturing [15]**.**

A laser beam is supplied to the WAAM process. There seem to be significant differences between having the beam in a leading or leading position relative to the wire and arc. Structures generated with arc-laser-hybrid methods are compared to those generated just using an arc as the heat source. To determine the impact of laser hybridization, geometrical and material factors are investigated using methods like x-ray, energy-dispersive X-ray spectroscopy, and high precision 3D scanning. Figure 3 demonstrates the laser wire arc welding of additive manufacturing. WAAM is capable of manufacturing intermetallic alloys and functionally graded materials. WAAM is a potential alternative to traditional subtractive manufacturing for generating big, costly metal components. According to current trends, the future prognosis for the WAAM process will incorporate automated process planning, monitoring, and control.

The manufacturing sector is interested in arc-welding-based additive manufacturing technologies because of their potential to build large metal components at a cheap cost and with a short production lead time. This paper presented wire arc additive manufacturing (WAAM) techniques, analyses mechanical characteristics of additively made metallic components, summarises WAAM process planning, sensing, and control developments, and concludes with recommendations for future study. the mechanical characteristics of additively produced materials like titanium alloy are equal to those of cast or wrought material.

4. CONCLUSION

The development of wire arc additive manufacturing techniques encloses a great metal components development that is interdisciplinary, integrating computational physics, thermo-mechanical engineering, and process planning. In light of the primacy of the cooling curve on the product microstructure, which is unaffected by process parameters, there are no significant changes between samples treated with various process parameters. All of the samples have 3 separate zones: the bottom zone which contains a ferritic structure with thin strips of pearlite, the middle zone, which seems to have equated grains of ferrite, and the top zone, which has a lamellar structure that is generally Bai nitic. The differences in the three discovered microstructures are attributable to the different thermal histories of the various welding beads deposited, with the top zone being impacted by the stronger thermal effects. Recent research has been useful in describing and confirming the WAAM of metal components. The automation of the process is believed to be the next step in the evolution of WAAM. Significant research and knowledge are required in process control and optimization (especially online process monitoring and residual stress and distortion management), as well as automated process planning (e.g., 3D slicing, path planning, and integrated milling). WAAM should not be expected to replace present subtractive manufacturing methods in all, or even most, industrial manufacture of large-scale structural parts. Furthermore, the pair should complement one another wherever feasible to limit material use. Additionally, based on the results of the existing research activity, a technique for generating a ferrite/bainite structure that meets the specifications of the end product may be presented, which could be produced by alternating refrigeration cycles with water or oil between the deposition of the weld beads.

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CHAPTER 17

ASSESSMENT AND SOUNDINGS OF CERAMICS DISC BRAKES

Dr.PrabhuKumar Sellamuthu, Associate Professor,
Department of Mechanical Engineering, School of Engineering, , Presidency University, Bangalore, India,
Email Id-prabhukumar.sellamuthu@presidencyuniversity.in

ABSTRACT:

Ceramic brake pads are composed of a ceramic that is quite similar to that used to produce pottery and plates. Ceramic brake pad material, on the other hand, is denser and far more enduring. Ceramic brake pads also include small metal strands, which contribute to improve friction and heat conduction. Ceramics disc brakes are made to reduce the weight of the cars, as they are 50% percent lighter in weight in comparison to metal brake disc. The objective of the ceramics weight is to reduce the weight of an automobile, provides les no of brakes per shift as well they are make to provide frictional stability in presence of any weather and temperature conditions. In future different types of ceramic materials are indulged in the brakes system to make different ceramic brakes procedures. Carbon ceramic disc brakes can be provide a new range of disc brakes in motor spot or in automobiles.

KEYWORDS:

Automobile,Carbon Ceramic,Ceramic Disc Brakes, Ceramic Brake Pads.

1. INTRODUCTION

The automobile disc-brake is shaped like a disc that rotates with the wheel hub. Brake pads clamping discs to create torque accomplishes the braking process. To create frictional torque, the brake pads are pushed against the braking discs or drums. To completing the braking process, the car decelerates. Disc brakes are the primary components of an automobile disc brake, requiring strong force, good elasticity, a high and stable friction coefficient, adequate wear resistance, acceptable heat resistance, effective heat dissipation, and appropriate heat capacity, among many other characteristics. The brake is one of the most important managerial systems in an automobile. They are required to stop the vehicle at the smallest possible intervals by turning mechanical energy of the vehicle into energy that is discharged into the environment. The most important criteria for brakes are that they be sufficiently strong to stop the vehicle at the quickest distance in an emergency. Disc brakes are normally employed on the front wheels of mid-range two-wheelers such as commuting and sports bikes [1].

The disc brakes system is usually found on the front wheels of most hatchback vehicles, entry-level sedans, and MUVs; however, it is also commonly found on both the front and rear wheels of high-end cars and SUVs in conjunction with hydraulic / vacuum brake describes the service. The name disc brake stems from the circular-shaped plate, disc, or rotor on which the disc brake pieces are placed. A typical Disc Braking system has a brake disc, two friction pads, and a brake caliper. To accomplish braking in a disc brake system, friction pads impart grip to the disc's external skin. Previously, brake discs were comprised of grey cast iron, yet they are heavy, reducing acceleration and using more gasoline.

Freon Lad’s technology innovation employs metal matrix composite for the disc, which is essentially an alloy of aluminum for weight and silicon carbide for strength. However, it was discovered that the ceramic addition made the disc very abrasive, resulting in a low and unstable coefficient of friction. As a conclusion, it was apparent that the surface needed to be developed in some way to address this issue. Sulzer Metso Ltd discovered an answer in the shape of a unique ceramic coating after conducting research. They created thermal spray technology as well as plasma surface engineering apparatus and coating materials for the assignment [2].

Carbon ceramic disc brakes are created by combining carbon fiber with a urethane binder and silicon. The discs are created by pouring this solution it in to a steel mound. To produce vents in the disc, steel inserts are inserted radially around the mound. The epoxy-carbon mixture is then squeezed into the mound, which is subsequently baked to attach the epoxy and carbon fibers. The disc's interior core is then filled with silicon. It is then returned to the furnace, where all of the oxygen is removed. The silicon melts and is pulled into the carbon, resulting in exceptionally hard silicon carbide. Diamond coated grinding discs are employed in few post-production machining procedures.Figure 1 depicts the ceramics disc brakes [3].

Figure 1: Depicts the ceramics disc brakes [4]**.**

Chemical confrontation, wear confrontation, temperature transmission, thermal fatigue, hardness, cohesive strength, fracture toughness, strength, present stability, and sneak are the most important qualities of ceramic coverings. Resistance. Single-phase ceramic coatings lack the mechanical qualities needed for disc brake coatings. As a result, Ceramic matrix composite coatings and composites research and analysis can assist us in identifying materials that can match the performance requirements Disc brakes for automobiles it will become the main research focus of Disc brake coating materials for vehicles [5].

2. LITERATURE REVIEW

In a review [6], The author S.Gopi et al. discussed in his study" Review on ceramic disc brake system" That Braking is a technique for transforming a vehicle's mechanical energy into mechanical energy that should be released in the form of heat. While not breaking within the vehicle, a rider may be trapped in a dangerous position. Brakes convert friction to heat; however, if the brakes become too hot, they will cease performing because they cannot disperse enough heat. As a result, studies are being conducted in this sector to reduce the temperature result, permitting us to function more efficiently. Several novel materials have been created for disc brake rotors to resist heated temperatures caused by braking action.

In a study [7], The author Sławomir Woch et al. discussed in hi study "Modified Hagg & Sankey Method to Estimate the Ballistic Behaviour of Lightweight Metal/Composite/Ceramic Armour and A Fuselage Skin of an Aircraft" That The technique assumption was established on examination on the mechanism of destruction of ballistic shields composed of various materials, notably ceramics, by small guns bullets. The ballistic shield's strong ceramic front blunts the bullet and breaks up the projectile's hard core utilised for armour penetrating. As a result of the impact, a conoid of finely crushed ceramic dust is created, absorbing energy in the process. The dust, which contains the leftovers of the projectile's energy, strikes the backing but spreads across a broader region. Energy is absorbed in stretching, breaking, and delamination with fibre backings.

IN a study [8], The author Wen Bian, et al. discussed in his study" Structural and tribological characteristics of ultra-low-wear polyethylene as artificial joint materials" A revolutionary metallocene accelerated high density polyethylene (HDPE) polymer is ultra-low-wear polyethylene (ULWPE). Previous research has revealed that it has exceptional biocompatibility and wear resistance, indicating a high potential for use in artificial joints. However, because it's a revolutionary material, its ceramics tribological behavior and wear resistance mechanism are unexplored.

In a study [9], The author Masato Nozaki et al. discussed in his study "Development of an inexpensive, highly wear-resistant ceramic cam follower Part 2 brazing technology " that Currently, ceramic materials with exceptional sliding capabilities are not extensively used for valve train components. Another major reason for this is their high price. A ceramic cam follower, originally designed with direct brazing technique, has the following characteristics and can be manufactured at the lowest cost: there are really just three parts. A steel body, a thin ceramic disc, and an active bonding foil. After brazing, no grinding is performed.

In a study [10], The author Wanyang Yang et al. discussed in his study "Research and prospect of ceramics for automotive disc-brakes" that Various characteristics and characteristics of ceramic disc brakes are examined, including fracture toughness, strength, compactness, corrosion resistance, wear resistance, micro-morphology, and thermal stabilities. Ceramics research directions including high-temperature performance, bionic structure, layered structure, porous structure, eutectic performance, superhard structure, and machinability are examined in the field of disc-brakes research.

In a study [11] , The author Heike Friedl et al. discussed in his study "Polymerization efficiency of different photo curing units through ceramic discs" that the ability of a variety of light sources and exposure modes to polymerize a dual-cured resin composite through ceramic discs of different thicknesses by depth of cure and Vickers micro hardness. Ceramic specimens were prepared and inserted into steel molds according to ISO 4049, after which a dual-cured composite resin luting material with and without self-curing catalyst was placed.

In a study [12], The author Hyungjo Joo et al. discussed in his study "Effect of disc material on particulate matter emissions during high-temperature braking" that High-temperature brake emissions were 's continuous four different braking discs: and Gy iron discs, ox nitride-coated grey iron discs, and ceramic discs. The brake emission tests were carried out utilizing a scale brake dynamometer outfitted with a high resolution electrical low-pressure impactor and a low-steel brake pad. Ceramic discs seemed to have the highest number concentration, whereas colored iron discs produced higher mass concentrations than others.

3. DISCUSSIONS

Disc brake system is well equipped for giving perfect balance and to stop the vehicle at certain time, Ceramics and the use of disc brakes can assist in encouraging the continuing growth of the automotive industry, which has helped to improve the mechanical qualities of vehicle brakes. Technology for producing ceramic powder and the forming process are important research connections in the development of new products ceramics. Understanding mature powder preparation and ceramics. The forming process, together with the implementation of these processes to automobile disc brakes, is a significant step in establishing the close correlation between ceramics and disc-brakes. Ceramics are made from extremely purity, ultrafine, and homogenous powders. In general, ceramic powder process entails solid-state, liquid-state, and gas-state reactions. The following characteristics represent the major stages of the powder preparation process: (1) The sol-gel technology, also termed as the micro emulsion method, is used to create powders with distinct size effects and nanoscale scales. (2) Production of composite powders with a core-shell structure that is covered with another component on the surface of ceramic ppapers.

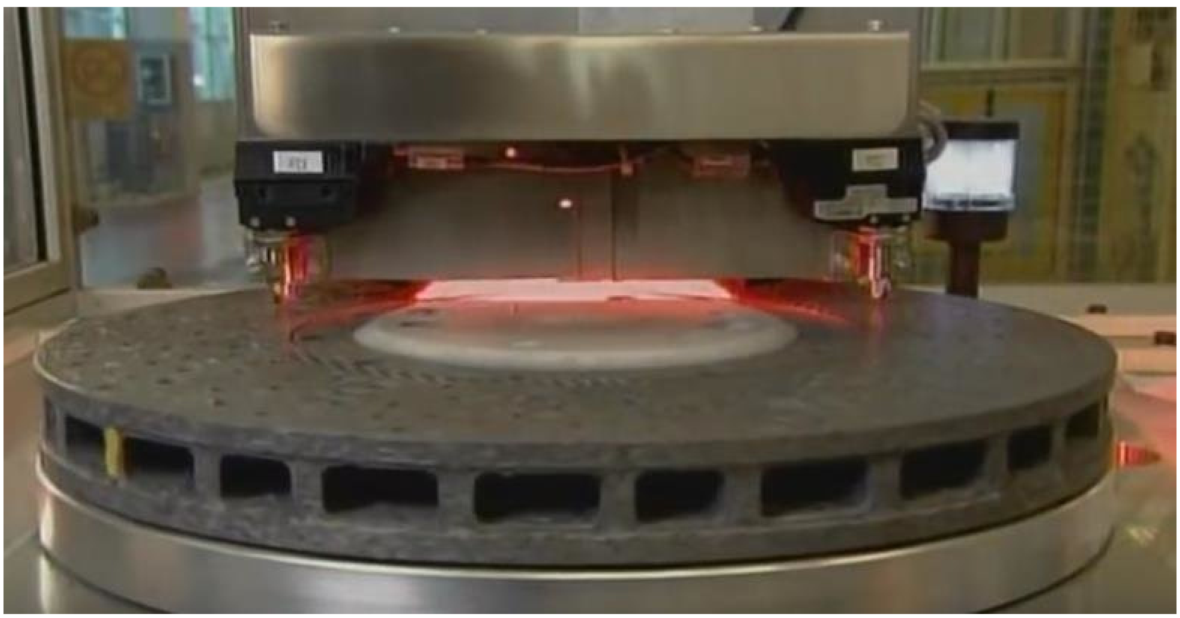

Figure 2: Demonstrates the procedure of making of ceramics carbon disc brakes [13]**.**

The ceramics preparation process is split into four stages: raw material and equipment selection, forming, sintering, and processing. Standard sintering, non-pressurized sintering, vacuum sintering, hot pressing, HIP sintering, oxygen sintering, and other pressure sintering are among the various types of ceramic sintering and preparation. Many new sintering techniques and methods, such as microwave sintering, spark plasma sintering, identity high-temperature synthesis, intelligent sintering, spray sintering, low-temperature sintering, forging densification, explosive consolidation, and selective laser sintering, have been investigated in recent years. In-depth studies have also been done on the molding process of concrete elements, which includes dry molding, plastic making, slurry forming, and solid mold less forming. Dry molded is divided into two kinds dry pressing and cold isostatic pressing. Extrusion, injection, hot wax casting, and film-forming are the four primary types of plastic formation. Slip casting, streaming forming, gel infusion model shaping, and in-situ solidification forming are the four primary types of slurry forming. Fused deposition modelling, three-dimensional printmaking, layered solid forming, stereo lithography, and selective laser sintering are the primary types of solid possible occurrence forming. Figure 2 shown the procedure of making of ceramics carbon disc brakes.

The making of ceramics carbon disc brake is established to complement a car's specific architecture, a carbon-ceramic brake is constructed in three stages: numerical modelling, prototype fabrication and testing, and testing on a real automobile. The brake disc is initially computationally modeled on the computer using the car's specific model data. The computer calculates characteristics such as the diameter of the brake disc, its thickness, and the height of the friction path. You must also calculate with the complete brake, with the ring and hub connected. Because of the varying coefficients of thermal expansion, this is a difficult design problem, as deviations must be corrected for at each operating temperatures. Carbon Ceramic Brakes helps to provide a no of benefits over traditional forged iron brakes. From a tenth or more in unsprang weight loss to a faster this innovative technology reduces stopping distances. Much enjoyment for the car enthusiast Regarding the Carbon Ceramic, performance-driven enthusiast Brakes answer the demand of drivers who want to brake. Formula One vehicles have high performance, while ensuring the luxury's comfort and lifespan as well as a sport vehicle.

Ceramic brake pads produce finer dust than semi-metallic brake pads when they wear, leaving less debris on the vehicle's wheels. Ceramic brake pads often last longer than semi-metallic brake pads and provide involves the improvement management and reduced wear-and-tear on brake rotors during their lifetime, without losing braking performance. The disc brake squeal noise is a pretty hard development that car manufacturers have faced for many years as a result of constant customers complaining and expensive assurance costs. To test the squeal tendency, the analytical approach employs a nonlinear static simulation sequence followed by a lovely Eigen value extraction. The effects of the most important operating factors (braking pressure and friction coefficient) on squeal propensity are examined. The effect of adjusting the rotor stiffness and rear plate stiffness below the entire entirely varied operating condition unit was studied. The ABAQUS/Standard finite part code package is used to examine friction-induced hydraulic brake squeal, which combines a nonlinear static analysis with such a flowery chemist value extraction approach. For the majority of drivers, ceramic brake pads provide excellent performance. Ceramic pad makers assert that because ceramic pads endure longer, they are less expensive in the long term. Early ceramic brake pads tended to wear down rotors faster and work badly until warmed up, thus this argument fell flat when the expense of replacing worn rotors was considered. Modern ceramic pads, on the other hand, have resolved these concerns and are less harsh on the rotors.

Metallic brake pads are less economical and less abrasive on rotors, but they come at the expense of increased noise, dust, and overheating. Metallic brake pads provide superior braking performance in heavy duty situations such as towing and abrupt stops. Under most situations, any type of brake pad will be enough for the typical driver. The choice is essentially between cheaper metallic pads, which make more dust, noise, and wear faster (but are gentler on rotors), and costlier and longer-lasting ceramic pads, which are quieter and cleaner but may harm rotors.

The friction generated by the brake pads pushing against the rotors turns kinetic energy into heat energy. This thermal energy creates heat, but because the major components are in touch with the environment, this heat may be efficiently distributed. This heat-dispersing feature reduces brake fade, which develops when braking performance is influenced by heat. Another advantage of disc brakes is its resistance to water fade, which happens when water on the brake lowers braking force substantially. When the cars are moving, the rotor turns at full speed and self-discharges water from the rotating speed rotors, delivering a continuous braking force.

The new techniques are dedicated to improving the toughness and operational reliability of ceramics. The brittleness, sensitivity to imperfection, and operational reliability have always been the main problems hindering their wide application. Therefore, the research on the strengthening and toughening mechanism and operational reliability has always been a hotspot in new techniques of ceramic parts forming. The sintering of high-performance ceramics usually adopts conventional sintering, hot pressing, and HIP sintering. With the development of science and technology and the improvement of material performance requirements, the Nano-sintering technology has become the focus.

When the driver presses the brake pedals, the brake booster (servo system) amplifies the power and converts it to hydraulic pressure (oil pressure) through the master cylinder. The pressure is sent to the brake on the wheels via a brake oil-filled pipe (brake fluid). The dispersed pressure pulls the piston on the four-wheel brakes. In turn, friction materials, such as piston brake pads, press on the brake rotors, which revolve with the wheels. The pad screws the wheels to the rotors on both sides, slowing and halting the vehicle. When the brake pedals are depressed, the master cylinder's high-pressure liquid pulls the piston outward. The revolving disc keeps the piston brake pads from slipping. Innovative approaches for producing ceramic components are gaining popularity. The new procedures are designed to increase ceramic toughness and operating dependability. Brittleness, susceptibility to imperfection, and operational dependability have always been main obstacles to their widespread deployment. In Figure 3 shown the injection of the ceramics disc.

Figure 3: Depicts the injection of the ceramics disc [14]**.**

As a result, the strengthening and toughening mechanism, as well as operational dependability, has always been a hotspot in novel ceramic component forming procedures. High-performance ceramics are often sintered via conventional sintering, hot pressing, and HIP sintering. With the advancement of science and technology, as well as the enhancement of material performance requirements, nano-sintering technology has risen to prominence. Nano-sintering has lower sintering activation energy, quicker sintering rate, and lower beginning sintering temperature than conventional powder sintering.

4. CONCLUSION

This review options for disc brakes are broad, with an emphasis on performance enhancement, cost reduction, and advancements in design and material. In actual life, an already existent material, such as cast iron, performs well and has been tried and proven, yet it does occasionally fail. As a result, traditional materials are being replaced with better suited materials in order to increase efficiency and performance, particularly in supercars. Carbon ceramic disc brakes are produced by combining carbon fibre with an epoxy binder and silicon. The discs are made by pouring this solution into a steel mould. To produce vents in the disc, steel inserts are inserted radially around the mould. The epoxy-carbon mixture is then squeezed into the mould, which is eventually baked to connect the epoxy and carbon fibres. The disc's centre core is then filled with silicon. It is then returned to the furnace, where all of the oxygen is removed. The silicon melts and is pushed into the carbon, resulting in exceptionally hard silicon carbide. In future , ceramics disc brakes will be modified and will consuming the place of metallic disc and new techniques are also want to improve the ceramics disc brakes and enhaced into more lightier and friction less.

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CHAPTER 18

PRODUCT ANALYSIS ON HIGH-SPEED MACHINING (HSM)

Mr .Ashok Singh Gour, Assistant Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-asgour@jnujaipur.ac.in

ABSTRACT: High speed machining is an advanced method which consist of a cutting-edge, evolving milling machine that is used to create complicated components with high productivity, overall efficiency, sustainable, and affordability. We employ high-speed processing because it is more efficient than conventional machining and allows us to make superior products. It is used to increased productivity and surface quality of material and helps to reduce the manufacturing time and increase the production efficiency for better featuring.Because of the greater speed and amount of feed utilized in high-speed manufacturing, the material is removed so quickly that very little heat is transmitted throughout the operation. This reduces shop emissions while drastically reducing turnaround time (since less time is required for chilling and hardening).

Keywords:

Affordability, Cutting-Edge, Efficiency,High-Speed Machining, Material.

1.INTRODUCTION

High-speed manufacturing is a contemporary technology that, when compared to traditional cutting, allows for greater efficiency, precision, and workpiece quality. Dr. Carl Salmon, a German inventor, pioneered high-speed machining (HSM) in the 1920s. He established that the heat created at the contact here between chopping tool and the work would peak at a given critical spindle speed for a given workpiece metal. This necessary cutting speed fluctuates according to the metal alloy being processed. Salmon also discovered that there was a precise spindle speed range on each side of this peak where the cutting process could not remove metal. The high speed manufacturing is consistently working for hard steel material to give bet significant feature promising to give perfect surface [1].

The removal of cutting heat in metal cutting is mostly reliant on the heating of a fluid medium of refrigerant such as moisture coolant, compressed air, or carbon dioxide. This cooling method is also known as forced convective boiling. The vapor pressure of the liquid is the amount of energy required to shift the condition of liquid coolants from liquid to vapor. The amount of heat needed to turn a unit quantity of liquid into vapor without changing the temperature is known as the specific heat of vaporization. The desire for high-speed machining with incredible precision has grown in industries that formerly used copper electrodes, and the demand for graphite has increased. However, the electrical environment for electrostatic discharge machining in components with specific communities and finer surface quality tends to result in more electrode wear with graphene sheets [2].

High energy is expended during high-speed manufacturing. The energy spent and the processing time, on the other hand, determine the energy per unit created. Diaz et al. revealed that the energy per unit created in high-speed end machining were much lower than in typical cutting rates. The decrease in energy consumed per unit created is due to a reduction in processing time. As a result, reducing computation has a bigger influence on energy consumption per unit created than increasing power needed.The variables in high-speed machining, especially milling, are the same as in classical milling. Speeds and feeds must be specified, as well as the depth of cut. Slow, heavy cuts, on the other hand, are substituted with quick, lighter cuts in a high operation procedure. While it may appear counterintuitive to take lesser cuts whenever heavy cuts are available, businesses that can make this mental shift can create more accurate parts faster [3].

EDM technology was employed for the final machining of hardened materials, and while this technique was quite successful, shops were always striving for more effective and faster ways to make their goods. As CAD/CAM program technology progressed and new and more effective jigs and fixtures development became available, the utilization of these sophisticated CAM systems increased. Although this advanced innovation was first centered on the die mound sector, it has grown much more ubiquitous now and is present in a variety of production [4].Figure1 illustrates the process of point cutting in high-speed machining

Figure 1 : Illustrating the process of point cutting in high speed machining [5].

Metal percentage removal are now quicker than it was before, What was called high speed machining only a few years ago is now considered standard. Many variables are pushing businesses to cut metal quicker. Better and more sophisticated mechanical devices and CNC processing enable the machine to cut accurately at increasing speeds and feeds although the machine tool itself must be robust and well equipped enough for high speed machining, the real magic lies in the toolpath generated by today's advanced CAM software packages. The ability to produce a cutter path with a consistent chip load and tool engagement - especially in the corners - is really the secret sauce to the whole process. The finite control of the toolpath, and the ability to consistently control the amount of material engagement the tool will encounter, allows for dramatic increases in the cutting parameters. Even small diameter tooling can be pushed far beyond traditional limits [6].

The overall procedure of high matching, the length of the cut, frequency, and federate must be lowered due to higher linear forces and stresses on the cutter... Further to that, as a result of additional friction, coolant is frequently required for a satisfactory conclusion. In top to the heat buildup generated by this friction, the process's intermittent over-engagement will result in significant tool wear and a substantially shorter total tool life than could be accomplished using high speed machining procedures. The waste is coming out in the form of chips by cutting the hard metal out and it can be stored as combining steel for the new material [7].

In high-speed machining, the influence of tool dynamics has a significant impact on the accuracy of the machined component. It was discovered in this investigation that a little increase in tool over-hang might cause higher vibrations owing to a loss of stiffness. Impact tests were done with accelerometers positioned at the tip of the devices to establish the frequency response characteristic (FRF) of the tool. The accelerometers were hit with hammers at the identical positions.A technique which improve High-speed machining having model that utilizes lighter milling passes with high spindle speeds and feed rates to generate a very high metal-removal rate. It helps in minimizing cycle time, extend tool life, and increase shop productivity [8].

2. LITERATURE REVIEW

In a study [9] The authorG.Gorsler et al. Discussed in his study High speed machining of brass rod alloys. Brass is well for those processing parameters, but its ultimate productive potential with high-speed machining warrants additional investigation. An intensive testing programmer on typical brass rod alloys was carried out in laboratories and production environments utilising current machine equipment. Machinability data acquired for turning, drilling, and milling provides fresh insights into in the implications of improving cutting force, efficiency, surface integrity, and chip formation on tool life, feed rate, and cutting force.

In a study [10], Kapil Paulo et al. Discussed High speed machining, High-Speed Machining covers all aspects of this significant subject, from the underlying processes of the technology to potential future research possibilities. This book will teach readers how to select the optimum approach for their specific assignment, how to configure their equipment to avoid noise with wear, and how to utilise simulation tools to simulate high-speed machining operations. Throughout, the many uses of each innovation are covered, as are the most recent results by renowned experts in this field.

In a study [11], B.D. Fox-Rabinovich et al. discussed Progress in high temperature nanomechanical testing of coatings for optimising their performance in high speed machining. In high speed machining, frictional heating occurs in very high temperature, nevertheless the nanoindentation testing used to assess new PVD coating systems for increased cutting performance are always done at room temperature. If microstructural measurements are about to be employed successfully in the optimization of applications for high speed machining, they must be done at the appropriate temperature. High temperature micro - hardness data for a wide range of boron carbide hard coatings on tool steel are examined, and design criteria for coating optimised for various machining applications are proposed.

In a study [12], Xueping Shivpuri et al. discussed Chip fracture behavior in the high speed machining of titanium alloys. Titanium alloy machining is a severe fracture operation connected with a localised adiabatic shearing process. Titanium alloy chip segmentation is often characterised by an adiabatic fracture band (ASB) and a localised microfracture evolution mechanism. Because of its very high strain intensity, ASB has been identified as a forerunner to fracture locus. Aside from strained intensity, stress been such (pressure-stress states) has been found as an important component in controlling the fracture process by varying the critical absorption rate and critical failure strain.

In a study [13], Abraham Wang et al. discussed Multi-dimensional circular supply chain management: A comparative review of the state-of-the-art practices and research In recent years, the resource efficiency (CE) idea has received widespread attention in both practise and academics. This study examines current practises and research in "circular supply chain management" (CSCM), which is the incorporation of CE thinking into procurement (SCM) with the objective of reaching "zero wastes." The review includes 68 real-life CE implementing cases gathered by the Ellen American Foundation and 124 papers in prestigious academic journals in logistics and supply chain management. According to the comparative review, CSCM includes several dimensions such as closed-loop SCM, reversal SCM, remanufacturing SCM, recyclable SCM, and occupational symbiosis.

In a study [6], Jalumedi Paul et al. discussed High-speed machining of composite materials High-speed manufacturing of fibre-reinforced composites improves machining efficiency and productivity while reducing machining faults, with delamination being the most common.

3. DISCUSSION

The focus of the manufacturing sectors is generally on faster machining of components paired with better throughput without compromising accuracy, surface polish, and repeatability. High Speed Manufacturing processes (HSM) involves faster material removal than conventional machining, and feed, transverse speed and engine power characteristics, tool geometry, cutting tool, NC programmer preparation, programmer transfer and execution all play a role. HSM ensures quality, surface finish, extended tool life, accuracy, and overall productivity increase. When compared to traditional machining, high speed machining employs a higher rotation speed of more then 20000rpm and greater feed rates, and work material is accomplished with tiny size cutting tools that provide quicker and lighter cuts.

Machining requires an understanding of the force operating on the tool. The estimate requires knowledge about cutting forces. Power requirements, as well as the proper design of machine tool parts, tool holders, and fixtures for vibration-free operations Many Dynamometers and other force measurement equipment have improved the precision with which tool forces may be measured. By measuring cutting forces, one may gain a better understanding of the cutting mechanism, such as the impacts of cutting force and machinability. of the surface, the chip creation process, and tool wear Even under unstable state situations, the cutting force is influenced by numerous variables The fluctuation of cutting speed with time is a common feature. Cutting forces may be classified into three types. Thrust force, feed start forcing, and other components

Organizations are taking the job done in an effective way possible by using technology and cutting-edge high-speed machining techniques, managing that people with fewer manpower and preserving both money and effort. Hagerty routinely works with engineering firms that wish to increase the efficiency of their machining operations but don't always have the necessary equipment or tools. A business that uses bigger dimension tools or Computer - aided manufacturing that are not authorized for growth and achievement, for example, may not have been able to cut labor hours by 30-40%, but they may still profit from high-speed manufacturing High-speed machining provides a variety of spindle speed, each with its own set of benefits, and may be tailored to the substrate and item being created.

High-speed machining, on the other hand, avoids thermal transfer between the chip and the product by cutting at a faster rate than traditional techniques. As a consequence, the treated metal preserves its structural integrity and is not vulnerable to structural alterations. This enables the processing of heat-sensitive materials in particular. Because the component remains at ambient temperature, it does not require heat treatment. Figure 2 illustrates the spindle working of high-speed machining.

Figure 2. illustrates the spindle working of high-speed machining [14].

High speed manufacturing (HSM) is a cutting-edge and growing machining process used to produce complicated components with high productivity, increased quality, sustainability, and economy. Initially, HSM was designed to process aluminium and alloy-based weapon and aviation components. Because of ongoing advancements in the field of Smm, newly available mechanical devices can process hard metals, difficult-to-cut materials, complicated 3D geometry, and controller features with great exactness.There has been a tremendous amount of work done to ensure the strength, accuracy, precision, and adaptability of high speed milling machines. Technological machine tools can now produce complicated 3D components in a single fixture, eliminating the need for secondary operations like as finishing and honing. The presence of High speed small machining manufacturing equipment is one of the key advances. As research shifts toward the fabrication of micro/nanoscale parts, where dimensional accuracy and reliability are critical, these tiny machine tools will play a vital role and can provide the needed criteria.

Machining is the removal of materials consist of a chip using a wedge-shaped tool. The most typical is metal cutting manufacturing process in industries The finite element analysis (FEM) is becoming the primary tool for metal simulation cutting procedures Depending on the cutting conditions, the chip might well be continuous, fragmented, or discontinuous. Temperature Wear resistance, work piece interface polish, micro - hardness, and energy requirements are all affected. Many researchers concentrated their research. on chip formation prediction during high-speed milling.High speed manufacturing is commonly associated with spindle speeds exceeding 15k rpm, although it is much more than that. When selecting any great fit machine for HSM, the entire machine must be considered. Thermal compensation, rotating machines stiffness and structure, positioning information, the mobility control system, tool attachment, and many other factors must all be carefully considered before deciding on a machine for the job. Figure 3: Illustrate the momentum and inertia origin from high speed machining.

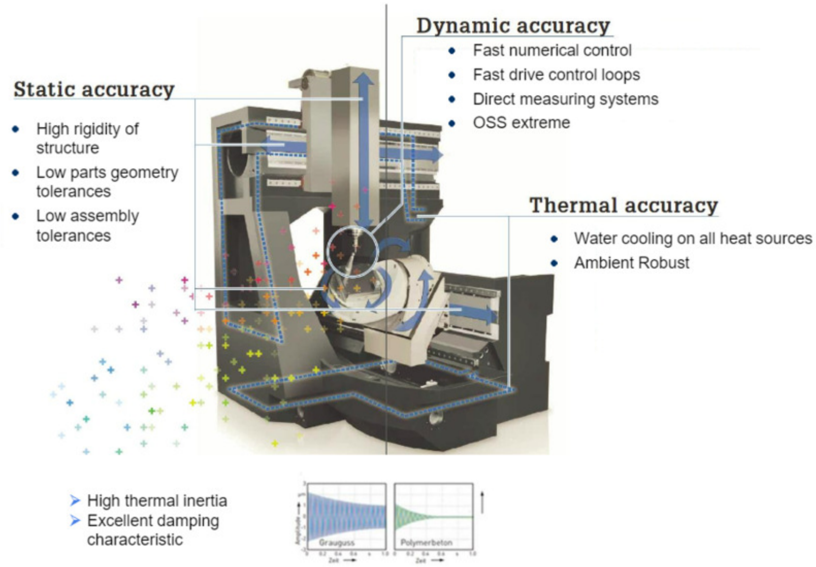

Figure 3: Illustrate the momentum and inertia origin from high-speed machining[15]

High speed manufacturing is commonly associated with spindle speeds exceeding 15k rpm, although it is much more than that. When selecting any great fit machine for HSM, the entire machine must be considered. Thermal compensation, the rotating machine's stiffness and structure, positioning information, the mobility control system, tool attachment, and many other factors must all be carefully considered before deciding on a machine for the job.

Precision and microscopic scale manufacturing sectors are key users of high-speed machine tools. Micro and nanoscale manufacturing is the focus of study in the twenty-first century. The available micromachine tools have a minimal precision of 1 nm and consistency of 50 to 300 nm due to advancements in the control system and machine tool components. As a result, HSM is widely employed in precise and micromachining applications. The surface finish of a machined item following high-speed machining provides additional information on the physiological qualities of the part. surface machining Surface integrity involves the presence of microcracks, surface polish, untempered and over-tempered steels, and other factors. Mertensite, phase conversion, residual machining stresses, carbide pull-out from the surface layer, plastic deformation, and microhardness change It is well known that residual tension on the machining surface and subsurface exists. Fatigue life, tribological characteristics, and distortion all have an impact on a component's service quality. The cutting mechanism of HSM varies from traditional machining due to the workpiece's thermal softening effect over strain hardening. Furthermore, it has been shown that HSM produces a substantial quantity of heat. In reality, temperatures in the primary shear zone are high enough to soften the cutting material, resulting in a decrease in cutting forces. Cutting forces are significantly higher in traditional machining. Because of the shallow depth of cut and high cutting speed used in HSM, the machined surface authenticity and surface quality are significantly different from conventional machining, resulting in the elimination of built-up edge formation, pecker outer edge, stress-free components, and extremely better surface finish.

4. CONCLUSION

In conclusion, HSM is a growing and important machining technology with several applications in various sectors including aircraft, automotive, electronic, and medicinal for microfabrication, accuracy machining, high-dimensional data accuracy, and surface polish. HSM will replace sluggish machine tools with advanced high-speed machine tools in the future for increased productivity, precision, sustainability, and economy. •HSM necessitates the use of specialized cutting tools that can spin at high speeds without failing. Furthermore, the filet knife materials must be capable of withstanding high cutting temperatures. To support vibration caused at maximum speed during metal cutting, the HSM machine base must be vibration free and rigid. As a result, it necessitates the search for high-damping materials as well as system design. There is still a need to design and refine submicron stages with the appropriate travel range for precision micromachining. Aside from fast cutting speed, HSM involves several aspects such as chip unloading, feed, depth of cut, gear, CAM software, and CNC controllers. As a result, research into the impact of these characteristics on exceptional productivity, the environment, and indeed the economy is required. As the world moves toward shrinking machinery components, it will open up a new field of study for the creation of hyper micro/Nano machine tools and the optimization of current high-speed microscopic machine tools for increased accuracy and output values outcomes.

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CHAPTER 19

COMPREHENSION OF WORKING OF HYBRID REGENERATIVE BRAKING SYSTEM

Mr. Robin Khandelwal, Assistant Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-robinkh16@jnujaipur.ac.in

ABSTRACT:

Regenerative braking is a mechanism used on electric and hybrid automobiles to replenish the battery and aid the hydraulic brake system in stopping them. It is used because it transfers kinetic energy from braking into electricity supply that charges the vehicle's power line battery. Regenerative braking systems are intended to collect, store, and reuse part of the braking energy of a vehicle in order to increase fuel efficiency or extend the range of hybrid and electric vehicles. Electric batteries and/or supercapacitor, flywheels, and hydraulic accumulators are examples of energy storage medium. The main out6come of this is its saves energy and help the environment to no polluted. Future regenerative brake technologies will also include new types of motors that are more economical as generators, new motor drive designs that are constructed with mechanical energy in consideration, and electric systems that are less prone to power dissipation.

KEYWORDS:

Electric, Energy Storage, Hybrid Braking System,Mechanical Energy, Regenerative Braking.

1. INTRODUCTION

When a traditional vehicle engages its braking, kinetic energy is transformed to heat due to friction between the disc brakes and the wheels. This heat is carried away in the airstream, resulting in energy waste. The overall amount of electricity lost in this manner is determined by how frequently, how hard, and just how long the breaks are deployed. Regenerative braking is a procedure in which a part of the vehicle's kinetic energy is saved via a short-term storage mechanism. A power transfer system directs energy ordinarily squandered in the brakes to the energy reserve during deceleration. On the mom way, a truck might drive 100 miles between stops. Even if the mechanism is 100% efficient, this represents a little savings. Driving in the city center includes considerably more braking actions, resulting in a much larger energy loss and bigger potential savings. There is much greater economic potential with buses, taxis, tractor trailers, and so on.

Fuel efficiency is an energy recovery methodology that slows a moving car or object by converting the latter's angular momentum into a form that can be employed instantaneously or stored until it is needed. The electrically powered motor in this system leverages the vehicle's movement to recover electricity that would be lost to the brake pads as heat. This approach differs from traditional braking methods. Excess kinetic energy is transformed to undesirable and wasted heat in such systems owing to friction in the brakes or with regulates body temperature brakes, where its energy is recovered by employing electric engines as generator but is instantly dissipated as warmth in resistance.

The regenerative braking used as breaking system because regenerative braking enhances energy production for a similar energy input to a vehicle, efficiency improves. The number of tasks done by the vehicle's engine is reduced, resulting in a reduction in the quantity of primary energy necessary to propel that vehicle. The primary energy saved over a specific lifetime must outweigh the system's initial cost, size, and weight penalties in order for a system of regenerative braking to be cost effective. Any auxiliary resource transfer or electricity production equipment should be efficient, small, and reasonably priced, and the energy storage unit should be compact, robust, and capable of managing high power levels effectively.

A Hybrid Electric Vehicle (HEV) merges an EV powertrain system with traditional powertrain components such as an internal combustion motor. A PHEV is made up of an electrical powertrain equipment and a conventional powertrain system that both deliver power to the drive motors at the same time. An HEV can possibly increase the engine performance envelope and fuel efficiency while decreasing pollutants by combining an auxiliary powertrain, such as an internal combustion engine alternator combo, with a traditional EV powertrain. A hybrid system is a vehicle that combines two types of drive (an internal combustion motor (ICE) and an energy storage device). A series hybrid drive, includes three primary system components that are organized in series: an ICE, a generator, and an electric motor. The generator converts the mechanical energy created by the ICE to electrical energy, which is then turned back into mechanical power in the motor. Losses from each of the heat exchange steps are inherent in the process. The vehicle powertrain is made up of nonlinear systems that drive the wheels, such as the engine, gearbox, differential, and axle system. Furthermore, many accessories like as serpentine belt, power brakes, and air conditioners are linked to the engine. The vehicle drivetrain is a collection of electromagnetic, mechanical, chemical, and thermodynamic elements that work together as a nonlinear dynamic integrated system to provide transportation power.

The oil burning unit in hybrid systems can function under steady-state circumstances, allowing products of combustion to be reduced to a minimum. When the steady-state production exceeds the vehicle requirement (at low speed with aaffic), energy is stored and utilised to supplement. when it is required (when accelerating). The engine may be separated from the road load. Permits the vehicle to be run close to its most economical fuel usage settings or switched off. More complex braking systems have been developed in recent years, allowing us to adjust the force on each wheel individually. The completely programmable hybrid brake system may be programmed to provide braking forces to both the front and back wheels in accordance with the proper braking force distribution . This control approach is capable of achieving optimal braking performance.

When the needed total braking force for the front axles is less than that provided by the electric motor, the total braking force is produced by the electric motor, and no rear brake force is applied. Nonetheless, mechanical braking generates the whole braking force required for the rear wheels to adopt the I-curve,When the needed total braking power on the front wheels exceeds the capacity of the dc engine, both electric and mechanical brakes must be used. To capture additional braking energy, the electric motor should indeed be set to create its maximum braking force, which is limited by the electric motor or power efficiency.

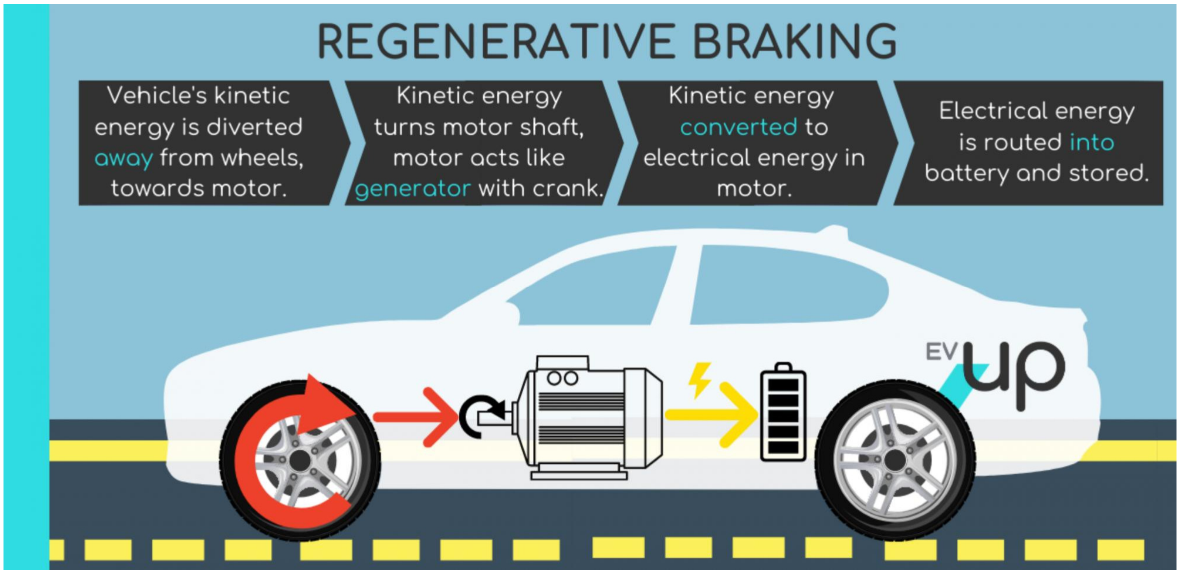

Figure 1: Illustrates regenerative hybrid breaking system procedure.

2. LITERATURE REVIEW

In a study [1], The author Qiwei Zhou et al. Discussed the coordinated control of regenerative braking system and abs in hybrid electric vehicle based on composite structure motor. An anti - lock braking system (ABS) ensures that the wheels do not lock during the braking process, which is an important device for braking safety. Regenerative braking is an important device for hybrid automobiles since it increases the car's cruising range. As a result, mix and match of a disc brake and an Abm is a critical study area. The coordinated management of the regenerative brakes and the ABS in the sports vehicle based on the monocoque motor is investigated in this study (CSM-HEV). First, two novel braking modes are proposed: turbocharger coordinated slowing (EMCB) dual and braking (DMB), as well as a coordinated control model for regenerative braking and ABS.

In study [2], The author Julius Abouelamaimen et al . Discussed The role of supercapacitors in regenerative braking systems. A supercapacitor module was used as the energy storage system in a regenerative braking test rig to explore the opportunities and challenges of implementing supercapacitors for regenerative braking in an electric drivetrain. Supercapacitors are considered due to their excellent power density and cycling characteristics; however, the performance under regenerative braking conditions has not been well explored. Initially the characteristics of the supercapacitor module were tested, it is well known that the capacitance of a supercapacitor is highly dependent on the charge/discharge rate with a drop of up to 9% found here between the rated capacitance and the calculated value at a 100 A charge rate.

In a study, The Author Peng Karimi et al. disucussed an unique fuzzy sliding-mode control method inside an adaptive control approach for energy management mechanisms in regenerative braking electric automobiles The fuzzy logic controller's efficiency is demonstrated by its ability to alter the sliding mode settings based on the slip ratio position error between the desired slip ratio and the real slip ratio. Specifically, by setting the pneumatic brake torque and motor torque, the suggested torque distribution approach may integrate the optimal battery state and energy efficiency under realistic limits.

In a study [3], The author Ricardo Mendes et al. discussed Regenerative braking system modeling by fuzzy Q-Learning. The regeneration factor, which indicates the ratio of braking energy recovered to battery to total deceleration energy, is difficult to quantify with independent sensors. In this research, a based optimization (RL) approach is utilised to update and refine a fuzzy logic model for diesel generator (FLmRB) for modelling the regenerative braking systems of Electric Vehicles (EV) (RBSs). A professional may deduce the regeneration factor using the suggested technique by tweaking the model for a given EV using real data acquired from field testing, with only variables measured by independent equipment, namely EV accelerating and jerking, and road inclination, as inputs.

In a study [4],The author Xiaohong Peng et al Discussed Regenerative braking system of electric vehicle driven by brushless DC motor. Regenerative braking can help reduce energy and increase the range of electric cars (EVs). This study demonstrates a new regenerative braking system (RBS). The RBS is designed for brushless dc (BLDC) motors and focuses on braking force distribution as well as BLDC motor management. The classic proportional-integral-derivative (PID) control is used in this study for BLDC motor control, while fuzzy logic control is used for braking force distribution. Because difficulties and problems is longer than PID control, PID control can regulate the braking torque in real time. In compared to existing alternatives, the new approach performs better in terms of realisation, resilience, and efficiency.

In a study [5], The author Hongjuan Zhang et al . Discussed Multi-Parameter Collaborative Power Prediction to Improve the Efficiency of Supercapacitor-Based Regenerative Braking Systems. Designed according to the requirements regenerative braking technology improves the motor's energy use efficiency. The power imbalance between of energy storage device and the motor, on the other hand, would lead the powersource to absorb electricity from the power grid, resulting in wasteful energy loss. To address the power mismatch, this research proposes a multi-parameter collaboration power prediction management of a motor-driven system. The mechanism of the flow of energy is examined.

In a study [6], The author Yang Tang, et al . Discussed Dynamic coordinated control for regenerative braking system and anti-lock braking system for electrified vehicles under emergency braking conditions. The economy of electronic cars may be increased by employing the motor to collect braking energy. However, because the vehicle's regenerative braking (RBS) and anti-lock hydraulic cylinder (ABS) are incompatible, the energy lost while brake cannot be recovered in an emergency. The logic threshold control approach combined with parametric analysis is used in this research to investigate the relationship between slip rate and the stopping tension during the ABS compression stage and to get the composition rule of something like the braking horsepower necessary for ABS braking. To increase the efficiency of brake energy recovery, a control approach to integrate RBS and ABS while activating ABS is proposed based on this rule.

3. DISCUSSION

Mechanical braking induces friction between the brake pads and the brake disc. It wastes heat by converting the vehicle's kinetic energy. However, the regenerative mechanism recovers part of the wasted energy and repurposes it. This waste energy is captured and converted into power by the system. Renewable power recharges the batteries of an electrical or hybrid car.

The parking brake has been frequently used on electrified railroads by employing train motors as generators when braking. For many years, this idea has been used, and with the increasing electrification of railroads, many electric trains have been constructed with such mechanisms in mind. The easy accessibility of sophisticated electronic parts and advances in control circuitry has increased the efficiency of railway regenerative braking.

According to one report, electrical energy usage is lowered by 37%. Several computer simulation studies have been performed to simulate the effect of electric engines on voltage regulation and load flow. By reversing the process that propels the automobile forward, regenerative braking converts kinetic energy into electricity. The drivetrain in electric vehicles is supplied by a battery pack, which drives motors (or motors), generating torque-rotational forceon the wheels. In other words, excess electricity from the battery is converted into mechanical energy, which drives the wheels. The momentum from your spinning machine is utilized to change the direction of power - from the electromotor (s) to the batteries - using regenerative braking. To initiate regenerative braking, just withdraw your foot from the throttle or, in certain situations, press the brake pedal. Electrically powered vehicles can save energy if they utilize appropriate control systems to transfer KE to electrical power for storage and actually. An electric vehicle's drive motor can be configured to serve as a generator, giving a variable resistor and brakes torque to the legs. The electric motor acts as a generator to keep the battery charged during regenerative braking. Since there are significant fixed mechanical losses, the process is less efficient at low power, therefore regeneration is not practicable at low speeds and must be complemented by hydraulic brakes.

In regenerative braking, the generator that powers an electric vehicle simultaneously serves as a brake. The system comprises a dual-function electric motor. It functions as a motor in one motion and as a generator in the other. It turns mechanical energy into electricity and drives the tires when used as a motor. Nevertheless, while braking, it reverses direction and transforms into an electricity generator. When you use the brakes on a hybrid or electrically powered car, the electric motor reverses direction, putting it in generator mode. As a consequence, the wheels slow down.

For many years, the automobile industry has studied hydraulic regeneration devices for use in hybrid cars. A gas-filled hydraulically accumulator is a potential energy production device that takes the form of a cylindrical or spherical vessel that can contain huge volumes of physiological fluid under pressure. The gadget stores energy by compression of a gas (often nitrogen) and has proven to be far more practical than weight or spring-loaded types. They are also lighter, less expensive, and more compact. An accumulation, an oil reservoir, and a variable displacement injector comprise the hydraulic system. The wheel-driven hydraulic pump generates pressure in the reservoir and transfers energy via the purple motor unit.

Figure 2: Illustrates an accumulator.

A car's braking system is typically based on anti-lock brake technology. However, because it generates unneeded heat while braking, the typical braking approach wastes a lot of energy. As a result, the introduction of mechanical energy in electric cars has addressed these difficulties, and it also helps to preserve energy and gives greater efficiency to a car. In regeneration mode, the motor acts as a generator, converting kinetic energy to electrical energy to recharge the battery or capacitors. Meanwhile, the brake connection with this study the wheel speed and calculates the needed torque as well as the extra energy from the rotational force that may be converted into electricity and supplied back into the banks during regeneration mode.

The regenerative braking method receives brake pressure orders as a psi signal from the master cylinder's pressure sensor. This signal is finally transformed to electric brake torque (Nm) by the motor to aid the hydraulic brakes. As a system backup, the brake button is also utilized to detect braking. The operator is not controlling braking if somehow the pedal switch and piston rod sensor indicate low. If there is a brake sensor command, the driver is controlling braking. After passing via the brake control design subsystem, the voltage request from the driver block reaches the battery subsystem. The positive power empties the battery while the negative power charges it. The battery is depicted as a look-up table, with the battery parameters of conventional, electric, combination, and fuel cell automobiles swiftly analyzing their performance and fuel efficiency.

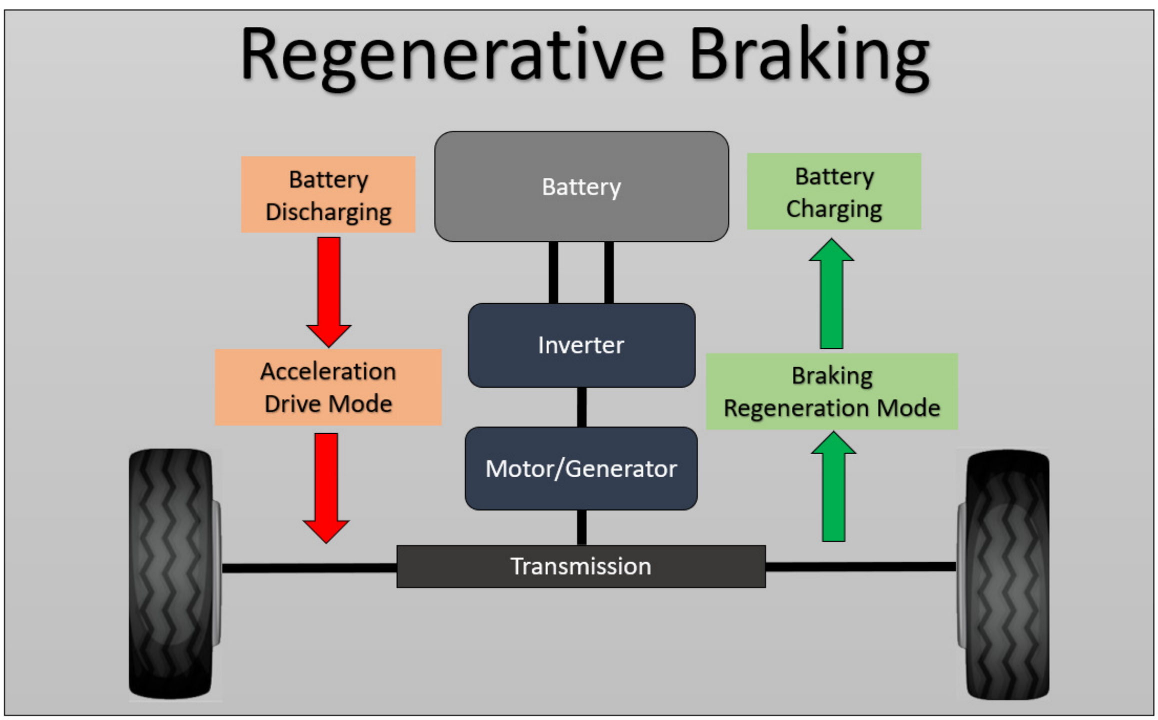

Figure 3: Illustrates the working of a hybrid regenerative braking system.

The user may receive datasheets, modify vehicle and component specs, and run them under different test settings. The battery has an early SOC of 90%. When positive power is applied, the discharge block is activated. In the discharge block, we calculate the maximum module voltage that may be given based on the SOC vs voltage plot of the battery system. This component voltage is then multiplied by the number of cells connected in series to calculate the battery pack voltage. The current that can be delivered to the motor is then calculated using the electrical load and the highest achievable voltage at that SOC.

The greatest amount of energy that the generator can sustain limits this current. When a negative voltage is applied, the charge block is activated. In the charge block, we determine the maximum feasible charge electricity and voltage that can be delivered into the battery based on the SOC levels and as previously mentioned. This current is also restricted by the generator's maximum current capabilities. When the power requirement is zero, the vehicle comes to a complete stop, or the braking force is insufficient to provide a substantial voltage, the cell idle block is activated. During this period, no current is removed or returned. Figure 3 illustrates the working of a hybrid regenerative braking system.

To deliver the best of both worlds, hybrid electric vehicles combine an electric motor with an internal combustion engine. They combine an internal combustion engine's operating range with the fuel economy and emissions-free qualities of an electric motor. If a hybrid is to maximize fuel economy and emit as low carbon emissions as feasible, the battery must be charged for as long as possible. If the battery in a hybrid car loses its charge, the combustion engine is completely responsible for operating the vehicle. At that time, the vehicle is not again a hybrid, but rather a regular automobile that runs on fossil fuels.

Automotive experts have devised a variety of tactics to maximize hybrid efficiency, such as aerodynamic body slimming and the use of composite materials, but regenerative braking is likely the most essential. However, in a hybrid arrangement, these sorts of brakes can only supply energy to the electric motor portion of the powertrain via the aircraft's battery. Internal combustion engine. This kind of brake provides no benefit to the engine. These efficiencies are required in part owing to the significant difficulty of locating a location to recharge a hybrid. Longer excursions are difficult while relying on the turbo engine internal combustion engine which negates some of the benefits of having a hybrid.

4. CONCLUSION

Regenerative braking is an important feature in electric vehicles since it may save up to 8-25% of wasted energy. This quantity of energy saved can be utilized to lengthen our daily commute or to boot up the car's accessories. Also, modern power electronic components such as a supercapacitor, DC-DC converter (Buck-Boost), and flywheel have improved the regenerative braking system. The ultracapacitor improves the car's transient condition at startup, provides a smoother charging characteristic for the battery, and improves the overall operation of the fully electric system. The Buck-Boost converter aids in power management in the regenerative braking system by increasing acceleration. Furthermore, the flywheel is employed to improve the power recovery process via the car's wheel. Regenerative braking systems are constructed to collect, store, and reuse part of the braking energy of a vehicle to increase fuel efficiency or extend the range in hybrid and electric vehicles (FEV/HEV). Electric batteries and/or ultracapacitors, flywheels, and hydraulic accumulators are examples of energy storage mediums.

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CHAPTER 20

INVESTIGATING THE FUNCTION OF MULTI-VALVE ENGINE

Mr. Dipendra Kumar, Associate Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-dipendra1987@jnujaipur.ac.in

ABSTRACT:

A cross or multivalve engine does have more than two valves in each cylinder. A multi-valve engine may breathe better and function at greater revolutions per second (RPM) than a 2 different engine, resulting in more power. It offers more airflow because of the increased coverage, as well as the location of the fuel pump in the middle of the head for improved flame propagation. The main benefits of a multi-valve head are that it allows for even more airflow via larger coverage, that the spark plug is placed in the middle of the cylinder for better flame propagation, and that it leads to increased efficiency. The main outcome of the multi-valve is that increases actuator area and optimizes intake and exhaust valves flow, improving combustion, volume flow rate, and energy density. In the future, Exhaust valves open to enable the evacuation of engine exhaust from the complete combustion after ignition, whereas intake developed to allow the passage of an air/fuel combination into the vehicle's chambers before compression and ignition.

KEYWORDS:

Combustion, Cylinder Head,Multi-Valve, Multi-Layer Valve, Revolutions.

1. INTRODUCTION

To improve performance, multi-valve engine designs have three, four, or five valves per cylinder. Any four-stroke internal combustion engine requires at least two valves per fuel tank: one for air intake (and often fuel and another for combustion gas exhaust. Increasing the number of valves expands the valve area and improves the flow of intake as well as exhaust gases, improving combustion, volumetric efficiency, and power output. Because of the multi-valve geometry, the spark plug is ideally located within the combustion chamber for optimal flame propagation. Multi-valve engines typically have smaller valves with lower reciprocating mass, which can reduce wear on each cam lobe and allow for more power at higher RPM without the risk of valve bounce. Some electric motors are designed to open each intake pipe at slightly various periods, increasing turbulence and improving air-fuel mixing at low engine speeds. More valves also help to keep the cylinder head cool. The disadvantages of inter engines include increased manufacturing costs and the possibility of increased oil consumption due to the increased number of the valve stem seals. Some SOHC multi-valve engines (such as the Mazda B8-ME) are using a single spoon rocker arm to drive two valves (generally the exhaust valves) to reduce manufacturing costs by using fewer cam lobes.

1.1 Three-valve cylinder head

There is one large exhaust valve and two smaller intake valves on this. A three-valve layout allows for better breathing than a two-valve head, but the large exhaust valve limits RPM to the same level as a two-valve head. This design may have lower manufacturing costs than a four-valve design. The three-valve design was popular in the late 1980s and early 1990s, and it was the primary valve arrangement used in Ford De trucks and Ford SUVs beginning in 2004. The Ducati ST3 V-twin had found 3 heads.

1.2 Four-valve engine

This technology incorporates four valves, two for each of the engine's inlet and exhaust valves. As a result, it is distinct and superior to the conventional engine design, which employs one valve for each inlet and exhaust valve. This engine employs valves in the same way that the human nose does. So, two inlet valves mean more area to suck the air-fuel mixture in.

3.3 five-valve cylinder head

The five-valve head, with two exhaust valves and three inlet valves, is less common. The size of all five valves is comparable. Because each valve is small, high RPM and very high power outputs are theoretically possible with this design. Although a five-valve engine should have a higher maximum RPM than a four-valve engine, and the three inlet ports should provide efficient cylinder filling and high gas turbulence (both desirable characteristics), it has been queried whether a five-valve configuration provides a cost-effective advantage over four-valve designs. Because the injector must take up some space on the head, the rise of direct injection may make five-valve heads more difficult to engineer.

Yamaha has returned to the four-valve design after producing five-valve Genesis engines for several years.The various 1.8 L 20vT engines manufactured by AUDI AG, future models of the Ferrari Dino V8, and the 1.6 L 20-valve 4A-GE engine manufactured by Toyota in collaboration with Yamaha are examples of five-valve engines.

3.4 Beyond five valves

The total valve area decreases as the number of valves exceeds five for a cylindrical bore and equal-area-sized valves. The table below shows the effective areas of various valve quantities as a function of the cylinder bore. These percentages are based on simple configuration and do not account for orifices for spark plugs and injectors, but these voids are typically located in "dead space" that is not available for valves. In addition, in heads that have a uniform number of valves per cylinder, intake valves are frequently larger than exhaust valves

LITERATURE REVIEW

Tsuzuku, Hiroyuki Tsuchida, and Naoki [1] explained the Output and fuel consumption of motorcycle multi-valve engines explained There were four, five, and six-valve engines built, with two, three, and four intake valves, respectively. The relationship between the intake valve means effective area and the number of valves required to achieve the required maximum output was then scrutinized using these engines by varying the intake specifications. By comparing the cylinder flow of four and five-valve engines, the improvement of ignition in the light load range at low speeds was also investigated. As a result, it was discovered that the maximum output of multi-valve engines is proportional to the intake valve mean effective area for an identical single cylinder volume and generated at essentially the same mean intake Mach number irrespective of the number of valves. In addition, the consequence of five-valve engines with the larger intake valve implies effective area than four-valve engines showed they were able to attain both satisfactory mean flow coefficient and tumble

López, E. J. and Nigro, N. M.[2] explained validation of a 0d/1d computational code for the design of several kinds of internal combustion engines It is presented a code for computational simulation of internal combustion engines. The ow through pipes and manifolds are modeled using onedimensional gas dynamics equations, while the remaining components inside the engine (cylinders, valves, etc.) are modeled using thermodynamic or

0D models. The developed numerical code can simulate spark ignition and compression ignition, two-stroke and four-stroke, multi-cylinder and multi-valve engines, naturally aspirated or turbocharged, and various combustion chamber geometries. The code was written in Python, which is a dynamic item programming language with strong support for integration with other programming languages and instruments. The computational techniques used in the discretization of the formulae are presented, as well as implementation details. Several test cases are also included to demonstrate the code's performance.

K. Nariman-Zadeh[3] explained the modeling and multi-objective optimization of a variable valve-timing spark-ignition engine using polynomial neural networks and evolution which The flow restriction at the cross-sectional area of the intake system is the primary cause of the efficiency decrease at part load for four-stroke spark-ignition (SI) engines. Valve timing has traditionally been designed to optimize operation at high engine speeds and large open throttle conditions. Several studies have shown that variable valve timing can improve engine performance under part-load conditions. Controlling valve timing can be used to improve torque and power curves while decreasing both emissions and fuel consumption. A group method of data handling (GMDH) type neural network and evolutionary algorithms (EAs) are first used in this paper to simulate the impacts of intake valve-timing (Vt) and engine speed (N) of a flash engine on both developed engine torque (T) and fuel consumption (Fc) using experimentally obtained training and test data. Using such obtained polynomial neural network models, a cross EA (non-dominated sorting genetic algorithm, NSGA-II) with a new diversity maintaining mechanism is then used for Pareto-based optimization of the variable valve-timing engine, taking into account two competing objectives such as torque (T) and fuel consumption (Fc). The comparison results show that GMDH-type models outperform feedforward neural network models in terms of statistical measures in training data, testing data, and the number of hidden neurons. Furthermore, it is demonstrated that the Pareto-based multi-objective optimization of polynomial models can uncover some interesting and important relationships, as well as useful optimum principles, involved in the performance of the valve's four-stroke spark-ignition engine.

Pengyun Jiang,[4] et al. explained CFD analysis of a gasoline engine exhaust pipe The exhaust pipe is an essential component of a gasoline engine. Its structure and performance have a serious influence on engine power, economy, and emissions, and it is one of the key technologies in the development of multi-valve engines. Solidworks Flow simulation was used to analyze the exhaust pipe to test the theoretical design of a 1.5L gasoline exhaust pipe. Pressure and velocity near the three-way catalytic converter and the oxygen sensor had been studied selectively. The results of the CFD simulation shows that the internal flow is laminar, and the sensor position is reasonable.

Andrew B. Moran,[5] et al. discussed gasoline/alcohol blends: Exhaust emissions, performance and burn-rate in a multi-valve production engine which A variety of gasoline/alcohol blends with up to 5% oxygen content by mass, including methanol, ethanol, isopropanol, and n-propanol, were tested in a multi-valve output turbocharger to quantify raw exhaust emissions, performance, and burn-rate. A heat-release prototype was developed to facilitate the measurement of the burnrate. The engine was run with a variety of control strategies, allowing the results to represent the response of various engine types. Alcohols reduced the equivalence ratio with regular open engine calibration, resulting in increased combustion duration and lower regulated emissions, with no difference between the impact of the various alcohols.

Huyong Miganakallu,[6] et al. explained To achieve an over-expanded cycle, high compaction with late intake valve closing (LIVC) is a common approach used by high-efficiency engines. A multi-link cranktrain can also achieve an over-expanded cycle, with the same geometric intake dislocation as a baseline engine but a longer expansion stroke. This simulation study investigates and compares two types of over-expanded circuit engines and baseline engines. The baseline engine model is based on experimental data from a four-cylinder, boosted, the flash of the light engine with a compression ratio (CR) of 10.5:1. The CR of a high compression ratio engine is 13.0:1 and that of a multi-link over-expanded motor is 10.5:1.

Jiajie Li, et al. explained Diesel engine condition monitoring and fault diagnosis are critical for safety production and maintenance cost containment. The digital twin method, which is based on info and physical model fusion, is gaining popularity. However, existing methods for dealing with complex physical systems lack tighter integration and optimization. The majority of deep learning algorithms transform data into physical model substitution. The deep learning diagnosis model's lack of interpretability limits its practical application. To gain access to interpretability, the ann model is gradually developed. In this paper, a digital twin auxiliary approach based on an adaptive sparse attention network is proposed for diesel engine fault diagnosis, taking into account its signal characteristics of strong angle domain correlation and momentary non-stationary, and a new soft threshold filter is designed to draw more attention to multi decentralized local fault information dynamically in real-time. The distribution of fault data within the initial signal can be better visualized using this attention mechanism to help explain the failure mechanism.

N. Arcoumanis, [7] et al. explained mixture distribution in a multi-valve twin-spark ignition engine equipped with high-pressure multi-hole injectors which Laser-induced fluorescence has primarily been used to categorize the two-dimensional fuel vapor intensity inside the cylinder of a multi-valve twin-spark engine with high-pressure multi-hole injectors. The effects of injector tip layout, in-cylinder charge motion, and injection timing have all been quantified. The flexibility of multi-hole injector nozzle design has proven to be a powerful tool for matching the total spray cone angle and the number of holes to specific engine architectures. Spray impingement on the piston and cylinder wall was found to be controlled by injection timing, contributing to quick and effective fuel evaporation. It was confirmed that in-cylinder charge motion plays a significant role in engine stability by assisting in the road transport of the air-fuel mixture toward the ignition places (i.e. spark plugs) in the form of a uniformly distributed charge or by preserving charge stratification depending on the engine's operating mode.

Peter Heuser[8] et al. explained the results of both theoretical and empirical investigations in the field of the variable feeding influence of flash engines. Different degrees of freedom for a variable intake profile are considered and evaluated in terms of their potential to reduce pumping losses, support mixture formation, and enhance combustion, such as variable intake opening and closing events, valve lift, and the disablement of one of the intake valves per cylinder of either a multi-valve engine. According to the findings, more effort is required to convert the potential of reduced pumping losses due to unthrottled SI-engine loading into fewer gallons of fuel and good driveability. Increased gas velocities during intake for low load and engine speed, as well as adjusted residual-gas fractions based on operating conditions, prove to be very efficient parameters for improving the performance of the engine under unthrottled conditions.

Peter Heuser, [8] et al. explained strategies to improve si-engine performance employing variable intake lift, timing, and duration which are the results of theoretical and experimental investigations in the field of variable intake-valve control of spark-ignition engines. Different degrees of freedom for a variable intake profile are considered and evaluated in terms of their potential to reduce pumping losses, support mixture formation, and improve combustion, such as variable intake opening and closing events, variable valve lift, and the discontinuation of one of the intake valves per cylinder of a multi-valve engine. According to the findings, more effort is required to convert the potential of reduced pumping losses due to unthrottled SI-engine loading into reduced fuel consumption and a good drivetrain. Increased gas accelerations during intake for low engine speeds and loads, as well as adjusted residual-gas fractions for different operating conditions, prove to be very efficient parameters for improving engine performance when running unthrottled. Another important consideration is the optimized intake-lift profile for maximum volumetric efficiency across the entire engine speed range while taking into account the dimensions of the intake manifold and the ability to uninstall one of the intake valves of a 4-valve-per-cylinder engine.

3. DISCUSSIONS

Energy Efficiency of the Traditional Cae

During the compressed air state change process, the energy of compressed air could be decided to convert to mechanical work. In Figure 1, the working process of a single-cylinder CAE can be divided into three stages. The previous literature has depicted the working process.

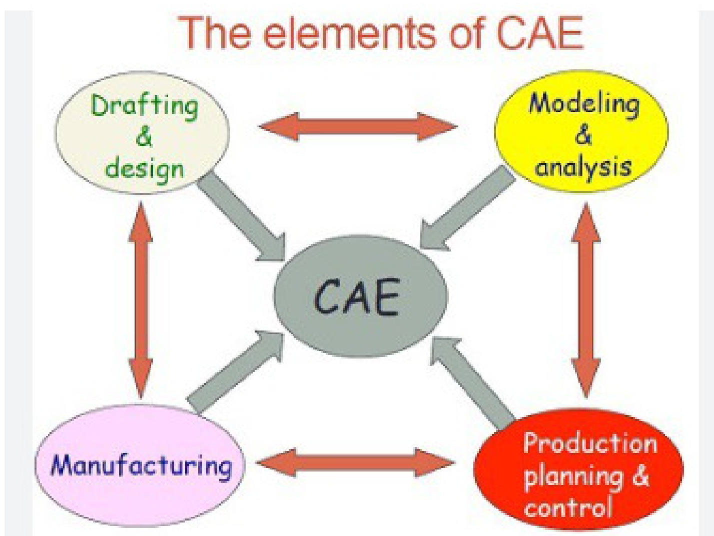

Figure 1: Represent the Energy Efficiency Of The Traditional Cae

3.1 Multi-valve design

To boost performance, a multi-valve design often contains three, four, or five actuators per cylinder. Each four-stroke internal combustion engine requires at least two valves in every cylinder: one for air and fuel intake and another for combustion gas exhaust. Increasing the number of valves expands the valve area and enhances the flow of intake and exhaust gases, improving combustion, volume flow rate, and power production. Because of the multi-valve shape, the spark plug is optimally situated inside the combustion chamber for optimum flame propagation. Multi-valve engines often feature smaller valves with lower reciprocating mass, which may minimize wear on each cam lobe and allow for greater power at higher Velocity without the risk of valve bounce. Certain engines are designed to expand each intake valve at a slightly different time, increasing turbulence and enhancing air-fuel mixing at low engine speeds. Additional valves also help to keep the cylinder head cool. The downsides of multi-valve engines include increased production costs and the possibility of increased oil consumption owing to the increased number of valve stem seals. Certain SOHC multi-valve engines (such as the Mazda B8-ME) employ a single fork-shaped rocker arm to drive two valves (usually the exhaust valves) to minimize manufacturing costs by using fewer cam lobes.

3.2 Three-valve cylinder head

There is one huge exhaust valve and two smaller intake valves on this. A three-valve head provides more ventilation than a two-valve head, but the huge exhaust valve limits RPM. This design may have cheaper production costs than a four-valve variant. This design was popular in the late 1980s and early 1990s, but four and five-valve versions have mostly replaced it.

3.3 Four-valve cylinder head

This is the most common style of multi-valve head, having two exhaust valves and two intake valves that are comparable (or slightly bigger). This design provides comparable ventilation to a four-head, and since the tiny exhaust valves allow for high RPM, it is ideal for high-power outputs.

3.4 Five-valve cylinder head

The five-valve head, with two exhaust valves and three intake valves, is less frequent. The size of all five valves is comparable. Since each valve is tiny, this design allows for efficient breathing as well as high RPM and extremely high power outputs. It has been questioned whether a five-valve arrangement provides a significant advantage over four-valve versions. A five-valve design ought to have a greater total RPM, and the three intake ports should provide excellent cylinder filling as well as high turbulence (both desirable traits). After many years of producing the five-valve Genesis engine, Yamaha resorted to a more expensive four-valve design. Figure 2 represents the multi-valve engine.

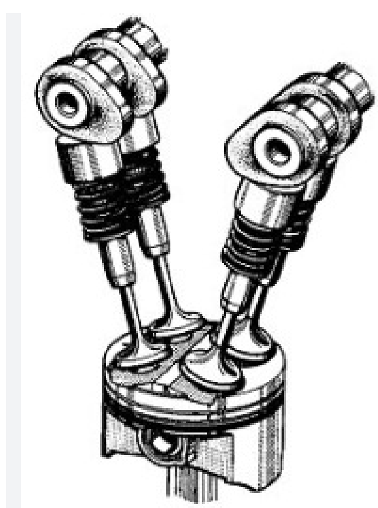

Figure 2: Represent the multi-valve engine.

3.5 working principle behind a multi-valve engine

A four-stroke internal combustion engine needs a well-burning air-fuel combination within the combustion chamber to provide a decent level of power while also delivering excellent fuel economy. The air-fuel combination may enter the combustion via the valves. Naturally, if the intake valves allow for a greater flow of air into the combustion process, the engine will be able to breathe better, resulting in more effective fuel combustion.

To demonstrate this mathematically, envision the intake valve on a two-valve engine as a single, huge circle, as well as the intake valves on a three or four-cylinder engine as multiple side circles. Now, the quantity of air that these valves can permit into the combustion process is mathematically represented either by the wall area of the imaginary cylinder that is produced when the valves are pushed inside. Assuming the valve travel in all circumstances is the same, say, X, we must do the following calculation.

3.6 advantages of a two-valve per cylinder setup

There are several benefits to using a three or four-gate cylinder over a two-valve cylinder. Yet, there are some disadvantages. A two-valve cylinder has its own set of benefits as well, and that's precisely the reason why there still are so many conventional two-wheelers that have two valves per cylinder. These are a few of the benefits of a two-valve arrangement that make them relevant even today.

A two-valve-per-cylinder configuration is both simple and economical. A four-valve system is more capable, but it is more complicated and harder to design and manufacture. A four-valve arrangement is much more difficult to get properly in terms of metallurgy and thermodynamics than a two-valve system. The intricacy of a four-valve system also contributes to an increase in expenses. As a result, four-valve engines are much more costly and are not necessarily the best solution for a price-sensitive market like ours.Lastly, since the airflow is constrained, the layout of a two-valve-per-cylinder engine tends to permit stronger low and mid-range torque in certain circumstances. This is countered by four-valve engines with variable valve timing.

In a nutshell, three or multiple engines are often superior to their two-valve counterparts and are more desirable if the additional expense is acceptable. Two-valve units, on the other hand, are still very capable if money is a consideration; they're dependable, fuel efficient, and provide dependable performance for daily usage.

CONCLUSION

The valves are situated in the engine's head and are responsible for allowing air and/or fuel into the chambers to be combusted (intake valves) and allowing the exhaust from that combustion to exit the cylinders (exhaust valves). Multi-valve engine designs feature three, four, or five gates per cylinder to boost performance. Each four-stroke engine with combustion needs at least two valves per fuel system: one for air intake (and typically fuel) and another for exhausting combustion gases. Raising the number of valves increases the valve area and enhances the flow of intake and exhaust gases, resulting in improved combustion, volume flow rate, and power production. The spark plug is advantageously situated inside the combustion chamber for efficient flame propagation due to the multi-valve shape.

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CHAPTER 21

AN OVERWHELMING ANALYSIS OF ADVANCESIN PLASTIC WELDING

Mr.Sanjeet Kumar, Associate Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-sanjeet.kumar@jnujaipur.ac.in

ABSTRACT:

Heat generation is used to connect two or more independent portions of thermoplastic materials to create a welding joint, also known as the joint region. Typically, heat is used on the borders of the plastics to melt the edges until the edges may be blended. The process of forming a molecular link between two suitable thermoplastics is known as plastic welding. Welding provides higher strength while shortening cycle times. Any weld involves three major steps: pushing, heating, and cooling. Plastic welding procedures are distinguished principally by their source of heat. The objective of plastic welding used to form a molecular link between two thermoplastics that are compatible Welding offers increased strength while decreasing cycle times. In the future, plastic welding is useful in numerous automotive, medical, and electronics packaging applications. There have also been advancements in textile joining as well as the merging of different materials.

KEYWORDS:

Materials, Non-Renewable Sources,Plastic Welding, Thermoplastic Materials.

1. INTRODUCTION

The latest century period is on the verge of a catastrophic dynamism crisis since non-renewable sources of energy are rapidly depleting, while renewable energy remains immature to fulfill ever-increasing energy demands. At this complex level, each activity that saves energy is valued in a variety of ways. The use and help of ultrasonic vibration have proven to be essential in a wide range of fields, including contemporary medicine and medical diagnostic testing, chemical and food manufacturing, metal joining and processing, and so on, not to mention the direct service of ultrasound in extremely sensitive sectors such as marine, safety, and defense. From the standpoint of a materials engineer, ultrasonic vibrations provide two major benefits to material processing: they reduce energy consumption and process costs. The use of ultrasonic in metalworking dates to the beginning of the twentieth period.

Ultrasonic environments are utilized in a variety of manufacturing procedures, including machining, shaping, and joining, to enhance the quality of finished items. The physical motions of the papers in the layer through which sound travels make up the atmosphere. The ultrasonic range is the term used to describe the frequency range between 20 kHz and several gigahertz. The impact of ultrasonic vibrations on metals and alloys is mostly used in manufacturing. Welding is also becoming more essential as a result of the development of high-performance thermoplastic composites, the usage of which has the potential to revolutionize assembly procedures in aerospace applications. Plastic welding is useful in numerous automotive, medical, and electrical packaging applications. There have also been advancements in textile joining as well as the merging of various materials (for example plastics to metals or ceramics). The laser provides a highly controlled heat source in terms of both the quantity of energy provided and the position or size of the supplied heat. The necessity for the joint to be flexible, as in a blood-warming bag, or stiff, as in the hard enclosure of a medical device such as a glucometer, will impact the choice of welding process for plastic. Speed, amount of welds, and manufacturing quality are all important considerations. Reviewing some of the welding possibilities reveals the breadth of the available alternatives.

Composite materials are recognized as sensational materials which can get wrapped in one form and it is easy to help the procedure of plastic welding. Plastic welding is an autohesion-based technological operation. Autohesion is the ability of two separate surfaces of the same substance to create stable bonds when they come into touch.' These linkages keep peeling at bay at the first contact surface of the linked pieces. When two molten surfaces of the same polymer are brought together, the interfaces will adjust to all points otheror full-time, achieving close intercepting tracked by intermolecular interaction. Welding diffusion and chain entangled together. The degree of welding (DW) is determined by a variety of factors, including material qualities, temperature, interfacial pressure, and other variables.

The diffusion process is crucial in the peeling of the seam. As a result, increasing the welding temperature should raise the joint strength to a value equivalent to the strength of the material there in the seam. When this value is reached, the nature of failure changes. A further increase in the welding temperature may enhance the autohesion strength but does not raise the overall strength of the joint, which is limited by the quality of the material in the seam. As a result, the relationship between joint strength and welding temperature should develop a curve at the temperature of transitioning from peeling to tearing with tearing.

Plastic welding is useful in numerous automotive, medical, and electrical packaging applications. There have also been advancements in textile joining as well as the merging of various textures (e.g. plastics to metals or ceramics). The laser provides a highly controlled heat source in terms of both the quantity of energy provided and the placement or size of the delivered heat. These characteristics are becoming increasingly relevant for both small and big devices where complicated joint lines and goods with thermally vulnerable areas are manufactured. Plastic welding pushes the intercourse of welding, comprises the value, and enhances the value of welding procedures. Welding-induced distortion measurements are often taken to give measures of the welded structure either during or after welding, and in certain circumstances to offer real data for evaluating the correctness of mathematical, numerical, or empirical forecasts. Hot welding is either responsible for the form of welding to join two components using hot techniques. Plastics may be joined together using six distinct techniques. They fulfill purpose will mostly rely on the kind of plastic used, the size the form of the plastic parts being welded connected, and how long the cycle time the amount of time the machine can operate before requiring a cool-down phase needs to be. Every plastic welding technique has benefits and drawbacks, so you must adapt the technique to the intended outcome and the characteristics of the plastic components.

Ultrasonic Welding technique sends high-energy waves through the plastic components to be connected. This approach is frequently used since it may be used with a variety of materials, albeit it is frequently only applicable to lap joints. Laser Welding is a Laser welding uses laser radiation to heat and melt plastic by passing it through one component and into the connecting piece, producing a highly clean weld. It is one of the quicker ways to weld plastic and can be used to heat huge surface areas. Due to the application of radiation, it needs specialized training, making it less prevalent. Linear Vibration Welding is obtained from primary method of joining two independent pieces of plastic together uses friction heat. While being pressed against the component it is connected to, one portion is shifted. Then, more pressure is used so that the two portions solidify into one when the heat is removed. Orbital Vibration Welding is a technique likewise creates heat through friction and applies it to the components that are being joined. Even though this technique is excellent for welding curvatures, it is exceedingly delicate and cannot be utilised for all welds.

Spin Welding is a Another technique that employs frictional heat to fuse polymers, spin welding is relatively straightforward and takes little training to use. There must always be extensive preparation done that before weld is completed, and at minimum one of the sections must be round. Hot Plate Welding is a technique that allows for the employment of even the most intricate welds since it directly applies infrared heat to the plastic using a hot plate. Hot plate soldering has a very quick cycle time and can even connect curved parts. There may be considerable operating expenses associated with this process, and it is frequently ineffective on materials that are especially thin.

2. LITERATURE REVIEW

In a study [1], The author Sha Lin et al. Discussed Optimization on ultrasonic malleable welding schemes founded on two dimensional photonic structure of crystal. Large-scale equipment is required for thermoplastic welding of bulky products. However, because of the significant lateral vibration, the displaced distribution at the tools' radiated surface is not uniform. The two-dimensional (2D) phononic crystal (PnC) is presented in this study by processing grooves that are regularly organised in large-sized tools. Compared to the conventional experience-based grooving method, this approach is distinct. The feature of PnC suppresses the lateral vibration. Six various types of 2D PnC-based ultrasonic thermoplastic welding systems with varying groove length and height are designed in this work.

In a study [2], The author Jiromaru Hongoh et al. Discussed Ultrasonic malleable joining by means of important and higher quality incidences. The simultaneous study of basic and higher vibration vibrations for ultrasonic plastic welding. Due to the greater vibration loss of polymers at higher frequencies, welding properties are enhanced. The 26 kHz welders tip may vibrate as fast as 3 sets (peak-to-zero value) at a basic frequency response, and there are many higher resonances reaching up to 95 kHz whose oscillation velocity are far faster than the frequency response. The mug welding of 1.0 mm thick polypropylene strips is evaluated in settings where the vibration system is controlled by mixed regulating voltage of fundamental and higher resonance frequencies.

In a study [3], The author Yasuo et al. Discussed Radiative heat transfer in plastic welding process. In addition to providing a brief overview of plastic welding advancements to date, the innovative CO2 laser plastic welding approach was designed from the perspective of heat transfer and contains contemporaneous radiation and conduction processes. Both CO2 laser tests and numerical simulations that take into account the simultaneous radiation and passage of heat throughout the welding process demonstrate the concept and characteristics. By using the overlapping identical plastic sheets with a combination of infrared energy absorption heating and temperature diffusion cooling processes, the suggested procedure's viability is verified.

In a study [4], The author Özgür et al. Discussed Project and production of automatic plastic valve fusing engine. For the purpose of fusing pressure and tension bags using plastic valves, the malleable soldering method is a commonly used technology. Traditional techniques have drawbacks in terms of process performance, creation excellence, and economic considerations. Considering that the bulk of current production expenses go toward assembly, businesses are increasingly focusing on and moving toward assembly automation in an effort to cut budgets, speediness up production, and improve efficacy.

In a study [5], The author Jiyan Lin et al. Discussed Study on a Large-Scale Three-Dimensional Ultrasonic Plastic Welding Vibration System Based on a Quasi-Periodic Phononic Crystal StructureThe performance of an ultrasonic welding vibration system is primarily influenced by the uniformity of loudness distribution and amplitude gain. A new design method for a large-scale three-dimensional high frequency plastic linking vibration system based on a sub phononic crystal structure is proposed in order to increase the uniformity of amplitude allocation and amplitude acquire of the welding surface to improve the presentation of the quivering system.

In a study [6], The author Abimanyu Prantasi et al. Discussed Oxy Acetylene Welding Analysis for Plastic Welding of Thermoplastic Polymer Materials A method of adhering to workpieces, particularly plastic materials, is known as plastic welding. The purpose of this study was to use acetylene oxy welding to combine thermoplastic polymer materials. The electrode on the workpiece are melted during the connecting process, allowing the conductors to fuse with the parent material. Plastic sheets made of polyethylene (PE), polycarbonate (PVC), and polypropylene (PP) with the proper voltages from their parental units are the materials utilised. The weld findings are examined using a dye adhesive after the welding procedure. The dye penetrant's best outcomes are evaluated for hardness next.

3. DISCUSSION

The welding-induced distortion affects the whole welded structure, as opposed to the welding-induced residual stress, which is typically limited in the area around the weldment. Due to the variations of the substructures caused by welding, there may be severe fit-up issues when putting welded elements into another structure. One common instance is in shipbuilding, when substantial welded panels must be pieced together gradually into the final shape of either a ship via welding. Due to the tiny formability dimensions of the panel, welding-induced bowing distortion is frequently the most difficult issue in shipbuilding.

Plastic welding is utilized in hundreds of various ways on a wide variety of items, including auto components, medical equipment, and products in the industry of life sciences. Plastic welder is a clever technique for making products less corrosive. It is not always feasible to create goods out of a specific item when plastic is required. Plastic welding is far more beneficial than alternative methods since it can quickly and cheaply combine distinct elements to make a single product. The beneficial characteristics of ultrasonic plastic welders are also present in ultrasonic metal welders as an industrial process, although there is more competition from alternative metal-joining techniques. In addition to micro bonding, its principal uses are in the construction of electrical machines, transformers, switch, and relays in the electric and electronic sectors. Since there are few trustworthy options for attaching aluminum wires, ultrasonic welding is helping the current trend of replacing copper with aluminum.

Ultrasonic power densities are extremely high at the point of contact with the welding tip, averaging around 10,000 watts per square inch. Due to tip wear caused by this, ultrasonic welding is already impracticable for hard metals. Another restriction is the compatibility of the materials, which must not have too much of a difference in hardness in order to allow for mutual abrasion. With a revolving tool and a pin that almost fully enters the workpiece, the procedure is performed. It doesn't need to be specially prepared because the junction is a yawning chasm butt joint. However, a strong clamping force is required since the tool exerts a lot of pressure as it moves. If complete welding penetration is necessary, this also holds true for the root face. Using this technique, which is similar to milling, the material is forced past the spinning pin and entirely fills the space behind it instead of being sliced. The temperature is raised via friction and the "stirring" action to soften the material without melting it. The revolving tool's form is intended to press down on the weld convexity, keeping it level also with original surface. Most frequently, objects thicker than around 25 mm are welded both from sides. In Figure 1 shown the process of power welding of plastics.

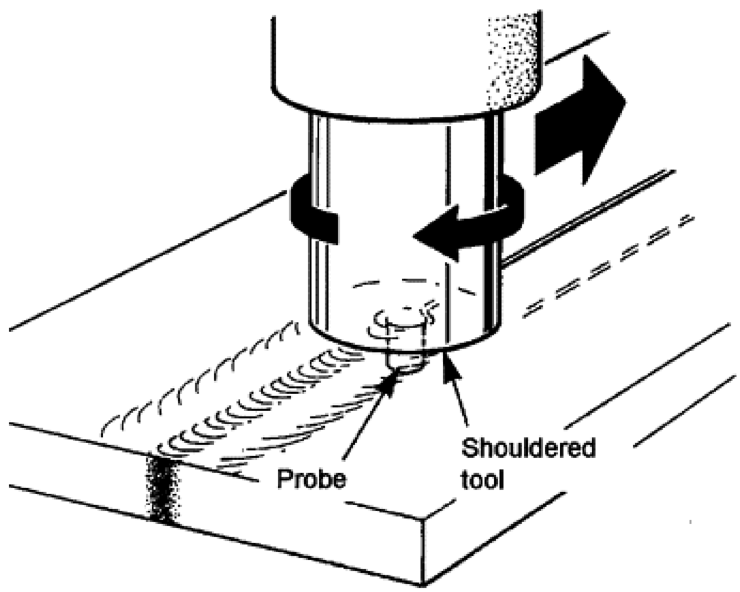

Figure 1: Illustrate the process of power welding of plastics.

Vibration welding has several potential benefits over traditional fabrication welding methods like hot vapor and extrude welding process, including improved formability, particularly for bold units, the ability to weld almost all thermoplastics, simple joint design, practically flash-free welds, and the fact that it is an autonomous system, reducing the likelihood of weld failure. The FSW technique currently has the drawbacks of only having been demonstrated to produce linear welds and not being commercially available to connect polymers. The reality is procedure is quite cold. Despite some heating, cleaning rather than material melting is more important for welding than melting. Oxides and other contaminants are broken up and dispersed when surfaces are linked by ultrasonic shear, which also produces mutual abrasion of the surfaces. Under pressure, the exposed, plasticized metal surfaces are pulled together, and solid-state bonding occurs. In this regard, ultrasonic welding is similar to spin welding or pressure soldering, with the important exception that there is no obvious component movement or significant material movement.

In actuality, the process is fairly "cold." Although considerable heating occurs, cleaning rather than material ice melt is more crucial for welding. When surfaces are connected by ultrasonic stress, which also causes mutual wear of the surfaces, oxides and other impurities are divided up and distributed. The uncovered, plasticized metal sides are drawn together under pressure, resulting in solid-state bonding. In this respect, ultrasonic welding is comparable to spin riveting or pressure solder, with the crucial distinction being that there is no visible component movement or substantial material displacement. Low heat and little deformation are hence characteristics of ultrasonic metal welding. Welding temperatures are generally lower than the melting points of the metals, which helps prevent embrittlement and the development of intermetallic compounds with high resistance in dissimilar metal welds. Low heat and little deformation are hence characteristics of ultrasonic metal welding. Welding temperatures are generally lower than the melting points of the metals, which helps prevent embrittlement and the development of intermetallic compounds with high resistance in dissimilar metal welds.

Ultrasonic generators used to weld polymers typically operate at a frequency of 20 to 40 kHz. Since this is hardly heard, the majority of small-scale work won't need a sound-absorbing enclosure. Work can occasionally vibrate at subharmonic frequencies, within the audible range. With larger equipment using various heads and power clamping, protection against the operator's hands getting caught and effective attenuation of something like the high frequency sound can be provided by an enclosure made of relatively thin metal sheet covered in a layer of vibration damping material.

Hard, brittle materials like alumina, various ceramics, and glass have shown to be the best candidates for ultrasonic machining. Currently, two techniques are in use. Abrasive slurry (often boron carbide, silicon carbide, or aluminum oxide) is supplied between the nonrotating vibration tool and the workpiece in the earlier technique known as ultrasonic impact grinding. It is possible to replicate strange three-dimensional forms, with the final impression being a shadow of the original. Clusters of holes can also be machined simultaneously. Due to its intrinsic slowness, the approach has few commercial applications.

Heating in plastic varies essentially as the squared of the stress amplitude and is a function of supersonic stress. The contact area between the pieces being connected is minimized to increase the tension in the weld zone. Static: During welding, clamping force is employed to hold the components together. After ultrasonic irradiation, a brief "hold time" is added to give the plastic t80 time to solidify before unclamping. Normal welds usually arc in under a second.

One thermoplastic is sealed to another thermoplastic that is equivalent using a method called heat sealing. The thermoplastics are sealed or joined together using the direct contact technology of heat sealing, which employs a persistently heated die or sealing bar. There are several uses for heat sealing, including thermally activated adhesives, heat seal connections, and sealing with film or foil. Common uses for the heat dissipation technique include: In a lot of smart phones, as well as in medical and communications equipment, LCDs are connected to PCBs via heat seal connections.

Ultrasonic plastic welding demands far greater power densities than cleaning does; these densities are generally hundreds of watts per single inch at the weld and the contact of the workpiece-equipped tool. To exert such force Plastic welding horns with densities, operate at amplitudes of 0.001 to 0.005 inches, which is more than 10 times greater than cleaning, and because of the high energy storage, show extremely strong symmetry. Mechanical reverberations Moreover, contingent on must be lodge a bigger range to applications, including stresses, and mechanical loading may occur during the welding. A new type of equipment has to be created, increasing ultrasonic power, to meet these requirements technological advancements.

Bloodtest film and filter material for the blood, virus, and most other pulse oximeter devices used in the health establishment today are likewise made using heat sealing. To seal and/or prevent contaminants for medical test equipment, sample collecting trays, bottles, and containers used for food items, laminate foils and films are frequently heat sealed out over top of plastic medical trays, Microtiter (microwell) dishes, bottles, and containers. When producing bags or flexible containers for the medical and food industries, heat sealing is used to either perimeter weld the polymer coating of the bags or to seal ports and tunnels into the bags. Hot bar sealers, Impulse sealers, and other heat sealers are provided to combine thermoplastics such as thermoplastics. It is used to join thermoset constructions and offers a great bonding strength. Ultrasonic welding (UW) is a very quick joining technology. Compared to more traditional connecting techniques like adhesive, mechanical, and others, it is more economical. The extensive progress that has been made by that of the scientific and academic communities toward the UW of nanocomposites to date is presented in this review study. . Different ultrasonic welding modes, their processing parameters (weld duration, weld pressure, amplitude, kind of energy directors (EDs) impacting welding quality, and benefits and disadvantages of UW compared to conventional attachment procedures).

In order to improve strength and ductility, corrosion and fatigue resistance and fatigue, formability, and other qualities, FSW can locally remove casting flaws and modify microstructure. It is a solid state joining method that has gained widespread acceptance as a way to weld aluminum and magnesium alloys with high-quality. In the stir zone, this procedure can also create fine-grained microstructures to provide super plasticity. Weld nuggets (WN), thermomechanical affected zones, and heat impacted zones are the three main classifications of friction stir weld microstructure. The WN is distinguished by an area that is strongly distorted and dynamically recrystallized.

The energy manager is a man-made resin protrusion on a composite case rich in resin that prepares not include any fibers. It is positioned at the interface during welding. Because of the smaller cross section of the ED, ultrasonic welding works on the viscoelastic heating phenomena at the interface, which serves to increase the viscoelastic heating of the specimen itself by focusing the energy at the interface. Due to the fact that the final weld quality is influenced by the form, size, morphology, and arrangement of ED, their design is crucial to obtaining a sound welding.

Numerous welding parameters related to the welding process regulate or have an impact on the ultrasonic welding quality. The vibration largeness, control, energy, repair duration, unthinkable during fusing, the weld force before, during, and after the welding process, as well as the hold time, are some of the crucial welding parameters. Additionally, during welding, weld energy, weld duration, and vertical displacement are all mutually exclusive. The quantity of energy supplied determines the welding's quality. Very high frequency is used in ultrasonic fusing, and frictional heat is produced at the interface as a result of mechanical vibrations being transferred via thermoplastic adherents. It facilitates the melting, flowing, and formation of the interfacial link between the thermoplastic materials. Viscoelastic resistance and surface friction are the primary heating processes. These investigations indicate that the surface friction is what causes the welding process to begin, after the polymer has achieved its glass transition temperature, viscoelastic heating takes over and delivers the most warmth throughout the welding process. Composite structures have replaced traditional metal structures in numerous sectors. A technical revolution in the manufacturing process is necessary because producing a completed composite item has significant production costs. The main factors influencing the final composite product's cost are material choice, production, and finishing procedures.

4. CONCLUSION

There is an increasing need from the productions to create new and quick connecting procedures aimed at huge or complicated constructions as the use of lightweight resources in aerospace, automotive, sports, wind turbine, and other sectors gradually increases. This review paper provides a thorough after doing a literature study, it was determined that synthesis attachment had enormous potential. It has certain benefits over traditional joining techniques when it comes to combining composite pieces. Numerous studies have been conducted to examine the various fusion bonding processes, employing many methods, such as ultrasonic fusing, resistance welding, friction welding, and others composites made of thermoplastics. With the integrated ED and flat ED film approaches, various demonstrators will be ultrasonically welded for industrial applications, including framesets, stringers of the portioned section, flanged structures, and many more. The related consequences and difficulties can be discussed from the thorough research. Continuous ultrasonic welding of complicated structures must be researched, and its performance should be compared to that of the commonly employed adhesive bonding.

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CHAPTER 22

A WIDE-RANGING STUDY ON DUAL FUEL ENGINE

Mr .Ashok Singh Gour, Assistant Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-asgour@jnujaipur.ac.in

ABSTRACT:

Dual fuel engines are those that can run on a combination of two different fuels. Dual fuel engines frequently combine the usage of diesel and oil and gas fuels. High octane fuel and an advanced pilot injection technique (high diesel fuel injection volume with two pilot injections) are used by dual fuel engines converted from diesel engines with coal and gas intake systems to create a PPCI combustion pattern. A liquid fuel is always used to initiate combustion in a dual-fuel engine. Under load conditions, dedicated dual-fuel engine can instantly transition from operating on liquid fuel to operating on gaseous fuel and vice versa while using less then 1% of liquid fuel. Diesel fuel usage is lowered by dual fuel engines, which results in financial savings. One of the main expense categories for digging and well-servicing procedures is fuel. Reduced running costs from dual fuel engines result in financial benefits.

KEYWORDS:

Dual Fuel Engine, Fuels, Gas-Air Mixture, Injection Technique.

1. INTRODUCTION

The dual fuel combustion system consists essentially of a homogeneous gas-air mixture compressed rapidly below its auto ignition conditions and ignited by the injection of pilot liquid fuel near th centertop dead center position. At atmospheric pressure, the primary fuel is g6enerally vapor and controls the power output. The pilot liquid fuel, which is injected through conventional diesel injecting drug, normally contributes only a small fraction (e.g., less than 10%) of the maximum power output. Unlike a spark-ignited gas engine, that also requires an adequate and continuous gas supply, a dual fuel engine can be switched entirely to conventional solvent diesel fuel procedure whenever preferred without affecting the power output.

The engine is a critical component of any automobile. Many studies are currently being conducted on engines in order to achieve maximum mileage but rather power at the lowest possible cost. Because of the high cost and scarcity of petroleum fuel, an alternative fuel is also necessary to power an engine (diesel and petrol). Many engines that can run on alternative fuels have been developed, one of which is a dual gas engine. CNG and LPG fuel engines are dual fuel engines that are commonly used today. Due to the high cost of diesel, dual fuel engines are used.

The presence of gaseous fuel has a complex effect on both the pre-ignition and post-ignition processes, depending primarily on the fuel used, its concentrations, but instead operating conditions. It is observed that the ignition delay of pilot fuel increases significantly with the addition of gaseous fuel and decreases later with further gas addition. This increase far outweighs the decrease in partial pressure of oxygen caused by the addition of the gaseous fuel or the cooler temperature of the charge at around the top dead centre position caused by the charge's higher overall specific heat. To cause these variations in the delay, the gaseous fuel must actively participate in an unknown way in the pilot fuel's pre-ignition chemical processes.

The exhaust gas evaluation of a dual fuel engine typically shows that significant amounts of fuel gas can endure the combustion process when fed to the engine at concentrations well below or above some two limiting concentrations. These limits, which are broadly identified as the mixture's effective flammability limits, are a function of the two components of the fuel and the operating conditions. The accepted lower flammability limit is lower than just the accepted higher flammability limit.

This is thought to be due to pilot oil ignition failure, because the power output just on the verge of failure, while erratic, is quite high, indicating that combustion is still taking place to some extent. Fortunately, in most real world applications, excessively rich or ultra-lean mixtures are not required. Full diesel operation may be used for sitting idle or low load operation. Various gaseous fuels are receiving attention in the efforts to develop fairly clean and efficient burning fuels. This is further motivated by the steadily increasing availability of natural gas as a result of advances in cryogenic technology that allow this fuel to be stored and transported economically in liquefied form. Lower fuel and maintenance costs, as well as longer engine life, are advantages. In past years, the reappraisal and further growth of gas-powered vehicles on a commercial basis has been actively pursued, primarily due to concerns about air pollution and the cost of liquid fuels.

The use of gaseous fuels in diesel engines is neither new nor recent. Its origins can be traced back to the turn of the century, when Dr. Rudolph Diesel patented a spark ignition engine that ran on coal gas as a fuel. Following that, more successful commercial applications appear to be the ones that were developed, primarily for stationary applications. The first dual fuel operations were those carried out by Cave, Helmore, and Sokes in 1929, in which hydrogen was directly caused as a secondary fuel in diesel engines. It was stated that if hydrogen was consumed instead of diesel fuel as even the load decreased, a 20% savings in diesel fuel could be realised. The National Gas and Oil Engine Co. in Great Britain produced the first commercidual-fueldual fuel engine powered by town gas or other types of gaseous fuels by 1939. This engine was relatively simple to operate and was primarily used in areas where cheap stationary power production was required. Manufacturers converted some original compression ignition diesel cars to dual fuel operation by using a double plunger scheme or two pumps in the engine's injection system to handle the small amount of diesel fuel required for ignition.

preheating the intake gas-air mixture reduces engine output at nearly full load by providing higher mixture temperature changes than under ambient intake conditions and thus decreasing the percentage of unreacted gases getting passed through the engine. Partially restricting the charge's air component to produce an effectively wealthy mixture for the same mat of gaseous fuel addition improves part load performance to a point by increasing the charge mixture resilience. However, caution should be exercised to ensure that pilot energy is not jeopardized.

2. LITERATURE REVIEW

B. Denis Ashok,[1] et al. explained lpg diesel dual fuel engine is known as an 'LPG-diesel dual fuel engine' because it runs on both normal diesel fuel and LPG fuel. LPG dual fuel engines are modified diesel cars that use LPG as the primary fuel and diesel as the secondary fuel. LPG dual-fuel engines have high thermal efficiency at high output, but performance suffers during part different loads due to poor charge utilization. This issue can be solved by adjusting factors such as pilot fuel quantity, injection timing, gaseous fuel composition, and intake charge conditions to improve the performance, combustion, and emissions of dual-fuel engines. According to the studies, the use of LPG in diesel engines is one of the capable methods for reducing PM and NOx emissions; however, at part load, there is a fall in efficiency and power output compared to diesel operation.

HyunchunWright,[2] et al. explained phenomenological micro-pilot ignition model for medium-speed dual-fuel engines which The medium-speed dual-fuel engine has gained popularity in the marine industry due to the benefits of meeting stringent emission regulations and the relative affordability of fossil fuels. The ignition process has a significant impact on the subsequent combustion processes and fuel efficiency in such engines. This study created a phenomenological mini ignition model with a small number of tuning parameters in order to better understand the ignition event and control the dual-fuel engine. The model includes a spray and a chemistry submodel to accurately capture the interaction between direct injection of a small amount of diesel fuel (referred to as micro-pilot) or a two-stage ignition of the diesel fuel mixed with both the surrounding reactive charge at low temperatures. By assuming a realistic trapezoidal fuel injection profile and a varying discharge coefficient during the transient spray period, a 1D transient spray model has been modified to reproduce the micro-pilot spray characteristics. A 0D transient flamelet approach that relies on a contrasted flow reactor is used to model the chemical reactions. Three sets of experimental data are used to validate the model: ECN Spray A (constant volume chamber), RCEM with optical accessibility, and finally, a medium-speed dual-fuel engine. Quantitatively good predictions of spray formation, ignition delay, but instead ignition location are demonstrated across a wide range of conditions, from conventional diesel ignition to micro-pilot ignition in a dual-fuel engine. Finally, the developed model is used to investigate the qualities of micro-pilot ignition in medium-speed dual-fuel engines.

Andrea Oneto[3] et al. explained marine dual fuel engines monitoring in the wild through weakly supervised data analytics which Maritime transportation accounts for approximately 80% of global freight movements, significantly influencing the world's environmental footprint. Dual fuel engines, which run on both gaseous and liquid fuels, are an attractive way to reduce emissions at the expense of increased monitoring complexity. Motivation: Data-driven methods are at the cutting edge of research and maritime industrial applications, and they typically necessitate a large amount of data sets, i.e., sensor measurements plus the related engine status, which is usually annotated by human operators and is expensive and rarely available in the wild. Unlabeled samples, on the other hand, are widely, cheaply, and easily available. The availability of a network of sensors and a factory automation capable of capturing and storing the associated stream of data is the enabling technology for data-driven methods. Methods: To achieve this goal, we will use a Digital Twin of the dual fuel engine or novelty detection algorithms and compare them to state-of-the-art fully supervised approaches. Results on information recorded from a real-data validated simulator of a marine dual fuel engine show that the proposed weakly supervised tracking approaches lead to a negligible loss in accuracy when compared to costly and often impractical fully supervised ones, supporting the proposal's validity for use in the field. Conclusion: Based on the available data, the main outcome is a guideline for picking the most effective data-driven dual fuel engine monitoring method.

Federico Accurso[4] et al. explained experimental and numerical investigation of the ignition process in a large bore dual fuel engine which Due to their low emissions and fuel flexibility, dual fuel engines powered by natural gas but instead ignited by a small amount of diesel fuel have emerged as extremely appealing solutions in the marine and power generation sectors.

However, stricter emissions standards and market demands for more cost effective dual fuel engines necessitate shorter engine development cycles. Reliable experiential fast running 0D/1D combustors models can thus be used as effective tools for reducing testing time and cost. Nonetheless, due to the chemical interaction of diesel and methane, as well as the combustion mode transition from diesel autoignition to premixed flame propagation, simulation of the dual-fuel combustion process seems to be particularly difficult. Correct simulation of the diesel injection, air entrainment, and autoignition processes is thus critical for combustion process prediction and reliable engine performance estimation. The goal of this paper is to investigate the ignition process in dual fuel engines using detailed exploratory study and to provide a suitable 0D predictive detonation model for simulations of the ignition process. Based on the mechanism of 0D detailed chemistry reactions, an ignition delay model was developed and validated against experimental data from a large test campaign. Several diesel injection strategies were considered in terms of injected quantity, pressure and duration, and different in-cylinder conditions.

Farag K. Selim,[5] et al. explained time and frequency analyses of dual-fuel engine block vibration which A single-point time, frequency inventive analysis was performed to investigate the engine-block vibration of a dual-fuel LPG-diesel engine. Liquefied petroleum gas (LPG) was used as the primary fuel in a diesel engine, with diesel fuel serving as a pilot fuel to ignite the gaseous fuel. The vibrations of the dual-fuel engine are compared to the sound waves of the base diesel engine as a reference. Engine cylinder head vibration was measured under various engine operating conditions such as load, speed, injection timing, and compression ratio. For the vibration signal from both engines, the Fast Fourier Transform (FFT), Short Time Fourier Transform (STFT), and root mean cube of vibration signal have been calculated. The dual-fuel engine has been found to be less vibrational than the diesel fuel. When compared to a diesel engine, the vibration of a dual-fuel engine has been distributed over a narrow range of frequencies. These results of low vibrational levels for dual-fuel engines when compared to diesel engines under similar operating conditions would encourage us to look into the possibility of using the double engines for better environmental and structural performance further.

Mirosław Chojnowski,[6] et al. explained a review of low-co2 emission fuels for a dual-fuel rcci engine which the problems of emissions from cars in the context of the possibility of there own reduction by utilizing fuels with hydrogen as an additive or hydrotreatment. Because of their properties, these fuels may be a suitable response to increasingly stringent exhaust emission regulations. Using such fuels in reactivity controlled dual fuel engines (RCCI) is currently the most efficient way to use them in internal combustion (IC) engines. Because of the low-temperature burning in this engine, all modern fuels designed for high-efficiency combustion engines can be used. Higher thermal efficiency than in traditional engines allows for further reductions in CO2 emissions. The research on this subject was compiled in this work, and conclusions were drawn regarding further possibilities of popularising the use of these fuels in a wide range of applications and the possibility of using them on a large scale.

Ngayihi Abbe Emmanuel,[7] et al. explained performance map of a lpg-diesel dual-fuel engine based on experimental and non-linear least squares determined wiebe function which The achievement of sustainable and climate-friendly economies through renewable energies, as well as the transformation into competitive and industrialised economies, are among the African Union's (AU) goals for 2063. Implementing new technologies that enable high-level performance in the transportation and manufacturing industries via low-polluting power systems is therefore critical to meeting these goals. In this regard, dual-fuel engines that combine the low-polluting properties of natural gas with the performance of diesel offer promising prospects. Modern engines require the use of an experimentally generated map to be designed and monitored, which comes at a cost. In this paper, we present the development of a dual-fueled engine map based on a new methodology followed using the nonlinear least squares method, with the Wiebe coefficients trained using Gaussian models for different speeds. The model is validated against experimental data with a 2% error. The generated map with the mass fraction of primary fuel z, equivalence ratio, and engine speed as varying parameters shows that as z and speed increase, so does specific consumption. As the equilibrium ratio increases, thermal efficiency decreases. Nitric oxide (NOx) emissions decrease with increasing and increase with speed, whereas unburned hydrocarbon (HC) emissions increase with increasing and decreasing. The specific rate is very low by 0.1% for every 0.2% increase in speed and 2.1% increase in z. A 0.1% increase in results in a 0.25% reduction in NOx emissions. These findings are consistent with previous experimental work, demonstrating the utility of framework engine maps in dual-fuel engine design.

Yingjie Zhu,[8] et al. discussed study of injection pressure couple with egr on combustion performance and emissions of natural gas-diesel dual-fuel engine which Natural gas (NG) dual-fuel engines can achieve the same thermal efficiency as diesel engines while emitting less pollution. The trade-off relationship among both CH4 and NOX emissions, on the other hand, limits the development of dual-fuel (DF) engines. In order to address this issue, this study investigates the effects of injection pressure (IP) and exhaust gas recirculation (EGR) ratio on the combustion and emissions of diesel/NG dual-fuel engines. In the high-temperature combustion chamber, the results show that the diesel/NG dual fuel has a distinct three-stage heat release characteristic. As the injection pressure rises, so does the methane flame propagation speed and the indicated thermal efficiency (ITE). However, due to the low temperature, methane in the crevice region and cylinder wall cannot be ignited; these are the main sources of methane emissions. When the EGR rate is increased, the indicated thermal efficiency first rises and then falls, and diesel is cleaved through the reaction chain, PC4H9 C2H4 CH4, to produce CH4; this is one of the causes of CH4 emissions. When the EGR rate is low (less than 10%), CO and CH4 emissions are not sensitive to IP; when the EGR rate is high (>30%), increasing the IP can significantly reduce CO and CH4 emissions. As a result, the diesel/NG DF engine can achieve higher ITE and reduce pollution when the injection pressure is 160 MPa and the EGR rate is 20%.

Hall, Carrie and Kassa, Mateos [9] explained advances in combustion control for natural gas–diesel dual fuel compression ignition engines in automotive applications which Dual fuel engines that use gaseous fuels have been around for more than a century, but developments in fuel injection technologies and electronic regulate have changed drastically the methods of combustion control used in automotive applications. Early efforts to leverage natural gas on compression ignition engines used both natural gas and diesel in a dual fuel configuration, but relied on map-based methods to determine the quantities and timings of single injection events for each fuel. Many new combustion strategies have been enabled by multi-pulse injection and fuel injection with electronic capabilities, necessitating the use of more complex methods of control. Novel dual fuel combustion approaches, such as reactivity controlled compression high-pressureignition and the introduction of high pressure innate gas injection, have resulted in cleaner, more efficient combustion processes for diesel-natural gas dual fuel engines, but have also resulted in more complex combustion phenomena.

3. DISCUSSION

3.1 Working of dual fuel engine:

Natural gas is introduced into the engine's intake system in dual fuel mode. The air-to-natural gas mixture is again drawn into the cylinder in the same way that a spark-ignited engine would, but with a leaner air-to-fuel ratio. Diesel fuel is injected near the end of the compression stroke and ignites, having caused the natural gas to burn. A dual fuel engine can run on 100 percent diesel fuel or a diesel/natural gas substitution mixture, delivering same power density, torque curve, and transient response as a base diesel engine.

There is some leeway in the quality of gas used by the operator. A lower-cost, lower-quality gas with a lower substitution rate can be used by an operator, or a higher-quality fuel at a slightly higher cost with a higher rate. Dual fuel engines in the United States must comply with applicable compression ignition emissions laws. While specifics vary, an oxidation catalyst is typically required to reduce carbon monoxide (CO) and non-methane paraffinic (NMHC) emissions.

With changes in charge temperature, the dual fuel engine feed mixtures normally lie within a narrowing range for stable operation. The working region is bounded on one side by mixtures that cause excessive pressure rise and knock, and on the other by mixtures that cause erratic engine operation and, eventually, ignition failure. The experimental evidence suggests that the transition from non-knocking to knocking is sharp, well defined, and repeatable, and is accompanied by an abrupt change in the shape of the pressure diagram displaying the characteristic high frequency pressure oscillations, which was used to detect the onset of knock. Additionally, marked changes in the derived rate of comparable "heat release" by combustion from pressure data sets can be observed.

The nature of the gaseous fuel, the charge temperature, and, to a lesser extent, the pilot quantity are the dominant factors influencing the occurrence of knock. Significantly more power could be obtained there at rich mixture knock limit than at the lean mixture knock limit. When compared to the ignition character traits of the main primary fuel gas, as indicated by its effective octane rating, the cetane number of the pilot fuel has relatively little effect in determining the onset of knock. The increase in CO concentration observed while small amounts of hydrocarbon gases were inducted in the intake air, , is the direct result of quenching occurring in the oxidation reactions of over-lean various gases surrounding ignition foci. Because of the delayed ignition at these fuel-air percentages, the exhaust stroke significantly chills the reactions. As more gaseous fuel is added to the combustion chamber, the CO concentration rises until the effective flammability limit is reached. Increased chances of combustion tend to ensure that the oxidation processes are completed.

Lowering the ingestion temperature reduces the completeness of the oxidation reactions. Compression and fire temperature and pressure are reduced, which reduces CO oxidation further. Furthermore, the effect of cold intake temperature on extending the delay period deep into the development stroke chills these reactions even more. When the mixture ratio is in the flammable range, however, the flame travels to the majority of the combustion chamber, and the intake temperature does not appear to affect the extent of CO survival. Increasing the pilot fuel with gaseous fuel operation has a clear advantage in reducing this partial oxidation product, as observed throughout the experiments. The increased pilot quantity plays a role in increasing the number of ignition nuclei and resulting in a larger volume of combustion activity in the gas-air charge. A significant increase in the heat released by the pilot increases the effective heat release rate 9 and tends to raise the temperature before subsequent combustion. However, the magnitude of the pilot has little effect on flammable mixtures producing less CO in the exhaust.

The formation of nitrogen oxides is generally aided by high oxygen concentration in the environment at higher temperatures. As a result, at low fuel-air ratios where oxygen is abundant, the effect of temperature is expected to dominate. Because the delay period is being extended further into the expansion stroke, a slight decrease in combustion temperature is to be expected with lean dual fuel operation. As a resul, there was a decrease in NOx composition for low fuel-air ratios. When the gas-air ratio is further enriched, the No x concentration rises at a slower rate than in diesel operation, until the effectual flammability limit is reached. The use of gaseous fuels in the air inhibits the formation of locally overrich mixtures, which is common in straight diesel operation. When the flammable threshold is met, the aerosols of nitrogen rise at a steeper rate, owing to the uniform oxygen accessibility and the increased overall temperature caused by flame travel.

The performance and emissions of dual-fuel engines vary depending on operating conditions and the complexity of the control system. Under moderate to high load, dual fuel engines perform best and can often equal or outperform pure diesel engines in terms of fuel efficiency. They could also achieve much lower emissions (especially of NOx and particulate matter (PM)) than a pure diesel by operating with a lean air-fuel ratio. Existing dual-fuel conversions have significant increases in CO and HC emissions, as well as a loss of gas mileage at light loads. Because they run unthrottled, the air-fuel mixture has become leaner as the load is reduced. As the mixture thins, combustion degrades, leaving a large amount of partial reaction products in the exhaust. Because many diesel engine applications, particularly vehicles, require a significant amount of light-load operation, the high emissions and poor efficiency of dual-fuel engines in the this condition are a significant disadvantage. This is possibly the most important reason why almost all new heavy-duty natural gas truck engines in growth are spark-ignition rather than dual-fuel designs. However, recent technological advances in large a double engines, combined with a new generation of electronic fuel real - time monitoring and control systems, may allow one to overcome the problems of light-load emissions and fuel efficiency in the dual-fuel turbocharger, while maintaining and even improving the dual-fuel approach's advantages.

3.2 advantages of dual fuel engine:

Less fuel utilisation, i.e., as diesel fuel costs more, changing over a crankshaft to run on air and a small amount of diesel is more efficient. It is not necessary to begin fitting and begin framework.

4. CONCLUSION

A dual-fuel engine always starts the combustion process with liquid fuel. Under load, dedicated dual-fuel engines could really use less than 1% liquid fuel and instantly switch from solvent operation to gases operation and vice versa. The dual fuel combustion system is essentially made up of a homogeneous gas-air mixture that has been compressed quickly below its ignition conditions and ignited by the inoculation of pilot fuel near the centertop dead centre position. The primary gasoline is g6enerally vapour at atmospheric pressure and controls the power output.

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CHAPTER 23

A DEVELOPED MODEL OF A GROUNDNUT SHELLING MACHINE USING A THERMAL MOTOR

Mr. Robin Khandelwal, Assistant Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-robinkh16@jnujaipur.ac.in

ABSTRACT:

Groundnuts are the most consumable item in the food industry. To remain groundnut fresh and more consumable they are shelled, the process is known as shelling and the machine which is required for shelling is known as the groundnut shelling machine. The problem why this research is done is because the food industry required a machine that can give perfect shelling towards the groundnuts and increase their quality with their increase in their production. The objective of the study is based on the groundnut shelling machine which uses a thermal motor for the run. The outcomes of the study find a proposed model for the shelling machine which gives extraordinary results and perfect shelling to the groundnut with the use of a heat engine that converts the energy into mechanical work. In the future, this method can be more beneficial if it gets sensors to stop or start the thermal engine and will be more beneficial for low-range businesses.

KEYWORDS:

Groundnut, Heat Engine, Shelling, Shelling Machine, Thermal Motor.

1. INTRODUCTION

Groundnuts are a common source of food that is either consumed as peanut butter, mashed and used to make groundnut oil, or just eaten as a sweet snack. The sixth-most significant oilseed harvest in the world is groundnut. It has a protein content of 26-28%, a fat content of 48-50%, and a high concentration of vitamins, minerals, and dietary fiber [1]. It thrives on soils with good drainage, a loose texture, and enough levels of calcium, potassium, and phosphorus. Worldwide, groundnut is grown in more than 100 nations. 97% of the world's acreage and 94percent of the crop's output are in developing nations. Asia and Africa produce the majority of the world's groundnuts respectively accounting for 56% and 40 percent of the total area and 68% and 25% of the total production. several shelling machines based on various methodologies have been created. These devices include motorized rubber groundnut shellers, baby groundnut shellers, and hand-operated groundnut shellers, to name a few. These equipment are exceedingly costly and out of reach for farmers and small-scale producers due to customs fees [2].

Demand for groundnut products is rising, and the application heavily depends on how clean the nuts are. The separation procedure is typically a time-consuming, energy-draining activity. A shelling machine was created to effectively remove the nuts from their shell. The groundnut pod is broken by the machine using an auger screw [3]. Grain shelling, also known as the separation of grains of their stalk, pod, or cub, can be done by rubbing, impact action or any mix of these. The process of crushing or squeezing the pods here between fingers and thumb to break off the capsules and extract the seed is the most common shelling technique that is still commonly practiced in the northern portion of Nigeria. This approach requires a lot of energy, is time-consuming, and has low efficiency. In addition, just 1-2 kg of groundnuts is produced every man-hour [4].

Groundnut shelling is mostly accomplished via mechanical and traditional methods. Traditional methods of shelling included manual pressing of the pods or stomping of animals with sticks [5]. While using mechanical methods necessitates using machinery to shell groundnuts, the most often used way of shelling is been happening in today's world. India now has the second-place position globally in the horticulture sector [6]. a sizeable portion of the oilseeds are used in Indian agriculture. The most important oilseed from there is groundnut or peanut. According to Badami's assessment from 1936, the Magellan expedition introduced the groundnut to India for the first time around 1519. One of the more important and major oilseed crops on the globe is groundnut. It mostly comprises 48.5% oil, 25.33% protein, 10.2% sugar, 500–600 calories, and 40.5% fat. The most amazing and important nutrient, absolutely lacking in others, is groundnuts. As a result, this item has undergone extensive development. There have been so many years in the west using traditional groundnut isolation methods. Usually, the laborers segregated the instance from peanuts [7].

The present research is about Groundnut Shelling Machine Using Thermal Motor. This research is featured in several sections where the first is an introduction and the second section is a literature review and suggestions for previous studies in the context of the Model of the Groundnut Shelling Machine. In addition, the methodology section of this study is mentioned where the data in different sub-sections are examined. After that, the results and discussion part are discussed where the results are compared with existing data, followed by the methods applied in this research. Finally, the conclusion of this research is declared where the research gives the result as well as the future scope.

2. LITERATURE REVIEW

Adetola Olufemi and Opeyemi Akinniyi [8] developed a small-scale groundnut shelling machine in which Every living thing needs food to survive. It comes in many different forms, including groundnut. The hopper, throat, shelling component, power transmission unit and frame are the five fundamental parts of the machine. The constructed machine needed an average of 58.02 mins to shell the theoretical capacity of 2.5 kg/batch, achieving a shelling efficiency of 80.39% with a loss of 3.125% owing to crushing. Findings demonstrate that the machine's lowest output is 20.666 kg per hour and that it increases when the feedstock's moisture content decreases.

Manishkumar M [9] et al. discussed groundnut peeling shelling machines which The majority of the land is utilized for agriculture, which yields goods or semi-finished items. Another agricultural semi-finished product is groundnut. The creation of several groundnut Sheller machine components, including their design and manufacture. Therefore, in this design, various components are required, and the design of various parts will lead to an improvement in the visual appeal of those parts. It comprises steps including design, manufacture, and component assembly, among others. A centrifugal Bambara peanut bean shelling machine was created to shell different sizes and types of Bambara groundnut.

Akindele F. Ossom [10] proposed design modification and performance testing of a Bambara groundnut Sheller Earlier, a centrifugal Bambara groundnut pod shelling machine was created to shell different sizes and types of Bambara groundnut. Made and developed using materials that were readily accessible in the area, the sheller. The hopper, the shelling unit, and the power transmission unit are the three primary components of the machine. The nuts were merely broken by the sheller, and the result was the shell and kernel. The test's findings revealed that the machine's capacity, seed breakings, partially shelled peas, unshelled pods, and cracking efficiency were, respectively, 83.2%, 17.4%, 7.8%, 9%, and 75000 seeds per hour. To improve the handling of Bambara groundnut and improve the timeliness of operation, this design was changed to include a separating unit.

Jose D. Petingco [11] et al. Peanut threshing and shelling machines for community-based peanut enterprises in developing countries The absence of acceptable and efficient postharvest mechanization technology limits the Philippine peanut value chain. Imported equipment is not made to work with local kids or the country's current farm circumstances, thus a machine peanut stripper and a mechanical peanut Sheller were created locally utilizing resources that were readily accessible.

Man Mohan Mathew [12] et al. discussed the performance evaluation of power-operated coconut de-shelling machines for different varieties of coconut. A coconut deshelling machine shortens the laborious human procedure and saves time. When a skilled person ran the machine, it was found to have a de-shelling capacity of 141 nuts per hour, 148 nuts per hour, and 144 nuts per hour, respectively, with a de-shelling efficiency of 89%, 92%, and 90% for the Tiptur Tall, Kulashekhara Green Tall, and West Coast Tall kinds. In terms of de-shelling capacity and efficiency, there were no discernible differences between the three kinds, and the machine performed admirably with each.

Jingyu Wang [13] et al. proposed the design and experiment of a four-channel fully automatic shelling machine for ripe fresh camellia oleifera fruit. Aiming at the problems of low shelling rate and high breakage rate in the process of shelling ripe fresh Camellia oleifera fruits, a four-channel fully automatic shelling machine was designed. To address the issues of low shelling rates and increased breakage rates in the process of shelling mature fresh Camellia oleifera fruits, a multiple fully automated shelling machine was built.

Muritala O. Alhassan [14] et al. explained the development of a moringa oleifera seed shelling machine in which the interest in mass-producing moringa seeds has been sparked by growing knowledge of their significance. Shelling is a crucial step in preparing the seed for its widespread use. The majority of rural moringa seed growers employ conventional techniques of shelling. The machine is very useful for rural people, farmers, and small-scale industries for post-harvest processing of moringa seeds since its cost and operational principle is within their technical know-how and capability.

Temidayo C. [15] et al. explained Performance Evaluation of a Melon Shelling Machine with Different Power Sources. To ascertain the impacts of shelling speed and moisture content and equipment productivity, performance assessment of a fuel-engine and an electric motor-powered machine utilized for shelling melon seeds were carried out in this study. Weighted at 25g apiece, water was sprayed on the unshelled melon seeds before they were partly dried with ambient air for 25 minutes. This improved the efficiency of shelling by allowing the skin coat to gradually soften and the cotyledon to separate from the shell with ease. The melon seeds were used to assess the parameters (machine productivity, throughput capacity, and percentage seed damage). Melon seeds were used in the assessment for the shelling performance with 5 distinct moisture levels (7.48, 10.24, 13.92, 18.36, and 21.44%) dry basis (d.b.) at three distinct shelling speeds (850, 1000, and 1200 rpm).

Kasali A. Raji [16] et al. explained the design and fabrication of motorized maize shelling machines Agricultural goods are processed into high-quality forms, which not only extends their usable lives but also boosts the farmers' overall net returns. A focus on demand-led design was made, which entailed understanding the needs of the farmer and building a suitable system to address those needs. Many farmers raise maize, but due to the high cost of a few of the foreign threshing machines, they are unable to purchase them. High labor intensity and large levels of waste. The purpose of this device was to shell wheat and separate the grains from the cob.

Mogaji [17] explained the design and fabrication of an improved maize shelling machine uses the goal of this effort is to design and create a maize shelling machine that is more effective mechanically and in terms of time management, cost, portability, and cost. The technique required choosing the right materials and applying theories of failure to calculate the maximum shear stress that may be applied to the bearing supports. It includes the design calculations required to do this task. The efficiency of this work's shelling without shattering the maize cob is an improvement.

Bo Yuan Shamsudin [18] et al. discussed the performance of a jatropha fruit shelling machine and the future improvement which provide to produce Jatropha seeds for the biodiesel industry, the shells of fruits have been removed using the Jatropha fruit shelling machine. The Jatropha fruit shelling machine's effectiveness was assessed. The machine mainly comprises a separating unit a vibrations sifter and a cracking unit featuring compression rollers. The machine mainly comprises a separating unit a vibratory sifter and a cracking unit featuring compression rollers. The research showed that the seeds' shells could not be entirely separated from their seeds by the vibratory sifter. The machine's separation effectiveness was discovered to be 91.25%. In reality, the machine's cracking mechanism tended to create broken-up shells and seeds.

S. J. Olatunji [4] et al. revealed an ergonomic evaluation of a cashew nut shelling machine which is An ergonomic analysis of a cashew nut shelling equipment used in a hamlet. A cashew nut-breaking device that is manually controlled was examined. Physiological, posture and subjective measures were made on 50 participants in the research. The study illustrated how ergonomics might be crucial to minimizing monotony, enhancing user acceptance, and facilitating the transfer of technology in underdeveloped nations.

Hou Hongjie [19] et al discussed the analysis and optimization of the process of adjustable double drum castor shelling based on the discrete element method which is challenging to get via trials of the castor capsule's shelling stress, which is essential for the construction of the machine's essential parts. The castor capsule shelling process is subjected to a stress study. The standard castor variety Tongbi 11 is used as the research subject in this work, and a model for castor shelling is developed. The shelling apparatus was created specifically for the test. The outer drum's size is maintained, as well as the inner drum's angle is 4.5 when the pace of shelling is at its peak. The drum measures 605 mm in length.

O. Ojolo [20] et al. proposed the development of a cashew nut shelling machine to increase shelling effectiveness and full kernel recoveries for nuts roasted in hot oil, a macadamia nut shelling machine was created employing the impact method. The idea behind this was to use the maximum amount of kinetic energy to crack the cashew nutshell. Impact shelling techniques are effective with giant cashew nuts because they recover more of the full kernel than small and medium nuts.

Andrew Jacob [6] et al. proposed the effect of shelling speed, moisture content, and number of beaters on the cleaning and recovery efficiency of a mechanized centrifugal melon shelling machine. A designed automated centrifugal melons shelling and cleaning machine's speed of shelling, melons seed moisture content, and the number of beaters have all been studied using response surface methodology (RSM). The melon is shelled by the machine, which then removes the shells as well as other contaminants from the shelled seed. A central composite rotating design served as the experiment's foundation (CCRD). The trials' findings showed that a speed of 2300 rpm, a moisture content of 15% (w.b.), and 20 beaters produced the maximum shelling efficiency of 88.5%, while a speed of 959 rpm, a moisture level of 20% (w.b), and 18 beaters produced the lowest efficiency of 25.11%. As a consequence, standard input settings with excellent cleaning and recovery efficiencies were supplied.

Reviewing and understanding the literature relevant to the research objectives provided sufficient Insight into the many aspects of the Groundnut Shelling Machine. The number of Researchers studying groundnut shelling machine effects is large, indicating that there is plenty of Information available in this sector. There are enough disparities in terms of information and strong guidance or methods about groundnut shelling machines. As a result, this research is required. With the use of analytics and statistics, as well as a groundnut shelling machine, this study is analyzed and described the key topic of the use groundnut shelling machine by using a thermal motor.

3. METHODOLOGY

3.1 Design:

In this section, the working of the proposed collision groundnut shelling machine consists of the Input which consists of groundnuts, the ground nut is collected from the hopper which consists of a frame, and the hopper pushes the groundnut into a shelling chamber which is supported by thermal motor, then the shelled groundnut transfer by shelling chamber to chaff outlet to get fixed the fan compressed the heat management of making shelled groundnuts then at last the shelled groundnut is collected out from the Discharge Tube. Figure 1 shows the process of the groundnut shelling machine.

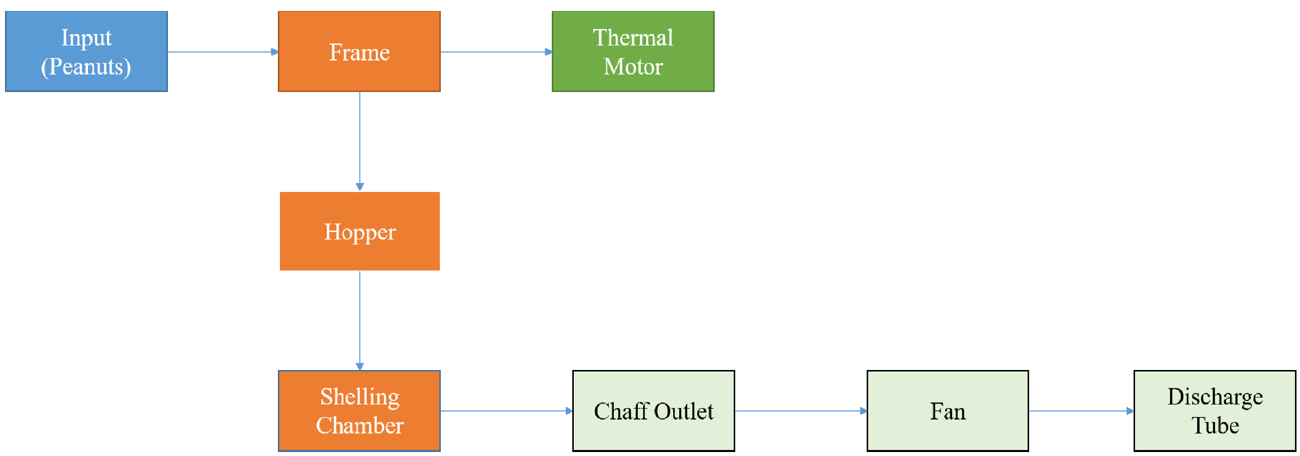

Figure 1. Shows the process of the groundnut shelling machine.

3.2 Sample/Instruments:

This section is occupied by a frame, hopper, shelling chamber, thermal motor, chaff outlet, and discharge tube, which brief introduction is illustrated below:

3.2.1 Frame:

Along with the prime mover, a frame is like a house which consists houses the hopper, shell, and separating unit (the separating unit is known as by which the shelling machine is running) thermal motor. Frame must have good welding characteristics and be able to endure loads and pressures because it is the machine's major support. Thus, mild steel was employed in the form of an angle bar.

3.2.2 Hopper:

During and before the shelling process, it holds the unshelled groundnut. It must be strong, corrosion-resistant, and able to sustain vibration loads and pressures. So, a mild steel sheet with a 2mm thickness is the material.

3.2.3 Shelling Chamber:

It houses the shelling drum and the auger. It is where the shelling is carried out. It must thus have high weldability, be able to endure loads and strains, and be corrosion resistant. The shelling drum's diameter is 206mm, and the anger screw's pitch is 100mm. The drum's active length is 500mm. Therefore, mild steel with a 2mm thickness was chosen.

3.2.4 Chaff Outlet

By applying pressure from the fan, the broken pod is removed from the groundnut. The material of choice is mild steel, 2mm thick.

3.2.5 Fan:

Due to its low weight, aluminum was used in its construction. It is 30 mm in diameter, 300 mm long, and 2 mm thick, respectively.

3.2.6 Thermal Motor:

A thermal engine is a device that transforms heat into mechanical energy, which is subsequently used for the performance of mechanical work. It accomplishes this by lowering the temperature of a functioning material from one that is higher. Thermal energy produced by a heat source raises the temperature of the working substance.

3.2.7 Discharge Outlet:

Through this outlet, the shelled groundnut seed is gathered. The seeds are gravity-fed into the tray from the shelling chamber. It must have strong impact resistance and good strength. Thus, mild steel that was 2 mm thick was employed.

3.3 Data Collection:

Table 1. Illustrates the main components which are used in this groundnut shelling machine.

S.no	Name of the Components	Length
1.	Hopper	10 mm
2.	Flame	15mm
3.	Discharge	20mm
4.	Thermal Engine	40cc
5.	Input peanuts	100 gram
6.	Outrage discharge	97mm

3.4 Data Analysis:

The process starts with the input which consists of peanuts that are going inside through the hopper by flame. The flame consists of the thermal engine which processes the material to conduct under the shelling chamber, with the use of the thermal engine which converts the thermal energy into mechanical energy the shelling chamber forward the peanut to the chaff outlet where the peanut is required to get the shell, with the help of fan the peanuts get attach into a shell, thus the chaff outlet gives out the shelled peanut which is gathered into a bunch at the discharge outrage.Figure 2: Depicts the flowchart of the process of the groundnut shelling machine.

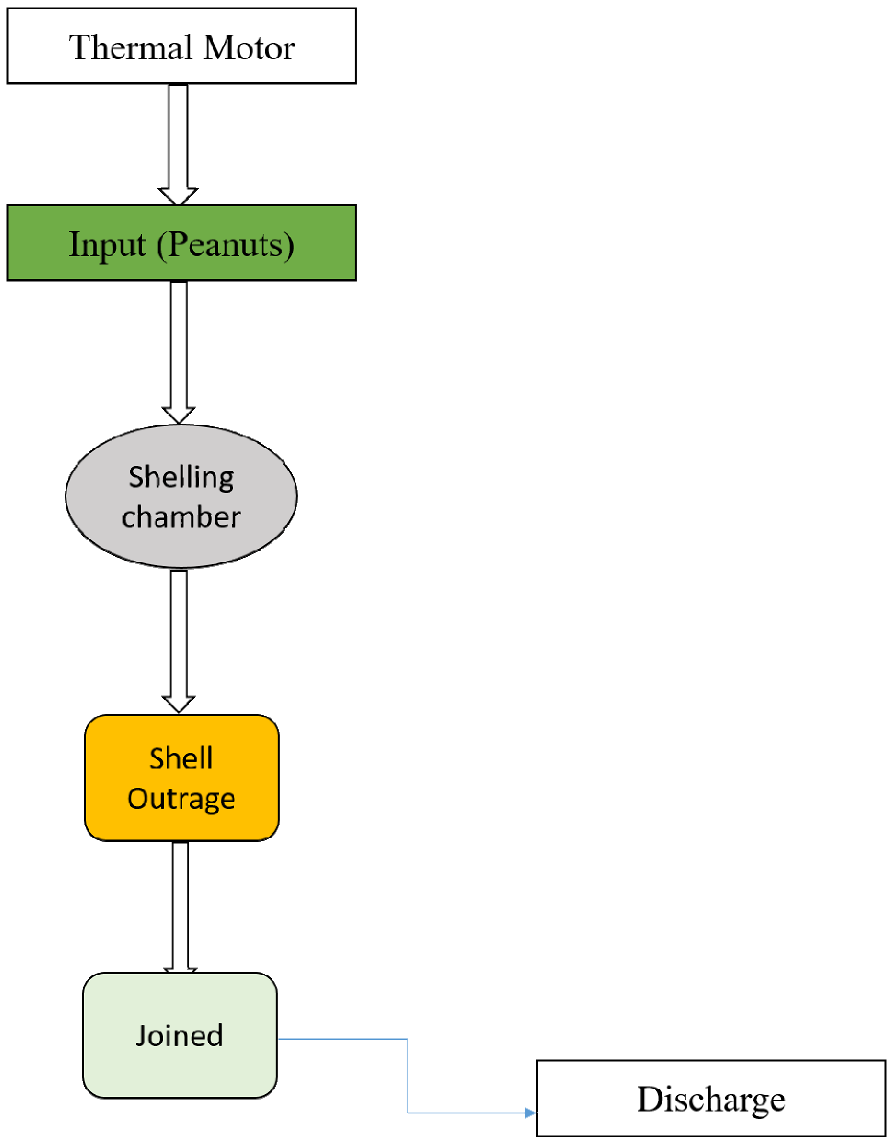

Figure 2: Depicts the flowchart of the process of the groundnut shelling machine.

4. RESULTS AND DISCUSSION

The Proposed model for the groundnut shelling machine is introduced in the above study which runs on a thermal motor to provide perfect shelling to groundnuts. In this study, the researcher makes a proposed system where the thermal motor comes out which works as a heat engine in the shelling machine. The thermal motor provides efficiency in the making of shelling because with the use of heat the shelling output with grow more in quality and quality also. The thermal motor is attached to the frame and inside the hopper which transmits heat energy towards the shelling chamber and by this heat the shelling machine runs, the peanuts were arranged in good shelling order and they rammed and bind up with shells perfectly, and they are carried out for Discharge tube.

From the research, the problem why is want to make because the peanuts industry is very rich in their requirement at the time, ground peanuts are so important in the flooding industry, so to obtain a high amount of groundnuts, the system requires a high-speed shelling machine that works on its tops and give their output in quantity as well as quality. The proposed shelling machine gives a remarkable output according to previous shelling machines in terms of quality and quantity also. All the peanut shells or groundnut shells are perfectly packed with the heat in the shell chamber, it will also maintain low cost to farmers or industry because the thermal motor uses any raw material to get on and provide heat in the form of mechanical energy so thus when the heat gets high, the production rate of the shelling machine will also be high.

5. CONCLUSION

The research study gives information about groundnut shelling machines by using a thermal motor. One of the main causes, why the production rates of groundnut shells go down due to loss of internal energy in the shell chamber where the shell does not so get perfectly attached, with the help of a thermal engine these problems will be ruled out and industry will find more productivity in case of quantity and quality. According to the Research, The Groundnut shelling machine is developed to reduce the loss of peanuts and provide them to stick into the shells perfectly. The development of a groundnut shelling machine provides a lot of easiness to the industries and to the farmers who provide peanuts which is very essential for them. Today people in the world like to eat groundnuts which are rich in higher proteins and especially for being a dry material that does not give so mat. The study gives outcomes that applying this proposed model the peanut gets more attached, there is no loss of peanuts in the shell chamber, and will provide great significance to collect the groundnuts. In future, In the future, this method can be more beneficial if it gets sensors to stop or start the thermal engine and will be more beneficial for low-range businesses.

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CHAPTER 24

A PROPOSED MODEL OF ELECTRICAL POPCORN MACHINE USING HOT ELECTRICAL COOKER SHELL FOR LOWER BUSINESS

Mr. Dipendra Kumar, Associate Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-dipendra1987@jnujaipur.ac.in

ABSTRACT:

Popcorn is one of the most enjoyable snacks in the world because its main advantage is it is low in calories and it light in nature and tastier. The popcorn is obtained from the maize nuts, on providing heat to the maize nut it converts itself into a puff, this effect is known as the kernel effect and, due to the puff and corn being the name of the maize it will like to know as popcorn. The problem why this research is made is to provide a popcorn-making machine that gives a high amount quantity concerning quality. The objective of the study is to a proposed model of an electrical popcorn machine using a hot electrical cooker shell for lower business. The outcomes of the study give an electrical popcorn machine that uses an electrical cooker, an electric cooker that provides heat and makes the maize best into popcorn. In the future, this method will be beneficial for small-class businesses and well maintain popcorn spaces.

KEYWORDS:

Electrical Cooker, Electrical Popcorn Machine, Maize, Popcorn Shell, Popcorn Machine.

1. INTRODUCTION

Popcorn is a type of corn kernel that expands & puffs up once heated, the same terms also apply to the food item created by the expansion. Popcorn is also known as popped corn, popcorns, or squeeze made up of maize[1]. The tough hull of a popcorn kernel houses the hard, starchy endosperm of the seed, which has between 14 and 20 percent moisture and turns into steam when heated. As the hull ruptures due to increasing steam pressure, the kernel is forced to grow between 20 and 50 times its initial size before cooling. This change to the small maze ingredient is known as popcorn [2]. Maize needs a lot of sunshine and a temperature above 100C during the long, low-temperature nights in favor to germinate. To bloom and fertilize, it also needs enough food and humid air [3]. The transition from male to female blooming is when the effect of water output is most important. Additionally, the need for water is closely tied to the climate as well as the size of the development circle [4].

The ears may be harvested when they are still green, before they are mature, or when they are fully developed, depending on the situation. maize may be harvested either manually or automatically, that is, using hands and hand tools or machines, which, depending on the kind, may either harvest grains directly or merely the ears. After being harvested, the ears are dehisced but instead dried, either naturally (using solar energy or heat from the sun) or artificially (using ovens and hot air blowers, Traditional granaries or specialized open sheds called cribs are two more options for drying.

A device used for popcorn for human consumption is called an electric popcorn machine. Due to the conventional conversion of electrical energy from the source to mechanical energy in the motor, the stirrer rotates the maize to prevent burning by using electricity as its source of energy. The government is required to support young technologists and engineers who have graduated from school and those who have not yet done so because of the load that technology has placed on humanity [5]. By offering them financial support, setting up functioning and sufficient equipment and facilities, employing competent and trained employees, and making education free for those who are not in a position to pay for it. If we are willing to absorb indigenous technical knowledge rather than that of the west, which is more expansive and occasionally inappropriate, we will be able to brag about technological development by doing this.

The present research is about an electrical popcorn machine using a electrical cooker. This research is featured in several sections where the first is an introduction and the second section is a literature review and suggestions for previous studies in the context of the electrical popcorn machine. In addition, the methodology section of this study is mentioned where the data in different sub-sections are examined. After that, the results and discussion part are discussed where the results are compared with existing data, followed by the methods applied in this research. Finally, the conclusion of this research is declared where the research gives the result as well as the future scope.

2. LITERATURE REVIEW

Leandra Ren [6] et al. discussed the production and selection of quality protein popcorn hybrids using a novel ranking system and combining ability estimates that Popcorn varieties are agronomic ally sub-optimal and genetically limited compared to other maize subspecies. Dent germplasm has been introduced to popcorn with varying degrees of success and typically results in significant popping loss to promote genetic variety and enhance popcorn agronomics. Through early QPP hybrid screening, further quantitative selection is being made to compare complex traits on a wide scale to elite popcorn varieties that are presently on the market.

Leandra Ren [7] et al. discussed a final selection of quality protein popcorn hybrids in which Quality Protein Maize Dent (QPM) and superior popcorn germplasm were used in an interpolation breeding method to create Quality Protein Popcorn (QPP) BC 2 F 5 inbred lines. because of their better agronomic, endosperm protein quality, and popping quality attributes, five QPP F 1 hybrids were chosen for further testing. Despite sharing phenotypic traits with their popcorn parents, these BC 2 F 5 QPP hybrids had somewhat less desirable popping traits than the original popcorn germplasm. Other hybrid production and testing programs can use the effective evaluation and ranking system approach used.

Eduardo Do Hönnicke [8] et al. discussed The term "fractal" refers to a class of complicated geometric structures that are not Euclidian or do not exhibit traditional spatial dimensions (1 or 2 or 3). In that it represents the degree to which an object's shape deviates from uniformity, the fractal dimension differs from the Euclidean dimension. a very straightforward experiment was conducted to investigate the fractal dimension of a popcorn grain both before and after the popping process.

Michael G. Vinson [9] et al. discussed the analysis of popcorn (Zea mays l. var. ever) for antioxidant capacity and total phenolic content Using the Folin-Ciocalteu and FRAP tests, the total antioxidant strength of raw and popped popcorn extract has been determined. Only the pericarp of the kernel, which was entirely attached to the oligosaccharide fiber matrix, contained polyphenols. The bioavailability of the phenolic acids was also estimated using in vitro digestion research. According to the Folin-Ciocalteu test, nine commercial popcorn samples have an average total polyphenol content of 5.93 0.92 mg/g after alkaline hydrolysis and 2.66 0.15 mg/g following in vitro digestion. It was discovered that the antioxidant capacity was not considerably reduced throughout the popping process. These findings suggest that the bound polyphenols are bioaccessible to a significant degree.

Lázaro da Costa Corrêa[10] et al. proposed the effects of moisture content and expansion method on the technological and sensory properties of white popcorn With a moisture level of 11.39% for the expansion technique without oil and 10.21% for the method with oil, the maximum points for expansion yield were noted. In both procedures (with and without oil), the lower expanded weight was shown at moisture levels of about 16%, when the greater expansion residue was also seen. When white popcorn is expanded without oil, the recommended moisture level ranges from 11.39 to 12.91%, and when it is expanded with oil, it ranges from 10.21 to 11.73%.

Leandra Rodriguez [11] et al. proposed quality protein popcorn cultivars were developed from a special genetic pool generated from regular popcorn and quality protein dent maize lines. A new sensory method was used to identify and compare distinctive traits in this population. It required the choice of specific descriptors for taste and texture in addition to hedonic numeric rankings of the common sensory traits appearance, aroma, texture, and taste with an "overall likability" score. These techniques may be used in a variety of sensory research, including those that discover trait correlations, customer preferences, and rankings of product acceptability. They are also easily transportable.

Gülay İdikut [12]discussed the determination of popping traits and grain quality of landraces popcorn populations. To assess the popping features and grain quality of populations by growing in Kahramanmaraş circumstances, the local variety (Nermin Cin) and 34 local popcorn populations that were acquired from Turkey's different areas were employed. In terms of the import of popping criterion and grain quality attributes, the greatest and lowest values of the features evaluated were attained. Specifically, there are 5 and 32 number populations for the popping volume, 16 and 26 number populations for the popping grain ratio, and 20 and 6 number populations for the grain's starch ratio. As a consequence of this study, it was possible to determine the genetic diversity among the nation's populations of popcorn.

Ricardo Tadeu de [13] Souza Sensory and nutritional evaluation of popcorn kernels with yellow, white, and red pericarps expanded in different. This study's goal was to assess how the pericarp's color and expansion process affected the sensory and nutritive qualities of popcorn kernels.After expansion, the sensory quality of corn popcorn grains is mostly influenced by the pericarp color and processing technique. The popcorn grains expanded in an oil-containing pan showed the best sensory ratings; they also underwent the biggest physicochemical and structural changes, as shown by viscoamylographic characteristics, demonstrating that starch expands farther during this type of processing.Compared to other processing methods, this one has the highest energy value without reducing the number of antioxidant-rich chemicals contained in the processed grains.

M.V.A. Faroni [14] et al. proposed the kinetics of the ozone gas reaction in popcorn kernels which to explore the kinetics of the ozone gas breakdown in the grain mass and to assess the impact of ozone treatment on grain quality, we measured the saturation durations for popcorn kernels subjected to various concentrations of ozone gas ($O3$) in a continuous flow.The quality examinations of the popcorn grains at these ozone levels did not turn up any changes that would endanger the product's viability as a consumer good.

Oloruntoba Bankole [15] et al. explained For breeding programmers, knowledge of the genetic and agronomic relationships between crop traits is crucial. This study looked at the relationships between 19 popcorn lines that were tested in duplicated trials at two different sites for grain production, popping expansion, and other agronomic characteristics. Finding lines with a suitable degree of popping volume and enhancing their grain yield and yield properties should be the main areas of improvement for popcorn.

ae Keun Park [16] et al. explained the genetic characterization of popcorn hybrids based on SNP genotyping and the development of rapid arms-based primers. Although the popularity of popcorn has increased recently, little has changed for growers or breeders. The vast majority of the popcorn sold domestically comes from foreign hybrids. To create hybrids suited for household circumstances, parental lines must be identified. The fundamental obstacle is still a small germplasm pool, though. To prevent genetic uniformity and lower the danger of stress sensitivity and yield loss, it is crucial to be aware of genetic heterogeneity in both commercial hybrids and germplasm. The suggested technique will be helpful for quickly and affordably determining the genetic purity of popcorn hybrids.

Chen Haipeng stated the dimensions and spectra of the t-popcorn graphs which are the parameters and spectrum of positive finite real number t-popcorn graphs. For t-popcorn graphs, we provide precise equations for the box dimensions and the Assouad spectra. t-popcorn graphs' Assouad spectra for 0 t 2. The conclusions are drawn from estimates of finer layers based on the parameter t that are connected to horizontal views and nonlinear collapsed views, respectively, and Chung-inequality Erd's and estimates of Duffin-Schaeffer type estimates.

Luiz Rafael Pinto [17] discussed overall heritability in popcorn estimated by a meta-analysis which to reliably assess selection gains in popcorn, this study conducted a meta-analysis to see how well it summarized the heterogeneous data of heritability estimates for the characteristics of grain yield (GY) and popping expansion (PE). Information about the heredity of popcorn was more easily synthesized because of the meta-analysis. For GY and PE, the combined heritability estimates () were 0.5208 0.0229 and 0.6356 0.0209, respectively, and for GY and PE, they were 0.3290 0.0292 and 0.3083 0.0298, respectively, in the narrow sense.

Draino Do Amaral [18] et al. Stated the exponential rise in nitrogen (n) fertilizer application has been linked to the global surge in agricultural productivity. Agriculture's extensive usage of nitrogen has harmed the environment. To maintain or improve maize output while minimizing the environmental effect, new solutions are required. Some hybrids are very productive and more effective than those that are sensitive to nitrogen. These may even be applied to farms with modest input levels for production, helping to assure food security.

Robert Strazielle and Catherine discussed the mouse at the popcorn stage of development In mice, rats, and rabbits, intense leaping and hyperexcitability occur at the popcorn stage of postnatal development. According to theory, the feature appears when ascending excitatory projections from the brainstem reach maturity and vanishes when descending inhibitory projections from the forebrain. Cortical-subcortical systems, which comprise the cerebellum and basal ganglia, may also play a role and need the action of biogenic amines, glutamate, and endocannabinoids.

Reviewing and understanding the literature relevant to the research objectives provided sufficient Insight into the many aspects of Popcorn and electrical Popcorn machine. The number of Researchers studying electrical popcorn machine effects is large, indicating that there is plenty of Information available in this sector. There are enough disparities in terms of information and strong guidance or methods about Popcorn and electrical Popcorn Machine. As a result, this research is required. With the use of analytics and statistics, as well as an electrical Popcorn Machine, this study analyzed and described the key topic of the use of an electrical Popcorn Machine by using an electric cooker.

3. METHODOLOGY

3.1 Design:

In this section, the design of the proposed model of the popcorn-making machine is illustrated as shown in Figure 1. The design process contains the input which is generally a maize small nut that is gathered into a shelling tube. the shelling tube contains of an electrical rotor, electrical cooker which is associated with an on off switch and a flavor container. The maize nut goes into the cooker and changes into popcorn and the popcorn is carried out from the discharge tube.

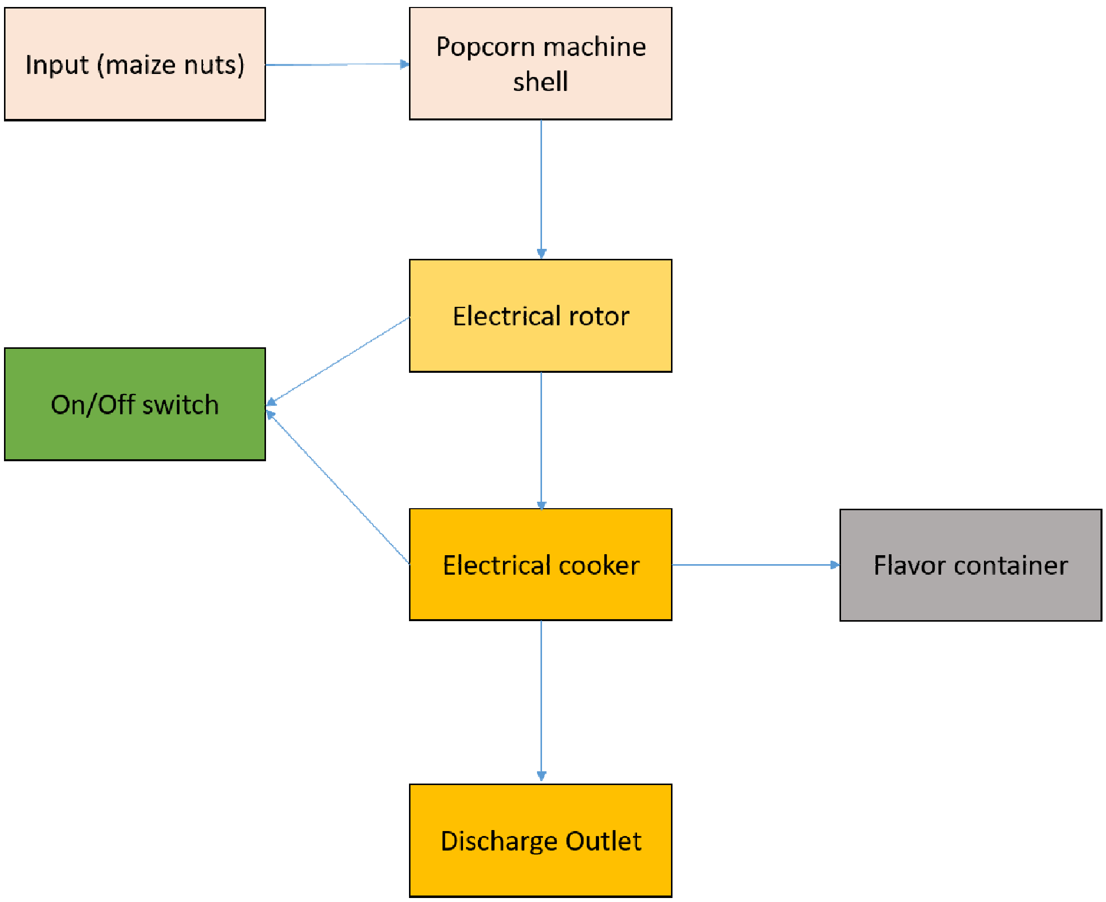

Figure 1: Shows a popcorn-making machine using an electrical cooker.

3.2 Sample/Instruments:

This section is consisting of instruments considered in this work which are provided for the popcorn shelling machine which is illustrated below:

3.2.1 Popcorn machine shell:

The popcorn shelling machine shell is made of glass where also the process of popcorn making is enrolled. The popcorn shell consists of the component which is required to make the popcorn. The popcorn machine shell is responsible for the known as Popcorn Machine carrying the components and the popcorn. In general, the whole process where popcorn is made is a shell.

3.2.2 Electrical rotor:

The electrical rotor is a device that is connected to the shell upwards and its downwards is connected to the cooker. It is generally used for mixing the flavor with the maize. When maize came and converts into popcorn then this rotor helps to provide mixing because of its rotating nature.

3.2.3 Electrical cooker:

An electrical cooker is a device which uses to boil food or which provide high steam for making maize into popcorn. The electrical cooker is composed of electrical energy that converts into heat energy and provides heat which converts into steam and that's y it is responsible for the maize nut which is converts into popcorn.

3.2.4 Flavor container:

The flavor container is the container that carries the flavor which is wanted to mix with the popcorn. The flavor container is composed of salt flavor and butter flavor which are added to the popcorn when popcorn is obtained in the electric cooker.

3.2.4 The discharge outlet or discharge tube:

The discharge outlet is the popcorn caring container form where the popcorn is collected. The discharge outlet is composed of a heating device that helps to the popcorn to remain warm.

3.2.5 Bulb:

The bulb in the popcorn shell is used to spread the light which helps to give light to the popcorn shell. Its lights give a good surrounding to the overall process and make everyone good to see the popcorn.

3.3 Data Collection:

For this study, the data collection is collected by the working process of this research which is illustrated in Table 1 below:

S.no	**Components**	**dimensions**
1.	Popcorn machine shell	25 ×50 mm
3.	Electrical rotor	50 mm
3.	Electrical cooker	100 m, 10 v electric use
4.	Discharge tube	100mm
5.	Power switch	10×15 mm

3.4 Data Analysis:

The process starts with the input which consists of maize, the maize was forwarded through the popcorn shell. The electrical cooker contains all the maize ingredients the cooker head cap is closed and the electrical rotor is attached between the cooker shell and cooker head cap. The electrical cooker uses power input in terms of electricity which turn into heat in the cooker, thus the cooker is acting like a small boiler, the electrical rotor is also started in the electrical cooker where the maize is changed into popcorn, the popcorn is carried away through the pipe which is connected to the discharge outlet, the discharge outlet stores the popcorn where the popcorn gets collected. Figure 2: represents the working process of the electrical popcorn machine.

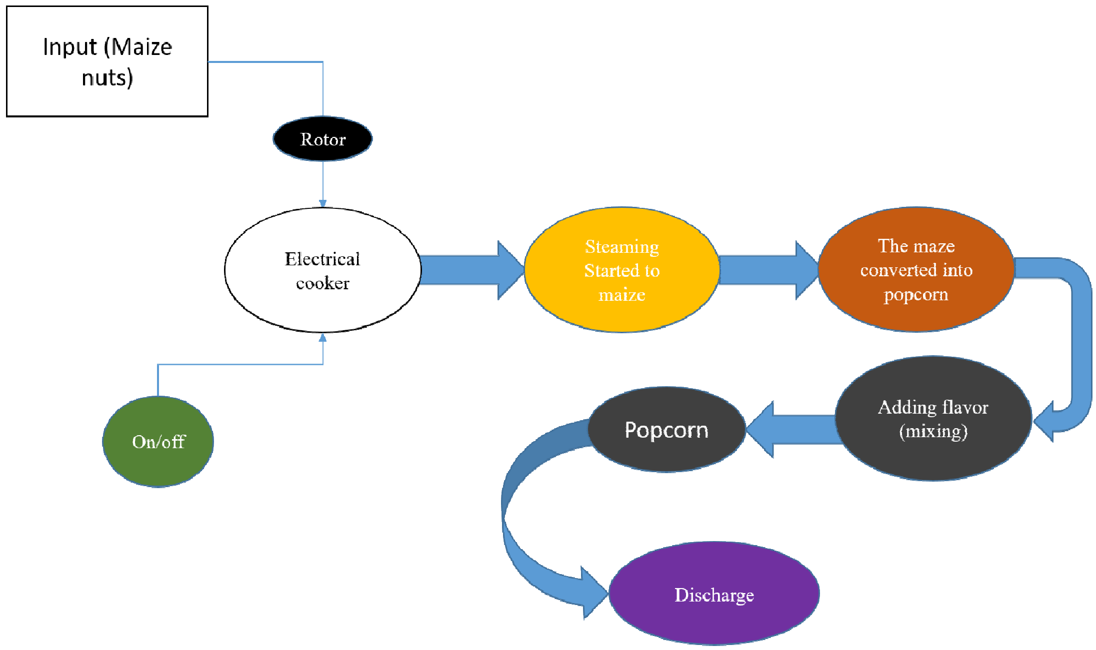

Figure 2: Represents the working process of the electrical popcorn machine.

4. RESULT AND DISCUSSION

The electrical popcorn machine is introduced in the above study which deals with electric cookers. In This study, the researcher makes an electrical popcorn machine with help of an electric cooker. An electrical cooker is a device which turns on electrically and uses electrical energy which changes into heat energy. The heat converts into steam that steam provides the maize to convert into popcorn. The electrical cooker takes maize from the popcorn shell, provides the maize heat and the maize is converted into popcorn due to the kernel effect. It uses a flavor changer by which the popcorn gets flavor also., the electric cooker can change the maize into popcorn in less time because occupies a large capacity of heat.

From the research, the problem why it is want to make is due to there is a shortage of perfectly grained popcorn, the popcorn is the most important snack which is enjoyed for eat. Popcorn contains fewer calories, so that is why it is light, so to obtain perfect quality popcorn it required perfect heat during its making process, an electrical cooker helps to provide an immense space that gives perfect heat to make the popcorn well finished in terms quality also and in terms of quantity also. The electric cooker will provide heat, it this heal the maize can get perfect heat in at shortage time and this method will get beneficial from other popcorn machines.

5. CONCLUSION

The research study gives information about electrical popcorn machines. One of the main cause, why popcorn is a favorite snack is because it is light in the presence and will provide fewer calories to the body. The major consent of an electrical popcorn machine using an electric cooker is to provide high-quality popcorn and give a perfect shape to them and provide a high quantity also. According to the Research, the electrical popcorn machine is developed a large amount of popcorn and provides perfect heat to the maize to convert it into popcorn. The development of electrical popcorn machines can help small businesses to get a high amount of popcorn in less time, this will help in low cost also. Today people in the world like to eat popcorn as their essential snack, whether it to watch a movie, whether to enjoy a party, all want to enjoy popcorn, so here researchers developed a proposed model for an electrical popcorn machine. The study gives outcomes that applying the electrical cooker will increase the popcorn quality and gives a high amount in quantity also, in future, this method will help to the small class popcorn businesses.

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CHAPTER 25

SPECIFYING THE SIGNIFICANCE OF STEAM TURBINE IN MODERN WORLD

Mr.Sanjeet Kumar, Associate Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-sanjeet.kumar@jnujaipur.ac.in

ABSTRACT:

A steam turbine is a device that uses pressurized steam's thermal energy to drive mechanical power on a revolving output shaft to generate electricity. the problem why the study is conducted because to determine how steam turbine works, what it is purpose and how its get work, so to find all the significance about the steam turbine, the study is conducted. The objective of the study is to determine the significance of steam turbine in modern world. The outcomes of the study give about the effeteness of the steam turbine and how they are beneficial for the nation and how it is responsible for the power generation is focusing in the study. In future, steam engine study will provide more knowledge about power generation because power generation is required to survive in the modern world.

KEYWORDS:

Power Generation, Steam Turbine, Thermal Energy, Turbine Works.

1. INTRODUCTION

All of our large coal-fired power plants employ steam turbines to propel the turbines or alternators that generate electrical energy. Steam produced by "boilers" or "steam generators" powers the turbines itself. In other words, a steam turbine uses a module for converting thermal energy into mechanical energy is a steam turbine. Converting hot steam energy into rotational energy is the main task in running a steam turbine. The structure of high efficiency given their significant role and intricate internal flow field, supercharger is a potential and difficult task. Any issue within a steam turbine will result in an increase in overall heat losses.

Steam energy is transformed into rotational energy as it flows through the turbine after leaving the boiler. The turbine often has numerous stages, each of which has a revolving blade and a fixed blade (or nozzle). Steam's potential energy (temperature and pressure) is converted by stationary blades into kinetic energy (velocity), which is then used to propel the flow onto the spinning blades. The pressure drop resulting by the rotating blades' conversion of velocity into forces rotates the turbine shaft. Due to their prices and efficiency, steam turbines have been used to power generators extensively throughout the past 100 years. The complexity of steam turbine structures varies depending on their capacity, intended use, and desired performance. Steam turbines often have a sophisticated design and use multiple stage steam expansion to boost thermal efficiency in power plant applications.

In contrast to a turbine used to power an electric generator, which runs at almost a constant speed, steam turbines to use as processing drivers typically need to work throughout a range of speeds. Input temperature, exhaust temperature, and the total turbine pressure ratio (inlet pressure/exhaust pressure) determine how much energy is contained in each kilograms of steam that passes through the turbine. Turbines that have condensation are ones whose output pressures are lower than atmospheric. For a given set of intake circumstances, they provide the highest overall blade pressure ratio and hence need the least amount of steam flow to generate the same amount of power. It takes a cooling medium to completely condense the steam. When the exhaust steam may be used elsewhere, quasi or back-pressure turbines are typically used to exhaust water at pressures over atmosphere.

In the present study, the importance and role of Steam Turbine. This study is featured in several sections where the first is an introduction and the second section is a literature review and suggestions for previous studies in the context of Steam Turbine. In addition, the discussion part is discussed. At last finally, the conclusion of this study is declared where the review gives the result as well as the future scope.

2. LITERATURE REVIEW

Nagib Elmekawy [1] et al. proposed computational modeling of non-equilibrium condensing steam flows in low-pressure steam turbines which Condensation in steam turbines' low pressure stages causes several efficiency losses and harm to the stator blades, including corrosion and pitting. The power producing industries have seen a lot of this issue. This study's goal is to accurately model the condensation plus shock wave phenomena at the steam turbine's final stage and, in turn, comprehend that phenomenon. The k-omega Turbulence model was used in ANSYS Fluent for the numerical simulation. The outcomes matched the values from the experiment.’

Dick Erik explained steam turbines which states commencing with the 2 important axial kinds, the operating concepts and structure of turbine generators. The significance of the reaction's intensity is explored. It is demonstrated how big steam turbines for electric power plants and small turbine for industrial uses are typically constructed. The examination of blades and vane forms concludes the chapter.

Joaquín López-Asensio, [2] examination of blades and vane forms of steam turbine. Understanding how design factors and chemical separation of combustion affect energy and exergy efficiency is the key objective. The system's primary components are analyzed for mass, energy, and exergy while taking six distinct sources of irreversibility’s into account. Grossmann diagrams show energy flows and prospective areas for development. ThermoCombustion, a simulated lab for combustion processes, provides the results. According to the exergy study, the boiler, chimney exhaust, steam turbine, and condenser are the main sources of exergy destruction. If the ignition temperature rises, less energy is destroyed during the reactive process, but NOx emissions would rise as a result. The regeneration cycle lowers overall irreversibility’s, improving the effectiveness of energy use.

Waqar Muhammad Rafique et al. discussed artificial intelligence based operational strategy development and implementation for vibration reduction of a supercritical steam turbine shaft bearing .A steam turbine's high-speed shaft bearing vibrations must be tightly regulated for safe and dependable power generation at power plants. ANN and SVM models are trained, verified, and compared by external testing process following significant data processing and learning-based visualization experiments conducted on the raw operational data. It is established that the turbine's bearing's relative vibrations have decreased and are now below the warning level. This solidifies the ANN process model's usage as a tool for operational excellence that reduces vibration in high-speed rotating machinery.

Anxi Liu [3] et al. discussed hybrid modelling and digital twin development of a steam turbine control stage for online performance monitoring. Thermal power plants frequently operate in off-design modes as a result of the increasing competition integration of renewable energy sources to thermal power sources. At the component level, steam turbine control stage systems are primarily used to alter the load in thermal power plants. To enable quicker and so more flexible operation of thermal plants and hence create options to integrate additional renewable power with little harm to efficiency and safety, accurate monitoring of control stage systems is essential. As a result, there is huge potential for the development of a plant-wide digital twin and for online performance monitoring because results show that the average relative errors between simulated and actual values of exit pressure and departure heat of control stages are within a scope of one percent.

Iang Ru, [4] et al. discussed fatigue life prediction of a supercritical steam turbine rotor based on neural networks which Rotor stability and safety are crucial for the efficient functioning of steam turbines. A data-driven neural network is presented to forecast the fatigue performance of a 350 MW super steam turbine rotor online. A huge sample dataset including temperatures and pressures is created for later neural network training after the finite element method is used to identify the risk zones of the entire rotor. It is demonstrated that the suggested neural network-based approach can evaluate the steam turbine's operational status during various cold starts and offer a workable online health able to monitor methodology for the steam turbine rotor, all without having to deal with the rather difficult thermo-mechanical analysis.

Karim Kordestani [5] et al. proposed design of an active fault tolerant control system for a simulated industrial steam turbine. In this research, an active fault control (FTC) method based on the combination of a statistics fault detection and diagnosing (FDD) component and an adaptive generalised predicting control (GPC) approach is suggested to accommodate for industrial steam turbine problems. For the set of underlying steam power plant flaws, an adaptive structure of the it’s internal mechanism has been developed to capture the flawed model. However, the GPC controlled configuration is changed via its calculation to demand for good control recovery with fewer strenuous control actions to address the most difficult errors.

Jie Liu [6] et al. discussed a study on the matching of constraint between steam turbine blade and laboratory specimens A major issue in accurately assessing the structural integrity of fractured structures is the constraint matching between lab specimens and real cracked structures. Different lab specimens and steam turbine blades with various constraints were chosen, and the compatibility of restrictions here between two was explored. It concludes the study of all the blades of steam turbine with its dimensions.

Yi-Jing Hu [7] et al. explained relationship prediction based on graph model for steam turbine control valve, that commonly experiences the problem of the dead zone, has an essential piece of equipment called the control valve. The graph concept is a promising technique for dead zone identification, however due to a lack of mechanism understanding, creating an accurate and full network topology is challenging. As a result, a graph model is suggested to forecast the linkages in the graph and gauge the interaction between variables of associated control valve equipment. The steam power plant control valve's linkages, as well as those of other associated industrial systems, may be estimated using the suggested graph model.

Cesar Pinto [8] et al. developed a steam turbine dynamic model for full scope power plant simulators which One of the key characteristics of the created model is its completeness, which aims to fully encompass the steam turbine working environment. Distinct areas inside the steam turbines' safe operating envelope are differentiated for modelling reasons. The impacts of thermal and rotating inertia that are crucial for steam turbine startup and shutdown are highlighted in detail. A 300 MW class steam turbine from an existing combined cycle power station is simulated using the developed heat turbine dynamic model. The findings of this paper imply that in order to obtain high fidelity results for steam turbine dynamic models, it is necessary to take into consideration a variety of physical phenomena, particularly those connected to processes of heat transfer.

Reviewing and understanding the literature relevant to the research objectives provided sufficient Insight into the many aspects of steam turbine. The number of Researchers studying steam turbine effects is large, indicating that there is plenty of Information available in this sector. There are enough disparities in terms of information and strong guidance about steam turbine. As a result, this study is required. With the use of analytics and statistics, as well as steam turbine, this study analyzed and described the key topic of elaborating the significance of Steam Turbine in modern world.

3. DISCUSSION

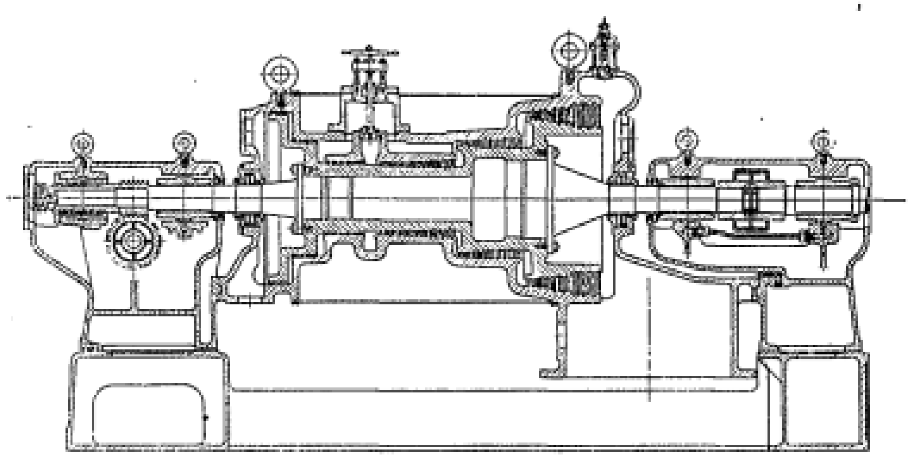

Figure 1: Illustrates the Pardon turbine.

A rotating heat engine, the steam turbine is well adapted to power an electrical generator. Keep in mind that steam turbines are used to generate nearly 90% of the power used worldwide. Sir Charles Parsons created the first steam turbine in 1884, which was attached to a dynamo and produced 7.5 kW (10 hp) of energy. All current and upcoming thermal power plants all share the steam turbine. Additionally, the usage of ordinary steam turbines provides the foundation for the power generation of fusion power plants. Almost majority of the world's commercial electrical power is produced by turbines that are propelled by the wind, water, steam, or burning gas. Through electromagnetic induction, the turbine turns mechanical energy into electrical energy as it powers a generator. Mechanical energy may be produced using a variety of techniques, such as heat engines, hydropower, wind power, and tidal power.

Heat engines power the majority of electric generation. The majority of the energy for these engines comes from the burning of fossil fuels, with a sizeable portion coming from nuclear fission and some from renewable sources. Using a variety of heat sources, the modern steam turbine (which Sir Charles Parsons designed in 1884) presently produces over 80% of the electric power in the world. Steam turbines are thought of as power-generating machinery that harms the atmosphere since they burn fossil fuels. In order to reduce air pollution, a waste heat recuperation boiler is erected, and NOx reduction operations are carried out. In contrast, the hydrogen-oxygen turbine's exhaust gas is exclusively made up of water vapor and is thought to be a power-generating device featuring great environmental performance. In Figure 1 shown the Pardon turbine.

3.1 Working of Steam turbine:

A rotating heat engine, the steam turbine is well adapted to power an electrical generator. Keep in mind that steam turbines are used to generate nearly 90% of the power used worldwide. Sir Charles Parsons created the first steam turbine in 1884, which was attached to a dynamo and produced 7.5 kW (10 hp) of energy. All current and upcoming thermal power plants all share the steam turbine. Additionally, the usage of ordinary steam turbines provides the foundation for the power generation of fusion power plants. The steam jet applies pressure to the blade as it moves around its curved surface because of its centrifugal force. Stages are each row of stationary nozzles and rotating blades. The fixed blades are circularly placed inside the circular turbine case, and the rotating blades are mounted on the turbine rotor.

The speed of the revolving blades in all turbines is inversely correlated with the speed of the steam flowing over the blade. Steam must move at an exceptionally high velocity if it is merely expanded from boiler pressure to the output end in one step. the typical main turbine in nuclear power plants operates at speeds of about 3,000 RPM for 50 Hz structures for 2-pole generators (or 1500 RPM for 4-pole generators) and 1800 RPM for 60 Hz structures for 4-pole generators, in which steam expands from pressures of about 6 MPa to pressures of about 0.008 MPa (or 3600 RPM for 2-pole generator). For practical uses, a single-blade ring will require extremely massive blades and a speed of about 30 000 RPM. The majority of nuclear power plants use a single-shaft jet engine that comprises of the main generator, an exciter, parallel number of co LP turbines, and one multi-stage HP turbine. The HP Turbine typically generates between 30 and 40% of both the average energy capacity of the electricity generation unit and is a double-flow small turbine with roughly 10 stages and shrouded blades.

An engine that rotates to generate heat, a steam turbine transforms the thermal energy in steam into mechanical or electrical energy. In its most basic form, a steam turbine is composed of a boiler (steam generator), turbine, reservoir, feed pump, and other auxiliary components. For example, compression, warming, and expansion happen continuously and simultaneously, in contrast to reciprocating engines. The fundamental functioning of a gas turbine is comparable to that of a gas turbine, with the exception that water and steam are used as the working fluid rather than air or gas. About 60–70% of the overall energy capacity of the power plant unit is produced by LP turbines. A turbine rotor is supported by two bearings, so that each turbine module has two bearings in total.

3.2 Types of Steam Turbines:

Depending on their design, static pressure, size, and other factors, steam turbines can be divided into many groups. However, there are only two fundamental types of steam turbines:

3.2.1 impulse turbines:

Moving blades and stationary nozzles alternate in the impulse turbine. In the impulse turbine, the steam expands in fixed nozzles while maintaining a constant pressure as it passes over the blades. Impulse type turbines include the Curtis, Rameau, and Brown-Curtis turbines. The De Laval, the first steam turbine, was a single-bladed impulse turbine. The steam pressure drops completely only in stationary nozzles. Although in theory there is no pressure drop in the moving blades of impulse blades, in practice there must be a slight pressure drop all across moving blades in order for the flow to occur. In impulse turbines, the majority of the pressurized potential energy is transferred to kinetic energy when the record amount through the nozzle.

When fixed nozzles' high-velocity steam strikes the blades, it changes direction and exerts force. The ensuing impulse propels the blades forward and turns the rotor. The differential pressure per stage may be rather significant in these turbines, enabling big blades and fewer stages. This is their principal characteristic. Except for reduced uses, turbine blades are compounded, an arrangement that considerably increases efficiency at low velocities. Reaction and impulse are widely used together in modern steam turbines, with the amount of each changing from blade root to the blade's edge. Typically, the rotor blades have an impulse edge at the root and a response blade there at tip.

A typical design is to give one or even more Curtis stages on the way up, decided to follow by Rameau or response staging. The Curtis stages considerably lower the tension and temperature of the fluid to a moderate level with a significant number of work per stage. Reaction stages are often determined to be the most effective when friction is taken into consideration, next by Rateau and Curtis within this order. Since frictional losses for Curtis stages are related to steam velocity squared, they are large because steam expands constantly throughout the reaction stage, frictional losses have become less important and flow velocities are less.

3.2.2 Reaction Turbine:

The response turbine is made up of alternating sets of stationary and moving nozzles (blades). Steam is expanded in both the fixed and movable nozzles of the reaction turbine. In other words, when the steam passes over the blades, it keeps growing. In the rotating blades, pressure and velocity are lost. A steam nozzle that is converging is on the rotating blades. As a result, as the much as over the rotating blades, its kinetic energy and steam pressure both rise as it expands.

In reaction turbines, where pressure potential energy is transformed into kinetic energy, the steam expands through fixed nozzle. High-velocity vapor from fixed nozzles strikes the blades (nozzles), which causes them to shift direction and expand even further. A force is applied as a result of the direction shift and steam acceleration. The rotor turns as a result of the impulse that propels the blades ahead. No net difference in steam velocity is seen across the stage, but there is a reduction in the pressure and temperature, which is due to the effort involved in driving the rotor. Because the pressure loss in such a single stage is constrained, this sort of turbine experiences pressure dips throughout a number of stages. Steam velocity through the stage does not change significantly, but pressure and temperature do, as a result of the work that went into driving the rotor. Because the pressure differential in a single stage is constrained, this sort of turbine experiences pressure dips throughout a number of stages.

The fundamental distinction between this type of turbine and an impulse turbine is the reduced pressure drop per stage, which results in smaller blades and more stages. Reaction turbines, on the other hand, are often more effective, or have better "isentropic turbine efficiency." Sir Charles Parsons is credited with creating the reaction turbine, sometimes referred to as Parsons Turbine. For the same level of thermal energy conversion in steam turbines, such as those used to generate electricity, a reaction turbine would need almost twice as many blade rows as such an impulse turbine. Despite being significantly longer and heavier as a result, a response turbine has a somewhat greater overall efficiency than an equivalent impulse turbine when converting the same heat energy conversion. Reaction and impulse are widely used together in modern steam turbines, with the amount of each changing from the blade root to the blade's edge. Typically, the rotor blades have an impulse blade there at root and a response blade at the tip.

3.3. Classification of Turbines:

In this section, the classifications of Turbines are classified which are illustrated below in the below subtitles.

3.3.1 Condensing Steam Turbine:

Thermal power plants are the most typical location for condensing steam turbines. The greatest amount of power is recovered from the steam in a condense steam turbine. In order to do this, exhaust from the reduced stage of the central turbine is condensed in a condenser. Depending on the use they are intended for and the working pressures, steam turbines may well be divided into many groups. The beginning and end characteristics of steam are affected by a turbine's industrial use. Any steam turbine that operates has to have a pressure differential between the steam source and the exhaust.

3.3.2 Back-pressure Steam Turbine:

A kind of steam turbine that's also employed in industrial applications when low- or medium-pressure steam is required. When high pressure steam reaches the pressure steam turbine, some of its thermodynamic energy is transformed into mechanical energy when the steam expands. An electric generator or other mechanical devices, such as motors, fans, compressors, etc., are powered by the mechanical energy.

3.3.3 Reheat Steam Turbine:

Two turbines are used for the expansion during a reheat cycle. The steam is heated at constant pressure in the boiler until it reaches a temperature that is typically equivalent to the initial superheat temperature after expanding in the high-pressure rotor to an intermediate pressure. Two turbines are used for the expansion during a reheat cycle.

3.3.4 Turbine with Steam Extraction:

A portion of both the steam can be extracted from an extraction turbine through one or more apertures in its casing at an intermediate pressure. The steam that was extracted might be applied to a procedure. Depending upon that steam turbine design, the steam extraction pressure might or might not be automatically adjusted.

3.4 Turbine Blades:

The turbine blades are the most crucial component. They are the key components that transform the working fluid's pressure energy into kinetic energy. There are two primary types of turbine blades:

3.4.1 Moving blades:

The thrust of steam received (induced by a change in momentum) and the expansion or acceleration of the steam opposite to them both cause the moving blades to move.

3.4.2 Fixed Blades:

In steam turbines, the kinetic energy is transformed into kinetic pressure potential energy as the steam expands through to the fixed blade (nozzle). High-velocity steam from stationary nozzles strikes the rotating blades, then changes course and expand. Reaction and impulse are widely used together in modern steam turbines, usually with variable degrees from the bifurcation point to the blade's perimeter.

3.5 Significance of Turbine Blades:

Impulses blade at the root and a response blade just at the tip. A turbine's efficiency and dependability depend on the blades' right design. Therefore, all engineers working on turbines must have a general understanding of the significance and fundamental design elements of steam turbines. The turbine blades are frequently the limiting element in gas turbines. The greatest temperature which the turbine can endure limits the cycle's peak temperature, which happens at the conclusion of the combustion phase. As usual, the highest limits on heating value are set by metallurgical factors (about 1700 K). Superalloys and a variety of cooling techniques, including internal air channels, pressure gradient cooling, and protective coatings, are frequently used in turbine blade construction. The capacity of turbine blades to withstand high temperatures was substantially enhanced by the creation of super alloys inside the 1940s and innovative processing techniques like pressure induced melting in the 1950s. Chromium, cobalt, and rhenium-based super alloys are often used in modern turbine blades.

Although steam turbine blades are not subjected to such high temperatures, they must resist a two-phase fluid operation. When condensed water is sprayed onto the blades, the high water droplet concentration might hasten the impingement and abrasion of the blades. To avoid this, for instance, condensate drains are provided in the steam pipe heading to the turbine. The design of the blades for the LP turbine's final stage presents engineers with yet another hurdle. Due to the large specific volume of steam, these blades must be extremely long, creating strong centrifugal forces when in use. Because of this, turbine blades are stressed by fluid forces that can result in fracture, yielding, or creep failures as well as Coriolis force (turbine stages can revolve at tens of millions of revolutions per minute, but normally at 1800 RPM).

Super alloys and a variety of cooling techniques, including internal air passages, boundary layer chilling, and protective coatings, are frequently used in turbine blade construction. The capacity of turbine blades to withstand high temperatures was substantially enhanced by the creation of super alloys in the 1940s and innovative processing techniques like vacuum induced melting in the 1950s. Chromium, cobalt, and rhenium-based super alloys are often used in modern turbine blades. To prevent harm from low-quality steam to the steam turbine blades, the steam must be warmed. When rainwater is blown onto the blades, the high concentration of water droplets will quickly impact and erode the blades. Condensate drains are put in the steam pipe going to the turbine to stop this from happening. In all applications, extraction-type rotors are typical. When necessary, steam can be collected from the turbine in some applications before it passes through the extraction turbine, the last step. Similar to back-pressure turbine, extracted steam may be employed in a variety of industrial processes or to increase the thermodynamic cycle's effectiveness. Heat regeneration is the common name for the second scenario.

4. CONCLUSION

The review study gives information about steam turbine and their significance in modern world. The major consent or significance of steam turbine is that they can be used power generation for the environment. According to the study steam turbine are used to produce electricity , they used the thermal energy which provides steam with rotating motion , the steam turbine helps to produce electricity . They are responsible for the power generation for the region alone. In the study, the steam turbine significance and their classification are been explained as to why they are so run in today's world. Today the world need electricity to charge their their phones , laptops , to light their houses the world requires electricity , so by the help of steam turbine provides electricity and which responsible for power generation. The study gives support to steam turbines used by industries in their region. In the future, steam engine study will provide more knowledge about power generation because power generation is required to survive in the modern world.

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CHAPTER 26

A STUDY ON SOLAR REFRIGERATOR WITHOUT COMPRESSORS

Mr .Ashok Singh Gour, Assistant Professor,
Department of Mechanical Engineering, Jaipur National University, Jaipur, India,
Email Id-asgour@jnujaipur.ac.in

ABSTRACT:

Globally increasing refrigeration demand resulted in increasing electricity production and, as a result, increased use of chlorofluorocarbons (CFCs), which contribute to ozone layer depletion. Because it can convert waste electricity into useful cooling, thermoelectric refrigeration is a new alternative. As a result, thermoelectric refrigeration is critical, particularly in developing countries where long life and low maintenance are required. The goal of this research is to design and build a working thermoelectric refrigerator that uses the Peltier effect to refrigerate and keep a specific temperature low. The requirements are to cool this volume to temperature in 2 hours and provide retention for at least the next half hour. Solar energy is also used to power our project also makes use of solar energy to power a thermoelectric system. In this project, we built a thermoelectric system that uses both solar power and an electrical power supply. The project has a variety of applications, including food preservation, military or aerospace equipment, and medical and pharmaceutical equipment. The temperature is monitored and the LCD is updated using a microcontroller.

KEYWORDS:

Electricity, Refrigerator, Solar Energy, Thermoelectric.

1. INTRODUCTION

The current trend in the first world is to look to renewable energy resources as a source of energy. This is done for two reasons: first, the lower quality of life caused by air pollution, and second, the strain that the world's ever-increasing population places on our natural energy resources[1]. These two facts lead to the realization that the available natural energy resources will not last forever. As a result, the ideal solution would be to use some type of renewable energy resource to provide energy to these houses without the need for an expensive electric grid connection. A RAPS (Remote Area Power Supply) powered by an alternative energy source is one solution[2]. A study conducted by the University of Cape Town's Energy development research up with interesting facts that can be used to support the applications of PV systems to Third World housing When the battery is fully charged, the thermoelectric cooler will use power from the PV panels, and at night, it will use a small amount of power to maintain the temperature in the cooler box[3]. In other words, if the system's battery is fully charged but there is no appliance to absorb the power generated by the PV panel, it will be wasted resulting in a lower efficiency factor for the entire PV system[4]. The cooler box integrated into a RAPS would allow for a very efficient system that would utilize all of the excess solar power generated. Thermoelectric coolers are solid-state heat pumps that are used in an application that required temperature stabilization, temperature cycling, or cooling below ambient temperatures. Many products can be used, such as blood analyzers and portable picnic coolers. This paper discusses the thermoelectric cooler's theory, as well as the thermal and electrical parameters involved[4]. A thermoelectric cooler, also known as a thermoelectric module or Peltier cooler, is an electronic component made of semiconductors that acts as a small heat pump. When a low-voltage DC power source is applied to a TE module, heat is moved from one side to the other. As a result, one module face will be cooled while the opposite face is heated. It is important to note that this phenomenon can be reversed by changing the polarity (plus or minus) of the applied DC voltage, causing heat to move in the opposite direction. A thermoelectric module may be used for both heating and cooling thereby making it highly suitable for precise temperature control applications[5].

The domestic refrigerator-freezers operating on alternative refrigerants such as HFC- 134a, contribute indirectly to global warming by the amount of carbon dioxide produced by the power plant to generate electricity to operate over a unit over its lifetime[1]. This contribution is nearly 100 times greater than the direct contribution of the refrigerant alone[6]. Moreover, approximately 62 million new units are being manufactured worldwide every year, and hundreds of millions are currently in. use. (UNEP,1995) it is expected that the production of refrigerator-freezers will substantially increase shortly as a result of the increased demand, especially in the developing countries. Therefore, in response to global concerns over greenhouse resorts are being made to produce refrigeratorfreezers with low energy consumption. In most of the developing third world, adequate supplies of drinking water and water for irrigation are scarce commodities[7]. In many places in Africa, India, and Central and South America, adequate supplies of water are found only at a considerable depth below the surface. These locations generally do not have the infrastructure to provide an electrical grid to pump the water with electricity nor do they have the infrastructure to provide roads to bring in electrical generators or even the fuel for those generators[1].

2. LITERATURE REVIEW

In 1834, a French watchmaker and part-time physicist, Jean Peltier, while investigating the " Seeback effect," discovered the Peltier effect and which is the fundamental principle behind a thermo-electric system. As we know, the physical principles upon which modern thermoelectric coolers are based date back to the early 1800s, although commercial thermoelectric (TE) modules were not available until almost 1960[3]. The first important discovery related to thermoelectricity occurred in 1821 when a German scientist, Thomas Seeback, found that an electric current would flow continuously in a closed circuit made up of two dissimilar metals provided that the junctions of the metals were maintained at two different temperatures[3]. Several experimental and numerical studies characterized the performance of TE heating and cooling system. For example, Luo, et al[4]performed experiments and verified that a TEHP system is more efficient than an electrical heating device, for its heating coefficient reached more than 1.6 with suitable operating conditions[4].

Riffat and Qiu [4] compared the performance of the thermoelectric air with two other types of domestic air conditioners, namely the vapor compression air- conditioner and the absorption air conditioner[2].

A partial list of other solar applications includes space heating and cooling through solar architecture, daylighting, solar hot water, solar cooking, and high-temperature process heat for industrial purposes[6]. Solar technologies are broadly categorized as either passive solar or active solar depending on the way that capture, convert, and distribute solar energy[8].

Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy[3]. Passive solar techniques include orienting a building to the Sun, selecting material with favorable thermal mass or light features: One Peltier is fixed in the box so that it can cool dispersing properties and designing spaces that naturally circulated air[9].

India is densely populated and has high solar insulation, an ideal combination for using solar power in India[9]. Much of the country doesn't have an electric grid, so one of the first applications of solar power has been for water pumping; to begin replacing India's four to five million diesel-powered water pumps, each consuming about 3.5 Kilowatts/, and off-grid lighting[5]. Some large projects have been proposed, and a 35,000 km^2area of that desert has been set aside for solar power projects, sufficient to generate 700 to 2,100 Gigawatts[1].

3. METHODOLOGY

3.1 Design

Product Architecture &Configuration: concept design of our project was created using Pro-Engineer software. The concept drawing is not to scale, nor is it the absolute final design that was fabricated. The Figure shows the concept, a cart layout where solar panels can be side mounted and hinged. The entire unit would also be mobile, using four wheels. The Figure depicts a schematic of our product architecture and configuration.

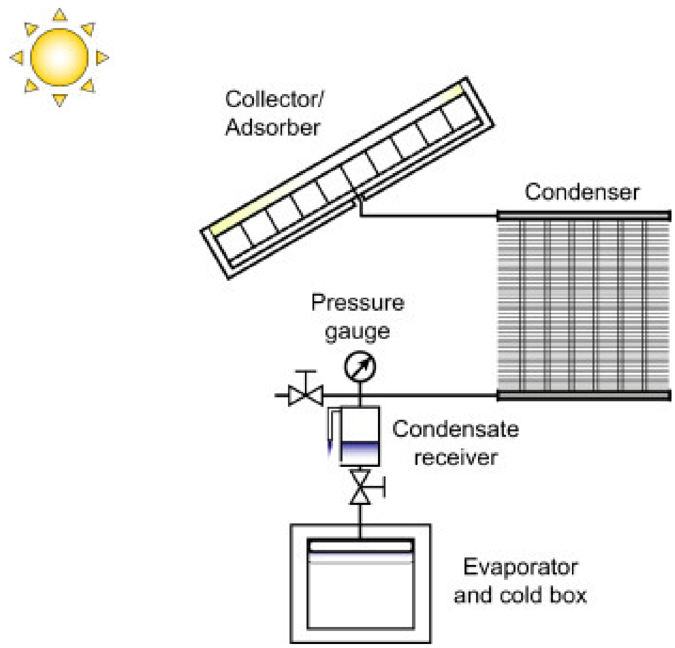

Figure 1: Illustrate the design of a Solar Refrigerator without a compressor

3.2. Instruments

Solar energy equipment comprises all the components of a solar system. Installation of all the solar equipment components enables the harnessing of the sun's energy and its conversion into electricity.

Let us learn everything about each of these components in detail.

3.2.1 Solar Panels:

If you are planning a switch to solar energy, you already know the benefits of using a solar panel but do you know how it works?

Here is a brief synopsis

i. The ultimate requirement-solar panels are responsible for harnessing electricity from sunlight.
ii. Each solar panel comprises individual solar cells that capture the sun's rays. Every cell has silicon semiconductors, boron (positive charge), and phosphorus (negative charge).
iii. On the other hand, sunlight comprises innumerable papers of energy called photons that capture the Sun's rays. The process is termed the photovoltaic effect, and the panels are also called photovoltaic solar panels. The wonders that solar panels can be of many kinds.

3.2.2 Solar Invertors

Now that you know about the panels and their mountings, the next most important solar energy equipment is the solar inverter. Your solar panels produce a direct current charge, while you require an alternating current in your house.

3.3 Data collection and analysis:

Solar thermal with single-effect absorption systems appears to be the best option, closely followed by solar thermal with single-effect adsorption systems. Compressor-free fridges aren't anything new. They're called thermoelectric coolers and depend on the Peltier effect, which removes heat by passing an electric current through the meeting points of two conductive materials. One material heats up, while the others cool down.

There's only one problem: Generally speaking, thermoelectric fridges aren't very good. Because the cooling element must be attached to where the waste heat is dispersed, the whole process is quite inefficient and only effective for cooling small spaces. That's why you tend to see thermoelectric coolers on inexpensive micro fridges-like a USB-powered can cooler that sells for $20.

As it turns out, however, the engineers at Haier may have solved one of the Peltier effect's most vexing practical drawbacks. They attached a heat pipe to the solid-state cooler, so that waste heat is dispersed through water that flows out the back of the unit- just like in a traditional fridge. Cold air is circulated through separate cooling pipes that surround the sides of the fridge, keeping the insides chilled

4. RESULT AND DISCUSSION

Table 1. Illustrate the table which expresses the temperature in *C & *F.

Sr.no.	**Time**	**Time**	**Temperature**	**Temperature**
	Sec.	**Min.**	***c**	***f**
1.	0	0	30	86
2.	32	0:32	29	84.2
3.	49	0:49	28	82.4
4.	62	1:02	27	80.6
5.	76	1:16	26	78.8

6.	88	1:28	25	77
7.	100	1:40	24	75.2
8.	120	2:00	23	73.4
9.	135	2:15	22	71.6
10.	152	2:32	21	69.8
11.	168	2:48	20	68
12.	196	3:16	19	66.2
13.	216	3:3	18	64
14.	244	4:04	17	62.6
15.	292	4:52	16	60.8
16.	332	5:32	15	59
17.	416	6:56	14	57.2
18.	524	8:44	13	55.4
19	780	13:00	12	53.6

Table 1 shows the table which expresses the temperature in *C & *F.The Realistic view of the refrigerator with a solar panel, charge controller, and battery. Power sterilization to operate the refrigerator depends on its actual temperature and the set value of the temperature to be stored. Table 1 shows the result of testing the refrigeration on a typical day. A solar cooling system collects solar power and uses it in a thermally driven cooling process which is in turn used to decrease and control the temperatures for purposes like generating chilled power or conditioning air for a building. The main objective of solar energy is to establish India as a global leader in solar energy by creating the policy conditions for solar technology diffusion across the country.

4.1 Benefits of Solar Refrigerators

Solar refrigerators provide a means for keeping food safe and preserved without the need to connect to utility-provided power/. They can also be used in cottages, camps, and other domiciles as an alternative to absorption refrigerators, as they can run year-round without fears of Freon leaks or other chemical concerns. It can keep perishable goods such as dairy cool in hot climates and is used to keep much-needed vaccines at their appropriate temperatures to avoid. It helps in saving your electricity bills and is an ideal choice.

4.2 Applications of Solar Refrigerators

1. It can be used in remote places where an electric supply is not available.
2. It can be used in the medical field-Pharmaceutical industry, medicine, medical equipment storage, etc.
3. Military- storing of consumable goods in war affecting zone, rural areas/, etc.
4. Dairy (milk) industry
5. Mechanical industry
6. Restaurant and hotel

7. Vegetables, fruits, beverages, etc.

5. CONCLUSION

A portable heating & cooling system was fictitiously employing an electricity module and electrical management unit & tested for cooling and heating purpose. The system is self-powers& is often utilized in isolated & foreign elements of the country wherever load shading- could be a major downside. The vital facet to be noted is that it's a one-time investment & is free from maintenance. The analysis of varied materials indicates that. The cooling rate for the physical phenomenon of water is high compared with the convection of water.The heating rate of water is above the cooling rate. Additional improvement within the potency of the system could also be doable through up-module contact resistance & thermal interfaces. This might be achieved by putting in additional modules to hide a bigger extent of the system

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