ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Preparation of Sun Flower Oil as Alternative Fuel and Experimental Investigation Using Bio Diesel Setup A Comparative Study with Single Cylinder Diesel Engine

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ABSTRACT:

Energy is the prime mover of economic growth and is vital to the sustenance of a modern economy. India ranks sixth in total energy consumption and needs to accelerate the development in this sector to meet its growth aspiration. Hence alternate fuels are needed to be produced. Alternative fuels, known as non-conventional or advanced fuels, are any materials or substances that can be used as fuels, other than conventional fuels. Alternative fuels are derived from resources other than petroleum.

Bio-diesel is environment friendly fuel which consists of alkyl esters of fatty acids. Bio-diesel can be derived from food grade vegetable oils, non food grade oils, animal fats and waste restaurant greases. It is a liquid fuel and is synthesized largely by replacing the glycerol molecules with short chain alcohols such as methanol or ethanol.

Our project involves preparation of Bio-diesel from palm oil, Blending of palm Bio-diesel diesel. There by conducting Performance Tests for alternate fuels and comparing the Performance characteristics with diesel fuel.

KEY WORDS:

Trans-esterification, acid & base catalysation, magnetisation stirrer,glycerine, Brake power Vs S.F.C. Brake power Vs Brake Thermal efficiency, Brake power Vs brake thermal efficiency, Brake power Vs indicated thermal efficiency,Brake power Vs mechanical efficiency, Brake power Vs BMEP, Brake power Vs IMEP.

INTRODUCTION:

Biodiesel

Biodiesel is an environmentally- friendly, renewable energy source that has better lubricating properties and much lesser emissions than today's lower sulfur diesel fuels. Biodiesel addition reduces fuel system wear, and in low levels in high pressure systems increases the life of the fuel injection equipment that relies on the fuel for its lubrication. Biodiesel gives more complete combustion thus increasing the engine energy output and partially compensating for the higher energy density of petro-diesel.

Need for an alternative fuel

The increasing industrialization and motorization of the world leads to a steep rise in the demand of petroleum products. Petroleum based fuels are stored fuels in the earth. There are limited fuels of these stored fuels and they are irreplaceable. With our present known reserves and the growing rate of consumption, it is feared that they are not going to last long. These finite resources of petroleum are highly

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concentrated in certain regions of the world has given rise to frequent disruption and uncertainties in its supply and as well as price. Although the present reserves seem vast, but the accelerating consumption will create a challenge before the world that a new type of fuels should replace the conventional fuels.

Advantages of Bio-fuels & Biodiesel

Advantages & Benefits

- Biodiesels are biodegradable.
- They are non-toxic.
- They have significantly fewer noxious emissions than petroleum-based diesel, when burned in an I.C engine.
- They are renewable.

Disadvantages with Biodiesel

- **Transportation & storage** of biodiesel require special management. Some properties of biodiesel make it undesirable for use at high concentrations.
- For example, pure biodiesel doesn't flow well at low temperatures, which can cause problems for customers with outdoor storage tanks in colder climates. A related disadvantage is that biodiesel, because of its nature, can't be transported in pipelines. It has to be transported by truck or rail, which increases the cost.
- Biodiesel is **less suitable for use in low temperatures**, than petro-diesel. The "cloud point" is the temperature at which a sample of the fuel starts to appear cloudy, indicating that wax crystals have begun to form. At even lower temperatures, the fuel becomes a gel that cannot be pumped. The "pour point" is the temperature below which the fuel will not flow. As the cloud and pour points for biodiesel are higher than those for petroleum diesel, the performance of biodiesel in cold conditions is markedly worse than that of petroleum diesel. At low stemperatures, diesel fuel forms wax crystals, which can clog fuel lines and filters in a vehicle's fuel system. Vehicles running on biodiesel blends may therefore exhibit more drivability problems at less severe winter temperatures than do vehicles running on petroleum diesel.

LITERATURE REVIEW:

T. K. Kannan and B. R. Marappan [9] Investigated the performance and emission characteristics of a diesel engine using THEVETIA PERUVIANA biodiesel with Diethyl ether blends in the ratio of 5%, 10%, 15% and 20%. From the detailed study it has been found that 20% DEE blend would result in 5% increase that of biodiesel at full load, reduction of 14.63% in smoke opacity. It was concluded that 20% DEE blend would result in better performance.

J. P. Subrahmanyam and M. K. G Babu[10] investigated the combustion and emission characteristics of diesel engine using karanja oil methyl ester (KOME) blend with Di ethyl ester in the ratio of 5%, 10, 15% and 20%Break Thermal Efficiency increased by 5.5% with 15% KOME blend. Smoke opacity reduced to minimum level of full at full load with 20% KOME- DEE blend. From the various KOME-DEE blends tests, the 15% KOME DEE was found to be the optimum blend on the basis of emission and performance characteristics

V. Rambabu [1] Investigated on the Performance, emission and combustion characteristics of DI Diesel Engine with Linseed methyl Ester along with Methanol Carburization. From this book the results and analysis the 1/32 th throttle valve opening(3.73% of Methanol at full load)along with Bio-diesel operation gives better thermal efficiency(23.546%)and low pollutants likeCO and HC.From the above analysis one can say 1/32th throttle valve opening is the better operating conditions with Linseed Methyl Ester

K. Prasada Rao [2] Investigated on the Performance characteristics of DI Diesel Engine using Mahua methyl Ester along with Methanol Carburization. From this book performance and emissions analysis one can observe on scarification of little amount of Brake Thermal Efficiency the pollutants HC, CO are low. In other words at 1/16 throttle valve opening the biodiesel

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

operation along with methanol is eco-friendly with significant brake power.

P. Ramesh Babu [3] Investigated the Performance characteristics of a VCR-DI- Diesel Engine using coconut methyl Ester blend with Di-ethyl ester in the ratio of 5%, 10%, 15% and 20%. Break Thermal Efficiency increased by 4.1% with 5% DEE blend EGT at full load, at CR 18.5:1 is 648^0C which is 6% lower when compared to that of CR 16.5:1 with 5% DEE blend. From the various CME-DEE blends tests, the 5% CME-DEE was found to be the optimum blend on the basis of emission and performance characteristics

WORKING PRICIPLE:

Preparation of Biodiesel from Palm Oil

Biodiesel is an environmentally friendly alternative diesel fuel consisting of the alkyl monoesters of fatty acids. It is obtained from triglycerides through the trans-esterification process. Biodiesel can be derived from food grade vegetable oils, non-food grade vegetable oils, animal fats, and waste restaurant greases. Transesterification is the general term used to describe the important class of organic reactions, where an ester is transformed into another ester through interchange of alkyl groups and is also called as alcoholysis. Transesterification is an equilibrium reaction and the transformation occurs by mixing the reactants. However, the presence of a catalyst accelerates considerably the adjustment of the equilibrium. The general equation for transesterification reaction is given below.

$$RCOOR' + R''OH \rightarrow RCOOR'' + R'OH$$

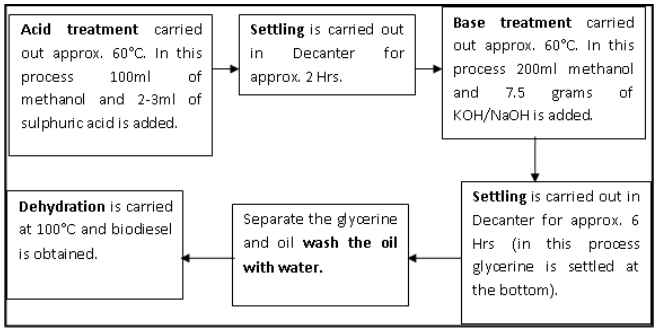
In this reaction, the fatty acid radicals of the triglyceride molecule split away from the glycerine backbone, and the fatty acid radicals make new ester connections with the alcohol molecules, resulting in free glycerine and fatty acid esters. These fatty acid esters are known as **biodiesel**. The symbols R_1, R_2, and R_3 represent straight chain fatty acid radicals.

$$\begin{array}{lll} CH_2COOR_1 & & \\ CH_3COOR_1 & CH_2-OH & \\ | & & \text{Catalyst} \\ | & & \\ CHCOOR_2 & & + \ 3 \ CH_3OH \rightarrow \\ CH_3COOR_2 & + \ CH-OH & \\ | & & (NaOCH3) \\ | & & \\ CH_2COOR_3 & & \\ CH_3COOR_3 & CH_2-OH & \end{array}$$

Triglyceride Alcohol
Mixture of Glycerine
(Vegetable oil)
fatty esters

Trans-esterification reactions between triglyceride and alcohol

Trans-esterification



Block Diagram for Trans-esterification Procedure

The process of trans-esterification consists of four basic steps.

1. Acid treatment followed by settling process
2. Base treatment followed by settling process
3. Water washing
4. Dehydration.

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Acid Treatment

- For the acid treatment one liter of filtered raw Palm oil is taken into a conical flask and heated to 45°C to melt the solid fats present in the oil by keeping on an electric heater which is having a magnetic stirrer for continuous stirring of the oil, it is shown in the figure 4.3.
- 100% of Methanol of 99 % pure is added (0.1 liters/liter of oil) to the heated oil. It is stirred for five to ten minutes.
- 3 milliliter of 95 % pure sulfuric acid (H_2SO_4) is added for each liter of oil using a graduated eye dropper.
- The compound is stirred for one hour maintaining the temperature at 35°C to 65°C.
- Heating is stopped and the mixture is stirred for another hour.
- The mixture is allowed to settle for eight hours in a decanter to remove pulp portion present in the oil, which is precipitated at the bottom of the decanter.

One liter of raw oil in Settling process

Second stage (Base catalyzed stage)

- 7.5 grams of sodium hydroxide (NaOH) is added to 0.25 liters of methanol and stirred thoroughly to produce sodium-methoxide.
- Half of the prepared sodium-methoxide is poured into the unheated mixture and the mixture is stirred for five minutes. This will neutralize the sulfuric acid.
- The mixture is heated to 65°C and the whole reaction is maintained.
- Remaining sodium-methoxide is added to the heated mixture and stirred at a speed between 500 and 600 rpm, as shown in figure 4.6.
- After one hour the mixture is poured into a decanter and allowed to settle for 8 hours. As glycerin is heavier than the biodiesel, it will settle at the bottom. The glycerin is separated from the biodiesel, as shown in figure 4.7.

Base catalyzed stage

Glycerin Separated From The Oil In The Settling Process

Water washing

Bubble wash method is used, (refer figure 4.8) method of final washing of biodiesel is through air agitation but there is no need to monitor pH value of the oil any more since the biodiesel coming out is deemed effectively neutral. One-third of this water by volume is added to the oil and bubble washed up to remove the bubbles.The mixture is allowed to settle in a decanter for one hour and the water is drained-off later.

Dehydration

- The dehydration process is performed to remove the left over traces of water present in the oil after water washing.
- For removing the traces of water present in the oil, the oil is taken into a beaker, as shown in

ISSN No: 2348-4845
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figure 4.9 and heated on heater containing magnetic stirrer for continuous stirring.

- The oil is heated above 100°C as water evaporates at 100°C. The figure 4.10 shows the final Palm methyl ester (biodiesel) obtained after the transesterification process.

Water washing Oil is being heated removing water traces

Preparation of Bio-Diesel from blending of Palm Bio-Diesels

Using these alternate fuels had a serious impact on economic impact of industry/country. And that is why there are certain improvement technique aroused to make these biofuels to obtained with reduced cost with reduced pollution gases and these improvement technique are used due to following

Disadvantages

1. High cost when compared with diesel.
2. Quality of the Biofuel is not so good.
3. Calorific values are less.
4. Compression ratio is varies.
5. Efficiency and brake power is less.

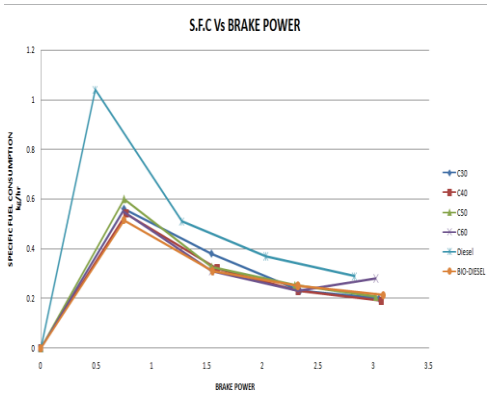
And hence due to above disadvantages improvement techniques is to be followed so as to overcome these disadvantages and to make them efficient and economical. Blending is the major improvement technique followed recently so that making the alternate fuels to near characteristic of conventional fuel Blending is a Mix (a substance) with another substance so that they combine together as a mass. while blending initially we are take different samples with different ratios of biodiesels like 20:80,30:70,60:40 etc. Finally we obtain better results at 70:30(palm biodiesel).

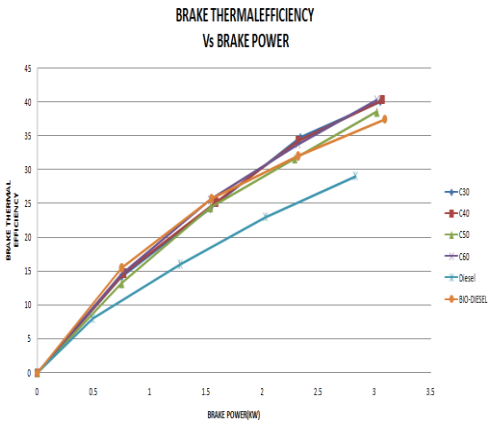
RESULTS:

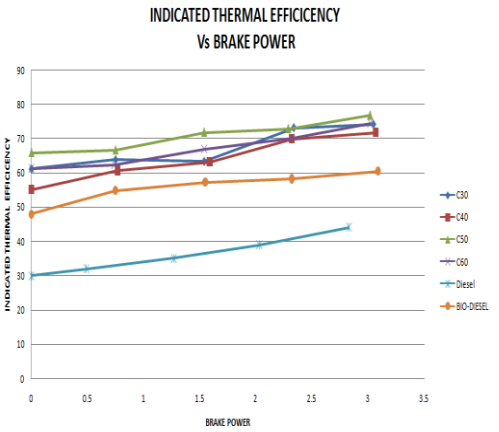
Performance Characteristics:

Performance charts are those which compare the performance parameters which are found on the engine for those produced diesels.These charts mainly drawn basing on the brake power Vs other parameters

some of these charts are drawn between the following-







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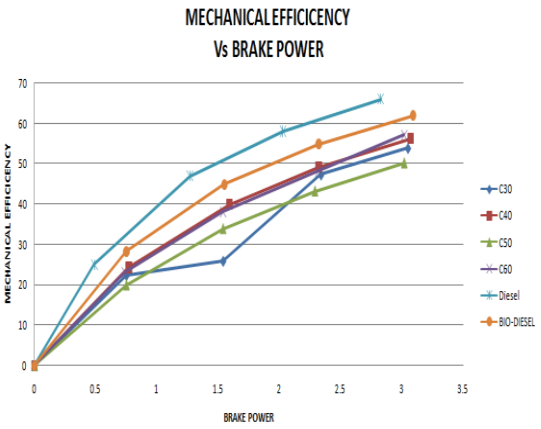

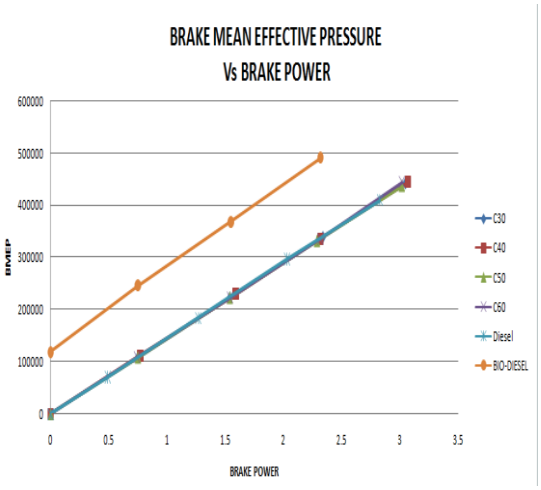

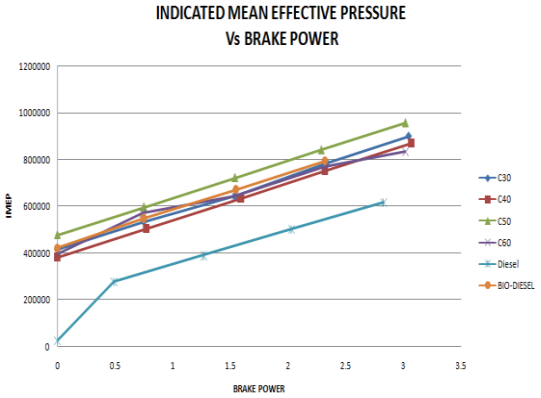

CONCLUSION:

- The biodiesel produced showed viscosity, specific gravity and calorific value are well within the range of diesel oil and all the properties satisfy the B.I.S standards of biodiesel.
- Flash and fire points of biodiesel are comparatively higher for biodiesel, thus the risk of fire hazards gets reduced and handling and storage of biodiesel is safer.
- Bio-diesel can be used in the existing engine without any modifications to the existing engine except fuel tank.
- From Fig 6.1: Compare to the other fuels, engine run with Blended Biodiesel takes less mass of fuel.
- From Fig 6.2: Compare to the other fuels running cost of engine using Blended Biodiesel is better.
- From Fig 6.3: Compare to the other fuels the engine run with Blended Biodiesel is having minimum frictional losses.
- From Fig 6.4: fuel consumption of Blended Biodiesel is less compare to other fuels.

Finally, it is found that the optimum performance is achieved with Blended Bio-diesel at 70:30 ratios of palm Bio-diesel in comparison with conventional diesel considering engine performance parameters.

FUTURE SCOPE:

As the injection pressure increase ignition delay period decrease, and causes for uniform heat release rate and reduction in knocks. For this justification, heat release rate measurement is required and p-θ diagram also required. The other part of the ignition delay period is chemical delay. Chemical delay depends on the quality of the fuel. Quality of fuel indicated by the Cetane number and quality of combustion predicted by exhaust gas analysis. So that exhaust gas analysis is the further work needed for clear justification. Black exhaust smoke from diesel engine is a result of incomplete combustion it indicates that some parts of the engine are malfunctioning and an excess amount of fuel is supplied by the pump. The excess fuel is often caused by drivers tampering with the pump to increase the net output of the engine at the cost of increased fuel consumption.

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