

EXPERIMENT INVESTIGATION OF ENGINE PERFORMANCE AND EMISSION CHARACTERISTICS BY USING TiO₂ NANO ADDITIVE AND BIODIESEL BLEND WITH DIESEL

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in
Mechanical Engineering

By

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DEPARTMENT OF MECHANICAL ENGINEERING

SCHOOL OF MECHANICAL ENGINEERING

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **AROCKIAJERALD A (Reg.No. 37150017)** and **DHANASEKARAN R (Reg.No. 37150052)** who have done the Project work in entitled **"EXPERIMENT INVESTIGATION OF ENGINE PERFORMANCE AND EMISSION CHARACTERISTICS BY USING TiO₂ NANO ADDITIVE AND BIODIESEL BLEND WITH DIESEL "** as a team under my supervision from December 2020 to April 2021.

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We **AROCKIAJERALD A (Reg.No. 37150017)** and **DHANASEKARAN R (Reg.No. 37150052)** hereby declare that the Project Report entitled “**EXPERIMENT INVESTIGATION OF ENGINE PERFORMANCE AND EMISSION CHARACTERISTICS BY USING TiO₂ NANO ADDITIVE AND BIODIESEL BLEND WITH DIESEL**” done by us under the guidance of **Mrs.P.Sivashankari, M.E., (Ph.D).**, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

DATE:

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ABSTRACT

Energy demand is the hot topic of all developing and developed countries. Every day Energy demand increases in a big rate. So, it is necessary to find an eco-friendly alternative solution, biodiesel is a promising alternative solution for this problem. The main purpose of this project is to test and compare the performance and emission of diesel engine using Celery seed oil Biofuel blended with diesel, Titanium oxide is used as a catalyst. Celery seed oil were esterified using the transesterification method. Then samples S1, S2, S3, S4, and S5 were prepared using sonication process. The measuring parameters are break power, break thermal efficiency, specific fuel consumption, and all emission parameter results shows that S1 gives better performance than D100 and other biodiesel samples.

Blend ratio S1 (10%Biodiesel – 90%Diesel)

S2 (20%Biodiesel – 80%Diesel)

S3 (30%Biodiesel – 70%Diesel)

S4 (40%Biodiesel – 60%Diesel)

S5 (50%Biodiesel – 50%Diesel)

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CHAPTER – 1

INTRODUCTION

Significant examination is centered around fuel utilization and emission decrease in the previous few years. There is developing interest on elective fills because of unpredictable petroleum derivative cost and consumption. In numerous applications like Transportation, Power age, Marine applications and so on, diesel Engines are being utilized as a significant source. During a century ago, the employments of fossil assets are expanding because of huge development of populace and change in way of life. This causes emergencies of petroleum derivative exhaustion For the diesel motors there is a dire requirement for appropriate elective energizes. In this venture we will inspect the utilization of diesel-raw grain oil in diesel four phase motor. With diesel and various mixes of germ oil, an endeavor will be made to investigate the exhibition and discharge qualities of a diesel motor. Interior ignition motors produce unwanted outflows during the burning interaction. The toxins that are depleted from the interior ignition motors influence the environment and cause issues like a dangerous atmospheric deviation, brown haze, corrosive downpour, respiratory risks and so on The physical and compound conditions that exist inside any such diesel motors under any conditions contrast extensively from sparkle start motors, on the grounds that, by plan, diesel motor force is straightforwardly constrained by the fuel supply, not by control of the air/fuel blend, as in ordinary gas motors. Because of these distinctions, diesel motors by and large produce an alternate exhibit of poisons than flash driven motors, contrasts that are at times subjective (what contaminations are there, and what are not), yet more frequently quantitative (the amount of specific toxins or toxin classes are available in each). For example, diesel motors produce one-twenty-eighth the carbon monoxide that gas motors do, as they consume their fuel in overabundance air even at full burden.

Particulate matter or residue is made during the fragmented ignition of diesel fuel. Its structure regularly incorporates many synthetic components, including sulfates, ammonium, nitrates, essential carbon, dense natural mixtures, and surprisingly cancer-causing mixtures and weighty metals like arsenic, selenium, cadmium and zinc. Despite the fact that simply a negligible portion of the width of a human hair, particulate matter shifts in size from coarse particulates (under 10 microns in measurement) to fine particulates (under 2.5 microns) to ultrafine particulates (under 0.1 microns). Ultrafine particulates, which are sufficiently little to enter the cells of the lungs, make up 80-95% of diesel residue contamination. Diesel motors add to the issue by delivering particulates straightforwardly into the air and by discharging nitrogen oxides and sulfur oxides, which change into "auxiliary" particulates in the environment. Like all fuel-consuming hardware, diesel motors produce nitrogen oxides, which can harm lung tissue, bring down the body's protection from respiratory contamination and deteriorate ongoing lung infections, like

asthma. They additionally respond with different poisons in the climate to shape ozone, a significant segment of brown haze.

Intense impacts of diesel fumes openness incorporate bothering of the nose and eyes, lung work changes, respiratory changes, migraine, weariness and queasiness. Persistent openings are related with hack, sputum creation and lung work decrements. Notwithstanding, countless epidemiological examinations from various pieces of the world have reliably recognized a relationship between surrounding levels of air particles and different wellbeing results, including mortality, intensification of asthma, constant bronchitis, respiratory plot contaminations, ischaemic coronary illness and stroke. Diesel motors likewise produce submicron ash particles that are accepted to intercede a few of the noticed unfriendly impacts.

It has been assessed that the particulate emanation from diesel motors per voyaged distance is more than 10 times higher than the discharge from petroleum motors of identical force running on unleaded petroleum, and more than 100 times higher than that from petroleum motors fitted with exhaust systems. Most significant wellsprings of diesel emanations, like ships, prepares, and trucks work in and around ports, rail yards, and intensely voyaged streets. The significant segments of PM are sulfates, nitrates, alkali, sodium chloride, dark carbon, mineral residue and water. The most wellbeing harming particles are those with a measurement of 10 μm or less, which can infiltrate and stop somewhere inside the lungs. Both short-and long haul openness to air contaminations have been related with wellbeing impacts.

1.1 OUTLINE OF THE PROJECT

Significant exploration is centered around fuel utilization and emanation decrease in the previous few years. There is developing interest on elective fills because of unstable petroleum product cost and depletion. In numerous applications like Transportation, Power age, Marine applications and so on, diesel Engines are being utilized as a significant source. During a century ago, the employments of fossil assets are expanding because of huge development of populace and change in way of life. This causes emergencies of petroleum product exhaustion For the diesel motors there is a dire requirement for reasonable elective energizes. In this task we will analyze the utilization of diesel-raw grain oil in diesel four cycle motor. With diesel and various mixes of germ oil, an endeavor will be made to break down the presentation and outflow attributes of a diesel motor. Inward ignition motors create bothersome discharges during the burning interaction. The contaminations that are depleted from the inward ignition motors influence the environment and cause issues like an unnatural weather change, exhaust cloud, corrosive downpour, respiratory risks and so forth The physical and synthetic conditions that exist inside any such diesel motors under any conditions contrast extensively from sparkle start motors, on the grounds that, by plan, diesel motor force is

straightforwardly constrained by the fuel supply, not by control of the air/fuel blend, as in ordinary gas motors. Because of these distinctions, diesel motors by and large produce an alternate exhibit of contaminations than spark driven motors, contrasts that are now and then subjective (what toxins are there, and what are not), however more frequently quantitative (the amount of specific poisons or poison classes are available in each). For example, diesel motors produce one-twenty-eighth the carbon monoxide that gas motors do, as they consume their fuel in overabundance air even at full burden.

Particulate matter or residue is made during the deficient burning of diesel fuel. Its synthesis regularly incorporates many synthetic components, including sulfates, ammonium, nitrates, basic carbon, dense natural mixtures, and surprisingly cancer-causing mixtures and weighty metals like arsenic, selenium, cadmium and zinc. Despite the fact that simply a small amount of the width of a human hair, particulate matter shifts in size from coarse particulates (under 10 microns in measurement) to fine particulates (under 2.5 microns) to ultrafine particulates (under 0.1 microns). Ultrafine particulates, which are adequately little to infiltrate the cells of the lungs, make up 80-95% of diesel sediment contamination. Diesel motors add to the issue by delivering particulates straightforwardly into the air and by discharging nitrogen oxides and sulfur oxides, which change into "optional" particulates in the air. Like all fuel-consuming gear, diesel motors produce nitrogen oxides, which can harm lung tissue, bring down the body's protection from respiratory contamination and deteriorate persistent lung infections, like asthma. They likewise respond with different contaminations in the environment to frame ozone, a significant segment of brown haze.

A few air poisons add to the fermentation of the climate. The main ones are talked about in this article and include sulfur dioxide (SO_2), nitrogen oxides (NO_x) and smelling salts (NH_3). The effect of SO_2 , NO_x and NH_3 can be seen in the reformist debasement of soils, water and woods. They additionally add to the arrangement of fine particles noticeable all around that cause respiratory illnesses. The acidifying capability of SO_2 , NO_x and NH_3 is usually estimated in SO_2 reciprocals

Intense impacts of diesel fumes openness incorporate aggravation of the nose and eyes, lung work changes, respiratory changes, cerebral pain, weariness and sickness. Ongoing openings are related with hack, sputum creation and lung work decrements. Notwithstanding indications, openness concentrates in solid people have recorded various significant incendiary changes in the aviation routes, eminently, before changes in pneumonic capacity can be identified. All things considered, such impacts might be significantly more inconvenient in asthmatics and different subjects with traded off aspiratory work. There is developing global concern with respect to the unfavorable wellbeing impacts of air contamination. Contamination is turning into a significant general

medical issue and policy centered issue, because of the fast development in total populace and the expanding overall movement from rustic to metropolitan zones .United Nations gauges have shown that 47% of the worldwide populace is living in metropolitan regions. This urbanization has carried with it an expanded requirement for transportation and henceforth an increment in engine vehicle created air poisons. Notwithstanding, an enormous number of epidemiological investigations from various pieces of the world have reliably recognized a relationship between surrounding levels of air particles and different wellbeing results, including mortality, compounding of asthma, persistent bronchitis, respiratory lot contaminations, ischaemic coronary illness and stroke. Diesel motors additionally produce submicron ash particles that are accepted to intervene a few of the noticed antagonistic impacts.

1.2 EMISSION FROM DIESEL ENGINE

Diesel motors have been utilized in uncompromising applications for quite a while now; it is as of late that it has gotten exceptionally famous in light obligation application because of their higher eco-friendliness. Higher eco-friendliness in the diesel motors is accomplished because of the great pressure proportions alongside high oxygen fixation in the ignition chamber. In any case, these equivalent elements results 2 in high NO_x discharge in diesel motor. The principle poisons of diesel motors are NO_x and particulate matter (PM). The instrument of arrangement of Nitrogen oxides and particulate matter inside the ignition office of diesel motors are conflicting and the concurrent decrease of both simultaneously is exceptionally troublesome. Scientists have endeavored to lessen the outflows and improve the eco-friendliness of diesel motors.

Diesel motors have been utilized in substantial applications for quite a while; it is just during the previous decade that it has gotten famous in light obligation application because of their high eco-friendliness. Higher eco-friendliness in the diesel motor is accomplished in view of the great pressure proportions alongside moderately higher oxygen focus in the burning chamber. In any case, these equivalent elements brings about higher NO_x emanation in diesel motor. The rigid outflow standards have been a significant main impetus to build up the interior ignition motors in a greater climate amicable way. The primary poisons from diesel motors are NO_x and particulate matter (PM). The system of arrangement of NO_x and particulate matter in the burning office of diesel motors are opposing and the concurrent decrease of both is exceptionally

troublesome. Analysts have endeavored to diminish the outflows and improve the fuel transformation productivity of diesel motors.

1.3. MAIN LOCAL AIR POLLUTENTS

1.3.1 Carbon Monoxide:

CO A gas shaped by the inadequate ignition of carbon-containing energizes. The more effective the burning cycles the lower the emanations. The primary open air wellspring of CO is at present street transport

1.3.2. Nitrogen Oxides:

NO_x All burning items in air produce oxides of nitrogen: nitrogen dioxide (NO₂) and nitric oxide (NO) – aggregately known as NO_x. Street transport represents about half of absolute discharges, more than the power supply industry and the modern and business areas set up. NO_x is additionally a forerunner of ozone and thusly an aberrant ozone depleting substance.

1.3.3. Particulates:

PM₁₀ Particulate matter more modest than 10 microns (10 millionths of a meter). They comprise of essential particles emerging from ignition sources (primarily street transport); auxiliary particles (chiefly sulfate and nitrate framed by climatic compound responses); and coarse particles (suspended soils and 3 cleans, ocean salt, natural particles and particles from development work).

1.3.4. Sulphur Dioxide:

SO₂, the transcendent source is the ignition of sulphurcontaining petroleum derivatives, essentially coal and hefty oils. Yield from street vehicles is moderately little, however burning of fuel (particularly diesel) makes a critical commitment to emanation levels in metropolitan regions.

1.3.5. 1, 3 Butadiene:

A gas at ordinary temperatures and pressing factors getting mostly from the Combustion of diesel and petroleum motors.

1.3.6. Volatile Organic Compounds:

VOC In daylight these respond with NO_x to frame ozone. It can consequently be viewed as a circuitous ozone harming substance. So high fixations by and large happen downwind of the source emanations, most habitually in summer, in the south, and in rustic

and rural regions. (Source: HM Customs and Excise, Using the duty framework to support cleaner powers, November 2000)

1.4 COMPRESSION ENGINE IGNITION

Emanations from a CI motor are a solid capacity of comparability proportion (Φ). Regular fumes outflows from a CI motor are oxides of nitrogen (NO_x), carbon monoxides (CO), unburned hydrocarbons (HC) and particulate issue (PM). NO_x development is reliant on the oxidation of climatic nitrogen and is unequivocally influenced by the chamber charge temperature. Absolute emanation of NO_x in a CI motor is higher contrasted with lean consume sparkle start (SI) motors since burning happens as a dissemination fire which happens at Φ near 1.0. In this area, the stoichiometric air-fuel proportion arrives at exceptionally high temperatures representing the undeniable degree of NO_x . CI motors that work at a lean blend with abundance air can assist with controlling the NO_x . Burning gases in lean blend keep on blending in with abundance air bringing about lower temperatures that debilitates the energy of NO_x arrangement. SI motors that work near stoichiometric produces higher NO_x levels than CI motors. Greatest fire temperature which happens at stoichiometric air-fuel proportion prompts the separation motors, in view of the non-homogeneity of air-fuel combination, some neighborhood spots in the chamber will be too shelter even consider consuming, prompting failure to fire and helpless ignition. 5 Other spots might be excessively rich with insufficient oxygen to respond with every one of the carbons. The two states of lean and rich blend produce high HC outflow. For CO discharge, it is shaped when a motor runs rich, consequently its arrangement doesn't rely upon the admission blend condition. PM emanation in CI motor is framed for the most part in the fuel rich zone where Φ is higher than 1.0 inside the chamber during the ignition because of inadequate burning of fuel hydrocarbons and some from greasing up oil.

1.5. PROBLEM STATEMENT AND RESEARCH OBJECTIVES

Higher fuel costs and progressively rigid outflow guidelines are worries for makers and administrators of pressure start motors. By changing the CI unit over to double fuel activity and using cheaper petroleum gas, both lower fuel expenses and lower outflows can be accomplished. Be that as it may, the expense investment funds through diesel dislodging and discharge decreases should be measured. Accordingly, the primary motivation behind this exploration is to address the difficulties related with double fuel motors to improve effectiveness and to get better control of the fumes emanations. Since double fuel motors produce higher HC and CO discharges than guidelines permit, ideas ought to be created to profitably control burning and outflows.

Theory: Over the previous five years, flammable gas fuel costs have stayed well underneath that of diesel fuel and have been more predictable contrasted with diesel fuel.

At the point when petroleum gas is presented in diesel motor, it ought to dislodge a portion of the diesel fuel in CI motor, along these lines diminish the fuel cost in double fuel motor.

Speculation: Being a most reduced part in paraffin family, the diesel ignition with gaseous petrol in double fuel motor is relied upon to create less PM. Also, since the premixed ignition occurs, the chance for locally rich blends to frame is decreased. Consequently, with lean conditions, the

fire temperature ought to be lower, in this way lessening the NO_x development in a double fuel motor.

Speculation: The proportion for the flammable gas and air entering the chamber isn't controlled. It is theorized that at these heap conditions, the gaseous petrol air combination is underneath as far as possible in the chamber and the infiltration of the diesel fuel fly doesn't stretch out across the chamber. Therefore, locales close to the edge of the ignition chamber with petroleum gas and air blends underneath as far as possible are either unburned (HC outflow) or somewhat consumed (CO emanation).

Given the difficult explanation over, the examination targets are as per the following:

- 1) To assess the emanations and execution of a double fuel motor and contrast the outcomes and the diesel same.
- 2) To build up a discharges control procedure to keep up relevant administrative guidelines on outflows levels.
- 3) To examine in-chamber burning by carrying out the CFD reproduction utilizing CONVERGE code with a decreased synthetic motor component for efficient. The area where the discharge is shaped will be explored too

1.6 NECESSITY OF ALTERNATIVE FUELS

It is obvious from the above consultations that, these days India is dealing with the twin issues of quick weariness of petroleum derivatives and natural corruption. Henceforth, there is an earnest need to decrease reliance on oil inferred fills for better economy and climate. Transformation of bio-root unusual powers can address the two issues. These energizes are fundamentally nonpetroleum and bring about energy security and natural advantages. They are accessible either in one structure or other for more

than 100 years. The ID of elective powers for use in I.C. motors has been exposed to concentrates all through the globe. Execution examinations have shown reasonableness of assortment of elective fills like hydrogen, alcohols, biogas, maker gas and different sorts of eatable and non-consumable oils. Notwithstanding, in the Indian setting, the bio-beginning energizes like alcohols, vegetable oils, and biogas can be utilized widely and address the issues identified with fuel emergency.

1.7 BIO-FUELS

In the transportation and farming areas, different sustainable fluid bio-powers got from organic assets have end up being acceptable options in contrast to powers got from unrefined oils. For the issues of ecological debasement, energy security, limiting imports, country business and agrarian economy, these biofuels are acquiring worldwide acknowledgment as an answer. The most encouraging biofuels, and nearest to being serious in current business sectors without endowment, are ethanol, methanol, vegetable oils and biodiesel.

Ethanol is utilized as fuel or as oxygenate to gas. Biodiesel is a subsidiary of vegetable oils and is produced using virgin or utilized palatable and non-consumable vegetable oils and creature fats through a compound cycle named trans-esterification. Biodiesel can be mixed in any proportion with petrol diesel fuel. Its higher Cetane number builds the ignition in any event, when mixed in the oil. A few examinations all throughout the planet uncover that if biomass energy is utilized rather than petroleum derivatives, there will be a net decrease in CO emanations and CO₂ discharges. SO₂ emanations from utilizing biomass energy will in general be significantly lower on the grounds that pertinent plants and trees contain just follow 15 amounts of sulfur contrasted with the extensively higher outflows from coal, fuel, and surprisingly some flammable gas. This drop in SO₂ is joined by a fall in the level of the other customary engine poison emanations like carbon monoxide, unburned hydrocarbons, and particulates. Notwithstanding, there is an expansion in the arrival of nitrogen oxides and aldehydes.

1.8 BIODIESEL

Biodiesel is a vegetable oil-based (soy or canola oil) fuel that runs in the current diesel motors, with no adjustments to the equipment. Biodiesel and biodiesel mixes can be utilized taking all things together pressure start (CI) motors that were intended to be worked on diesel fuel. It is less expensive than oil, feasible, and nontoxic; it doesn't create corrosive downpour (nonattendance of sulfur); and it doesn't contribute however much non-renewable energy sources do to an Earth-wide temperature boost. Studies have shown it lessens motor wear by as much as 30%, fundamentally in light of the fact that it gives superb grease (Agarwal, Bijwe, and Das, 2003). Indeed, even 2% biodiesel in ordinary diesel will help accomplish this improvement. Biodiesel fuel yields 220% more energy than

that needed to create, transport, and disperse it, which is because of the way that the feedstock crop gathers sunlight based energy and changes it into the biodiesel feedstock oil. Different biodiesel mixes, which incorporate various proportions of biodiesel and diesel from raw petroleum, can be utilized in vehicles relying on the vehicle's necessity and climate conditions. A 20% biodiesel will give a higher octane rating, unrivaled grease up, critical emanation decreases, and less harmful discharges; will essentially dispense with noticeable sediment outflows; and will have comparable fuel utilization, drive, and force. Premium biodiesel is a fuel made from vegetable oils by a transesterification interaction. Soybean oil is at present the main wellspring of vegetable oil for biodiesel fabricate in the United States

1.8.1 Biodiesel Production

The business strategy utilized for the biodiesel creation is the transesterification (additionally called alcoholysis). The transesterification comprises on the response of oils or fats (fatty substances somewhere in the range of 15 and 23 particles, being the most well-known with 18) with a liquor of low sub-atomic weight (generally ethanol or methanol) with the presence of an antacid impetus (typically NaOH or KOH) to create esters and glycerin. Typically, the response happens at barometrical pressing factor and 65°C of temperature. The interaction utilizes steady disturbance, during a time frame between one or twelve hours. The transesterification comprises of three successive and reversible responses (Figure 1). The stoichiometric proportion for the transesterification response is three moles of liquor and one mole of fatty oil (Figure 2). An additional measure of liquor is included request to move the response to the methyl esters development. Glycerin is likewise shaped in the response.

1 oil/fat + 3 methanol = 3 methyl esters +1 glycerin Figure 2. Transesterification response

1.8.2 Biodiesel Features

The biodiesel properties rely upon the pre-owned feedstock (new vegetable oil, squander cooking oils, creature fats, and so on) Significant properties of the biodiesel are:

- It can be utilized unadulterated or mixed with petrodiesel in motors
- It can be utilized in the diesel motor with no changes.
- it tends to be capacity in similar compartments than Petro diesel
- It can delay motor life because of the greater grease limit

- It improves burning cycle. The biodiesel contains in any event 11% oxygen. Biodiesel consumes better (more totally with few fuel unburned discharges) than petrol diesel. Less smoke is delivered. The utilization of biodiesel can decrease the outflows of unburned hydrocarbons (HI) in a 90%.

- It produces work
- It greases up moving motors
- It is Biodegradable
- It doesn't contain sulfur. No sulfur discharges are produced during the burning
- It is less inflammable contrasted and Petro diesel.
- During the burning biodiesel produces less unsafe gases into the climate contrasted and Petro diesel. Biodiesel diminishes the wellbeing hazards related with petrol diesel. The utilization of biodiesel diminishes discharge of PAH (distinguished as malignant growth causing). Biodiesel is nontoxic.

Ozone harming substance advantage. During the burning of biodiesel, the CO₂ cycle is shut. The CO₂ created during the burning is the measure of CO₂ which the plants can utilize through photosynthesis during development. Besides, this cycle infers low outflows of CO₂, because of the medium substance carbon for plants is 77.8% and for creature fats is 76.1%. While, the substance carbon for fossil diesel is 86.7%. The utilization of biodiesel can diminish the CO₂ outflows up to half in contrast with the utilization of oil diesel.

- The biodiesel transport and its stockpiling are less hazardous than the oil diesel, on the grounds that biodiesel has a flashpoint temperature of about 170°C in examination of 60 to 80 °C for oil diesel.
- It is non-irritating to the skin
- It has a wonderful fragrance

Additionally, those benefits likewise other monetary angles can be considered: Biodiesel add to expansion of fuel sources. It is a significant perspective for nations without petroleum product sources. The biodiesel adds to rural and country advancement. The most significant biodiesel weaknesses, in correlation with the petroleum derivative, are:

- 1) The expense. The biodiesel creation is today costly contrasted and Petro diesel.
- 2) The biodiesel needs more added substances, for the most part in cool nations, because of its high cloud point.

- 3) Lower long-term capacity dependability. The biodiesel gets rotten because of oxidation and bacterial air. This rancidity cycle produces aldehydes, ketones and acids, which have solid and undesirable scents.
- 4) It is required 1.1 liters of biodiesel to supplant one liter of petrol diesel, due to their lower calorific force.
- 5) High percent mixes of biodiesel can relax and debase particular sorts of elastomers and normal rubbers. For this situation, safeguards must be taken concerning the materials in fuelling framework.
- 6) Biodiesel may weaken the greasing up oil of motors.
- 7) The biodiesel delivers more NO_x emanations than Petro diesel- an examination of the discharges from biodiesel and Petro diesel is appeared in table 4

1.8.3 Advantages Of Bio-Diesel

Biofuels are viewed as a more maintainable option in contrast to regular petroleum and diesel got from petroleum derivatives since they come from inexhaustible sources, which additionally assimilate carbon dioxide (CO₂), despite the fact that CO₂ will be discharged as a result of energy utilized in the gathering and creation measure. Studies show that the general CO₂ reserve funds from biofuels contrasted with ordinary petroleum and diesel differ between 20% to 70% contingent upon the kind of yield and the energy devoured in developing, reaping, shipping and handling the harvest into a fuel.

- Biodiesel is the similarly perfect and harmless to the ecosystem just elective fuel
- Biodiesel runs in any customary unmodified diesel motor. It very well may be put away anyplace that petrol diesel fuel is put away.
- Biodiesel can be utilized alone or blended in any proportion with oil diesel fuel.
- Studies have tracked down that the lifecycle creation and utilization of biodiesel delivers around between 80-100% less carbon dioxide and practically 100% less Sulfur dioxide discharges.
- β Combustion of biodiesel alone gives more than a 90% decrease altogether unburned hydrocarbons and a 75-90% decrease in sweet-smelling hydrocarbons.
- Biodiesel further gives huge decreases in particulates and carbon monoxide than petrol diesel fuel.
- Based on Ames Mutagenicity tests, biodiesel gives a 90% decrease in malignancy hazards.

- Biodiesel is 11% oxygen by weight and contains no sulfur. The utilization of biodiesel can expand the existence of diesel motors since it is more greasing up than petrol diesel fuel while fuel utilization, start, power yield and motor force are unaffected.
- Biodiesel is protected to deal with and transport since it is pretty much as biodegradable as sugar, multiple times less harmful than table salt and has a high flashpoint of about 125C contrasted with oil diesel fuel, which has a blaze point of 55C.
- Biodiesel can be produced using inexhaustible oilseed yields like soybeans, rapeseed, cottonseed and mustard seed and non-consumable oilseeds.

1.8.4 Process Description

The biodiesel is delivered by transesterification of oil utilizing methanol (liquor) and NaOH (impetus). The interaction steps are:

- 1) The vegetable and waste cooking oils are gotten. They are shipped to the plant with trucks.
- 2) The oils are put away in external tanks of the plant.
- 3) Drying and pretreatment of the oil.
- 4) The oil transesterification. The reactor is planned by 8000 hours out of each year, with an every day biodiesel creation of 200 tons each day. The interaction begins with the refined oil. In the reactor, the oils are blended in with the methanol, in overabundance, NaOH (impetus)
- 5) The response items are killed with a mineral corrosive. Methanol in abundance is vanished, and afterward consolidated and put away to be reused in the following cycle.
- 6) The biodiesel is put away in tanks with nitrogen inclusion to evade its oxidation. The truck load is performed under nitrogen infusion to dodge its debasement in transport.

1.9 ESSENTIAL OILS

Fundamental oils are the concentrated fragrant oils of plant leaves, blossoms, seeds, bark, roots, and the skins of certain natural products. They shift in strength yet are in every case exceptionally strong, and frequently smell best when weakened (as in different oils, colognes, and shampoos). Those fundamental oils got from trees are by and large delivered by a protracted steam refining measure applied to either the slashed wood or the leaves and branch finishes of the tree

1.10 ESSENTIAL OIL CATEGORIES

Most fundamental oil aromas can be arranged into the accompanying classifications:

1.10.1 Camphoraceous

A camphoraceous fragrance is one that is like camphor; a firmly sweet-smelling, practically therapeutic aroma. Camphoraceous fundamental oils incorporate eucalyptus, frankincense, hyssop, marjoram, rosemary, sage and, obviously, camphor

1.10.2 Floral

Fundamental oils got from blooming natural sources are alluded to as flower fragrances. These fundamental oils incorporate clary sage, chamomile, geranium, jasmine, juniper berry, lavender, rose, and ylangylang.

1.10.3 Mint

Spices in the mint family are emphatically fragrant, and the aroma has for some time been worshipped by cultivators. Truth be told, in Greek folklore, mint is alluded to as "the spice of cordiality." One of the previously referred to employments of mint was as an air deodorizer. Fundamental oils with a mint fragrance incorporate pennyroyal, peppermint, spearmint and wintergreen, among others.

1.10.4 Musky

Musky fundamental oils have vigorous, hearty fragrances that are especially entering and tantalizing to our feeling of smell. These incorporate myrrh, patchouli and citronella

1.10.5 Spicy

Sweet-smelling and strengthening, fiery fundamental oils can be livening up any room. Fundamental oils with this sort of aroma incorporate anise, basil, cinnamon, ginger, nutmeg, oregano, tea tree, thyme, and then some

1.10.6 Sweet

One of the most popular scent categories, our sweet-scented oils include citronella, grapefruit, lemongrass, lemon, lime, orange and tangerine

1.11 COMMONLY USED TYPES:

Of the hundreds of oils available, some of the most popular essential oils include:

1.11.1 Clary Sage

May help to relieve hot flashes and promote sleep

1.11.2 Eucalyptus

An ingredient in steam inhalations to clear congestion and colds

1.11.3 Lavender

Often used for relaxation and to improve sleep

1.11.4 Lemon Oil

Lemon oil is normally utilized in the sorts of financially accessible items you experience each day. In the event that you stroll down the walkways of any supermarket, you'll discover everything from family cleaner to hand cleanser to enhanced shining water with the pith of lemon. Just like the case with numerous citrus oils, the aroma intently emulates that of the organic product from which it's determined: brilliant, light, fiery, and clean.

1.11.5 Peppermint

Use for migraines and different sorts of torment

1.11.6 Sweet orange oil

In investigations, it decreased uneasiness when it was breathed in, and when applied topically, it hindered members' heartbeat rates and breathing rates, while they likewise detailed inclination more bright and incredible.

1.11.7 Rosemary

A stimulating scent said to boost attention and focus

1.11.8 Tea Tree

Used as for fungal skin infections and as a spot treatment for acne

1.11.9 Cinnamon oil

If lemon oil is bright, cool, and invigorating, cinnamon oil is its opposite: sweet and spicy, musky and warm. For me, cinnamon conjures up a distinct mixture of sexy exoticness and cozy familiarity, which makes sense because it's both a Far East import and a spice drawer mainstay.

Texas Oil is the naturally occurring essential oil from the wood of the native Texas Cedar (*Juniperus Mexicana*). The oil is recovered through the physical separation process of partial pressure steam distillation

1.12 TRANSESTERIFICATION

This interaction changes the sub-atomic construction of lipid particles and along these lines the actual properties. Albeit even refined unadulterated plant oil (PPO) can be straightforwardly utilized in refitted diesel motors, biodiesel, which is made by a

transesterification step, is very much like fossil diesel and consequently can be devoured in like manner diesel motors which are refitted with just little endeavors.

Transesterification is additionally called alcoholysis, is the interaction by which the refined oil particle is "broke" and the glycerine is eliminated, bringing about glycerine cleanser and methyl or ethyl esters (biodiesel). Natural fats and oils are fatty oils which are three hydrocarbon chains associated by glycerol. The bonds are broken by hydrolyzing them to shape free unsaturated fats. These unsaturated fats are then blended or responded with methanol or ethanol shaping methyl or ethyl unsaturated fat esters (monocarbon corrosive esters).

The combination isolates and settles out leaving the glycerine on the base and the biodiesel (methyl-, ethyl ester) on the top. Presently the division of these two substances must be directed totally and rapidly to keep away from a turned around response.

These transesterification responses are frequently catalyzed by the expansion of a corrosive or base. For the transesterification cycle, chiefly the alcohols methanol and ethanol are utilized. Hypothetically, transesterification can be likewise handled with higher or optional alcohols. Thinking about wide assortment of oils and fats that can be utilized to create biodiesel, there is a more prominent reach in the qualities of biodiesel energizes than for ethanol fuel. Ethanol is really one quite certain particle, though biodiesel is a blend of atoms that differs fairly, contingent upon the underlying oil or fat source used to deliver the fuel

1.13 CELERY SEED OIL

The Celery seed (*Zingiber officinale*) is a herbaceous perpetual sweet-smelling plant has a place with the family Zingiberaceae, for the most part disseminated in East Asia and tropical Australia, the rhizomes of which are utilized as a zest. In Indonesia ginger was normally utilized as a flavoring for dishes, an element for refreshment and a wellspring of prescriptions. In the fields of medication, ginger was utilized for treating different illnesses like colds, intestinal worms, gout, bronchitis, asthma, coronary illness, and can be utilized to improve absorption. Close to crude utilization, ginger can be handled to acquire the fundamental oil. The fundamental oil got from ginger has numerous utilization and benefits, for example, demonstrated to be a functioning antimicrobial for gram-positive microbes as well as for gram-negative microscopic organisms and demonstrated having a cell reinforcement capacity so it very well may be utilized as normal food preserver.

1.13.1 Countries where it's found

The plant is found in India, China, and France. The plant is likewise found to grow in Madagascar, Brazil, and few Asian areas. Collecting Information Celery Seedplant is best reaped following 10 months of ranch. It is a perpetual plant growing up to 9 feet.

1.13.2 History of the Plant

The plant has been utilized since the 18 century in India. It is a herbaceous plant with since quite a while ago, extended and thin stems each with a terminal blossoming top. Antiquated fragrance advisors utilized the oil to lessen pressure and to improve blood flow. Indian cleanser creators have utilized this oil for quite a long time

1.13.3 Extraction Process

The oil is removed from the leaves of the Celery Seedplant by steam refining. The oil is golden yellow in shading with new, citrus scent.

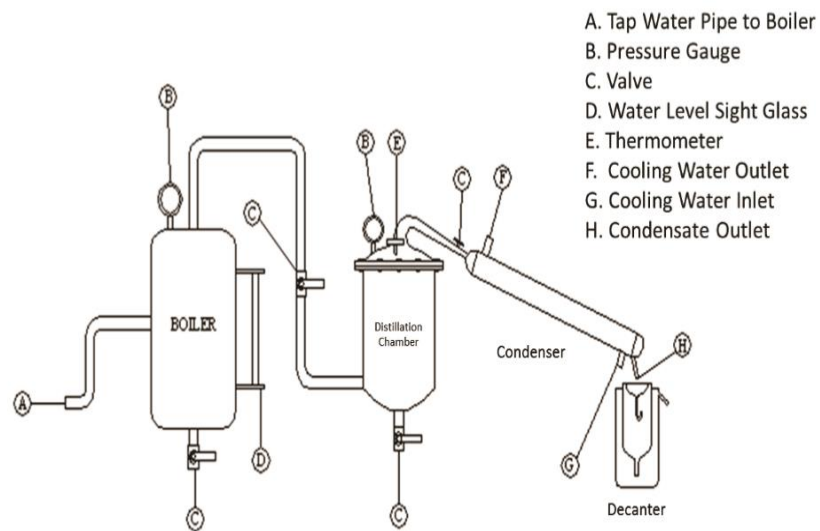


Fig: 1.1: Celery Seed oil

1.13.3.1 Steam Distillation Process

Steam refining measure was completed in a specially estimated refining gadget combined with electrical steam kettle. Electrical steam heater utilized 220 volts, 16-amperes worth electric flow and equipped for delivering 20 bars (max) at 214°C of steam. The refining gadget was furnished with exclusively estimated condenser and glass decanter to isolate oil from condensate. The plan of the device can be found in Figure 1. The volume and width of refining chamber were 16.5 liters, 256 mm separately and utilizing tempered steel with the thickness of 2 mm as the material. The refining chamber was likewise furnished with a steam wholesaler which is mounted 700 mm from the lower part of the chamber and grinding which is mounted 300 mm from the steam merchant as the spot to put ginger rhizome. Around 500 grams pre treated rhizomes were put on the grinding inside the refining chamber and 1.5 bar steam were utilized with the stream pace of 0.35; 0.55; 0.76; and 1.16 ml/s as the variable. These cycle conditions depended on

the limit of mechanical assembly. The refining interaction was kept up for 8 hours with estimation of the oil acquired in consistently. This interaction was rehashed twice



Hydro distillation process

CHAPTER – 2

LITERATURE REVIEW

1. Mofijur, et al (2013)

Evaluation of biodiesel blending ,engine Performance and emissions characterstics of Jatropha curcas Methyl ester

They have researched that the expansion of TiO_2 expanded the brake motor force and force 10.20% and 9.74% and diminished the brake explicit fuel utilization 27.73% and 28.37%, individually contrasted with mixes without TiO_2 added substance TiO_2 added substance builds the greatest chamber pressing factor and warmth discharge rate, subsequently improved the motor execution and ignition . The consequences of fumes outflow showed a diminishing in CO, HC and smoke darkness emanations, while expanded CO_2 and NO discharge.

2. Ganesh ,et al (2011)

Effect of nano-fuel additive on emission reduction in a biodiesel fuelled CI engine

They have concluded that reduction in CO emission was observed with cobalt oxide and magnalium nano fuel additive. Cobalt oxide showing 50% reduction at 75% load, because cobalt oxide acts as anoxygen buffer and donates surface lattice oxygen. The performance and emission characteristics decreased with nano additives

3. Husnawan M,et al (2009)

Use of post flame metal-based andoxygenated additive combination for biodiesel- dieselblends

They have inferred that by utilizing vegetable oil based added substance joined with metal based added substance. Test was directed utilizing biodiesel from palm mixed with diesel, the outcomes shown that fuel consumes better and abundance air decreases the CO substance

4. Madhusudhan, et al (2019)

Effect of NiO nanoparticles on performance and emission characteristics at various injection timings using biodiesel-diesel blends

They have researched that the huge decrease in emanations of HC and CO by the utilization of NiO particles in the base fuel. Indeed, even it was discovered that CO_2 outflow improved definitely. In this way progression of fuel infusion timing and with presence of nano molecule improves the presentation and decreases hurtful emanations

of the motor. Added substances upgrades the motor boundaries there by decreasing the discharge

5. Harveer et al (2018),

Performance and emission characteristics of an agricultural diesel engine fueled with blends of Sal methyl esters and diesel

They have reasoned that , the fuel properties, exhibitions and fumes gas outflows of corn-based biodiesel and its mixes with diesel fuel are examined, considering the biodiesel quality standard ethanol and biodiesel creation ought to be incorporated into the bio processing plant idea, which will bring about the creation of numerous other high worth added items with close to zero waste.

6. Manzoore, et al (2018)

The effect of nano-additives in diesel- biodiesel fuel blends: A comprehensive review on stability, engine performance and emission characteristics”,

They have investigated that The smoke emission of diesel engine was reduced drastically for all CIME nano emulsions compared to both pure biodiesel and diesel fuels at all engine loads. Combustion characteristics of in cylinder gas pressure and heat release rate were increased significantly by the addition of nano particles with pure Calophyllum, inophyllum at all engine loads.

Diesel fuel emulsion. The results achieved demonstrated an improvement in the thermo physical properties, enhancement in the heat transfer rate, and stabilization of the fue they have investigated that The smoke emission of diesel engine was reduced drastically for all CIME nano emulsions compared to both pure biodiesel and diesel fuels at all engine loads. Combustion characteristics of in cylinder gas pressure and heat release rate were increased significantly by the addition of nano particles with pure Calophyllum, inophyllum at all engine loads.

I mixtures. Also, there was an increase in the engine performance

parameters and reduction in the exhaust emissions depending on the dosage of nanofluid additive.

7. Asokan, et al (2019)
combustion and emission characteristics of diesel engine fuelled with papaya and watermelon seed oil bio-diesel/diesel blends

They have investigated that The smoke emission of diesel engine was reduced drastically for all CIME nano emulsions compared to both pure biodiesel and diesel fuels at all engine loads. Combustion characteristics of in cylinder gas pressure and heat release rate were increased significantly by the addition of nano particles with pure Calophyllum, inophyllum at all engine loads.

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9. Asokan, et al (2019)
combustion and emission characteristics of diesel engine fuelled with papaya and watermelon seed oil bio-diesel/diesel blends

They have disclosed how to beat the issues related with biodiesel i.e., A fuel added substance for the most part improves the burning proficiency and decreases the contamination. Significant benefit of nanoparticles is its size on the grounds that there is zero chance for fuel injector and channel stopping up as in the event of micron measured particles.

10. Asokan, et al (2019)
combustion and emission characteristics of diesel engine fuelled with papaya and watermelon seed oil bio-diesel/diesel blends

Trial tests were examined to assess the exhibition, emanation and ignition of a diesel motor utilizing flawless rapeseed oil and its mixes of 5%, 20% and 70%, and standard diesel fuel independently. The outcomes show that the utilization of biodiesel produces lower smoke darkness (up to 60%), and higher brake explicit fuel utilization (BSFC) (up to 11%) contrasted with diesel fuel.

11. Asokan, et al (2019)

combustion and emission characteristics of diesel engine fuelled with papaya and watermelon seed oil bio-diesel/diesel blends

They have examined that burning, execution and discharge qualities of traditional diesel fuel and biodiesel created from soybean oil and its mixes (B10, B20, B50) were thought about. The tests were performed at consistent state conditions in a solitary chamber direct infusion diesel motor over the whole rpm range (1200–3000 rpm). During the tests, the fuel utilization, contamination outflows, exhaust temperature and in-chamber pressures were estimated. The burning investigations showed that the expansion of biodiesel to regular diesel fuel diminished the start delay and decreased the premixed top. These outcomes showed that biodiesel could be utilized with no motor changes as another option and harmless to the ecosystem fuel.

12. Asokan, et al (2019)

combustion and emission characteristics of diesel engine fuelled with papaya and watermelon seed oil bio-diesel/diesel blends

They have researched that the added substances assume a critical part to build motor execution and outflow decrease in diesel motors. The attributes of execution and emanation of pressure start motor fuelled with various biodiesel mixed with various added substances were examined and contrasted and those fuelled with diesel fuel and slick biodiesel. Expansion of nano particles will diminish the boundaries of outflow. It is seen that the utilization of biodiesel prompted misfortune in motor influence because of low temperature properties and lower warming estimation of biodiesel contrasted with diesel.

13. Asokan, et al (2019)

combustion and emission characteristics of diesel engine fuelled with papaya and watermelon seed oil bio-diesel/diesel blends

They have presumed that delivered bio diesel from papaya and watermelon seed oil by trans-esterification measure utilizing methanol and KOH (impetus) and another biodiesel for example WP is created which is a combination of papaya seed oil biodiesel and watermelon seed oil biodiesel in 1:1 proportion is readied. The mixes (B0, B20, B30, B40, and B100) of WP with diesel and watermelon 100% and papaya 100% are utilized for additional testing. The presentation, ignition and discharge test were led on single chamber 4-stroke diesel motor utilizing various mixes of these biodiesels and the outcomes showed that B20 is predominant mix among other biodiesel mixes

14. Atul Dhal, et al (2019)

Performance, emissions and combustion characteristics of Karanja biodiesel in a transportation engine

Impact of Karanja biodiesel (Karanja oil methyl ester; KOME) and its mixes on motor execution, discharges and burning qualities in an immediate infusion pressure start (DICI) motor of a medium size utility vehicle with changing motor speed and burden has been examined. Most extreme force achieved by 10% and 20% KOME mixes were higher than mineral diesel, while higher biodiesel mixes created somewhat lower force. BSFC for lower KOME mixes was similar to mineral diesel anyway BSFC expanded for higher biodiesel mixes. BSCO, BSHC and smoke discharges of Karanja biodiesel mixes

CHAPTER – 3

AIM AND SCOPE OF THE PROJECT

3.1 AIM

To look at the presentation and discharge qualities of DI motor utilizing Titanium Oxide (TiO_2) Nano-added substances as an impetus in Celery Seed biodiesel mixes with unadulterated diesel and to decide the best mix of biodiesel mix for ideal execution and Emission.

3.2 SCOPE OF WORK

To Determine the boundaries, for example, absolute fuel utilization and brake warm productivity and emanation qualities, for example, Nitric-Oxide, Oxygen, Carbon-dioxide, Hydrocarbon, Carbon-mono oxide and smoke thickness at various loads and brake power for unadulterated diesel and different blend of Celery Seed oil blended independently with TiO_2 utilizing AVL 5 di-gas dissect

CHAPTER – 4

METHODOLOGY AND EXPERIMENTAL WORK

4.1 METHODOLOGY

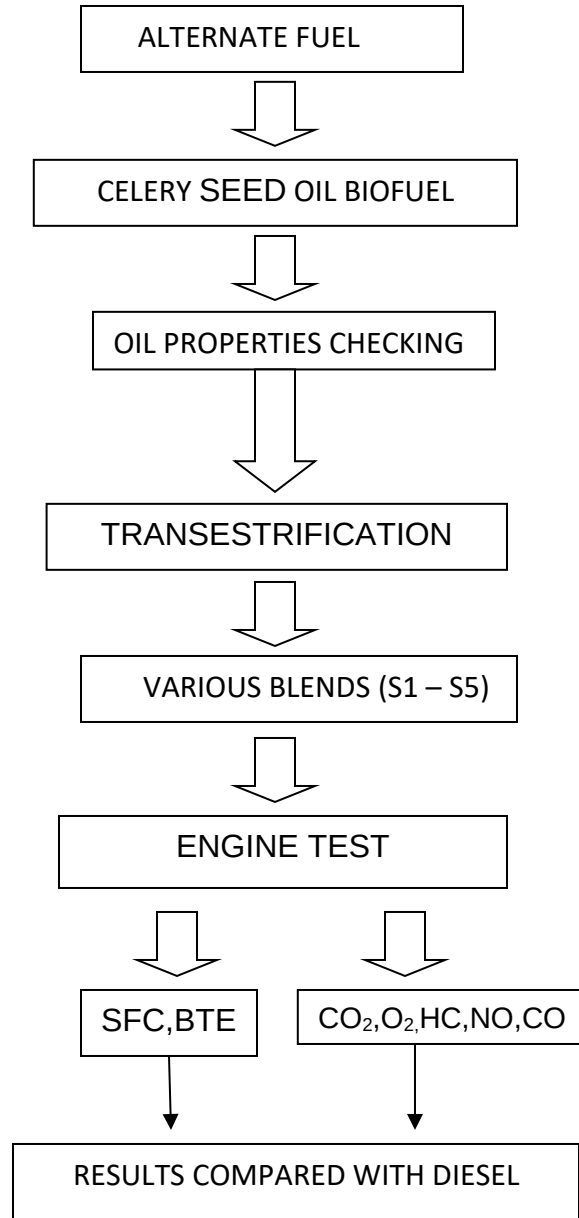


Fig.4.1: Methodology

4.2. CELERY SEED BIOFUEL PREPARATION

Celery Seed oil was esterified utilizing the transesterification technique. The base catalyzed transesterification measure is the response of a fatty substance (Fat/oil) with a liquor to form ester and glycerol within the sight of a base impetus, which in the majority of the cases is either sodium hydroxide (NaOH) or Potassium Hydroxide (KOH). This cycle brings the fuel properties nearer to that of diesel and diminishes its consistency. The oil properties were checked after the oil was esterified and the free unsaturated fat worth is 0.846%

Table: 4.1 Properties of Celery Seed oil

S. No.	Properties	Results
1	Density	0.870g/CC
2	Kinematic viscosity	1.344cSt
3	Moisture content	0.013%
4	Flash point by PMCC method	86°C
5	Fire point by PMCC method	98°C
6	Calorific value	7411.599cal/g

4.2.1 Transesterification process

The transesterification cycle was trailed by attractive mix apportion which is a typical procedure used to blend fluids. An attractive blender is a lab gadget that utilizes a turning attractive field to create a scene bar (likewise called "insect") submerged in a fluid to turn rapidly at a speed of 1200 rpm at 40 deg cel, subsequently mixing it. The turning field made by a pivoting magnet set underneath the vessel with the fluid. Absolutely five examples to be specific B10, B20, B30, B40, and B50 were readied. B10 contains a combination of 90% of diesel, 10% of Celery Seed biodiesel and cerium oxide nano added substance 30 ppm. B20 contains a combination of 80% of diesel, 20% of Celery Seed biodiesel and 30 ppm of cerium oxide nano additive. B30 contains a combination of 70% of diesel, 30% Celery Seed biodiesel and 30 ppm of cerium oxide. B40 contains a combination of 60% of diesel, 40% Celery Seed biodiesel and 30 ppm of cerium oxide. At long last B50 contains a combination of half of diesel, half Celery Seed biodiesel and 30 ppm of cerium oxide All five samples permitted to blend in the attractive mixing machine

for 30 minutes each. Following 20 minutes every one of the five examples were prepared to test in the motor.

Table: 4.2 Transesterification Report of Celery Seed biodiesel

S. No.	Parameters	Results
1	Free fatty acid	0.11%
2	Catalyst (NaOH) quantity	5 grams
3	Oil to methanol molar ratio	1:6
4	Temperature	60°C
5	Reaction time	90 minutes
6	Yield	97.3%

4.3 EXPERIMENTAL SETUP

The transesterification interaction was trailed by attractive mix apportion which is a typical strategy used to blend fluids. An attractive blender is a research center gadget that utilizes a pivoting attractive field to create a scene bar (likewise called "insect") drenched in a fluid to turn rapidly at a speed of 1200 rpm at 40 deg cel, subsequently mixing it. The pivoting field made by a turning magnet set underneath the vessel with the fluid. Absolutely five examples to be specific B10, B20, B30, B40, and B50 were readied. B10 contains a combination of 90% of diesel, 10% of Celery Seed biodiesel and cerium oxide nano added substance 30 ppm. B20 contains a combination of 80% of diesel, 20% of Celery Seed biodiesel and 30 ppm of cerium oxide nano additive. B30 contains a combination of 70% of diesel, 30% Celery Seed biodiesel and 30 ppm of cerium oxide. B40 contains a combination of 60% of diesel, 40% Celery Seed biodiesel and 30 ppm of cerium oxide. At long last B50 contains a combination of half of diesel, half Celery Seed biodiesel and 30 ppm of cerium oxide All five samples permitted to blend in the attractive mixing machine for 30 minutes each. Following 20 minutes every one of the five examples were prepared to test in the motor.



Fig 4.2: Engine set up

4.3.1 Engine details

IC Engine set up under test is Research Diesel having power 3.50 kW @ 1500 rpm which is 1 Cylinder, four strokes, Constant Speed, Water Cooled, Diesel Engine, with Cylinder Bore 87.50(mm), Stroke Length 110.00(mm) Connecting Rod length 234.00(mm), Compression Ratio 18.00, Swept volume 661.45 (cc).

4.3.2 Combustion Parameters

Explicit Gas Constant (kJ/kg K) = 1.00, Air Density (kg/m³) = 1.17, Adiabatic Index: 1.41, Polytrophic Index: 1.15, Number of Cycles: 10, Cylinder Pressure Reference: 6, Smoothing 2, TDC Reference: 0 Table 4.3 Explains about the Engine Specifications

Table: 4.3 Engine Specifications

Product	VCR Engine test setup 1 cylinder, 4 stroke, Diesel with EGR (Comp.)
Engine	Make Kirloskar, Type 1 cyl., 4 stroke Diesel, water cooled, power 3.5kW at
	1500rpm, stroke 110mm, bore 87.5mm. 661cc, CR17.5, Modified to VCR
	Engine CR 12 to 18. With electric start arrangement, battery and charger
Dynamometer	Type eddy current, water cooled,
Propeller shaft	With universal joints
Air box	M S fabricated with orifice meter and manometer
Fuel tank	Capacity 15 lit with glass fuel metering column
Calorimeter	Type Pipe in pipe

EGR	Water cooled, SS, Range 0-15%
Piezo sensor	Range 5000 PSI, with low noise cable
Crank angle sensor	Resolution 1 Deg, Speed 5500 RPM with TDC pulse.
Data acquisition device	NI USB-6210, 16-bit, 250kS/s.
Piezo powering unit	Model AX-409.
Temperature sensor	Type RTD, PT100 and Thermocouple, Type K
Temperature transmitter	RTD PT100, Range 0–100oC, 3 No's; Thermocouple, Range 0-1200oC, 2 No's
Load indicator	Digital, Range 0-50 Kg, Supply 230VAC
Load sensor	Load cell, type strain gauge, range 0-50 Kg
Fuel flow transmitter	DP transmitter, Range 0-500 mm WC

Table 4.4 Refers The Performance Of Parameters in Dynamo Meters

Table: 4.4 Performance Parameters

Orifice Diameter (mm)	20.00
Orifice Coefficient. Of Discharge	0.60
Dynamometer Arm Length (mm)	185
Fuel Pipe dia (mm)	12.40
Ambient Temp. (deg C)	27
Pulses Per revolution	360

4.3.3 specification of gas analyzer

4.3.4. Measuring ranges:

Oxygen (O₂) 0 - 25,00 % volume Carbon monoxide (CO) 0 – 15,00 % Carbon dioxide (CO₂) 0 – 20,0 % Carbon hydride (HC) 0 - 20000 ppm n-hexane Nitrogen monoxide (NO) 0 - 2000 ppm Excess Air calculated according to Brettschneider Temperature -40 ... +650°C Rounds per minute 400 ... 10000 U/min

4.3.5. Precision:

Oxygen (O₂) $\pm 0,1$ % or $\pm 3\%$ Carbon monoxide (CO) $\pm 0,06$ % or $\pm 5\%$ of measured value Carbon dioxide (CO₂) ± 0.5 % or $\pm 5\%$ of measured value Carbon

hydride (HC) ± 12 ppm or $\pm 5\%$ of measured value Nitrogen monoxide (NO) ± 5 ppm or $\pm 5\%$ of measured value Temperature $\pm 1\%$ ($T < 150^\circ\text{C}$) + 2% ($T < 250^\circ\text{C}$) $\pm 3\%$ ($T > 250^\circ\text{C}$) rounds per minute $\pm 1\%$

4.3.6. Resolution:

Oxygen (O₂) 0,01 % Carbon monoxide (CO) 0,01 % Carbon dioxide (CO₂) 0,1 % Carbon hydride (HC) 1 ppm Nitrogen monoxide (NO) 1 ppm Carbon hydride (HC) 1 ppm Nitrogen monoxide (NO) 1 ppm Temperature 0,1°C Rounds per minute 1U/min (< 6000) or 10U/min (> 6000)

4.3.7 Procedure of Experiment

- The filters of the engine were replaced and the injectors were cleaned and calibrated according to the desired pressure.
- Samples prepared (B10(S1), B20(S2), B30(S3), B40(S4) AND B50(S5))



Fig.4.3.Test Samples

- The AVL gas analyzer and smoke meter were introduced. The contribution to the gas analyzer was taken from the fumes port of the motor.
- The gas tank was then loaded up with diesel and the motor was run.
- The motor was run at different heaps of the dynamometer – 0,3,6,9,12.
- kgs and particular readings were taken for fuel utilization/sec.
- The readings of gas analyzer and smoke meter were noted for each situation.
- After every one of the readings were taken, the extra diesel was depleted out of the tank and emulsion was poured.

- Same steps were taken and the readings were noted down for the emulsion.
- Before utilizing the following emulsion the motor was again run with diesel so that the results are not one-sided.
- After taking every one of the perceptions diagrams were plotted to think about the execution attributes and emanation qualities of the motor in case of diesel and emulsion.
- 10. Before utilizing the following emulsion the motor was again run with diesel so that the outcomes are not one-sided.

4.4. AVL GAS ANALYSER

AVL gas analyzer for estimation of co hc co2 o2 and lambda. Contamination testing machines. Our clients are workshops, car designing schools iits nits rta all motor maker. It is convenient sort and used to quantify convergence of SO₂, NO, CO, CO₂ and O₂ from stack or kettle outflow gases, in which SO₂, NO, CO and CO₂ are estimated by miniature stream infrared sensors and O₂ by electrochemical sensor, with discretionary gas temperature, pressure, speed and so forth, computing burning productivity, lambda, and so on 0+*[[[-



Fig 4.4: Gas Analyser

A Gas analyzer estimates follow gases by deciding the assimilation of a transmitted infrared light source through a specific air test. Follow gases found in the Earth's climate get energized under explicit frequencies found in the infrared reach. The idea driving the innovation can be perceived as testing the amount of the light is consumed by the air. Various atoms noticeable all around assimilate various frequencies of light. Air with heaps of a specific gas will ingest to a greater degree a specific recurrence, permitting the sensor to report a high grouping of the relating atom .Infrared

gas analyzers generally have two chambers, one is a reference chamber while the other chamber is an estimation chamber. Infrared light is transmitted from some kind of source toward one side of the chamber, goes through a progression of chambers that contains given amounts of the different gases.

4.5 SONICATION PROCESS

Sonication is the demonstration of applying sound energy to upset particles in an example, for different purposes like the extraction of various mixtures from plants, microalgae and kelp. Ultrasonic frequencies (>20 kHz) are typically utilized, prompting the cycle additionally being known as ultrasonication or ultra-sonication. In the research center, it is normally applied utilizing a ultrasonic shower or a ultrasonic test, informally known as a sonicator. In a paper machine, a ultrasonic foil can disseminate cellulose filaments all the more consistently and fortify the paper.

Sonication has various impacts, both compound and physical. The compound impacts of ultrasound are worried about understanding the impact of sonic waves



Fig 4.5 Sonication Process

on compound frameworks, this is called sonochemistry. The synthetic impacts of ultrasound don't come from an immediate cooperation with sub-atomic species. Studies have shown that no immediate coupling of the acoustic field with synthetic species on a sub-atomic level can represent sonochemistry or child radiance. All things being equal, in sonochemistry the sound waves relocate through a medium, inciting pressure varieties

and cavitations that develop and breakdown, changing the sound waves into mechanical energy.

4.6 EXPERIMENTAL TEST

A solitary chamber has 4-stroke, direct infusion Kirloskar TV1 diesel motor with a greatest evaluated yield of 5.20 kW at 1500 rpm was used to get the arrangement of exploratory information required .The motor has a pressure proportion of 17.5. The motor has a cleared volume of 661.45 (cc), bore measurement of the motor is 87.50 mm and stroke length of 110.00 mm. Infusion pressure is 210 bar kept up continually all through the cycle.

4.6.1 Pure Diesel Value (D100)

Unadulterated diesel is tried in diesel motor to think about the exhibition and discharge boundaries of celery seed oil bio energizes .The outcomes got from the presentation and emanation test are classified underneath

Table: 4.5 Values of Neat Diesel (D100) at different loads

BP (KW)	BP (LOAD)	BTHE(%)	SFC (kg/kWh)	NOx (PPM)	CO2 (%)	HC (PPM)	CO (%)
0.03	0%	2.45	2.48	138	2.09	53	0.073
0.99	25%	16.49	0.52	235	2.73	53	0.075
1.88	50%	22.75	0.38	432	3.61	53	0.07
2.78	75%	31.71	0.29	603	3.69	54	0.067
3.47	100%	32.59	0.20	1151	5.32	57	0.058

4.6.2 Sample 1 (B10 + D90 + 100 ppm TiO₂)

B10 test is set up by transestrification and sonication measure. celery seed oil is esterified by transestrification interaction to eliminate the free unsaturated fats present in it .Then 10% of celery seed biodiesel is blended in with 90% of unadulterated diesel and 100 ppm of Titanium oxide nano added substance then this combination is mixed utilizing sonicator machine at 1200 rpm .Then this combination is tried in Diesel motor .Results are plotted underneath in the table.

Table: 4.6 Sample blend 1

BP (KW)	BP (LOAD)	BTHE(%)	SFC (kg/kWh)	NOx (PPM)	CO2 (%)	HC (PPM)	CO (%)
0.03	0%	3.54	3.42	75	0.91	50	0.06
0.99	25%	18.41	0.62	125	1.20	51	0.057
1.88	50%	23.82	0.41	203	1.25	51	0.54
2.78	75%	32.46	0.35	354	1.58	52	0.50
3.47	100%	35.82	0.31	550	1.92	53	0.49

4.6.3 Sample 2 (B20 + D80 + 100 ppm TiO₂)

B20 test is a combination of 20% of esterified celery seed biodiesel, 80 % of unadulterated diesel and 100 ppm of Titanium oxide nano added substance blended utilizing sonicator machine. The underneath table shows the discharge and execution boundaries of B20 Sample, as referred in table 4.6

Table: 4.7 Sample blend 2

BP (KW)	BP (LOAD)	BTHE(%)	SFC (kg/kWh)	NOx (PPM)	CO2 (%)	HC (PPM)	CO (%)
0.03	0%	2.92	3.05	62	0.87	54	0.075
0.99	25%	16.21	0.55	125	1.23	54	0.078
1.88	50%	21.13	0.42	228	1.94	56	0.082
2.78	75%	25.42	0.35	466	2.34	57	0.083
3.47	100%	28.57	0.31	647	2.53	60	0.085

4.6.4 Sample 3 (B30 + D70 + 100 ppm TiO₂)

B30 test is a mix which contains 30% of esterified celery seed biodiesel, 70 % of unadulterated diesel and 100 ppm of Titanium oxide nano added substance blended utilizing sonicator machine. The underneath table shows the and execution outflow boundaries of B30 Sample

Table: 4.8 Sample blend 3

BP (KW)	BP (LOAD)	BTHE(%)	SFC (kg/kWh)	NOx (PPM)	CO2 (%)	HC (PPM)	CO (%)
0.03	0%	2.85	3.11	78	0.90	55	0.077
0.99	25%	13.97	0.64	139	1.55	55	0.079
1.88	50%	25.05	0.35	217	1.60	56	0.081
2.78	75%	26.22	0.34	398	2.00	59	0.084
3.47	100%	29.06	0.31	634	2.98	62	0.088

4.6.5 Sample 4 (B40 + D60 + 100 ppm TiO₂)

B40 sample is a blend which contains 40% of esterified celery seed biodiesel, 60 % of pure diesel and 100 ppm of Titanium oxide nano additive stirred using sonicator machine. The below table shows the and performance emission parameters of B30 Sample

Table: 4.9 Sample blends 4

BP (KW)	BP (LOAD)	BTHE(%)	SFC (kg/kWh)	NOx (PPM)	CO2 (%)	HC (PPM)	CO (%)
0.03	0%	1.83	4.87	90	0.87	58	0.080
0.99	25%	13.59	0.65	176	1.86	59	0.082
1.88	50%	21.18	0.42	272	2.12	61	0.083
2.78	75%	24.52	0.36	444	2.55	63	0.087
3.47	100%	31.71	0.28	627	2.64	65	0.092

4.6.6 Sample 5 (B50 + D50 + 100 ppm TiO₂)

B50 test is a mix which contains half of esterified celery seed biodiesel, 50 % of unadulterated diesel and 100 ppm of Titanium oxide nano added substance mixed utilizing sonicator machine. The beneath table shows the and execution outflow boundaries of B30 Sample.

Table: 4.10 Sample blends 5

BP (KW)	BP (LOAD)	BTHE(%)	SFC (kg/kWh)	NOx (PPM)	CO2 (%)	HC (PPM)	CO (%)
0.03	0%	1.50	3.94	85	1.18	58	0.085
0.99	25%	14.71	0.60	172	1.63	61	0.087
1.88	50%	24.14	0.37	377	2.28	63	0.088
2.78	75%	27.90	0.32	462	2.24	63	0.092
3.47	100%	33.27	0.25	641	2.82	69	0.095

CHAPTER – 5

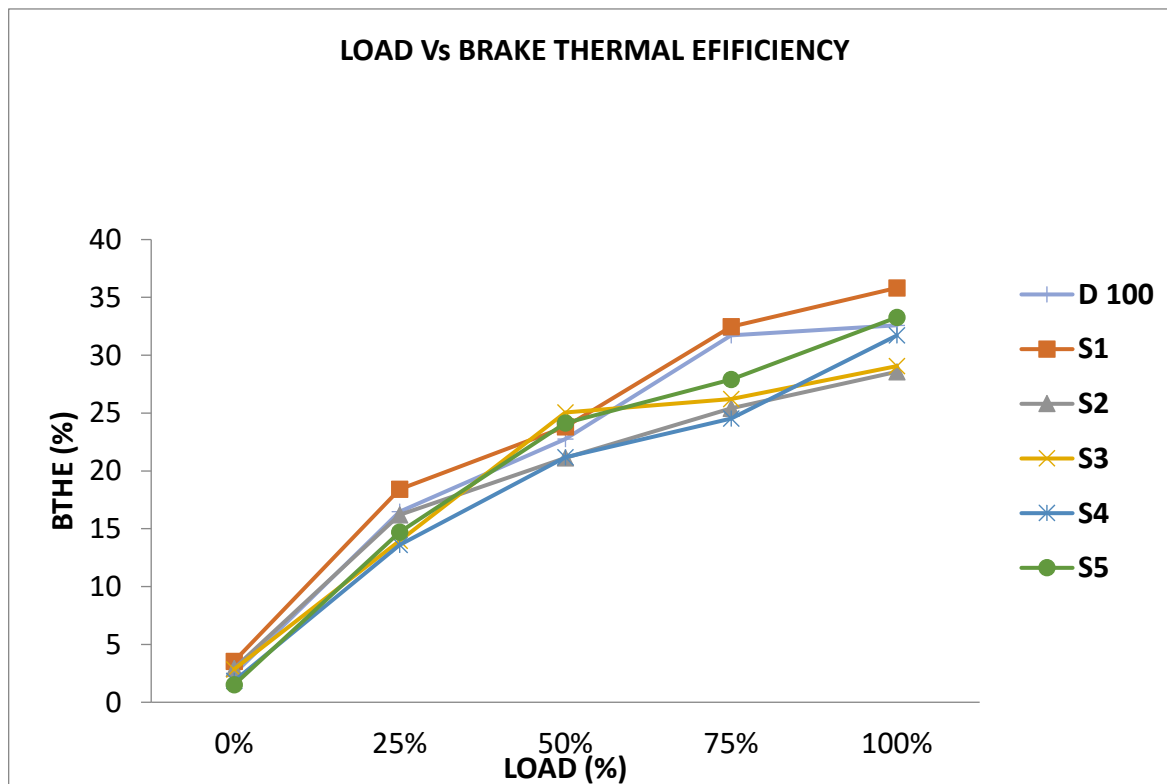
RESULT AND DISCUSSION

5.1 RESULTS

The biodiesel prepared in the five samples were one by one poured into a container which is attached to the venturimeter in the front. The venturimeter shows the amount of fuel exactly sent to the engine. The exhaust is attached to a smoke meter in order to obtain the amount of pollutants released. The results obtained from each of the blend are compared in a graphical format below.

5.1.1 Load Vs Brake Thermal Efficiency (BTHE)

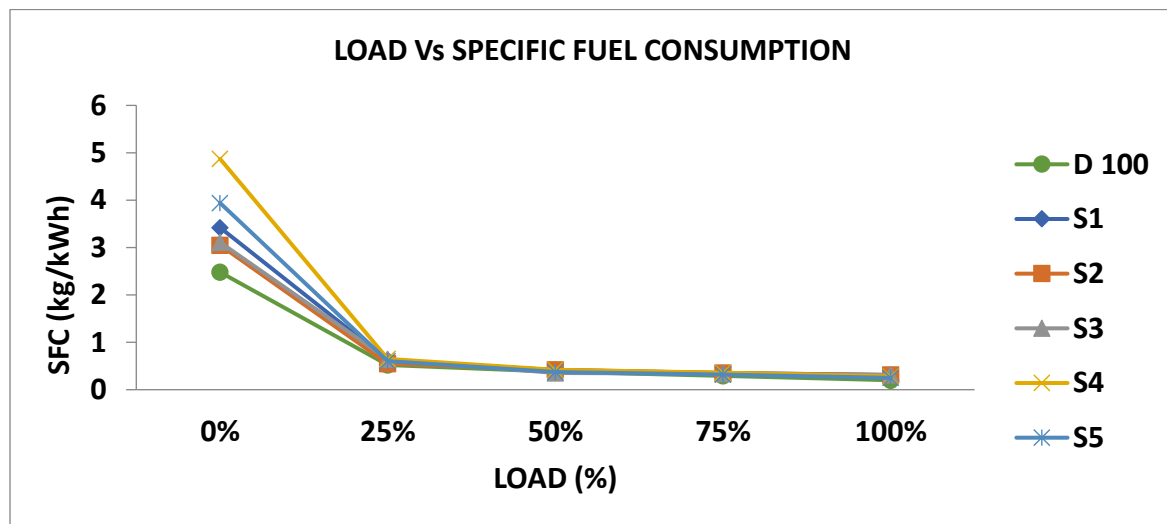
The above figure shows the performance of the brake thermal efficiency for different loads with blended fuel at different ratios of diesel, Celery Seed oil with Titanium oxide. Brake thermal efficiency will increase with increase in load, from graph we can observe there is an increase. The BTE of all the samples have been increased and it is near to diesel. The maximum increase in BTHE can be seen in where S1 (10%Biodiesel – 90%Diesel)



Graph : 5.1 Load Vs BTHE

5.1.2 Load Vs Specific Fuel Consumption (SFC)

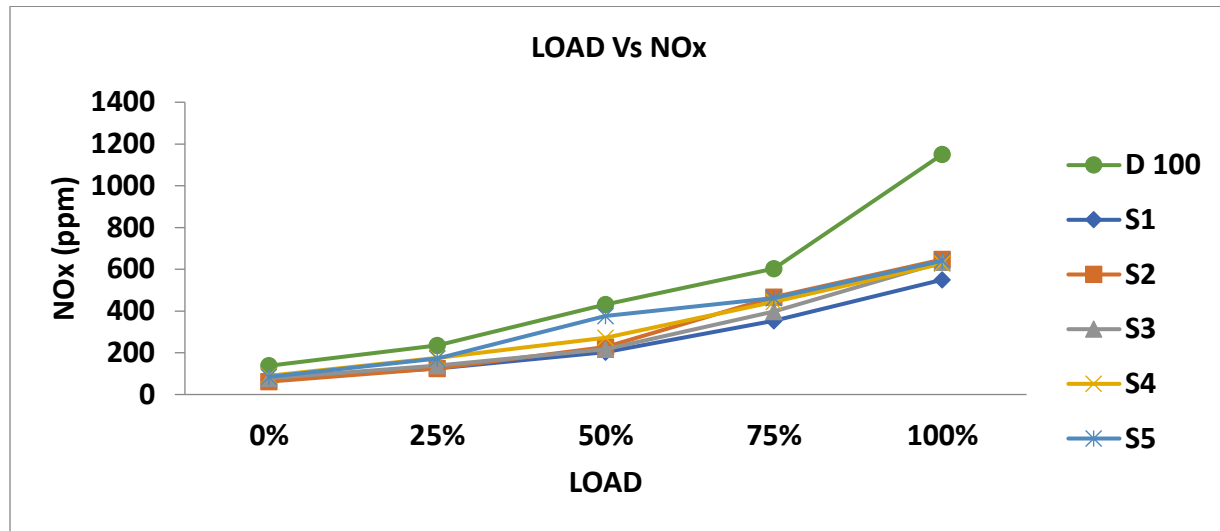
The above figure shows the exhibition of the particular fuel utilization for various burdens with mixed fuel at various proportions of diesel and Celery Seed oil with Titanium oxide. The Specific fuel utilization will diminish with expansion in load, from chart we can see there is a lessening in SFC. All the example esteems are closer to diesel.where 20%biodiesel +80%diesel



Graph: 5.2 Load Vs SFC

5.1.3 Load Vs NOx

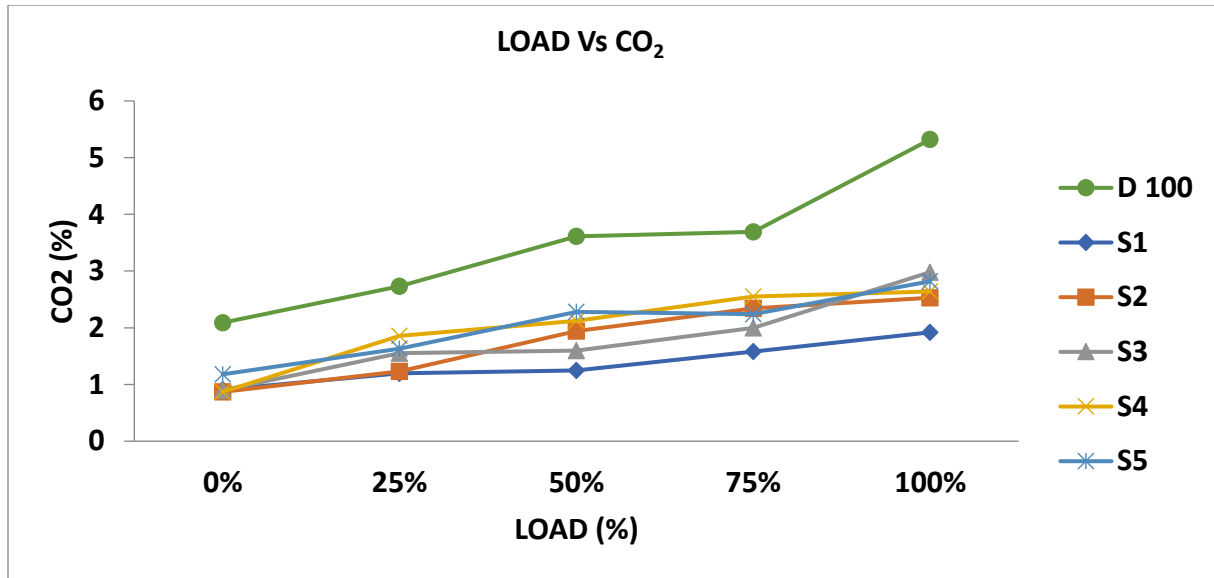
variety of NO at various burdens When contrasted with diesel every one of the NOx is a significant particulate that must be decreased ,above diagram shows the examples discharges less measure of NOx The most extreme decrease of NOx is at test 1.where 30%biodiesel +70%diesel



Graph: 5.3 Load Vs NOx

5.1.4 Load Vs CO2

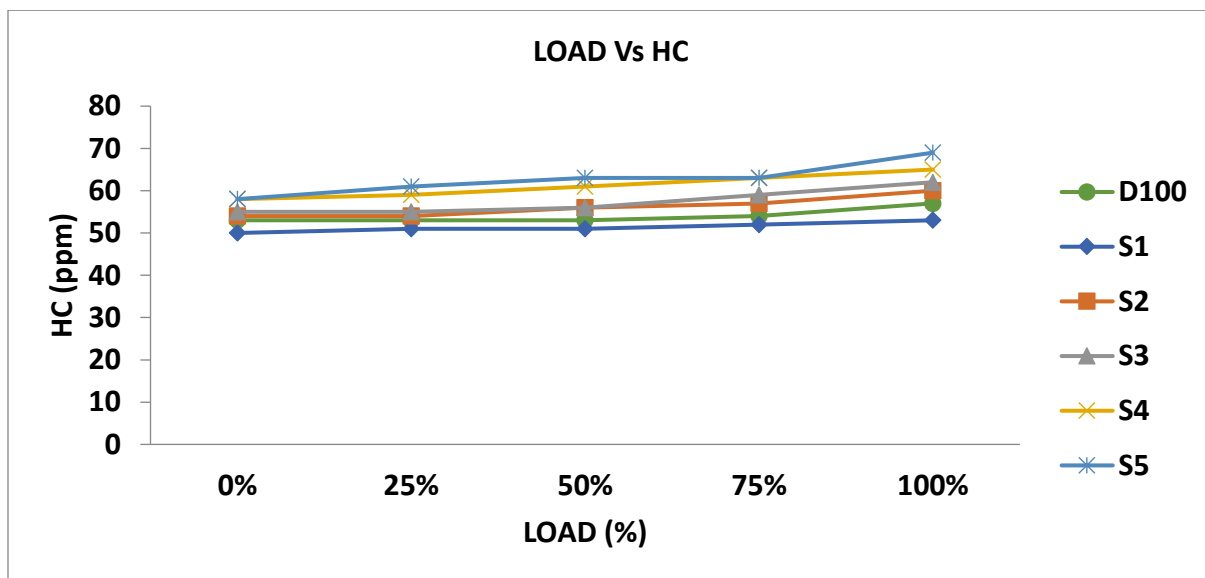
By expanding the heap CO2 outflow additionally increments and it is a reason for a worldwide temperature alteration and its quality is acceptable. The outflow of CO2 less taking all things together examples The greatest decrease of CO2 can be found in example 5



Graph: 5.4 Load Vs CO₂

5.1.5 Load Vs Hydro carbon (HC)

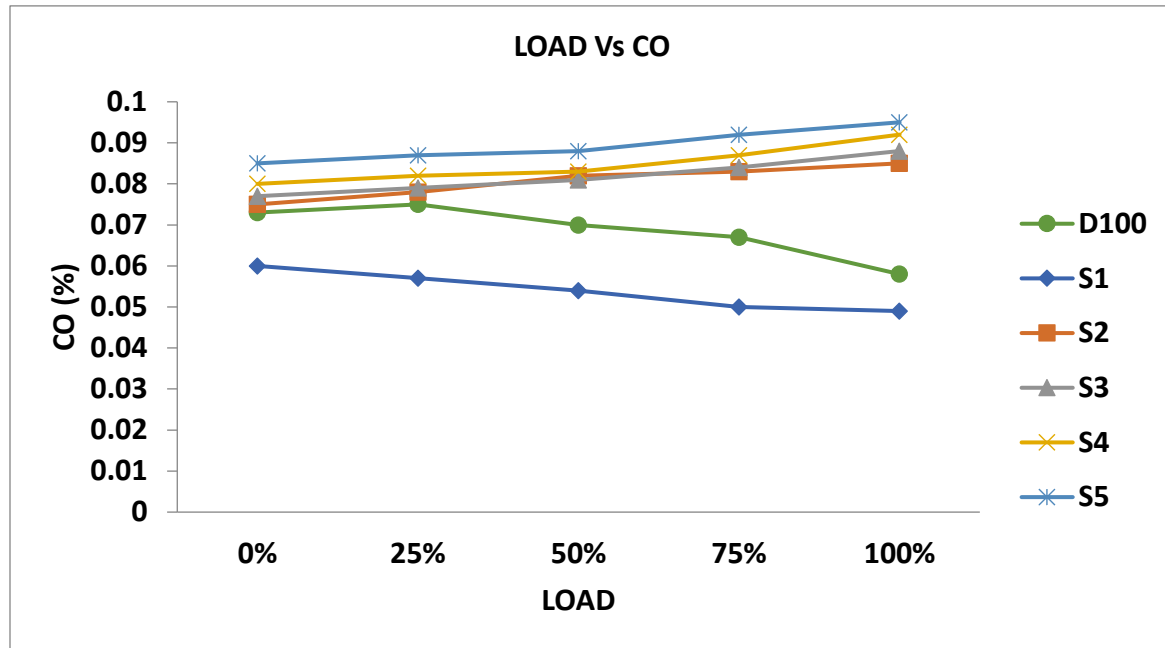
The above diagram shows that the measure of HC radiated during testing. Hydrocarbons result from the inadequate ignition of powers. The HC outflow increments with increment of motor burden. From the outcomes we can reason that every one of the examples aside from test 1 radiates more measure of HC emanation is less in example 4 when contrasted and diesel.where 40%biodiesel+60%diesel



Graph: 5.5 Load Vs HC

5.1.6 Load Vs Carbon monoxide (CO)

Carbon consumes without inadequate oxygen, Carbon monoxide is shaped. It is poisonous and unsafe to the climate. From the qualities got we can see that every one of the examples delivering less CO than diesel. Least measure of CO is delivered from test 1.where 50%biodiesel+50%diesel



Graph: 5.6 Load Vs C

CHAPTER – 6

CONCLUSION

6.1 SUMMARY AND CONCLUSION

The experimental investigation of performance and the emission characteristics of celery seed oil and its blends have been performed in DI diesel engine and has been completed; the following conclusions have been drawn.

- FIG 5.1- Brake thermal efficiency is increased with increasing load for diesel-biodiesel blends with addition of urea based catalytic converter, in sample 15% BTHE increase compare with pure diesel at full load condition, remaining sample nearer to almost diesel value
- FIG 5.2- Specific fuel consumption is less with diesel-biodiesel blends with titanium oxide when compared to diesel and there is an little variation with increase in load
- FIG 5.3 - The NO_x emissions with all the biodiesel blends shows less amount of NO_x release when compared with diesel and the minimum amount of NO_x emission is at sample 1 that is 550 ppm (90%diesel+10%biofuel+100 ppm titanium oxide)
- FIG 5.4 - The CO₂ emissions are lower for all the diesel-biodiesel blends and the maximum reduction of CO₂ emission is for sample 1
- FIG 5.5- HC emission is less with sample 1 (90%diesel+10%biofuel+100 ppm titanium oxide) when compared to diesel
- FIG 5.6 - CO emission is higher at lower load and then decrease at maximum load at sample 1(90%diesel+10%biofuel+100 ppm titanium oxide) but all other sample higher when compare to pure diesel
- Finally, it was found that B10 sample, Celery Seed oil with titanium oxide has shown the better result means of emission as well as performance compare to pure diesel. Sample 1 (B10 + D90 + 100 ppm titanium oxide) could be taken into consideration as an alternate solution when compare with existing model.

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