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Performance Test for Alternative Fuel in Single Cylinder Diesel Engine

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Abstract: **At present every country is facing two major challenges namely energy crisis and environmental degradation. Carrying need of the day is to mean fuel, more fuel and cheaper fuel. More over the growing use of petroleum fuels in the ever increasing number of automobiles is causing rapid degradation of environment in every country due to vehicle exhaust pollution.**

To meet this twin problem of fuel oil scarcity and air pollution caused by the growing use of petroleum fuel, alternate renewable clean burning fuel should be explored for using motor vehicles. Alternate fuel is very essential that of alternatives for the fossil fuels such as atrophy, pongamia, coconut oil , etc. It has been found that now a day's biodiesel plays an important role in the automobile industry.

This project aims at reducing the cost of the fuel consumers by blending the coconut oil with diesel with different proportions and testing the performance of blended diesel. The tests were carried out for raw coconut oil 70% with 30% diesel and camphor tablets. The performance were studied and it is concluded that, the bending of 20%, 40%, 60%, 80% and 100% at room temperature gives better fuel consumption and also improves emission norms.

Keywords:-- Biodiesel ,esterification process ,coconut oil, alternative fuels

I. INTRODUCTION

Bio - diesel is methyl or ethyl ester of fatly acid made from virgin or used vegetable oil (both edible and non edible) and animal fats. In our coconut, there is fatly acid hence at first esterification process is done by means of heating oil with ethanol. The coconut oil can be classified as virgin coconut oil, refined oil, hydrogenated oil

B 20 (a blend of 20% by volume Bio-diesel with 80 % by volume petroleum diesel) as an demonstrate significant environment benefits in US with a minimum increase in cost for fleet operation and other consumers. Bio-diesel is registered as a fuel and fuel additives with the US environmental protection agency and clean diesel standards established by the California Air Resources Board.

Neat (100%) the department of energy and department of transportation of US have designed Biodiesel as an alternate fuel. Studies conducted with Biodiesel on engine have shown substantial reduction in particulate matter (25 to 50%). However a marginal increasing on NOx (1 to 6%) is also reported, but it can be take care of either by optimization of engine parts or by using De-NOx catalyst.

HC and CO emissions were also reported to be low here. Bio - diesel has been accepted as clean alternative fuel by US and its production is about 100 million gallons. Each state has passed specific bills to promote the use of Bio - diesel by reduction of taxes sunflower oil, rapeseed etc., Thailand uses palm oil. Ireland uses fired oil and animal fats. Due to its favourable properties can be used as a fuel for diesel engine (as either B5- a blend of 5% Bio - diesel in petroleum diesel fuel or B20 or B100).

USA uses B20 and B100 Bio - diesel. France uses mandatory in all diesel fuels it can also be used as additive to reduce the overall sulphur content of blend and to compensate for lubricity lost due to sulphur removal from the diesel fuel. The viscosity of Bio - diesel is higher (1.9) to 6 cst) and it is reported to result in to gum formation on injector, cylinder liner etc if used in neat form.

However blends up to 20% should not give any problem. While an engine can be designed for 100% Biodiesel use, the existing engines can use 20% Bio- diesel blend without modification and reduction in torque output. In USA 20 % Bio-diesel blend is being is used, while in European countries 5-15% blends have been adapted.

Biodiesel is a liquid fuel that is created by chemically process-ing vegetable oil and altering its properties to make it perform more like petroleum diesel fuel. It was first evaluated seriously in the late 1970s but was not widely adopted at that time.

The topic of biodiesel fuel has been receiving a great deal of interest recently, and both large- and small-scale manu - facturers have started production at locations throughout the state. However, many people are still

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uncertain about whether biodiesel is a reliable, safe fuel to use for diesel engines.

This fact sheet explains the major differences between biodiesel and petroleum diesel (also called petrodiesel), including information about biodiesel additives and blends. The companion fact sheet in this series Using Biodiesel Fuel in Your Engine explains the performance you can expect when running an engine on biodiesel.

II. PROPERTIES OF BIO –DIESEL VERSUS PETROLEIUM DIESEL

The sizes of the molecules in biodiesel and petroleum diesel are about the same, but they differ in chemical structure. Bio- diesel molecules consist almost entirely of chemicals called fatty acid methyl esters (FAME), which contain unsaturated "olefin" components. Low-sulfur petroleum diesel, on the other hand, consists of about 95 percent saturated hydrocar- bons and 5 percent aromatic compounds.

The differences in chemical composition and structure between petroleum diesel and biodiesel result in several notable variations in the physical properties of the two fuels.

The seven most significant differences are as follows

1. Biodiesel has higher lubricity (it is more "slippery") than petroleum diesel. This is a good thing, as it can be expected to reduce engine wear.
2. Biodiesel contains practically no sulfur. This is also a good thing, as it can expected to result in reduced pollution from engines using biodiesel.
3. Biodiesel has a higher oxygen content (usually 10 to 12 percent) than petroleum diesel. This should result in lower pollution emissions. But, relative to petroleum diesel, it causes slightly reduced peak engine power (~4 percent).
4. Biodiesel tends to thicken and "gel up" at low temperatures more readily than petroleum diesel. Some types of oil are more of a problem than others.
5. Biodiesel is more likely to oxidize (react with oxygen) to form a semisolid gel-like mass. This is a concern, especially for extended fuel storage and when using engines that are only operated occasionally (such as standby power generators). A good method for storage is to use a dry, semi-sealed, cool, light-tight container.
6. Biodiesel is more chemically active as a solvent than petro-leum diesel. As a result, it can be more aggressive to some materials that are normally considered safe for diesel fuel
7. Biodiesel is much less toxic than petroleum diesel. This can be a real benefit for spill cleanups.

The quality of petroleum diesel fuel tends to be more uniform and reliable, especially when compared to small-scale production of biodiesel where quality control may or may not have been good. Petroleum diesel can vary in quality from plant to plant or from region to region, but the variations are typically much smaller. Poor-quality biodiesel fuel can lead to many problems in engine performance, and care should be taken to ensure that your fuel is of good quality (see the Re-newable and Alternative Energy Fact Sheet: Using Biodiesel Fuel in Your Engine).

1.5 Blends

Biodiesel fuel blends very easily with petroleum diesel. These blends are described by their percentage of biodiesel (e.g., "B20" has 20 percent biodiesel, 80 percent petroleum diesel). In general, the properties of a blend will lie somewhere between the properties of the biodiesel and the petroleum diesel. Blends are sometimes used to improve the lubricity of petroleum diesel or reduce its sulfur content. Probably the most useful reason for a biodiesel producer to blend would be to improve cold-operating characteris-tics during the winter.

A mix of 70 percent biodiesel and 30 percent petroleum diesel has been reported to be effective for mild winter conditions. Kerosene, also known as #1 diesel fuel, is blended with standard (#2) petroleum diesel during winter months (usually ~40 percent kerosene, 60 percent #2 diesel) to improve its cold-weather performance. This approach is probably the easiest way to make biodiesel usable during harsh midwinter conditions in Pennsylvania. However, keep in mind that only low-sulfur kerosene that is approved as an engine fuel should be used.

1.6 Summary

Biodiesel and petroleum diesel are very similar fuels, but they are not identical. However, the differences are remarkably small when we consider the radically different procedure for making biodiesel as compared to petroleum diesel. Many additives are available that can modify the properties of biodiesel fuel, and biodiesel can be easily blended with petroleum diesel fuel if desired. For additional information, please refer to the following Penn State Cooperative Extension fact sheets and reports:

Biodiesel *A* Renewable, Domestic Energy Resource.
Renewable and Alternative Energy Fact Sheet **Using** Biodiesel Fuel in your Engine
Making Your Own Biodiesel Brief Procedures and Safety Precautions Biodiesel Safety and Best Management Practices for Small-Scale Noncommercial Production.

III. DIESEL & BIO-DIESEL (COCONUT OIL) TECHNICAL REVIEWS

3.1 Introduction

The development of the internal combustion engine began in the late eighteenth century. Slow but steady progress was made over the next hundred years. By 1892, Rudolf Diesel had received a patent for a compression ignition reciprocating engine. However, his original design, which used coal dust as the fuel, did not work.

Thirty-three years earlier, in 1859, crude oil was discovered in Pennsylvania. The first product refined from crude was lamp oil (kerosene). Because only a fraction of the crude made good lamp oil, refiners had to figure out what to do with the rest of the barrel.

Diesel, recognizing that the liquid petroleum byproducts might be better engine fuels than coal dust, began to experiment with one of them. This fuel change, coupled with some mechanical design changes, resulted in a successful prototype engine in 1895. Today, both the engine and the fuel still bear his name. The first commercial diesel engines were large and operated at low speeds. They were used to power ships, trains, and industrial plants.

By the 1930s, diesel engines were also powering trucks and buses. An effort in the late '30s to extend the engine's use to passenger cars was interrupted by World War II. After the war, diesel passenger cars became very popular in Europe; but, they have not enjoyed comparable success in the United States yet.

Today, diesel engines are used worldwide for transportation, manufacturing, power generation, construction, and farming. The types of diesel engines are as varied as their use – from small, high-speed indirect-injection engines to low-speed direct-injection behemoths with cylinders one meter (three feet) in diameter. Their success comes from their efficiency, economy, and reliability.

The subject of this review is diesel fuel – its performance, properties, refining, and testing. A chapter in the review discusses diesel engines, especially the heavy-duty diesel engines used in trucks and buses, because the engine and the fuel work together as a system. Additionally, because environmental regulations are so important to the industry, the review examines their impact on both fuel and engine. We hope that you will find this review a source of valuable and accurate information about a product that helps keep the world on the move.

3.2 Diesel Fuel & Bio –Diesel Uses

Diesel fuel keeps the world economy moving. From consumer goods moved around the world, to the generation of electric power, to increased efficiency on farms, diesel fuel plays a vital role in strengthening the global economy and the standard of living.

The major uses of diesel fuel are:

- On-road transportation
- Off-road uses (e.g., mining, construction,and logging)
- Farming
- Electric power generation
- Rail transportation
- Military transportation
- Marine shipping

3.3 Bio-Diesel Fuel Driving Performance

Several operating characteristics influence engine performance, and their relative importance depends on engine type and duty cycle (for example, truck, passenger car, stationary generator, marine vessel, etc.). These characteristics are:

- Starting ease
- Low noise
- Low wear (high lubricity)
- Long filter life (stability and fuel cleanliness)
- Sufficient power
- Good fuel economy
- Low temperature operability
- Low emissions

Engine design has the greatest impact on most of these characteristics. However, because the focus of this publication is fuel, this chapter discusses how these characteristics are affected by fuel properties.

3.3.1. Starting

Leaks and heat loss reduce the pressure and temperature of the fuel/air mixture at the end of the compression stroke . Thus, a cold diesel engine is more difficult to start and the mixture more difficult to ignite when compared to a hot diesel engine. Engines are equipped with start-assist systems that increase the air temperature to aid ignition. These controls in the diesel engine can also decrease starting engine noise, white smoke, and cranking time.

Diesel fuel that readily burns, or has good ignition quality, improves cold start performance. The cetane number of the fuel defines its ignition quality. It is believed that fuels meeting the (*Standard Specification for Diesel Fuel Oil)s* minimum cetane number requirement of 40 provide adequate performance in modern diesel engines. The minimum cetane number in Europe is (*Diesel Fuel and BiodieselFuel Specifications and Test Methods.*) Some researchers claim that a number of modern engines can benefit from a higher cetane number when starting in very cold climates. Smoothness of operation, misfire, smoke emissions, noise, and ease of starting are all dependent on the ignition quality of the fuel. At temperatures below freezing, starting aids may be necessary regardless of the cetane number.

3.3.2 Power

Power is determined by the engine design. Diesel engines are rated at the brake horsepower developed at the smoke limit For a given engine, varying fuel properties within the specification range (see page 46) does not alter power significantly.

However, fuel viscosity outside of the specification range causes poor atomization, leading to poor combustion, which leads to loss of power and fuel economy. In one study, for example, seven fuels with varying distillation profiles and aromatics contents were tested in three engines. In each engine, power at peak torque and at rated speed (at full load) for the seven fuels was relatively constant.

3.3.3: Noise

The noise produced by a diesel engine is a combination of combustion and mechanical noise. Fuel properties can affect combustion noise directly. In a diesel engine, fuel ignites spontaneously shortly after injection begins. During this delay, the fuel is vaporizing and mixing with the air in the combustion chamber. Combustion causes a rapid heat release and a rapid rise of combustion chamber pressure. The rapid rise in pressure is responsible for the knock that is very audible in some diesel engines.

By increasing the cetane number of the fuel, the knock intensity is decreased by the shortened ignition delay. Fuels with high cetane numbers ignite before most of the fuel is injected into the combustion chamber. The rates of heat release and pressure rise are then controlled primarily by the rate of injection and fuel-air mixing, and smoother engine operation results.

A recent development is the common rail electronic fuel injection system. The use of a common rail allows engine manufacturers to reduce exhaust emissions and, especially, to lower engine noise.

3.3.4 Fuel Economy

Here again, engine design is more important than fuel properties. However, for a given engine used for a particular duty, fuel economy is related to the heating value of the fuel. In North America fuel economy is customarily expressed as output per unit volume, e.g., miles per gallon. The fuel economy standard in other parts of the world is expressed as volume used per unit distance – liters per 100 kilometers. Therefore, the relevant units for heating value are heat per volume (British thermal unit [Btu] per gallon or kilojoules per liter/cubic meter). Heating value per volume is directly proportional to density when other fuel properties are unchanged. Each degree increase in American Petroleum Industry (API) gravity (0.0054 specific gravity decrease) equates to approximately two percent decrease in fuel energy content.

ASTM International specifications limit how much the heating value of a particular fuel can be increased. Increasing density involves changing the fuel's chemistry – by increasing aromatics content – or changing its distillation profile by raising the initial boiling point, end point, or both. Increasing aromatics is limited by the cetane number requirement and changing the distillation profile is limited by the 90 percent distillation temperature requirement. The API gravity at 60°F (15.6°C) for No. 2 diesel fuel is between 30 and 42. The specific gravity, at 60/60°F, and the density, at 15.6°C, are between 0.88 and 0.82.

Combustion catalysts may be the most vigorously promoted diesel fuel aftermarket additive . However, the Southwest Research Institute, under the auspices of the U.S. Transportation Research Board, ran back-to-back tests of fuels with and without a variety of combustion catalyst.

These tests showed that a catalyst usually made "almost no change in either fuel economy or exhaust soot levels." While some combustion catalysts can reduce emissions, it is not surprising that they do not have a measurable impact on fuel economy. To be effective in improving fuel economy, a catalyst must cause the engine to burn fuel more completely.

However, there is not much room for improvement. With unadditized5 fuel, diesel engine combustion efficiency is typically greater than 98 percent. Many ongoing design improvements to reduce emissions may have some potential for improving fuel economy. However, several modern emissions control strategies clearly reduce fuel economy, sometimes up to several percent.

3.3.4: Wear

Some moving parts of diesel fuel pumps and injectors are protected from wear by the fuel. To avoid excessive wear, the fuel must have some minimum level of lubricity. Lubricity is the ability to reduce friction between solid surfaces in relative motion. The lubrication mechanism is a combination of hydrodynamic lubrication and boundary lubrication.

In hydrodynamic lubrication, a layer of liquid prevents contact between the opposing surfaces. For diesel fuel pumps and injectors, the liquid is the fuel itself and viscosity is the key fuel property. Fuels with higher viscosities will provide better hydrodynamic lubrication.

Diesel fuels with viscosities within the specification range provide adequate hydrodynamic lubrication. Boundary lubrication becomes important when high load and/or low speed have squeezed out much of the liquid that provides hydrodynamic lubrication, leaving small areas of the opposing surfaces in contact.

Boundary lubricants are compounds that form a protective anti-wear layer by adhering to the solid surfaces. The less-processed diesel fuels of the past were good boundary lubricants. This was not caused by the hydrocarbons that constitute the bulk of the fuel, but was attributed to trace amounts of oxygen- and nitrogen-containing compounds and certain classes of aromatic compounds. Evidence for the role of trace quantities is the fact that the lubricity of a fuel can be restored with the addition of as little as 10 parts per million (ppm) of an additive.

Lubricity enhancing compounds are naturally present in diesel fuel derived from petroleum crude by distillation. They can be altered or changed by hydro treating, the process used to reduce sulfur and aromatic contents. However, lowering sulfur or aromatics, does not necessarily lower fuel lubricity.

3.3.5: Fuel Stability-Filter Life:

Unstable diesel fuels can form soluble gums or insoluble organic particulates. Both gums and particulates may contribute to injector deposits, and particulates can clog fuel filters. The formation of gums and particulates may occur gradually during long-term storage or quickly during fuel system recirculation caused by fuel heating. Storage stability of diesel fuel has been studied extensively because of governmental and military interest in fuel reserves.

However, long-term (at ambient temperatures) storage stability is of little concern to the average user, because most diesel fuel is consumed within a few weeks of manufacture. Thermal (high-temperature) stability, on the other hand, is a necessary requirement for diesel fuel to function effectively as a heat transfer fluid.

Thermal stability may become more important because diesel engine manufacturers expect future injector designs to employ higher pressures to achieve better combustion and lower emissions. The change will subject the fuel to higher temperatures and/or longer injector residence times. Low sulfur diesel fuels tend to be more stable than their high sulfur predecessors because hydro treating to remove sulfur also tends to destroy the precursors of insoluble organic particulates .

However, hydro treating also tends to destroy naturally occurring antioxidants. It may be necessary for the refiner to treat some low sulfur diesel fuels with a stabilizer to prevent the formation of peroxides that are the precursors of soluble gums

3.3.5 Smoke

The fuel system of a diesel engine is designed and calibrated so that it does not inject more fuel than the engine can consume completely through combustion. If an excess of fuel exists, the engine will be unable to consume it completely, and incomplete combustion will produce black smoke. The point at which smoke production begins is known as the smoke limit. Most countries set standards for exhaust smoke from high-speed, heavy-duty engines.

In the U.S., the opacity of smoke may not exceed 20 percent during engine acceleration mode or 15 percent during engine lugging mode under specified test conditions. Smoke

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that appears after engine warm-up is an indication of maintenance or adjustment problems. A restricted air filter may limit the amount of air, or a worn injector may introduce too much fuel. Other causes may be miscalibrated fuel pumps or maladjusted injection timing. Changes made to fuel pump calibration and injection timing to increase the power of an engine can lead to increased emissions. Because smoke is an indication of mechanical problems, California and other states have programs to test the exhaust opacity of on-road heavy-duty trucks under maximum engine speed conditions (i.e., snap idle test).

Particulars	quantity	In %
Ethanol	500ml	50%
Copra coconut oil	1 litre	70%
Diesel	300ml	30%

The Owners of trucks that fail the test are required to demonstrate that they have made repairs to correct the problem. There are also smoke regulations for ships in port. Variation of most fuel properties within the normal ranges will not lead to the high level of particulate matter (PM) represented by smoking. The exception is cetane number; fuel with a very high cetane number can cause smoking in some engines.

The short ignition delay causes most of the fuel to be burned in the diffusion-controlled phase of combustion, which can lead to higher PM emissions.

Fuel can indirectly lead to smoking by degrading injector performance over time,

- Gums in the fuel are deposited on the injectors, causing sticking, which interferes with fuel metering.
- Petroleum resid or inorganic salts in the fuel result in injector tip deposits that prevent the injector from creating the desired fuel spray pattern. (Some low-speed, large diesel engines are designed to burn fuel containing large amounts of petroleum resid. These are typically used in marine and power generation applications.)
- Abrasive contaminants or organic acids in the fuel, or inadequate fuel lubricity cause excessive abrasive or corrosive injector wear.

IV. PETROLEUM DIESEL AND BIODIESEL

COMPARISON:

The switch from petroleum-based diesel compared to biodiesel has its advantages and disadvantages. There are changes in energy efficiency based on composition, changes in environmental impacts, and differences in cost between the two types of diesel.

4.1: Compositor Competitions:

Variables measured for diesel fuels that affect efficiency include viscosity, cetane number, flash point, carbon residue, and lubricity. Processing coconut oil the properties become closer to those of diesel fuels. This makes the biodiesel much more compatible with diesel engines

Table 1 Composition of Diesel & Bio-Diesel

V. MAIN PROPERTIES OF BIO-DIESEL

5.1: Viscosity

The its ability to flow. The viscosity of a fluid can be defined as the measure of how resistive the fluid is to flow. A very viscous fluid would have a greater resistance to flow. Raw plant oils can be 20 times higher in viscosity than that of petroleum fuels. Higher viscosity can lead to incomplete combustion and low fuel atomization because the fuel is thicker. A viscometer can be used to measure the viscosity of a fuel.

The main difference between diesel and plant oils is the viscosity of the oils. Plant oils have a much higher viscosity than diesel. Plant oil must be processed to be compatible with a diesel engine, for biodiesel this consists of a change from raw to methyl esters by transesterification.

5.2 : Cetane Number

The cetane number measures the time delay between the start of ignition and the start of combustion of the fuel. This measurement is used for light distillate diesel oils and biodiesels. The normal range is between 45 and 55 cetanes. A minimum number, of 47, is set for fuel quality. This measurement describes the combustion quality of diesel fuel in a compression ignition.

A higher cetane number correlates to a short delay between ignition and combustion, which provides for more time for complete combustion during the combustion process petroleum diesel, can have higher cetane numbers due to additives in the diesel, such as lubricants and detergents; this is the difference between regular and premium fuels.

Petroleum diesels range between 38 and 45 biodiesels normally range from46 to 52 making biodiesel engines more effect when comparing cetane numbers. Cetane numbers are measured by combusting a fuel in a Cooperative Fuel Research engine, under specific conditions. The second method for measuring cetane number is by injecting a sample into a constant volume container at a constant temperature.

The pressure will change when the fuel begins combustion, the time difference between injection and combustion is measured. Both of these methods are difficult to complete in a standard laboratory because the equipment is expensive; so a cetane index is used more frequently. The cetane index uses the density and distillation range of the fuel to calculate the cetane number.

5.3. Flash Point& Fire Point

The flash point of oil measures the ability for a heated fuel to ignite and measures the lowest temperature at which combustion can occur. A higher flashpoint temperature means it is harder for the fuel to ignite. The lower a flash point temperature is below ambient temperature the more dangerous the fuel is, because it is more likely to combust at any point. Petroleum diesel has a much lower flash point than biodiesel, so it will combust much easier, but is also much more dangerous to transport.

5.4: Carbon Residue

The carbon residue of oil will determine the amount of combustion of a fuel. The closer to complete combustion a fuel has, the fuel will leave fewer deposits meaning it will have a lower carbon residue. The deposits will decrease the efficiency of an engine. Biodiesel does have a higher percentage of carbon residue than petroleum diesel, transesterification does decrease this compared to fresh oils but not as low as petroleum.

5.5: Lubricity

The Petroleum diesel requires additives so that the fuel does not cause engine wear because of its low lubricity properties. The emissions from the additives contain particulate matter made up of acids (such as nitrates and sulfates), organic chemicals, metals, soil, and dust particles which can cause health and environmental problems. Biodiesel does not require any additives for lubrication when being used as the main source of fuel. In addition, biodiesel can be added to petroleum diesel as an additive to increase its lubricating properties without adding compounds that increase particulate matter.

5.6: Other Comparisons

The Storage can be a problem for fuels. Biodiesel can absorb water lowering the efficiency. Water can react to create soaps, which decrease the viscosity of the oil. Biodiesel does not require additives, is nontoxic to the environment and biodegradable. In addition, biodiesel has a higher combustion temperature and therefore is less ignitable so it safer to transport then petroleum diesel fuels.

5.7: Environmental Competitions

There are many favorable environmental traits to biodiesel. As stated earlier, the first trait is the absence of many harmful compounds that are normally found in petroleum diesel products such as sulfur and aromatics. There is also a reduction of unburned hydrocarbons, carbon monoxide, and particulate matter that is normal in a petroleum diesel fuel. Carbon dioxide is a major emission concern because its effect on climate change and greenhouse gases. A U.S. Department of Energy (National Biodiesel Board) study in 2009 found that biodiesel emits 78.5% less carbon dioxide then petroleum diesel. The emission amounts of different compounds as the biodiesel to petroleum diesel ratio was increased. Biodiesel emits less carbon monoxide and hydrocarbon emissions than petroleum diesel. One of the reasons for this is the higher amount of oxygen in biodiesel, which increases the amount of complete combustion of the fuel. One negative difference between petroleum and biodiesel is the increase in nitrogen oxides emissions, because of the higher amount of oxygen.

VI. CHEMISTRY OF BIODIESEL PRODUCTION

As stated, biodiesel can be produced through the transesterification process. Transesterification is done, because it decreases the viscosity of the oil, which will increase the efficiency of the engine and allow for a uniform combustion of the fuel. There are basic requirements for this reaction but some variations are made based on cost and different feed stocks.

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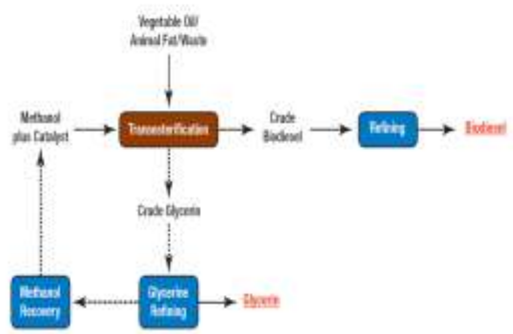


Fig 1. Block diagram of transesterification

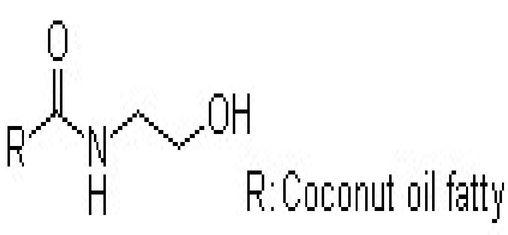
6.1. How Good Esterifies Coconut Oil With Camphor Tablets For Biodiesel

The COCONUT oil as a bio- fuel has physical properties very similar to conventional diesel. Emission properties, however, are cleaner for Bio-fuel than for conventional diesel. It has no poly aromatic compounds and reduced toxic smoke. coconut oil rund smoother and reduces engine knock it is a sustainable resource it makes an excellent substitute with some provisos. It solidifies at approx25 degree celcius.

However, bio-fuel meets these two important specifications and would help in improving the lubricity of low sulphur in (0.13- 0.16%) diesel. The present specification of flash point for petroleum diesel is 350 C which is lower than some other countries in the world (>550C).

Seeds, Seedlings, Cultivation method, Harvesting, life span of the tree, expelling oil, oil conversion to bio-diesel, Glycerin purification, Oil cake in to fertilizer or any other details on SESAME can be provided on request.

6.3 Structure of Coconut Oil



VII TO DETERMINATION OF FLASH POINT AND FIRE POINT OF THECOCONUT OIL

To find the flash and fire point of the given oil by Cleveland open cup apparatus

Apparatus Required

- ❖ Open cup tester
- ❖ Thermometer (0-400degcelus)
- ❖ Heating coil
- ❖ Sample of oil
- ❖ 5.Splinder sticks

Tabulation

Name of the oil: Diesel
Name of the Oil: Bio- diesel (8:2)

Flash point& fire point

S.NO	Thermometer Reading	observation	S.NO	Thermometer Reading	Observation
1	40		1	60	
2	41		2	61	
3	42		3	62	
4	43		4	63	
5	44		5	64	
6	45		6	65	
7	46		7	66	
8	47		8	67	
9	**48**	**Flashpoint**	9	68	
10	49		10	69	
11	50		**11**	**70**	**Flash point**
12	51		12	72	
13	52		13	74	
14	53		14	76	
15	54		**15**	**78**	**Fire point**
16	**55**	**Fire Point**	16	80	

Name of the oil: Diesel
Name of the Oil: Bio- diesel (8:2)

Flash Point& Fire Point:

The flash point of oil measures the ability for a heated fuel to ignite and measures the lowest temperature at which combustion can occur. A higher flashpoint temperature means it is harder for the fuel to ignite. The lower a flash point temperature is below ambient temperature the more dangerous the fuel is, because it is more likely to combust at any point. Petroleum diesel has a much lower flash point than biodiesel, so it will combust much easier, but is also much more dangerous to transport

Procedure

1. Fill the cleaned open cup with the given sample oil up to the standard filling mark of the cup
2. Insert the thermometer in the holder on the top edge

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of the cup .make sure that bulb of the thermometer is immersed in the oil and should not touch the metallic part

3. Heat the sample oil by means of on electric heater , so that the sample of the gives oil vapour at the rate of 10deg Celsius
4. When the oil gives out vapours spark to introducing the glowing splints flame and watch for any flash with flickering round
5. Continue the heating to note down the flash point fire point of the given oil
6. Repeat the test twice or thrice with fresh sample of oil until the results are taking
7. The observation are tabulated

VIII RESULTS

1. The Flash point temperature of the diesel oil is =48 deg Celsius
2. The Fire point temperature of the Bio- diesel oil =54 deg Celsius
3. The Flash point temperature of the diesel oil is =72 deg Celsius
4. The Fire point temperature of the Bio-diesel oil is =78 deg Celsius

IX. PERFORMANCE TEST ON FOUR STROKE DIESEL ENGINE

To conduct a performance test on Diesel engine and discuses about the performance of the diesel and bio diesel oil

Apparatus Required

1) Engine setup with loading arrangement
2) Tachometer
3) Stopwatch

Description

The diesel engine is coupled to an alternative through a flexi bile coupling device for the engine. Water absorbing the power generated by the cooling water line . A fuel measuring system consist ring of a mounted on a stand burette.

Engine Specification

It is single cylinder diesel engine used to testing performance of lemon sweet (skin) fuel , Now seeing some specification of this single cylinder diesel engine.

Name of the supplier - triple engineering coimbatore
Engine type - single cylinder vertical
Engine name - kirloskar engine
Rated speed -1500rpm
Maximum power -3.7kw
Stroke length -110mm
Cylinder bore -80mm
Orifice diameter -20mm
Type of cooling -water
Loading - water resistive loading

Procedure

A) The lubrication oil level, fuel supply and water supply are ensured.

B) The engine is started by opening the two de compressor lever and cranking with the help of handle.

C) After the engine reaches the minimum speed another de compressor lever is opened.

D) The engine is allowed to run on no load for sometimes.

F) The experiment is repeated for the various loads and corresponding readings are noted.

G) Check the lubricating oil level, Fuel level and cooling water supply.

H) At no load conditions the following readings are noted.
(i) Time taken for 10cc of fuel consumption.
(ii) Voltage required(volts)
(iii) Current required(amps)

I) Change the load conditions according to our requirements and readings were taken.

J) The specific fuel consumption and Brake thermal efficiency were calculated.

K) The above procedure is followed for other tests.

Experimental Tabulation Observation

Circumference of the brake drum (πd) =146mm
Diameter of the brake drum (D) =0.464mm
Radius of Brake drum (R= D/2) =0.234mm
Diameter of the Rope (d) =20mm

Engine Oil: Diesel

S	F	I	M	B	S	B	IT	F	B	I

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. NO	C (kg/s)	P (kw)	ECH %	P (kw)	FC (kg/s)	TH %	H %	UELPOWER (kw)	MEP Bar	MEPBar
1	1.317	1.8	0	0	0	0	20.1	5.923	0	0.88
2	1.804	3.6	50.27	1.81	0.99	22.3	42.5	8.1	0.89	1.77
3	2.405	4.6	61.08	2.81	0.85	26.0	43.5	10.3	1.3	2.27
4	3.074	6.01	70.13	4.21	0.78	28.5	44.4	13.8	2	2.97
5	4.368	7.4	75.9	5.61	0.72	30.6	47.7	19.6	2.7	3.65

Effective Radius (R_e=R+r) =0.242mm

Where FC = Frictional Power

IP = Indicated Power

BP = Brake Power

Indicated Power

It is defined as the power developed by combustion of fuel in the combustion chamber (ip). It is always more than brake power. It is given by,

$$p = \frac{ip60}{LARK}$$

where

p Is the Mean Effective Pressure,

ip Is Indicated Power

Indicated power watt

A Is the Area of the Piston

R Is the Rotational Speed

k Is the Number of Cylinders,

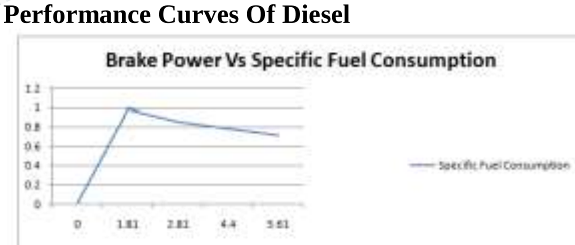
Volumetric Efficiency

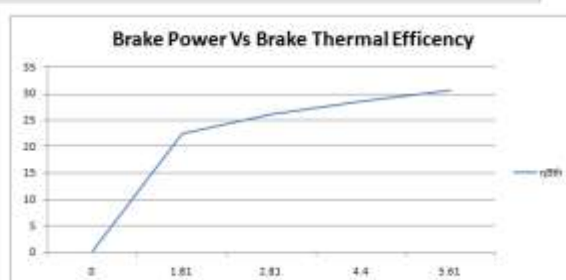
It is the ratio of the actual volume of the charge drawn in during the suction stroke to the swept volume of the piston. The amount of air taken inside the cylinder is dependent on the volumetric efficiency of an engine and hence puts a limit on the amount of fuel which can be efficiently burned and the power output. The value of volumetric efficiency of a normal engine lies between 70 to 80 percent, but for engines with forced induction it may be more than 100 percent.

Thermal Efficiency

It is the ratio of output to that of energy input in the form of fuel. It gives the efficiency with which the chemical energy of fuel is converted into mechanical work. It shows that all chemical energy of fuel is not converted into heat energy.

Performance Curves Of Diesel





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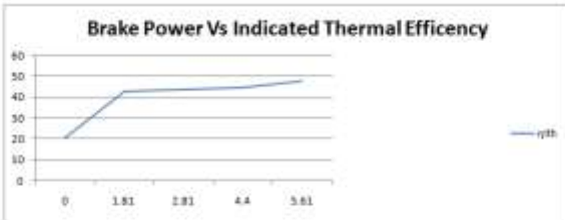
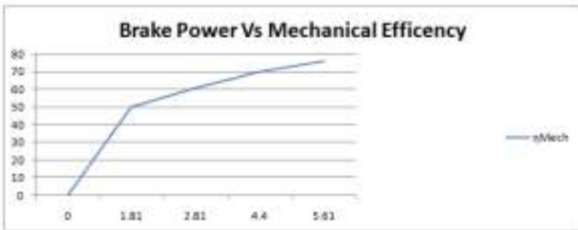
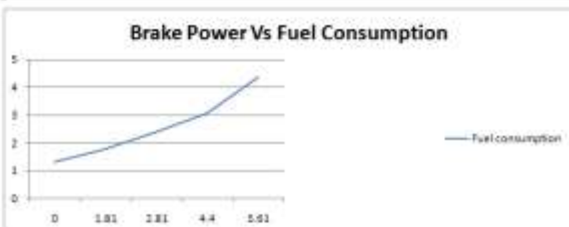




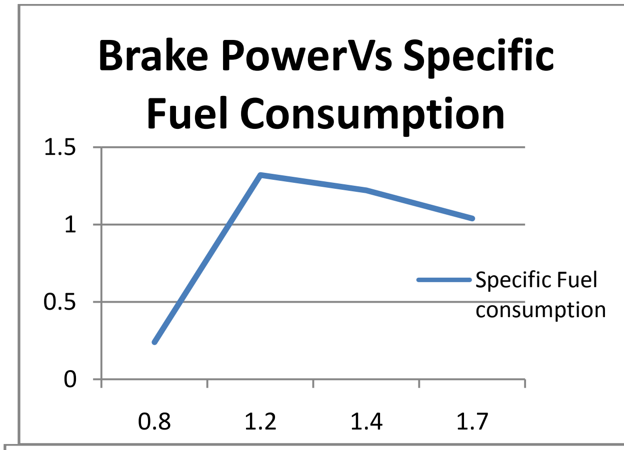


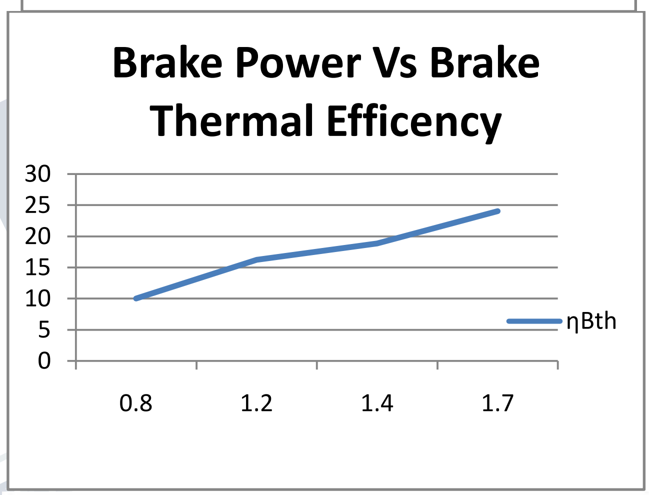
By Using Bio-Diesel (Observed Reading For B20)

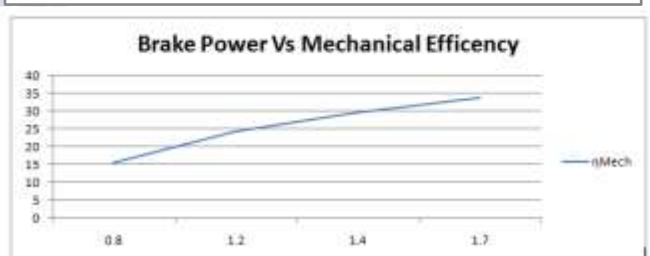
By Using Bio-Diesel (Calculated Reading For B20)

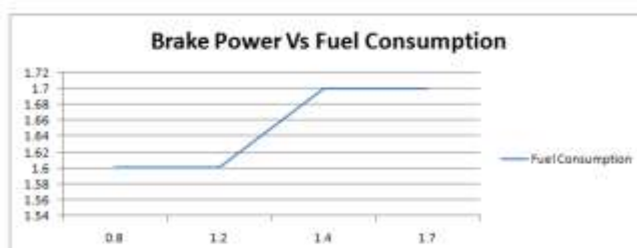
S.NO	AMP A	VOLT V	EX.TEMP	COOLING WATER INLET	COOLING WATER OUTLET	TIME FOR 10cc FUEL CONSUMPTION	TIME FOR COLLECTING 1LITRE OF WATER
1	0	220	154	30	34	58	6
2	3	210	160	30	34	50	6
3	6	210	164	30	36	48	6
4	7	195	170	32	36	44	7
5	8	198	176	32	36	43	7

Performance curves of bio – diesel(b20):









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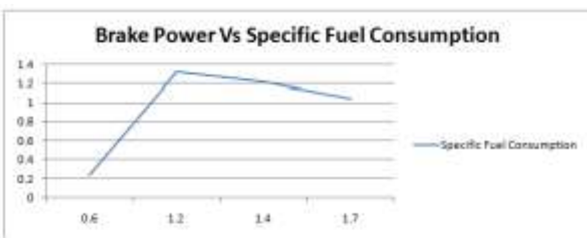
By Using Bio-Diesel (Observed Reading for B10)

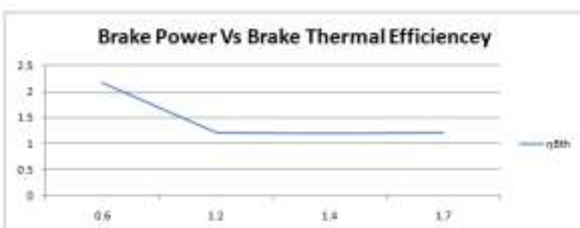
S.NO	AMP A	VOLT V	EX.TEMP	COOLING WATER INLET	COOLING WATER OUTLET	TIME FOR 10cc FUEL CONSUMPTION	TIME FOR COLLECTING 1LITRE OF WATER
1	0	240	110	30	34	71	6
2	3	210	140	30	34	56	6
3	6	210	160	30	34	52	7
4	7	190	170	30	35	48	7
5	8.5	190	180	30	35	46	7

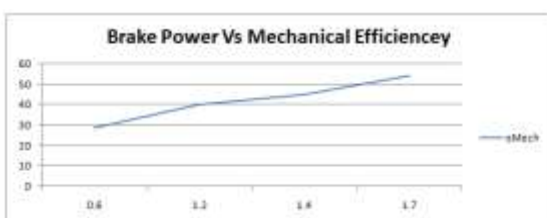
By Using Bio-Diesel (Calculated Reading for B10)

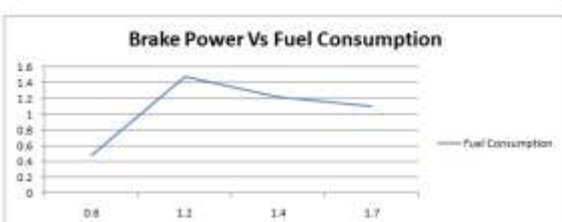
S.NO	TFC *10^-4 (Kg/s)	BP KW	SFC *10^-4 Kg/S	Fr.P KW	IP KW	MECH %	BTH %	ITH %	BMEP Bar	IMEP Bar	FU.P KW
1	0.48	0.6	2.17	1.75	2.38	28.4	10.5	39	0.91	3.49	5.6
2	1.48	1.2	1.2	1.75	3.01	39.8	19.5	40	1.8	4.56	6.4
3	1.2	1.4	1.19	1.75	3.02	44.8	20.4	44	2.85	4.60	6.6
4	1.1	1.7	1.2	1.75	3.13	54	22.68	46	2.57	5.4	7.2

Performance
E curves of bio-diesel (b10):

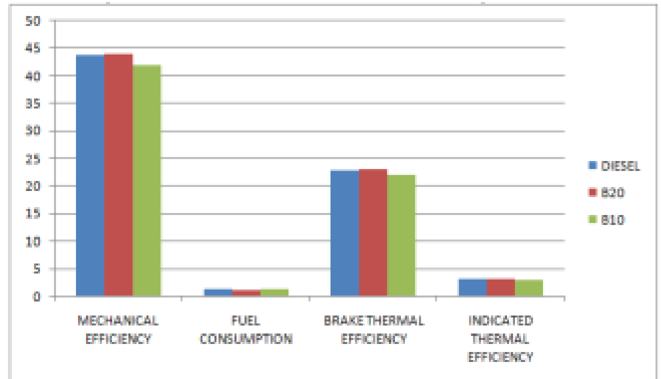








Results: (competition of diesel, b20 &b10):



CONCLUSION

The results of this study have confirmed that by using Bio-diesel B10 and B20 blend which gives BP, IP, FP, BTH, ITH, MECH as same as that of diesel. COCONUT oil is recommended as a heavy diesel fuel. Blending of fossil fuel with vegetable fuel has been recommended so as to reduce the carbon residue and acidity of fossil fuels.

The use of COCONUT oil blends would certainly reduce pollution of the environment by ordinary fossil diesel, would help boost agriculture and would help conserve the fossil fuel. And also it also avoids the demand of diesel in upcoming years. Hence COCONUT oil blends is recommended to avoid the demands and to avoid environmental pollution.

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Di Serio, M., Ledda, M., Cozzolino, M., Minutillo, g., Tesser, R. &Santacesaria, E. 2006. Transesterification of soybean oil to biodiesel by using heterogeneous basic catalysts. Industrial and Engineering Chemistry Research

