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Mechanical Engineering Department

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INSTITUTE VISION

“To be a preferred institution in Engineering Education by achieving excellence in teaching and research and to remain as a source of pride for its commitment to holistic development of individual and society”

INSTITUTE MISSION

"To continuously strive for the overall development of students, educating them in a state-of-the-art-infrastructure, by retaining the best practices, people and inspire them to imbibe real time problem solving skills, leadership qualities, human values and societal commitments, so that they emerge as competent professionals"

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

“To be the centre of excellence in providing education in the field of Mechanical Engineering to produce technically competent and socially responsible engineering graduates**”**

MISSION

“Educating students to prepare them for professional competencies in the broader areas of the Mechanical Engineering field by inculcating analytical skills, research abilities and encouraging culture of continuous learning for solving real time problems using modern tools**”**

Program Educational Objectives (PEOs)

The Graduates of the program will be able to

PEO1: Acquire core competence in Applied Science, Mathematics and Mechanical Engineering fundamentals to excel in professional career and higher study.

PEO2: Design, demonstrate and analyze the mechanical systems which are useful to society.

PEO3: Maintain professional and ethical values, employability skills and multidisciplinary approach to realize engineering issues in broader social context by engaging in life-long learning.

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1. Advanced Mixed Mode Solar Cabinet Dryer

Introduction

Drying is one of the methods used to preserve food products for longer periods. The heat from the sun coupled with the wind has been used to dry food for preservation for several thousand years. Solar thermal technology is rapidly gaining acceptance as an energy saving measure in agriculture application. It is preferred to other alternative sources of energy such as wind and shale, because it is abundant, inexhaustible, and non–pollution. Solar air heaters are simple devices to heat air by utilization solar energy and it is employed in many applications requiring low to moderate temperature below 80C, such as crop drying and space heating.

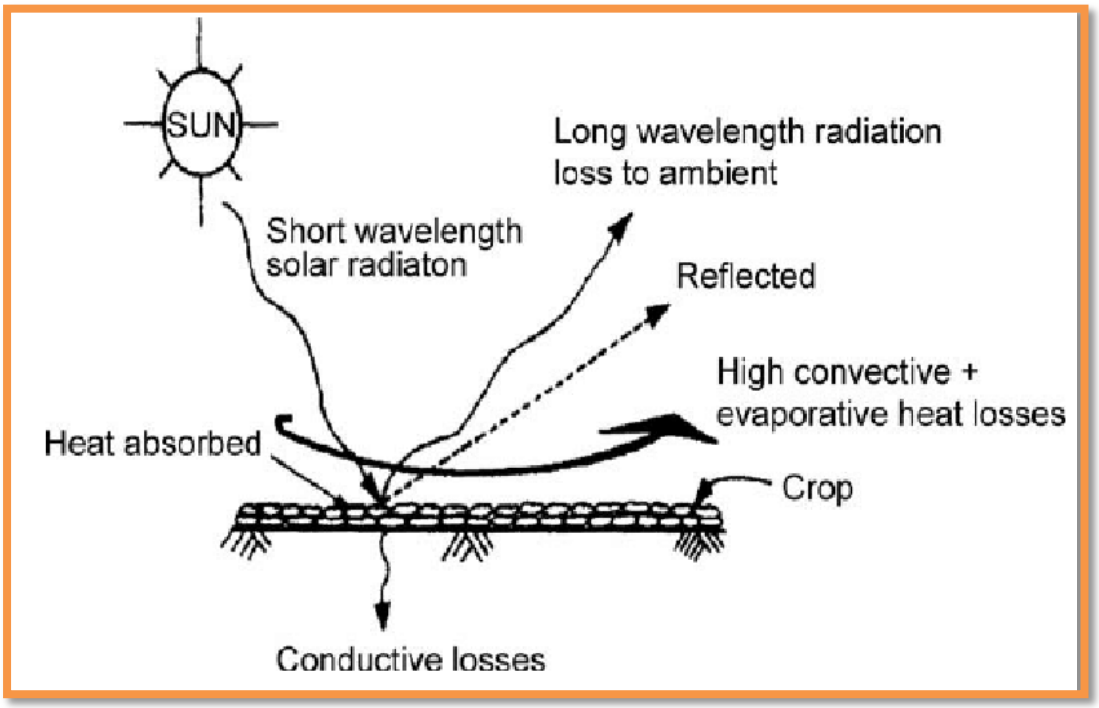

Figure 1.1 Working principle of open sun drying

Objectives

1. To eliminate the unwanted and unpredictable food spoilage.
2. To study the characteristics and performance of the solar dryer system with continous feeding & outlet mechanism.
3. To develop a solar dryer system for quality ensured products.
4. To Design & Develop low cost & Product based Automated (Ardunio Controlled) Solar Cabinet Dryer for the welfare of Farmers & Food Processing Industries.
5. To achieve favorable temperature for various agri-products with different wetness with the help of effective Solar Tracking system.

Schematic Diagram of Solar Air collector

Figure 1.2 Solar Air collector

Advantages

1. Drying is faster, as the temperature inside the dryer is higher than outside.
2. Less risk of spoilage because of no external air is in contact with the product.
3. It reduces losses and Quality ensured Products.
4. The product can be stored in the cabinet itself, if storage space is inadequate.
5. Increases the farmer income by quality product.
6. It doesn't require much of Maintenance.

Disadvantages

1. Drying can be performed only during summer and winter season.
2. Irresponsible use may lead to damage to the drying system.
3. One should know the use of digit temperature controller to set the desired temperature.

Future Scope

1. The capacity and efficiency of the can be increased by increasing the cabinet holding capacity and increasing the solar absorption area.
2. Solar tracking system can be replaced by dual axis solar tracking system so that it can absorb more sun radiation.
3. The cabinet can be replaced with 200micron UV protected fiber glass sheet for holding larger product and higher drying area.

2. Influence of Injection Pressure and Aluminium Oxide Nano Particle-Added Fish Oil Methyl Ester on the Performance and Emission of Compression Ignition Engine

Introduction

Nowadays, there is a greater requirement for diesel, on average, compared to the other fuels. Diesel engines play an extensive role in the transportation sector, trains, industries, and the irrigation sector. Compression-ignition engines are generally more efficient than spark ignition engines. However, the price of conventional fuels is gradually increasing. Diesel engines are the source of numerous poisonous emissions, such as particulate matter and nitrogen oxides, that cause acid rain formation, ozone the production of greenhouse gases, smog formation, and unwanted climatic changes. Diesel engine emissions can be reduced through various approaches, including the modification of the engine's design, the enhancement of engine combustion, the treatment of exhaust, and the use of fuel additives to reduce diesel emissions. The use of oxygenated fuels such as biodiesel is the best choice as a substitute for conventional diesel fuel.

Methods and Materials

The fish oil methyl ester was prepared by preheating the waste fish oil and then via transesterification process, as described in Figure 2.1. In this experiment, the Kirloskar TV1-type single-cylinder diesel engine was fuelled by FOME biodiesel, and a pure diesel mixture with the addition of aluminium oxide nanoparticles (Al2O3) was used to analyse the effects of the injection pressure and aluminium oxide nano-additives on the emissions and BTE of the compression ignition engine. The experimental arrangement used is depicted in Figure2.2.

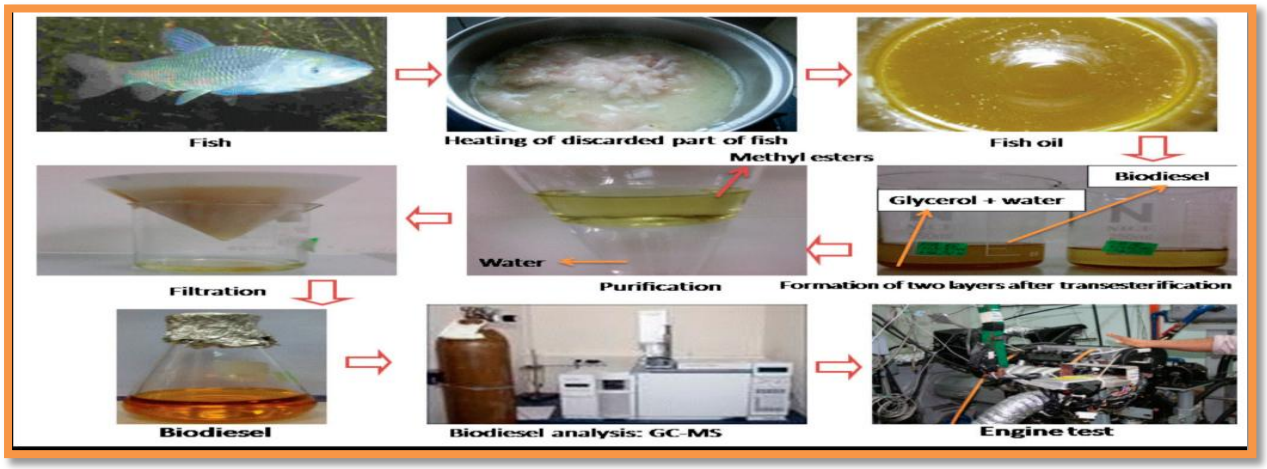

Figure 2.1 Step-wise preparation of fish oil biodiesel

Figure 2.2 Experimental setup

Conclusions

The present experimental work was conducted in order to analyze the emissions and performance characteristics of a CI engine fuelled by a mixture of diesel–FOME biodiesel fuel blends with Al nanoparticles at varying concentrations 5, 10, 15, and 20 ppm—in the fuel blend.

1. The B40D60A20 mixture exhibited optimized results for three-hole nozzle geometry with a 0.20mm orifice diameter and 260 bar pressure injection, wherein a reasonable increase in the BTE and reduced emissions were achieved.
2. Due to the catalytic character of Al2O3, the addition of Al2O3 nanoparticles at 20 mg/L in the FOME mixtures, i.e., the B40D60A20 mixture, provided the highest thermal efficiency of 30.9%, which is about 15.53% greater than the 100% FOME and 3.43% lower than the diesel, and also revealed a decrease in CO of 45.46%, HC of 17.29% 5%, NOx, and smoke of 21.28% compared to raw FOME. Additionally, the emissions are comparable with diesel at all loads.
3. A small-diameter nozzle achieves superior atomization by forming smaller-diameter fuel droplets, thereby enabling an improved air/fuel ratio and facilitating the combustion process. Therefore, a small diameter of injector leads to improved performance and emission characteristics.
4. Al_2O_3 potentiates an oxygen surge and further oxidises the unburned fuel inside the combustion cavity. As a result of the existence of Al2O3 in the test fuel, the levels of imperfect combustion products such as HC, CO, and smoke are significantly lowered for the B40D60A20 mixture.

3. Effect of Algae Biodiesel Blends with Nano-fluid Additives on CRDI Engine

Biodiesel is considered as a sustainable fuel, nontoxic and readily biodegradable, which has no aromatic compounds and possesses a high cetane number, high flash point and also excellent lubricity performance Despite the fact that it has many positive features, the direct application of pure biodiesel, or the use of high proportion of biodiesel in diesel blends may cause poor atomization and incomplete combustion, carbon deposits or clogging of fuel lines, as well as thickening and gelling of the engine lubricating oil due to its poor volatility and high viscosity In the recent decades, lower alcohols, mainly methanol and ethanol, in combination with diesel fuel, were vastly investigated for reducing the NO_x and the particulate emissions.

Schematic diagram

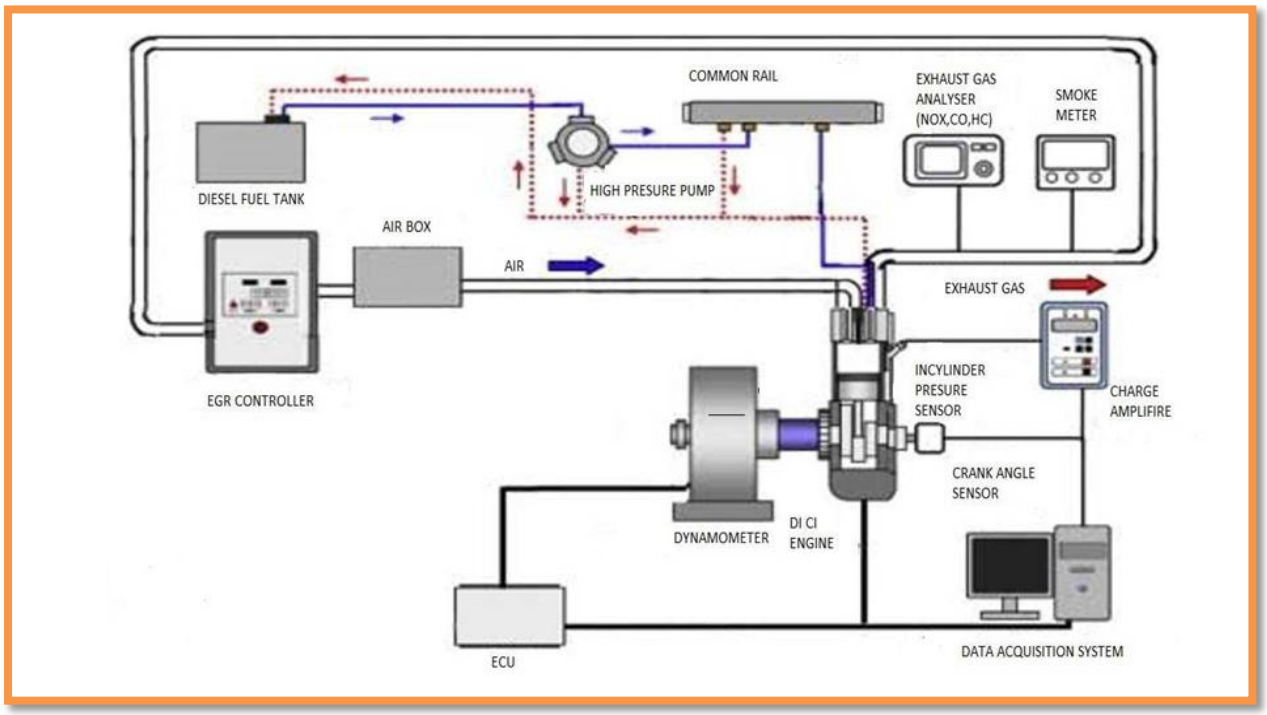

Figure 3.1 Schematic diagram of CRDI Engine

Scope and Objectives of the Project

1. To promote the alternative fuel sources used as biodiesel fuel added Graphene oxide **(**$C_{140}H_{42}O_{20}$) nano-particles in a Internal combustion engine.
2. To study the characteristics features of Algae biodiesel blends (B10D90A5, with Graphene oxide **(**$C_{140}H_{42}O_{20}$) nanoparticles as a additive.
3. To study the effect of Algae biodiesel blends with Graphene oxide posses on performance, combustion and emission characteristics.

4. To optimize the Algae biodiesel blends with Graphene oxide to suggest the best performance in CRDDI engine.

Methodology

1. Nanoparticles can improve the performance and combustion of biodiesel. Also works as a combustion booster.
2. Nanoparticles increases air-fuel mixture quality in the engine cylinder, which leads to complete burning.
3. The Nanoparticles-spiked fuels produced significantly lower quantities of nitrogen oxide, carbon monoxide and smoke.
4. Nanoparticles act as a cleaning agent.
5. Preparing the Algae bio-diesel blends with nano particle additives by volumetric basis. In this our experiments we choosen the blends such as B10D90A5, B20D80A10, B30D70A15, B40D60A20 and B100.
6. Characterise their properties of testing fuels by using laboratory facility and compare with standard diesel fuel.
7. Study the performance ,combustion and emission characterstics operated by Algae bio-diesel blends with Graphene Oxide nanofluid additives in CRDI engine.
8. Compared the experimental results of Algea biodiesel tested fuels with standard diesel fuel.
9. Experiments will repeated for above said different blends at different load conditions.
10. Based on the experimental results collected from the calculations and draw the necessary graphs to identify the optimized Algae bio-diesel fuel which will give the better performance.
11. Finally come to the conclusion to suggest the optimized best blend with highest thermal Efficiency and lowest emissions characteristics.

Expected outcomes/deliverables

To enhance performance and combustion characteristics CRDI engine by using Algaebio-diesel fuel with blended nano-particles and reduce the emission characteristics of CRDI Algae biodiesel fueled engine with blended nanoparticles.

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4. Experimental Investigations of Shot Peening Process on Aluminum Alloy

Introduction

Shot peening is a cold working process widely used to improve fatigue life of aerospace and automobile components. Stress peen forming is widely used in the aeronautic industry to produce thin components with complex shapes, involving double curvatures, such as wing skins. The influences of peening velocity and peening time on the resulting residual stress profiles can be experimentally tested.

Scope and Objectives of the Project

1. To conduct experiments using shot peening machine, to identify the most significant process parameters for aluminum alloy.
2. To investigate the friction and wear properties of short peened surfaces of aluminum alloys.
3. To study the most significant process parameters such as compressive residual stresses, wear resistance and corrosion resistance to enhance surface integrity and mechanical properties like fatigue strength of choosen functional materials

Methodology

1. The chemical composition of selected alloy aluminum will be known. The mechanical properties of parent material are taken. The specimens were made according to ASTM standards. The specimen used for determining the fatigue strength is prepared. Some specimens were shot peened for the purpose of comparing the peening effect. Known (A-type) Almen strip, is used to measure the intensity of shot peening.
2. Almen intensity was expressed as arc height of Almen strip. 0.15mm camber value was designated as 6A. Shot peening will be done using shot peening machine with known process parameters on specimen chosen. The shot flow rates will be different for different specimen to obtain shot intensities. The material was treated with different Almen intensities; 3A, 6A, 8A and 15A. In fatigue test the specimens are tested in fatigue testing machine at room temperature.
3. The residual stress induced by shot peening was measured by X-ray diffraction method.
4. Shot peening treatment is done in order to maximize the fatigue life of industrial steel components. It involves many different variables and physical phenomena. The optimal peening intensity to apply to different alloy aluminum with quite a broad range of mechanical properties can be determined in this study.

Expected outcomes/deliverables

It is a study and research type project to improve the mechanical properties like fatigue strength, wear resistance, corrosion and friction resistance properties of metal surface of functional alloy chosen in particular application component.

Advantages

1. Improve mechanical properties, Fatigue strength, Wear resistance and Corrosion resistance
2. Prevents cracking due to wear.
3. Prevents corrosion.
4. Prevents galling

Disadvantages

1. If a components surface is too hard, shot peening will not be effective.
2. If the surface temperature exceeds the normalizing temperature of the metal, the residual compressive stresses will be relieved and the shot peening benefits will be lost.
3. The shot peening process must be controlled.
4. This process costly

Applications

1. It is used in aero space industries.
2. In automobiles (Shot peening is used on gear parts, cams and camshafts, clutch springs, coil springs, connecting rods, crankshafts, gearwheels, leaf and suspension springs, rock drills and turbine blades.
3. In Foundries (It is also used in foundries for sand removal, de-coring, decaling, and surface finishing of castings such as engine blocks and cylinder heads.)
4. In Manufacturing (Its decaling action can be used in the manufacturing of steel products such as strip, plates, sheets, wire, and bar stock.)
5. Shot peening can apply materials on metal surfaces.

5. Multi Crop Harvesting Machine

Introduction

A combine harvester is a very useful agricultural machine that can harvest, winnow, and thresh rice, corn, wheat, sunflower, pulses, and other crops right out in the field. Harvesting crops in this manner in one operational process can save time as well as human labor, and bring down work costs for farmers.

Scope / Objectives of the project

In this project the main goal is the development of manually driven reaper by reviewing the previous reapers used for grain harvesting and drawbacks of the reapers. The objectives identified to accomplish the goal were:

1. To conduct field surveys to identify the present problems in agriculture harvesters.
2. To design and develop multi crop harvester.
3. To get more work done, more efficiently and a better grain yield at comparatively lower costs.

Methodology:

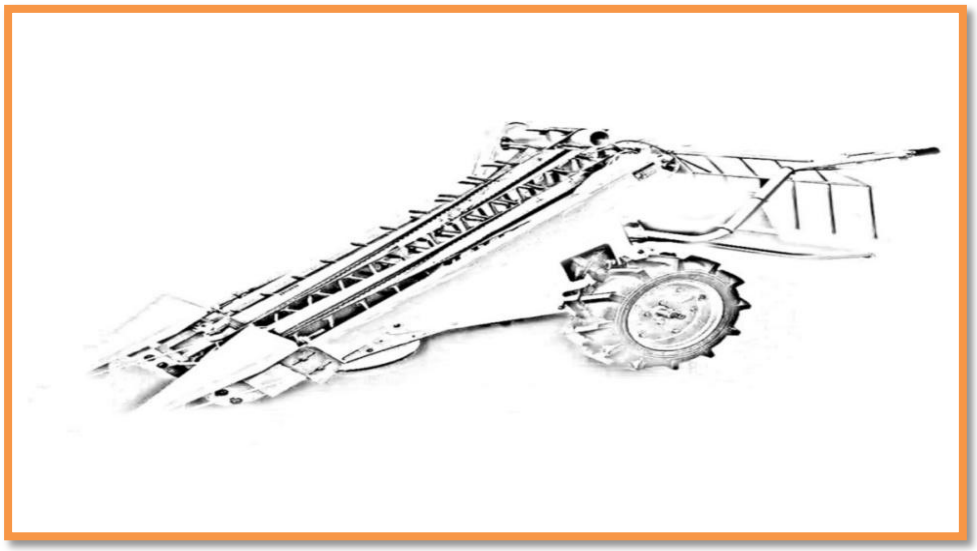


Figure 5.1 Working Model

1. First we hold the crop by belt: The holding of the corps by the belt is done by the belt mechanism.
2. Afterwards the cutter blade will cut the crops: The cutter blade will cut the crops stem by the cutting mechanism.
3. After the crops will hold by the belts and cut by the cutter, those crops are transferred to storage container.

4. After the storage container full then those crops are dumped there only.

The above steps are carried out to Decrease the cost of cutting, decrease the labor requirement for harvesting, decrease the efforts required for harvesting, using proper collecting mechanism to increase the efficiency of harvesting. Harvesting is the operation of cutting, picking or a combination of these operations for removing the crop from under the ground or above the ground and removing the useful part of fruits or grains from plants. Harvesting action can be done by four ways:

1. Cutting action with a sharp tool
2. This machine is compact and can cut up to one rows of plant.
3. It has cutting blades which cut the crop in a rotating blade type of motion.
4. A collecting mechanism is provided for the collection of crops to one side after cutting.

Expected Outcome of the project

1. Came up with present harvester problems and solutions for small farmers.
2. Reduce the human effort- Crop harvester is designed for reduce the human effort in which only one operator can be operate or handle the machine.
3. Reduce the cost- In the agriculture for cropping the soyabean, Jowar and Gram.
4. Reduce the time- It is possible to maximize cutting rate with minimum time.
5. Easy to handle-Crop cutter machine is easy to handle..

Advantages

1. It is very useful where labor scarcity is an issue.
2. Combine harvester provides cleaner grains by effectively separating weeds from grain.
3. The farm can be prepared easily in shorter time for the next crop.
4. Farmers can save the overall cost of harvesting from cutting to winnowing.
5. It reduces dependency on the human labour.

Applications

It can used for harvesting and cleaning of cereals such as wheat, barley, corn (maize), oats, rice, rye, and sorghum, as well as a number of non-grain crops, including flax, rapeseed, soybeans, and sunflower seeds.

6. Fiber Extraction from Banana Stem

Introduction

The banana plant contains good-quality textile-grade fibers popularly known as banana fiber. This fiber is another unexplored natural fiber used for the fashion and technical textile industries for sustainable product development. These fibers are extracted from the pseudostem of the banana plant.

Scope /Objectives of the Project

The major uses of banana pseudo-stem fiber are in making specialized and high-quality sanitary products such as baby pampers, textiles, and papers such as banknotes. The banana pseudo-stem fiber can also be used for ropes such as marine rope since this fiber has good resistance to sea water and has buoyancy properties. The objectives of the project are as follows.

1) To reduce a farmer waste
2) To increase textiles products
3) To make environmental friendly product

Plantation and harvesting

The banana plant has a shallow rooting system in which the pseudo-stems sprout vertically. As it develops, a single plant may produce about 25 of these pseudo-stems, which mature at different times. When the plants are 18–24 months old, the outer pseudo-stems are already mature and ready to be harvested. Then, about three or four pseudo-stems are stripped at a period of 6–12 months based on the rate of growth of the pseudo-stem. When the flower is out, the pseudo-stems are completely ready for harvesting. Furthermore, the shaft is cut off below the inflorescence with a knife or sickle attached to a long pole and then the pseudo-stems are cut at their base. Based on the extraction methods, the pseudo-stems can be either stripped/extracted of their fibers in situ or by using a decorticating machine.

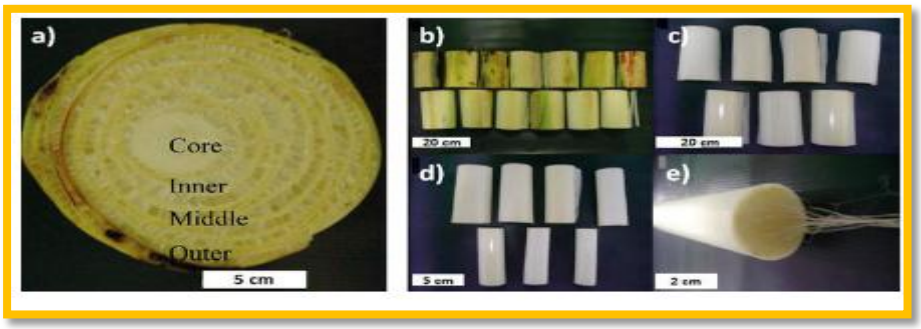


Figure 6.1 (a) Banana pseudo-stem trunk cross section and its parts: (b) outer parts; (c) middle parts; (d) inner parts; and (e) core parts

Extraction of fiber

Fibers from the banana pseudo-stem leaves can be extracted by a decorticator machine. It is a machine used to strip bark, skin, wood, stalk, and grain. The extraction process is conducted as soon as the pseudo-stem's leaves are cut. The common method in practice is a combination of water retting and scraping. The first step, called tuxing, is separating the fiber bundles from the remaining parts.

The leaves are stripped from the cut pseudo-stems. Afterward, a knife is put at the butt end between the outer and middle layers of the leaf shaft, and then the outer part is held firmly and pulled out. The width of fiber bundles that resulted from this tuxing process is approximately 5–8 cm and is the same as the length of the leaf.

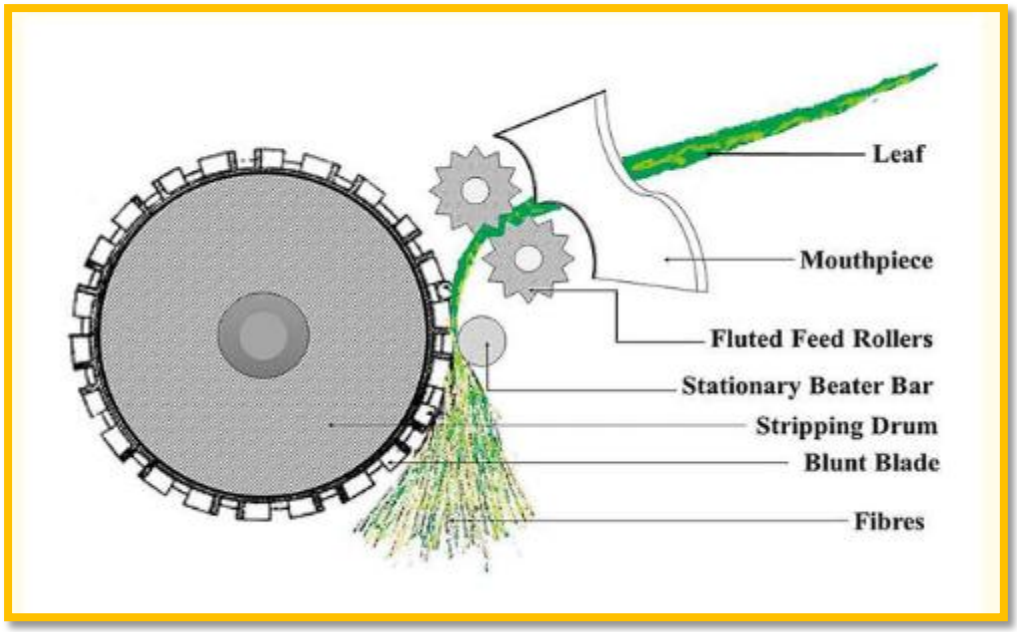


Figure 6.2 Pseudo-stem fiber extraction machines

Expected outcomes

1) Making high tensile strength products
2) Thermal resistance, UV resistance products
3) Good resistance to sea water and has buoyancy properties

7. Solar Operated Bore-Well Motor Lifter

Introduction

Bore wells are deep and the submersible pump is at the bottom of the long bore well pipe. Conventionally the bore well pipe and pump are lifted out of the bore well using which and pulley block. This is a very time consuming and laborious work. The bore well pipe lifter and transportation machine gives more than 3m /min transfer rate which makes the mounting and dismounting of the submersible pump in bore wells very fast and very easy. So that the total integrated information and steps to be followed during Bore well installation and lifting is to be focused. In the ancient days these process carry out with the help of chain pulley mechanism. This method is traditional method and very time consuming.

This mechanism also required no of labour to carry out the process. The main purpose behind our project is to lift the pump and motor in less time and human efforts with very simple and convenient mechanism. The additional benefit of this project is to lift anything fall down in the bore.

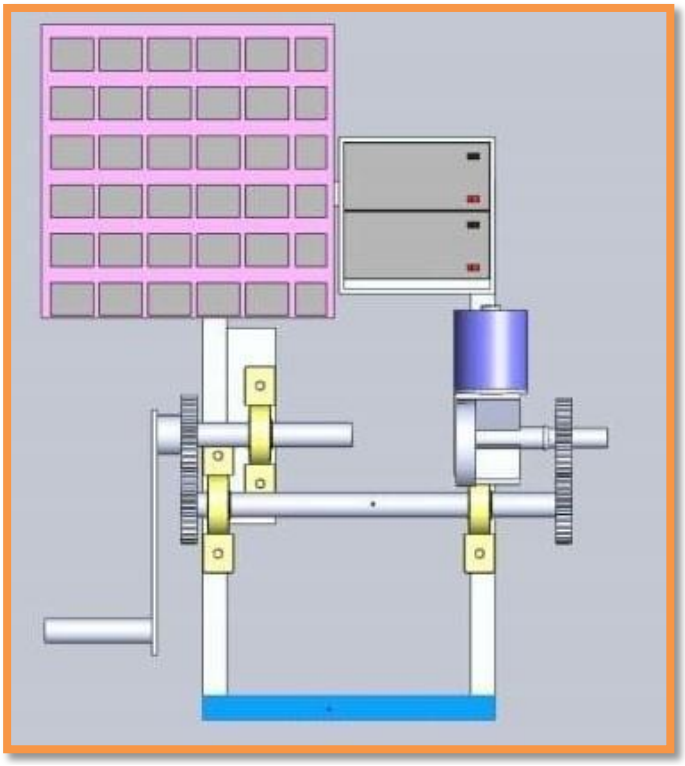


Figure 7.1 Block Diagram

Fabrication process

Welding is a permanent type of metal joining process that uses heat to form the bond. When metal is heated to a high enough temperature, it melts. In gas welding the heat comes from a hot burning flame at the tip of the torch. As the temperature rises heat fuses or melts together, the two adjoining pieces of metal .when the liquid metal cools, the two pieces have been joined together.

Arc welding is a type of welding that uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumables or non-consumables electrodes. The welding region is usually protected by some type of shielding gas, vapor or slag.arc welding process may be manual, semi-automatic or fully automated.

Turning is the process whereby a single point cutting tool is parallel to the surface. It can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using a computer controlled and automated lathe which does not. This type of machine tool is referred to as having computer numerical control, better known as CNC and is commonly used with many other types of machine tool besides the lathe.

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole in solid materials. The drill bit is a multipoint, end cutting tool. It cuts by applying pressure and rotation to the work piece, which forms chips at the cutting edge.

The grinding of solid matters occurs under exposure of mechanical forces that trench the structure by overcoming of the interior bonding forces. After the grinding the state of the solid is changed: the grain size, the grain size disposition and the grain shape.

Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole. Boring can be viewed as the internal- diameter counterpart to turning, which cuts external diameters.

Advantages

1) Hybrid (motor / handle)
2) Eco friendly
3) Easy to operate
4) Easy to rescue
5) Slow and safety operation
6) Portable

Applications

1) Applicable in bore well
2) Used in oil industries.
3) To lift load from multi storage building
4) Can be used for wells for maintenance work

8. Longitudinal Tensional Vibrations of the Chain Drive System of Mine Scraper Conveyor

Introduction

Because of its structural characteristics, the scraper conveyor can be regarded as a continuous rigid and flexible coupled structure. The operation of the equipment is often accompanied by corresponding longitudinal and torsion pendulum vibrations. Due to the harsh working environment and the impact of shear large coal rock, the chain becomes stuck by the impact load and stops working or even breaks in serious cases.

Mechanical model of the scraper conveyor chain drive system

Scraper conveyors are the main components of fully mechanized mining equipment. A scraper conveyor is a complex and highly coupled multi-body dynamics system. The working principle is to use the middle trough and the chain drive system to transport the coal. A drive motor propels the sprocket to rotate. The chain is engaged with the sprocket. The scraper is fixed on a chain as its traction component. As shown in Fig. 1, the scraper conveyor is mainly composed of the drive motor, middle trough, sprocket, scraper and chain.

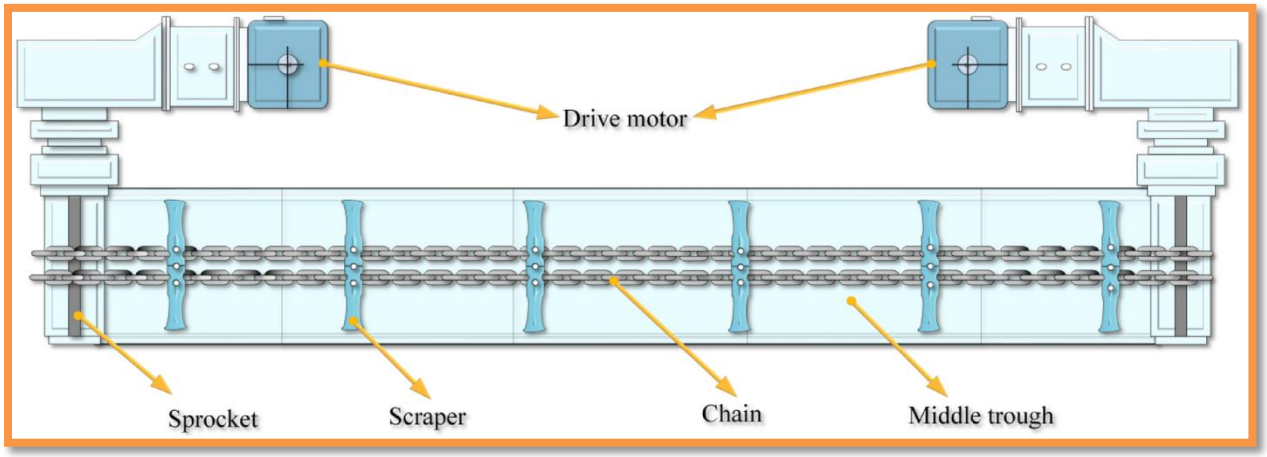


Figure 8.1 Mechanical model of the vibration of a torsion pendulum and a scraper force diagram.

Attenuation of the torsional vibration stress wave

Failure conditions such as the material loading process and chain breaking cause fluctuations in the running speed of the scraper chain drive system, the torsional vibration of the scraper, and the chain tension before and after the scraper. In the process of torsional pendulum vibration of the scraper, if each scraper and its connecting chain are regarded as a unit, it will make the model difficult to solve. Therefore, determining the maximum number of scrapers of torsional

pendulum vibration units in different sections along the conveyor is the key to realizing the numerical solution of the model.

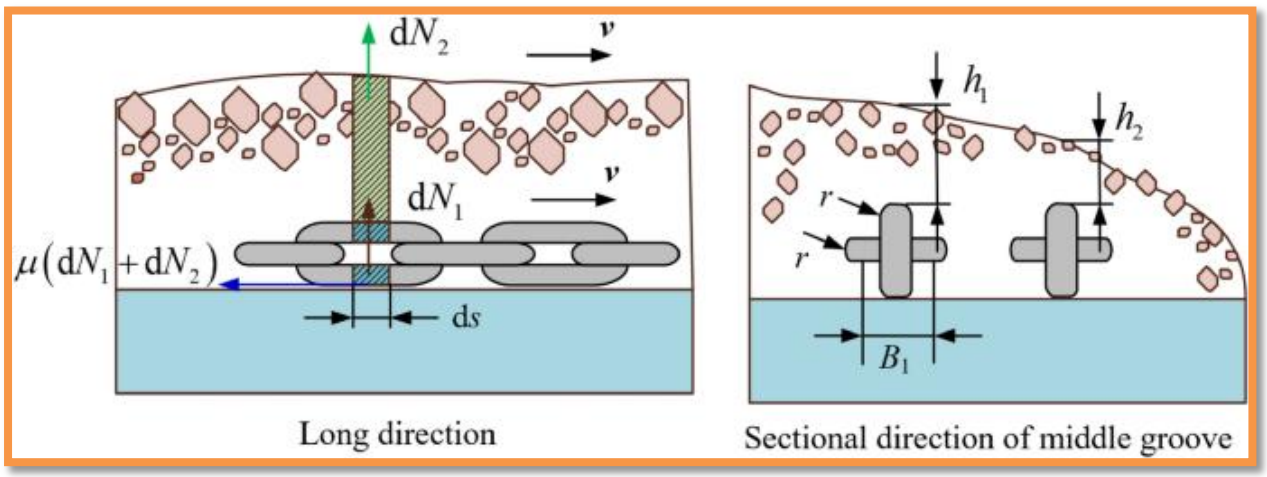


Figure 8.2 Sketch of the friction resistance of the running chain

Conclusions

The Kelvin–Voigt model and the point-by-point tension method were used to establish a mechanical model of the coupled longitudinal and tensional vibrations of the scraper chain drive system. The longitudinal and tensional vibration characteristics of the scraper chain drive system under different load excitations were studied by numerical simulation combined with experimental verification in the field.

The research results showed that excitation by the cargo load caused longitudinal vibration of the scraper conveyor, resulting in fluctuations in the running speed and chain tension. The most violent fluctuations of the scraper running speed and the chain tension were the result of the application of the cargo load excitation, which caused a maximum speed fluctuation of 119.5% and a maximum tension fluctuation of 78.6%. Excitation of a section by the cargo caused torsional vibration of that section of the scraper chain drive system, resulting in fluctuations in the tension difference between the two chains in the scraper chain drive system. The maximum percentage of tension difference between chain 1 and chain 2 was 8.6%. Further research showed that the cargo loading process caused slight torsional vibration of the scraper chain drive system, and the torsional vibration was more obvious when there was initially no cargo.

9. Crack Mechanism and Experimental Verification on Straightening of AZ31B Magnesium Alloy Plate

Introduction

Rolling process has become one of the main methods of magnesium (Mg) alloy plate production, it has the characteristics of refining grain, improving structure, and significantly improving the mechanical properties of the alloy1. However, Mg has a special hexagonal close-packed (HCP) structure, with few slip systems at room temperature, poor performance in pressure processing and plastic processing, and edge cracks will appear during rolling. On the other hand, the rolled Mg alloy plates will also have defects such as buckling and wave during transportation. Straightening, as an important link in the processing and forming process of Mg alloy plates, aims to improve the flatness and reduce residual stress effectively2. When Mg alloy plates with the above defects are straightened by cyclic tensile and compressive stress, stress concentration is easy to occur at the edge cracks, causing the initiation and propagation of micro cracks at the crack tip, and even causing the plates to fracture during the straightening process.

GTN damage model and determination of damage parameters

From the point of view of macro-scale mechanics, according to mechanics of materials and fracture mechanics, there are many methods can be applied to study the propagation of mixed mode crack, such as the energy release rate theory, the maximum tensile stress theory (maximum circumferential stress theory) and the strain energy density factor theory, among which the maximum tensile stress theory is most used in engineering practice. Erdogan et al.16 consider that the main factor of crack propagation is the maximum tensile stress at the crack tip. The crack tip splits when the circumferential tensile stress reaches the critical value of crack initiation.

The maximum tensile stress theory proposed in fracture mechanics has the following basic assumptions17:

(1) The maximum stress exists at the circumferential position of the crack tip, and crack propagates along the direction of maximum stress.

(2) The crack propagates when the maximum circumferential stress increases to the critical value for crack cracking.

When $r \rightarrow 0$, the components of stress in all directions are close to infinity at the crack tip, so take a smaller distance $r = r0$ at the crack tip, we can know the circumferential stress $\sigma\theta$ (Fig.

9.1) at different points on the circumference, the crack angle θ0 at the crack tip can be obtained by circumferential stress.

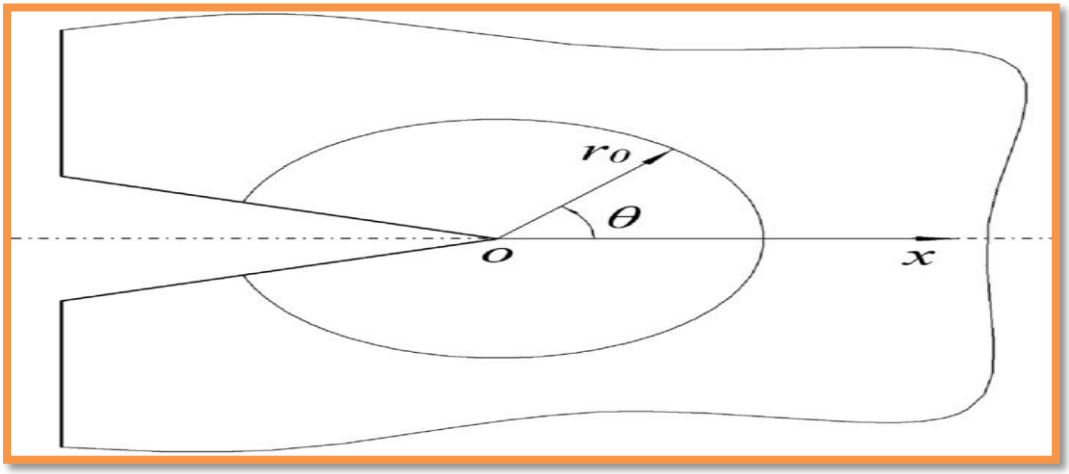
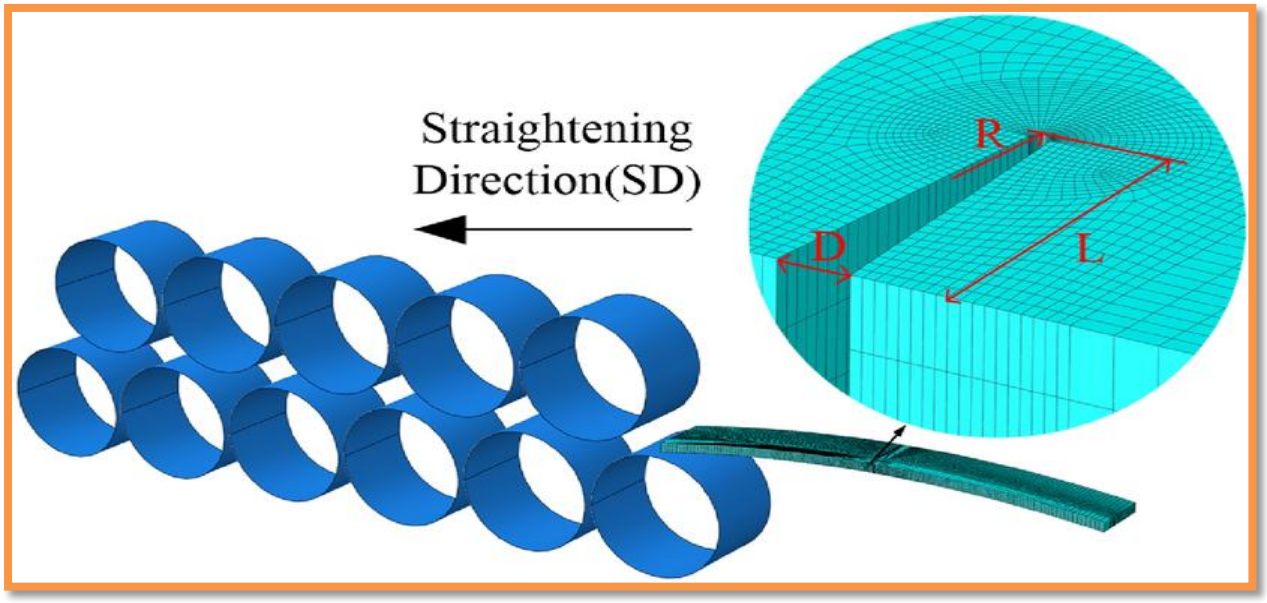


Figure 9.1 Stress field at crack tip Stress field at crack tip

Finite element model

As shown in Fig. 9.2, the finite element model of the straightening process of AZ31B Mg alloy plate at room temperature is established with the finite element software ABAQUS. The GTN damage parameters of AZ31B Mg alloy determined by tensile test. The element type is eight-node linear hexahedral element C3D8R, which adopts reduced integration and hourglass control23.



9.2 Straightening model of Mg alloy plate with prefabricated V-shaped edge crack.

10. Extreme Fast Charging of Commercial Li-Ion Batteries Via Combined Thermal Switching and Self-Heating Approaches

Introduction

The long charge time (>30 min) of electric vehicles compared with the refueling time of gasoline vehicles has been a major barrier to the mass adoption of EVs. Currently, the charge time to 80% state of charge in EVs such as Tesla models with fast charging capabilities is >30 min**5**. For a recharging experience comparable to that of gasoline vehicles, called extreme fast charging (XFC) of EVs, the United States Department of Energy has set a goal of <15 min charge time to 80% SOC, >180 Wh/kg discharge specific energy, and <20% capacity loss in 500 XFC cycles.

It is acknowledged that long XFC cycle life cannot be achieved in existing commercial high-energy-density lithium-ion batteries with graphite negative electrodes and transition-metal oxide positive electrodes such as lithium cobalt oxide. Reducing the charge time to 15 min requires a charge rate of 6C for the constant-current stage of Constant Current Constant Voltage Charging, which can trigger lithium plating on graphite negative electrodes and cause dramatic capacity fade in LIBs. Eliminating or mitigating lithium plating8, which requires faster ion transport and kinetics in LIBs, is one of the greatest research and development challenges remaining to enable XFC. Broadly, R&D efforts to develop XFC LIBs can be classified into four categories: the development of new electrolytes electrode materials charge protocols or heating strategies (i.e., improving the kinetics by increasing the temperature before XFC). Among these approaches, heating strategies have shown promising results for existing high-energy-density LIBs and thus have the potential to enable XFC of EVs in the near term.

A Schematic of different thermal protocols for XFC. Note CM refers to coolant modulation. The concept proposed in this paper combines CM with an active thermal switch. Prediction of battery **b** temperature and **c** negative electrode potential during 6C (~13 mA/cm^2) charging of 10-Ah C||LCO pouch cells with an initial T_B of 50 °C and different heat transfer coefficients. Insufficient thermal insulation can result in a temperature decrease and negative electrode potentials below 0 V vs. Li/Li$^+$ during XFC. **d** Thermally modulated charge protocol with thermal switching ratio ≥≥10 for XFC, designed with our ECT model. Note that in the OFF state of the thermal switch, the coolant flow was also OFF, whereas in the ON state, the coolant flow was also ON, i.e., we are simultaneously doing CM and ATS. **e** Linear actuator to mimic ATS for conducting controlled experiments. The gap between the battery and heat sink can be

tuned as the actuator contracts or elongates and, thus, the thermal contact changes. **f** Representative battery temperature evolution for XFC experiments using 5-Ah C||LCO pouch cells with different thermal protocols indicated by the line colors. The line styles denote four phases of the protocol, starting with XFC at 6 C (16.98 mA/cm^2). **g** Effective *h* between the battery and coolant for various cases obtained by matching the thermal model with the experimental temperature data from (**f**) *h* with the switch OFF and ON was comparable to *h* for insulation and cooling protocols, respectively. Note that h_{OFF} for CM alone is much higher than that for switch + CM resulting in a significantly lower T_B rise.

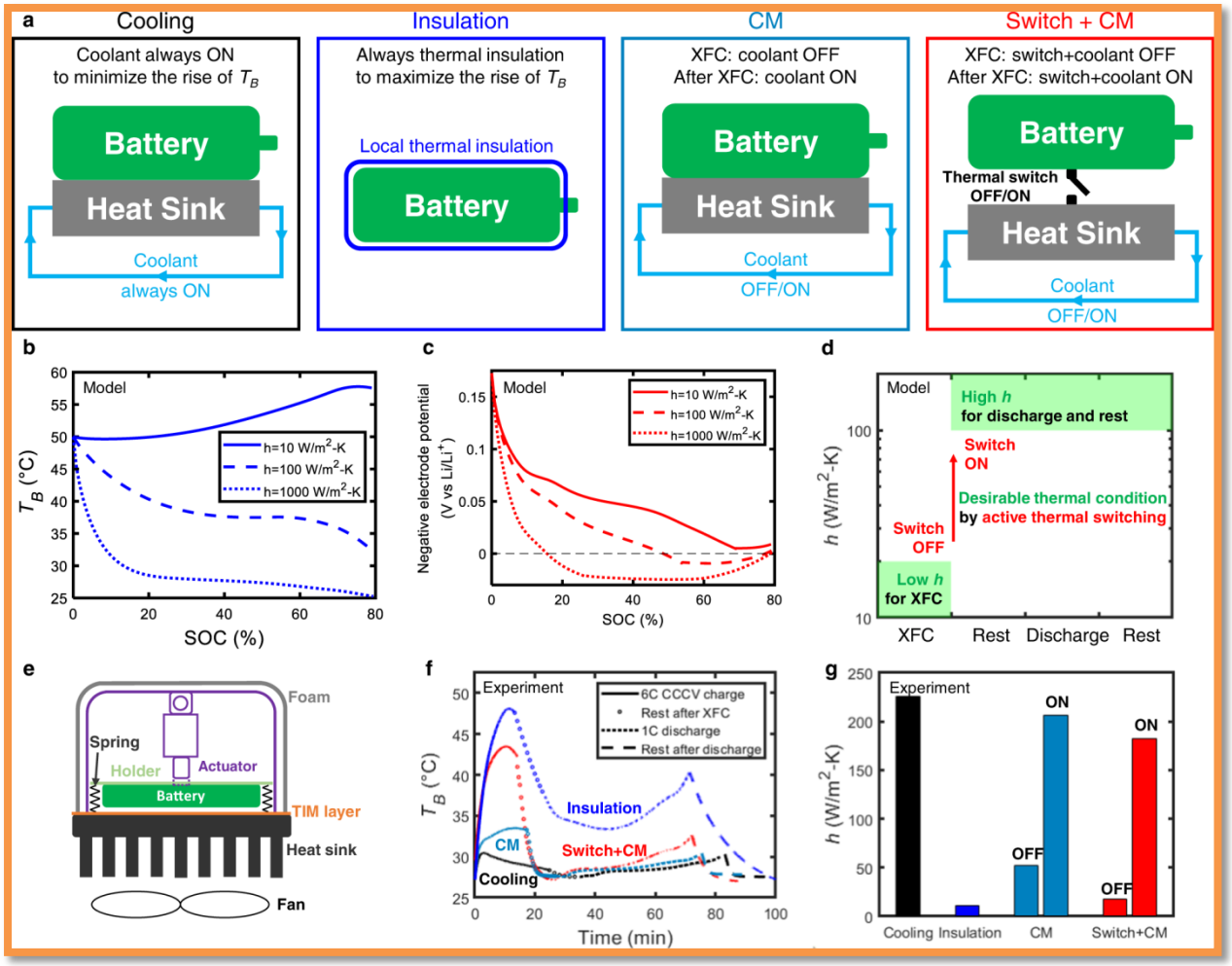


Figure 10.1 Active thermal switching for XFC

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11. Power Generation by using See Saw Mechanism

Introduction

Power generation using see-saw mechanism" uses the energy which gets wasted during the clutch operation. This project generates the electricity by using the energy stored in the wheel. If clutch pedal is not pressed then engine shaft and wheel shaft both are coupled. In this state motion is transferred from engine to the wheel. But when the clutch pedal is pressed, the engine shaft and wheel shaft will get disengaged. Hence no motion will be transferred. But during this state wheel of the vehicle have momentum and energy is stored in it which is not utilized nowadays. A large amount of electricity can be generated by using a certain mechanism. So, this project deals with the generation of electricity during clutch operation.

Mechanical Components

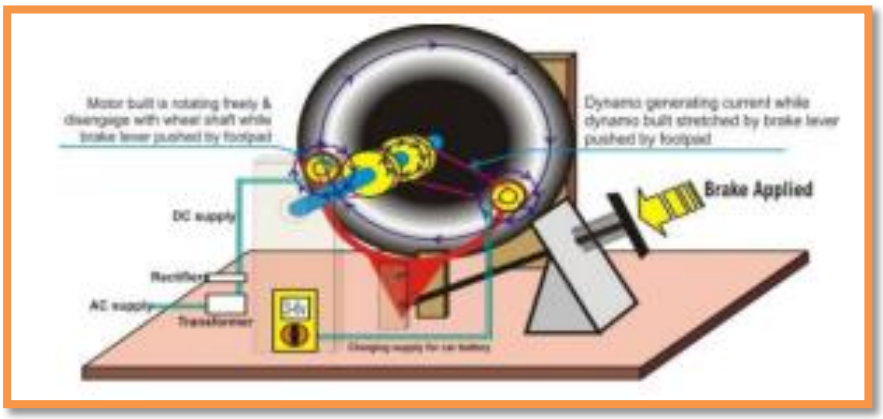

Figure 11.1 Working Model

Wheel

Motion will be transferred to the wheel with the help of motor. Wheel is mounted on the shaft which also carries two pulleys.

Pulley

The pulleys are used to transmit power from one shaft to another by means of flat belts, V-belts or ropes. Since the velocity ratio is the inverse ratio of the diameters of driving and driven pulleys, therefore the pulley diameters should be carefully selected in order to have a desired velocity ratio. The pulleys must be in perfect alignment in order to allow the belt to travel in a line normal to the pulley faces. The pulleys may be made of cast iron, cast steel or pressed steel, wood and paper. The cast materials should have good friction and wear characteristics. The pulleys made of pressed steel are lighter than cast pulleys, but in many cases they have lower friction and may produce excessive wear.

Rope drives

The belts or*ropes are used to transmit power from one shaft to another by means of pulleys which rotate at the same speed or at different speeds.

Shaft

A shaft is a rotating machine element which is used to transmit power from one place to another. The power is delivered to the shaft by some tangential force and the resultant torque (or twisting moment) set up within the shaft permits the power to be transferred to various machines linked up to the shaft.

Bearings

The bearing makes many of the machines we use every day possible. Without bearings, we would be constantly replacing parts that wore out from friction.

Multi meter

A multi meter or a multi tester, also known as a volt/ohm meter or VOM, is an electronic measuring instrument that combines several measurement functions in one unit. A typical multi meter may include features such as the ability to measure voltage, current and resistance. There are two categories of multi meters; analog multi meters and digital multi meters (often abbreviated DMM or DVOM.)

Dynamo

A dynamo, originally another name for an electrical generator, now means a generator that produces direct current with the use of a commutator.

Power Supply

In alternating current the electron flow is alternate, i.e. the electron flow increases to maximum in one direction, decreases back to zero.

Rectification

Rectification is a process of rendering an alternating current or voltage into a unidirectional one.

Transformer

A transformer is an electrical device that transfers energy from one circuit to another by magnetic coupling with no moving parts. A transformer comprises two or more coupled windings, or a single tapped winding and, in most cases, a magnetic core to concentrate magnetic flux. A changing currentin one winding creates a time varying magnetic flux in the core, which induces a voltage in the other windings.

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12. Manually Operated Eco-friendly Road and Floor Dust Cleaning Machine

Cleaning is a necessary factor of daily routine process. Effective cleaning and sanitizing help and protect the health of human beings directly and indirectly. The Road cleaner is used to keep our surroundings clean. So that we feel fresh while walking on the streets. Generally, in the era of modern technology, different devices such as electric motors, diesel engines, and robots are being used to clean the floor, road. But such processes create abundant pollution, maintenance and are very tough to carry out. So, in order to save energy and save nature, there is a need to develop, user-friendly road and floor cleaning machine. A machine which should be operated manually so that it can be as an alternative for conventional electric cleaning machine. The dust cleaning machine system is fixed with a pair of wheels which are connected with the help of shaft. The shaft makes the wheels connected to one and other.

The wheels are moved to the desired position with the help of manual force, which can handle is provided to move. The handle can be adjusted for a required height and are provided three adjusting holes for it. A chain drive is connected to the wheels and gear at each side. The chain is moved according to the wheel and gear. The brush moving the alternative direction of the wheels move and the brush brooms the waste present on the road also it dumps the waste into the waste-collecting box. The waste collection box is removed to dump the waste into desired places.

Figure 12.1 Working Model

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13. Mini Conveyor using Geneva Mechanism

Introduction

The geneva mechanism is a system to convert continuous circular motion into fixed step circular motion. Geneva mechanism requires a rising circular connector extending above the rotating disc to lock between slots in the geneva wheel and drive it. So here we propose a conveyer belt that moves products at regular time intervals, as needed by many automation lines. Our system uses a motorized disc to drive the geneva wheel. The geneva wheel is thus driven at regular time intervals. The wheel is connected to rollers mounted with conveyer belt. As the wheel rotates the belt also rotates at fixed intervals.

Working Principle

The working of Geneva mechanism was stated earlier; a continuous rotary motion is converted into the intermittent rotary motion. The 5VDC Motor is connected with the Geneva drive wheel. The voltage of the motor is being monitored and supplied by the bench top DC power supply. To control the direction of the rotation of motor, without changing the way that the leads are connected, an H-Bridge circuit can be used. An Arduino microcontroller or a regulator (rheostat) can be used to vary the speed of motor. The Geneva drive wheel consists of a pin and the Geneva driven wheel consisting of 4 slots. When Voltage is applied to the motor, it rotates, making the drive wheel rotate as well. When the pin of drive wheel inserts in a slot of the driven wheel, it causes the latter to rotate. The Geneva driven wheel is coupled to a crowned flat belt pulley. When the driven wheel rotates, this pulley also rotates and as the pulley at the other end of the belt is free to rotate as well, motion is induced in the belt. Hence, an object placed on the belt can now be transferred from one position to the other.

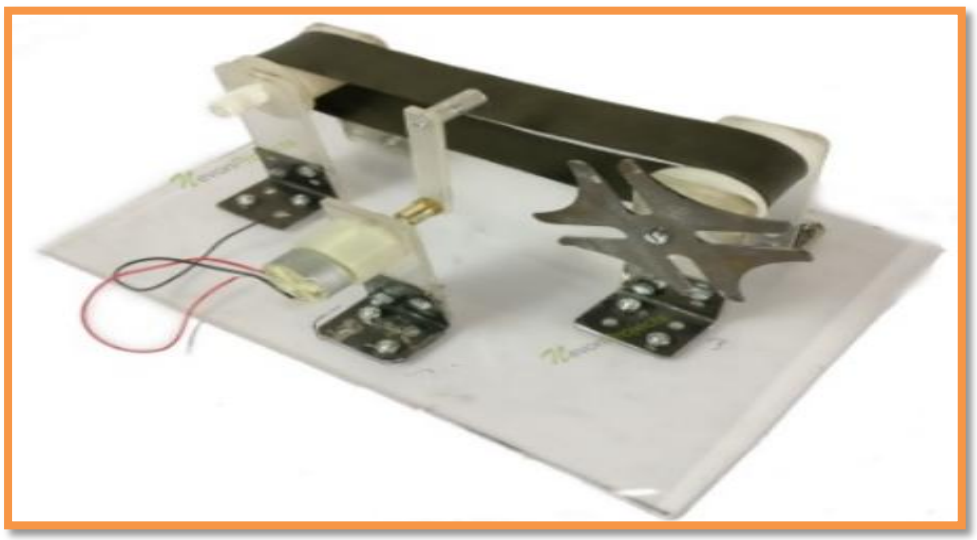

Figure 13.1 Working Model

Advantages

i. Available in a wide variety of sizes
ii. Maintains good control of its load at all times
iii. Cheap cost
iv. Minimal wear and tear leading to a long life span
v. Sufficient Time delay can be achieved easily
vi. Simple setup/installation in industry

Drawbacks

i. Difficult to change timing once design is finalized
ii. Not a versatile mechanism
iii. Once the number of dwells per revolution has been selected, the ratio of dwell period to motion is also established.
iv. All Geneva acceleration curves start and end with finite acceleration& deceleration which means they produce jerk.

Applications

i. Used in mechanical watches
ii. Pen change mechanism in plotters, automated sampling devices
iii. indexing tables in assembly lines, tool changers for CNC machines
iv. The Iron Ring Clock, prepared by students of McMaster University in Hamilton, Ontario, Canada uses a Geneva mechanism to provide intermittent motion to one of its rings
v. Modern film projectors may also use an electronically controlled indexing mechanism or stepper motor, which allows fast-forwarding the film.

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14. Archimedean screw Generator

Introduction

The Archimedean screw hydro turbine is a relative newcomer to the small-scale hydro world having only arrived on the scene over the last ten years. However, they have been around for many decades as pumps where tens-of-thousands have been installed worldwide, particularly in sewage treatment works. The same manufacturers that dominate the pump market are now the main suppliers into the hydropower market as well.

When used as a hydro turbine the principle is the same but acts in reverse. The water enters the screw at the top and the weight of the water pushes on the helical flights, allowing the water to fall to the lower level and causing the screw to rotate. This rotational energy can then be extracted by an electrical generator connected to the main shaft of the screw.

Archimedean screws for hydropower are used on low head/high flow sites. They can work efficiently on heads as low as 1 meter, though are not generally used on heads less than 1.5 m (more for economic reasons than technical ones). Single screws can work on heads up to 8 meters, but above this multiple screws are generally used, though in many cases for heads above 8 meters there may be more appropriate turbines available with much smaller footprints.

The maximum flow rate through an Archimedean screw is determined by the screw diameter. The smallest screws are just 1 meter diameter and can pass 250 liters/second, then they increase in 250 mm steps all of the way up to 5 meters in diameter with a maximum flow rate of around 14.5 m3/s. The 5 meter maximum is really based on practical delivery restrictions, and in many cases 3 meters is the maximum diameter that can be delivered to a site. If there is more flow available, multiple screws can be installed in parallel.

In terms of power output, the very smallest Archimedean screws can produce as little as 5 kW, and the largest 500 kW.

Basic layout of an Archimedean screw pump

The main parts of an Archimedean screw used as a hydro generator are shown below. The actual screw is below the upper bearing. The helical screw or ‘flights’ are made from rolled flat steel plate that is then welded to a central steel core. Most Archimedean screws have three flights, or three separate helices winding around the central core

Archimedean screws typically rotate at around 26 rpm, so the top of the screw connects to a gearbox to increase the rotational speed to between 750 and 1500 rpm to make it compatible with standard generators. Even though they rotate relatively slowly Archimedean screws can

splash water around, though this is reduced significantly by the use of a splash guard shown running down the left-hand side of the screw as shown below.

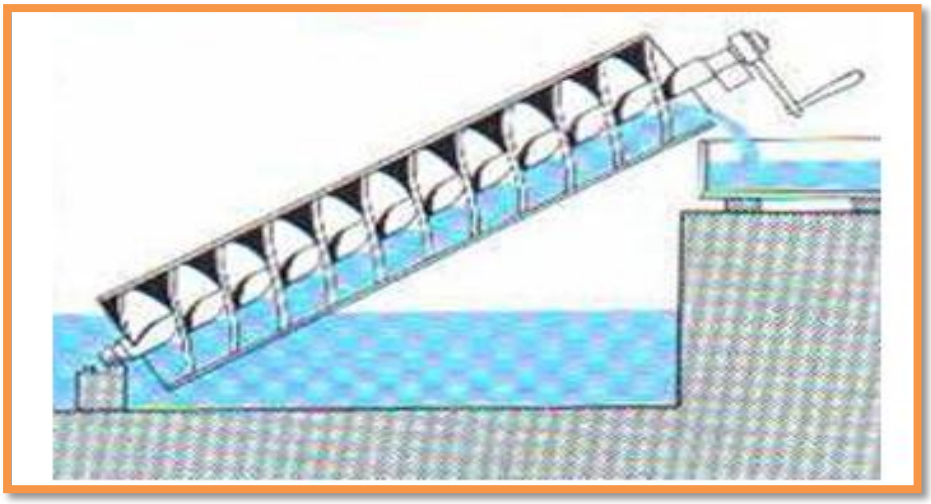

Figure 14.1 Basic layout of an Archimedean screw pump

Efficiency

A typical efficiency curve for a good quality variable-speed Archimedean screw is shown below. This is the mechanical efficiency, so doesn't include the gearbox, generator and inverter losses (these are approximately 15% on in total). It's worth noting that there are some Archimedean screw suppliers that 'over sell' the efficiency of screws, so be careful when comparing performance. A lower claimed efficiency may not be because a particular screw is inferior; it could just be that the supplier is more honest!

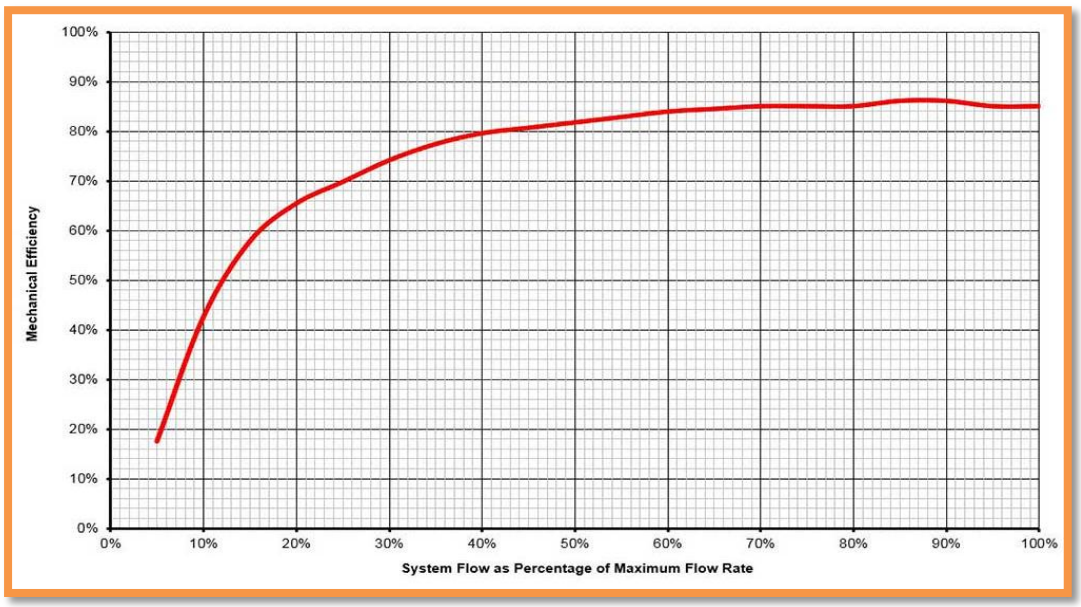

Figure 14.2 Typical Archimedean screw hydro turbine efficiency curve

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15. Biomass Briquetting Machine

Introduction

Briquettes are used as a alternative source of energy. Briquette made from waste material such as rice husk, bagasse, groundnut shells, cotton stalks and husk of soyabean and agricultural waste they are the less carbon emission. In India as well as foreign countries many of companies switched from fossil fuels to briquettes machine project to get ecofriendly bio fuel and also to save our environment from pollution and CO_2 emission. The raw material combined and compressed into briquette in order to burn longer and makes the transportation of goods easier. There is no fly ash when burning briquettes and have high burning efficiency. It is renewable energy source that make better our surroundings or environment and therefore it is presumed as energy source in many countries like India, Indonesia, Brazil, etc. In many developing countries with increasing population the amount of agricultural wastage also increased. These wastage get decompose and burnt due to this the smoke of the wastage cause air pollution. So to avoid this issue biomass briquette is an way of using agricultural waste.

Main Components of Briquetting machine

The Main Frame

The main frame supports the other parts of the machine. The frame made from mild steel plates. These plates are very useful for the fabrication of briquettes machine.

Hoper

This is where from the raw material is fed into the machine. It is generally conical in shape and made up of mild steel. The hopper size is designed in such a way that maximum raw material can be fed which can increase the production rate.

V-Belt

The belt is used for power transmission between motor and the shaft. A belt is used to link two or more rotating shafts mechanically. Belts are used as a source of motion to transmit power efficiently. Great amount of power can be transmitted from one pulley to another. The advantage of v-belt is it provides longer life and can be easily installed and removed.

Pulley

It is made of cast iron. Two pulleys are used one is driven by electric motor and other on screw. The drive element of a pulley system can be a rope, cable, belt or chain that runs over the pulley inside the grooves.

HP Motor

An electric motor is used to convert electrical energy into mechanical energy. Electric motors operate through the interaction between and electric motors magnetic field and winding current to generate force.

Screw

It is a power driven rotating screw for power transmission. Is a rotating machine element usually circular in cross section, which is used to transmit power from one part to another. The various members such as pulleys and gears are mounted on it.

Working

The raw material such as bagasse, babool wood, groundnut shell, soya bean husk, sugarcane waste, etc are gathered together and are added to the hopper in the required ratio to get the compact briquette. The briquettes making machine is operated by electric motor. Firstly the agricultural waste such as rice husk, bagasse, ground nut shells and husk of soya bean has-been poured through hoper. Then get start the motor and it is coupled with the screw by the help of v-belt and pulley. Due to this mechanism the sliding screw goes forward and it exerts pressure on plate which is attached to the screw. This plate presses the raw materials which is fed into the chamber and compress the raw material into briquettes. After that the sliding member is moved back to its initial position. This process is repeated to manufacture briquettes in continuous manner. So the finished product briquettes we get are completely clean, that is perfect for use in boilers, furnace and open fires. The density of biomass briquettes is higher than black coal.

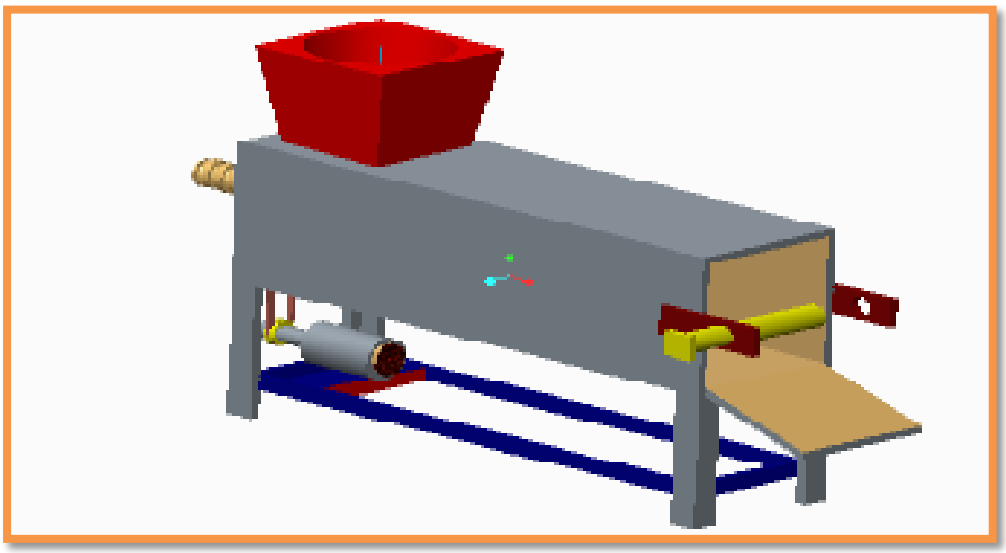

Figure 15.1 Isometric View of the Machine

16. Compressed Air Generator Using Vehicle Suspension

Introduction

Compressed air is a gas, or a combination of gases, that has been put under greater pressure than the air in the general environment. Current applications using compressed air are numerous and diverse, including jackhammers, tire pumps, air rifles, and aerosol cheese.

Here we fabricate the model of compressed air production using vehicle suspension. Man is need of energy at an increasing rate for his sustenance and well being ever since he came on the earth a few million years ago. Primitive man required energy primarily in the form of food. He derived this by eating plants or animals, which he hunted. Subsequently he discovered fire and his energy need increased as he started to make use of wood and other bio mass to supply the energy needs for cooking as well as to keep himself warm. After several years, man started to cultivate land for agriculture. He added a new dimension to the use of energy by domesticating and training animals to work for him. In this project we are collecting air from the air cylinder and store it as energy to compressor tank as non-conventional method by simply driving the vehicle.

Synthesis of compressed air

The compressed air is produced by two methods first is with the help of engine and compressor and another method is with help of suspension system. The disadvantage of first method is it decease the efficiency of engine and disadvantage of second method is required more space for installation.

Needs compressed air

- To operate pneumatic system in vehicle
- It saves fuel which was burn for running Air-conditioning.
- To recover the waste energy of suspension system

Working Principle

This project is designed with Pneumatic single acting cylinder, Quick exhaust valve, Non return valve, Air tank and Gate valve. The pushing power is converted into compressed air energy by proper driving arrangement. Pneumatic single acting cylinder is used for this project. The spring arrangement is fixed outside the pneumatic cylinder. The spring is used to return the inclined L-angle window in same position by releasing the load. The output air from the pneumatic cylinder is collected through quick exhaust valve and non-return valve. The pneumatic cylinder retracting action occurs with the help of quick exhaust valve and spring arrangement.

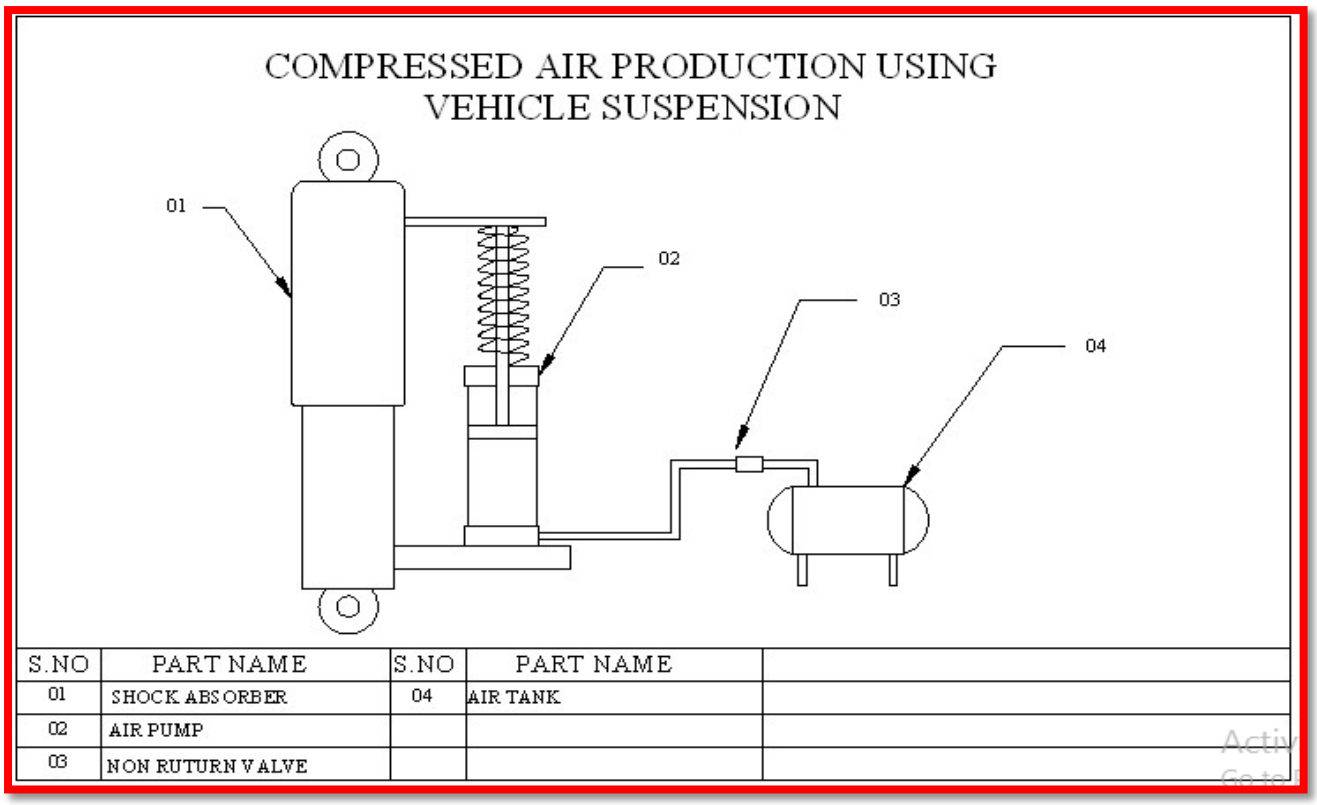

Figure 16.1 Schematic layout of working model

Advantages

- Air is produced in running vehicle
- No need of fuel or electrical power input
- This is a non-conventional system

Disadvantage

- It is difficult to store the compressed air while the vehicle is in motion.

Applications

- All highway roads
- Every road speed breaker
- Petrol bunk
- All vehicles

17. Automation of Seed Sowing Machine Using IOT

Introduction

In current world, every process is getting automated and people are getting used to adopt smart techniques to get their work done. It can be seen that with flow of time, how seed sowing techniques and equipment's have kept on progressing. Proper seed sowing is very important part of agricultural process and for the same purpose hand operated seed sowing machine have been designed and developed. Despite agriculture being one of the most important fields for determining the growth of a country, it is lagging in terms of smart working. One of the biggest irony is agriculture being the main occupation in many countries still it lags in using the smart techniques in this field..

Design of the machine

The seed sowing vehicle is designed based on two criterion. One is to keep the design in such a way that the working is as simple as possible and the other is to maintain low weight of the frame and reducing the number of pulleys used. The figure shows the model of the seed sowing machine developed using Solid works software. The optimum position of the components is decided through the help of the software model.

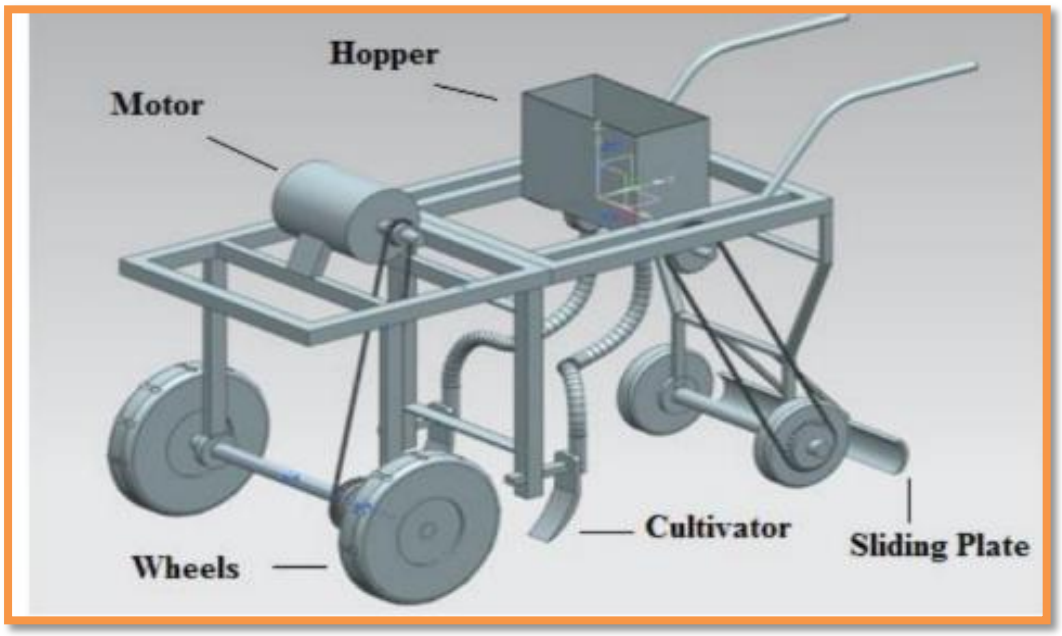

Figure 17.1 the model of the seed sowing machine developed using Solid works software

Working procedure

The block diagram of the circuit for automation is presented in figure 4. The battery positive is connected to stepper positive input terminal and negative terminal of battery to negative input terminal of stepper. The stepper steps down the voltage from 12 V to 5 V. This 5V is received at

the output terminal of stepper. Using jumper wires this output voltage is supplied to input terminals of ESP8266 wifi module. The positive of stepper is connected to 3.3V pin while the negative output terminal of stepper is connected to Gnd pin of the wifi module. As the microprocessor works on 5V, step down module is used to lower the 12V supply to 5V. Other 3.3V and Gnd pins of microprocessor provide input to relay through Vcc and Gnd pins of relay respectively. GP01 pin of ESP8266 is connected to IP pin of relay and provides input as on or off. The negative of the battery is connected to motor's negative and positive of battery is connected to com port of relay. The positive of motor is connected to NO (normally open) port of the relay.

The circuit is now complete and is online. The codes are uploaded to the microprocessor ESP8266 and then it is connected to mobile hotspot which is going to act as the controller of the machine. The microprocessor connects to specific hotspot which is specified in the code. As the on command is given through controller, the motor switches on and the motion is transmitted to front wheel through belt and pulley. For transmission, V belt and pulley system is used to have a positive drive. As the vehicle moves, the rear wheel transmits motion to seed distributer which leads to sowing of seed into soil.

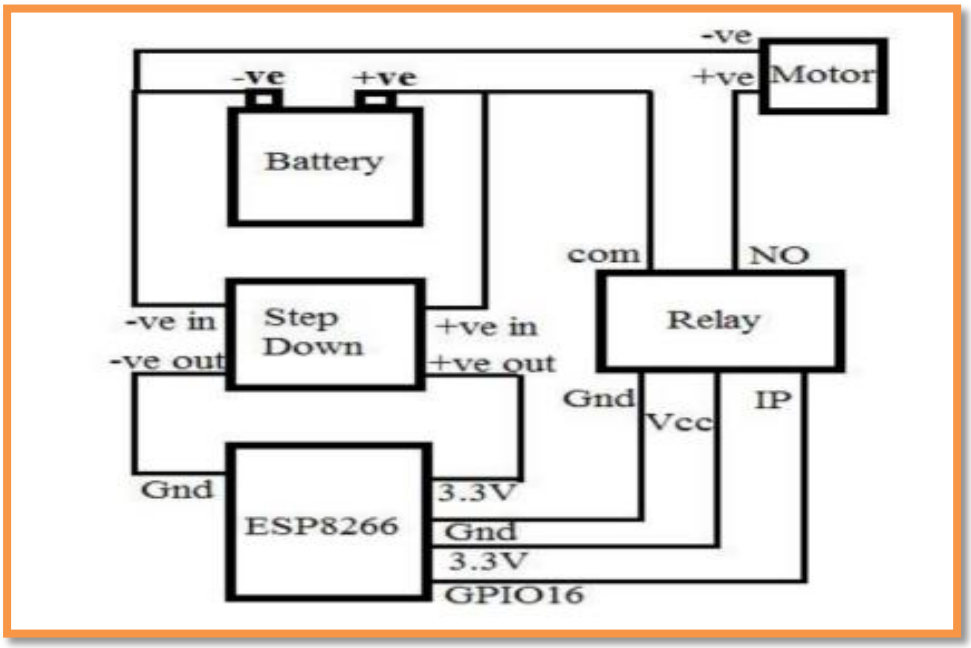

Figure 17.3 Block diagram of circuit

When command is given through android phone the motor transmits motion to the front wheels through belt and pulley mechanism. When the machine moves the rear wheel drives the seed distributer hence the seeds are sown at regular intervals from the hopper into the soil. The figure

6 shows the photographic views of individual electrical components used in the process of automation

Working model

The hopper is shown in figure 6. It stores the seeds. Figure 7 shows seed distributer. The function of the distributer is to seek seeds from the hopper one at a time and to flow it to the

The hopper is shown in figure 6. It stores the seeds. Figure 7 shows seed distributer. The function of the distributer is to seek seeds from the hopper one at a time and to flow it to the

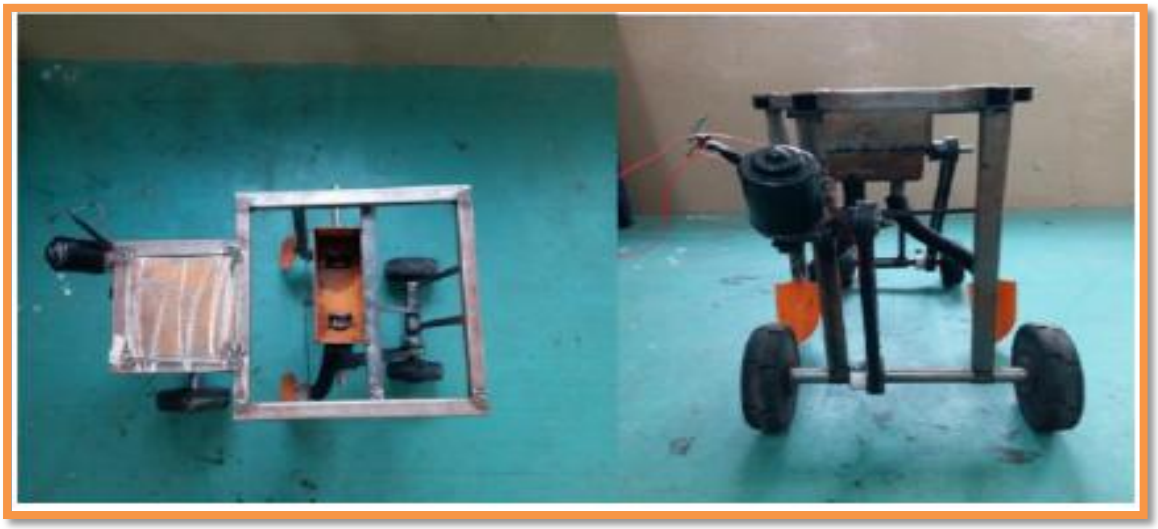

Figure 17.4 Working model in top view and front view

Conclusions

The seed sowing machine has been designed and fabricated and the process of seed sowing is automated using IoT in order to minimize the human effort. The modification in the selection of the micro-processor is done to achieve wireless connectivity between machine and the controller. ESP8266 has been used in order to host an application from another application processor. Relay is used to control a high- voltage circuit using a safe low-voltage circuit. As all connections are made and as soon as the circuit is closed, the electricity flows through the circuit and machine comes online to receive command from the controller which is android phone or laptop.

With the command the machine operates in the forward direction. The cultivators tilts the soil as machine moves forward and the seeds are dropped at regular intervals into the soil through distributer mechanism which consist of hopper and seed flow system.

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18. Promoting Photocatalytic Hydrogen Generation by Mn Dopants in 1- Dimensional Nanorods

The growing global energy crisis and the compelling requirement to reduce the overdependence on fossil fuels have increased the need for sustainable green energy. In particular, photocatalytic hydrogen generation via water splitting has drawn significant research attention as a promising strategy for addressing the energy crisis.

Among the strategies for producing hydrogen gas by water splitting, photocatalysis using sunlight is deemed highly suitable for green energy harvesting and sustainability. For instance, photogenerated charge carriers from semiconductor nanocrystals (NCs) can facilitate photocatalytic redox reactions like water splitting. Among the existing semiconductors for generating hydrogen gas by splitting water, CdS NCs are widely used due to their favorable bandgap of ~2.4 eV. However, their photocatalytic activity is limited by insufficient charge carriers and charge separation resulting from fast exaction recombination.

Recently, it has been established that advanced-shaped CdS NCs with improved charge separation can increase the efficiency of different photocatalytic redox reactions. The charge separation can also be increased by adding a metal co-catalyst which can efficiently accept electrons by electron transfer. Pt nanoparticles are the mostly used co-catalysts in CdS photocatalytic water splitting to produce higher hydrogen yields.

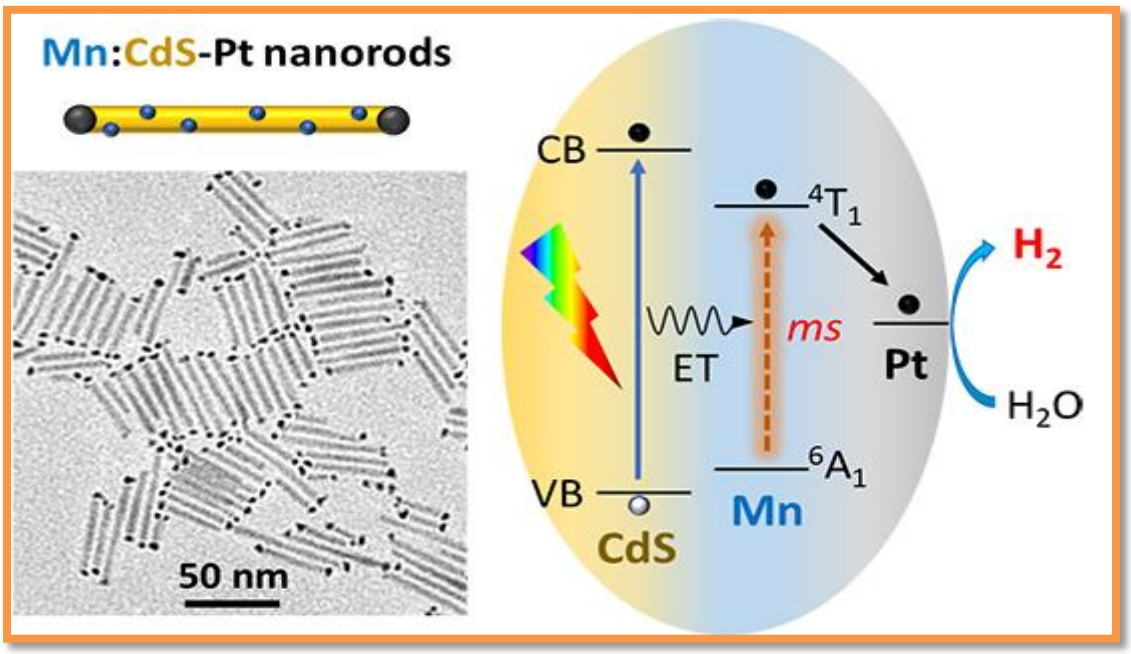

Figure 18.1 Hydrogen generation mechanism

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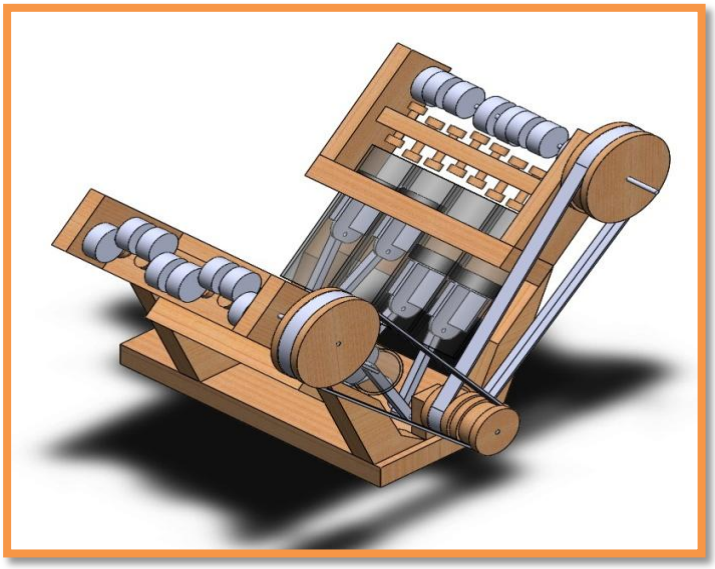
19. Design and Fabrication of V8 Engine

V8 engine is an eight-cylinder piston engine in which two banks of four cylinders share a common crankshaft and are arranged in a V configuration. The majority of V8 engines use a V-angle (the angle between the two banks of cylinders) of 90 degrees. This angle results in good engine balance, which results in low vibrations; however, the downside is a larger width than V8 engines that use a smaller V-angle. The V8 engine with a cross-plane crankshaft is a common configuration for large automobile engines. The displacement of modern V8 engines is typically between 3.5 to 6.4 L (214 to 391 cu in), though larger and smaller examples have been produced, such as the 8.2 L (500 cu in) V8 engine used in the 1971–1978 Cadillac Eldorado.

Due to its large external dimensions, V8 engines are typically used in cars that use a longitudinal engine layout and rear-wheel drive (or all-wheel drive). However, V8 engines have also occasionally been used in transverse engine front-wheel drive vehicles, sometimes using closer cylinder bore spacing's and narrower cylinder bank angles to reduce their space requirements The Machine aims to show the working of the v8 engine. The frame is mostly made of MDF. The rest of the engine accessories is made of mild steel, nylon and plastic. A motor rotates the crankshaft. The connecting rods of the 8 cylinders are connecting to the crankshaft and rotate according to their location on the crankshaft. A belt & pulley arrangement is placed at the end of the crankshaft, which is set in motion due to the rotation of the shaft. The belt & pulley arrangement revolves the cam on each side which in turn causes the inlet and outlet valves of the cylinder to reciprocate.



19.1 Working model of V8 Engine

Mr. Ramagouda Patil
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20. Solar Sea Water Desalination Machine with RO UV Purifier

Introduction

Only 3% of the water available on earth is fresh water. Two thirds of this fresh water is present in frozen glaciers. On an average over 1.1 billion people over the globe lack proper access to any fresh water reserves and over 2.7 billion people face scarcity of water at least once a month. But fortunately as we know 71% of earths surface is water and 97% of that water is sea water.

So here we develop a portable solar powered se water desalination as well as water purifier to solve the water problem with a smart innovative concept.

Key aspects of Desalination Machine

The solar portable desalinator serves the following key aspects

- Fast Water Desalination
- Instant Purification of desalinated water using RO system
- Added UV sterilization for virus bacteria sterilization
- Compact Design
- Portable Design Easy to Move
- Solar Powered – No External Power Needed
- Easy Maintenance System

Working

The machine makes use of a 3 stage process to convert salty seawater to pure drinkable water. The system first allows user to pour salty water via a mesh based inlet where large waste like plastic granules or stones, weed etc gets separated. This water is then pumped into a large purification chamber having 3 layers of purifiers including sand and gravel for filtering weed, sand and large salt particles.

The output of this process is still salty water but without any particles. This water is then passed on to the second filtration where we use reverse osmosis to filter out salt from the water. Here we use 3 filtration membranes to filter out fresh water from salty water and trap the salt particles in membrane filters.

This water is now stored in a tank just above the system. The system tap when opened allows water to run from the tank to the tap where we detect the flow when on and turn on the UV light for stage 3 filtration to deactivate any remaining bacteria and virus in the water. This water is now in drinkable form using 3 stage process without the use of any chlorine.

Now the pumps used in the system are powered by a large battery. This battery is in turn charged by 2 x 50Watt solar panels due to large availability of solar power in sea areas. This makes it very portable to be used on any beach front or on long sea voyages for easy and instant sea water filtration.

Figure 20.1 Working Model

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Group Photo of AIMSS - Special Task Team

Program Educational Objectives (PEOs)

The Graduates will be able to

PEO1: Acquire core competence in Applied Science, Mathematics and Mechanical Engineering fundamentals to excel in professional career and higher study

PEO2: Design, demonstrate and analyze the mechanical systems which are useful to society.

PEO3: Maintain professional & ethical values, employability skills, multidisciplinary approach & an ability to realize engineering issues to broader social context by engaging in lifelong learning.

Program Specific Outcomes (PSOs)

PSO1: Able to apply the basic principles of Mechanical Engineering in various practical fields to solve societal problems by engaging themselves in many state/national level projects.

PSO2: Able to analyze and design basic mechanical system using relevant tools and techniques.

PSO3: Able to resolve contemporary issues of industries through industry institute interaction and alumni social networks

Program Outcomes (POs)

PO1: **Engineering knowledge-** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis-** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions-** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems-** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage-** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society-** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability-** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics-** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work-** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication-** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance-** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning-** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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