© 2016 IJSRSET | Volume 2 | Issue 2 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Experimental Investigation on Four Stoke Diesel Engine Using Diesel-Jatropha/Rice Bran/Soybean Biodiesel Mixture Blends

Avinash B, Dr. Y T Krishne Gowda, Prof. Chethana G D

*[1] M Tech Student, Thermal Power Engineering, Maharaja Institute of Technology, Mysore, India
[2]Professor, Department of Mechanical Engineering, Maharaja Institute of Technology, Mysore, India
[3]Assistant Professor, Department of Mechanical Engineering, Maharaja Institute of Technology, Mysore, India

ABSTRACT

Biodiesel, the methyl ester of vegetable oil is a renewable, low environmental impact and potential as a green alternative fuel for diesel engine. High oil prices and growing concerns over climate change are driving investment and innovation in the biofuels sector as countries and industry increasingly look towards renewable bioenergy to replace fossil fuels. This study examines fuel properties, performance and exhaust emission of a diesel engine fuelled with three different biodiesel mixtures (i.e, Jatropha, Rice bran and Soybean oils) and their blends with diesel fuel. The results indicate that the calorific value of the blends decrease with an increase in concentration of three biodiesel in the blends. The brake thermal efficiency of diesel fuel is found to be higher, when compared to biodiesel blends. Biodiesel blends gives lower CO and NO_x than diesel fuel operation.

Keywords: Diesel Engine, Biodiesel, Jatropha Oil, Rice Bran Oil, Soybean Oil, Combustion Performance

I. INTRODUCTION

Petroleum diesel is one of the widely used fuel in most types of transportation. As the number of automobiles increasing in recent years has resulted in huge demand for petroleum products. With petroleum products reserves estimated to last for few years. Hence it is ideal time to use alternate fuels for engines should be derived from indigenous sources.

Biodiesel is considered one of the best alternative energy sources because of its ability potential to reduce dependency on fossil diesel fuel, used in CI engine without any modification. Biodiesel can be obtained through transesterification of vegetable oils, waste cooking oil and animal fats. Biodiesel is defined as animal fat or vegetable based diesel fuel consisting of chemically reacting lipids. Biodiesel is renewable, non-explosive, nonflammable, nontoxic, environment friendly, and similar to diesel fuel.

In the last two decades several researches has been made on many vegetable oils and animal fats. The main aim of many researches was to investigate properties of biodiesel and performance and emission characteristics. It is found that properties of biodiesel obtained from same biodiesel vary from one location to another.

Biodiesel can be produced by various feedstock's; Jatropha is rated as one of the best crop for future biodiesel production, rice bran oil is also preferential in rice cultivating countries like india, china, japan and soybean oil is also one of the promising feedstock for biodiesel production. In general, Jatropha curcus is a renewable non edible plant, Jatropha tree is easy to grow which is drought resistant, grows well in marginal soil condition and produces seeds for more than 50 years. The jatropha seeds contain 37%- 40% of oil which has identifies as source of biodiesel. Rice bran oil is also preferential in rice cultivating countries like india, china and japan. Rice bran contains 17-20% of oil by weight content and is one of the conventional low grade oil. Soybean is a versatile grain, which is commonly used by chemical and food industries. Soybean grows in different sizes and colors, that includes black, blue, brown and green. The hull of the bean is hard and water resistant. Soybean has about 17-25% oil content in grain.

This study examines the fuel properties, performance and emission characteristic of diesel engine fueled with blends of jatropha, rice bran and soybean biodiesels with pure diesel.

II. METHODS AND MATERIAL

Transesterification and Engine Test

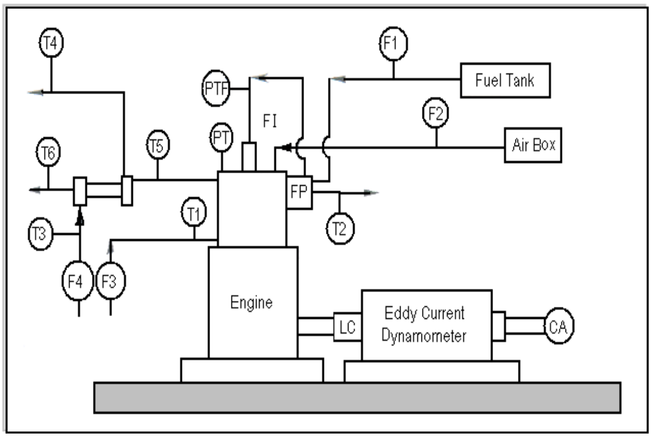
In this experiment mixture of jatropha, rice bran, and soybean biodiesels is blended with diesel fuel. Preparation of biodiesel for each oil is made through transesterification process using methanol and sodium hydroxide (NaOH) as reactant and catalyst.

Transesterification was carried out in a 3 neck flask equipped with stirrer and thermometer. About 6 m of catalyst (NaOH) is mixed in 300 ml methanol to prepare alkoxide, which is required to activate the alcohol. Vigorous stirring was done for 30 minutes in a closed container until the alkali is dissolved completely. The alcohol-catalyst mixture is then transferred to the reactor containing oil. Stirring of the mixture is continued for another one hour between 65 and 70^{o} C of temperature, the mixture is then taken out and poured into the separating vessel. The mixture is allowed to settle by gravity in a separating vessel. Without disturbing the vessel, the bottom layer of glycerol is separated out. The remainder in the vessel, i.e., methyl ester of oil is washed by pure water to remove impurities in the biodiesel.

Various blending combinations of three biodiesels with pure diesel i.e. Blend-1 (Jatropha 5% -Rice bran 5% -Soybean 5%- Diesel 85%), Blend-2 (Jatropha 10% -Rice bran 10% -Soybean 10%- Diesel 70%) and Blend-3 (Jatropha 15% -Rice bran 15% -Soybean 15%- Diesel 55%). The properties biodiesel blends (i.e. Blend-1, Blend-2 and Blend-3) and pure diesel such as Density, Specific Gravity, Kinematic viscosity, Flash point, and Calorific values are measured and noted. The properties biodiesel blends are shown in Table-1.

Experiment was performed on computerized test rig comprising of a four stroke, water cooled, single cylinder diesel engine. Engine is coupled to eddy current type dynamometer for loading. Necessary instruments are provided to measure cylinder pressure, exhaust gas temperature, engine speed, and torque. The schematic diagram of engine set up and specification of diesel engine as fig 2 and fig3.

PROPERTIES	**DIESEL**	**Blend-1**	**Blend-2**	**Blend-3**
SPECIFIC GRAVITY	0.827	0.831	0.842	0.855
KINEMATIC VISCOSITY At 40°C (Cst)	3.2	3.7	3.86	4.28
FLASH POINT °C	54	62	64	69
FIRE POINT °C	65	72	75	81
CALORIFIC VALUE kJ/kg	44514	43292	42680	40457



Schematic Diagram

Make	Kirloskar
Model	TV1
Type	Four stroke, water cooled
Bore	87.5mm
Stroke	110mm
Compression ratio	17.5: 1
Number of cylinders	1
Rated power	3.5 kW @ 1500rpm
Injection timing	23° bTC

Engine Specification

III. RESULTS AND DISCUSSION

The experiment determines optimum blend of biodiesels with pure diesel to get high engine efficiency. For this, diesel engine is operated using three different blends of biodiesels (i.e. Blend no.1, Blend no.2, Blend no.3) and with pure diesel.

i. Brake Thermal Efficiency:

Fig 5.1 shows the variation of brake thermal efficiency against brake power. It is observed from the graphs that, brake thermal efficiency is increasing with increase in brake power all biodiesel blends and pure diesel. From graph, diesel fuel has high brake thermal efficiency than biodiesels blend, this is because of low heating values of biodiesels. The brake thermal efficiency of Blend-1 and Blend-2 are almost same for all loads, and are higher than Blend-3.

ii. Brake Specific Fuel Consumption:

Fig 5.2 shows variation of BSFC against brake power. From graph, it can be observed that BSFC of diesel fuel is increasing continuously and rapidly as load decreases. The reason for increase in BSFC is friction power remains essentially constant, while indicated power is being reduced with the reduction in throttle opening.

The values of BSFC for Blend-3, Blend-2 and Blend-1 are higher than pure diesel, because higher density of biodiesel leads to more discharge of fuel injection pump thereby increasing fuel consumption rate.

iii. Carbon Monoxide Emission (CO):

The variation of Carbon monoxide emission with three biodiesel blends and pure diesel has been shown in fig 5.3. In comparison with diesel fuel, carbon monoxide (CO) emission values of blends usually reduced with increasing biodiesel content (Fig. 3). Maximum CO emissions are observed with diesel fuel.

It can be observed in the figure the variation of carbon monoxide against brake power with blend-3 has lower CO emission than pure diesel. This may be due to oxygen contents in the biodiesels which enables easy burning of fuel at high temperature.

iv. Hydro Carbon Emission (HC):

Unburned HC is the result of the incomplete combustion of fuels and flame quenching. The variations of Hydro Carbon (HC) emission with different three biodiesel blends is shown in Figure 5.4. It is observed from the fig that hydro carbon emission increases with increase in brake power for all biodiesels blend and pure diesel.

Blend-3 has lower hydro carbon emission compared to pure diesel and blend-2 and blend-1. This is because in lower combination of biodiesels blend the presence of oxygen in the biodiesel assists for complete combustion. As the biodiesels combination with diesel fuel increases, high viscosity and density of biodiesel reduces the complete combustion and increases the hydro carbon emission.

v. Nitrogen Oxide Emission (NO_X):

The effect of load on nitrogen oxides is shown in Figure 5.5. The nitrogen oxides (NOx) increased by increasing the load for each blend. From the results, NOx emission is lower for biodiesel blends than diesel.

From the fig it can be observed that Blend-2 has lower nitrogen oxide (NOx) emission than blend-3 and blend-1 and pure diesel operation. It also shows that the biodiesel blend ratios have more effect on the NO/NOx ratio at middle and high engine loads.

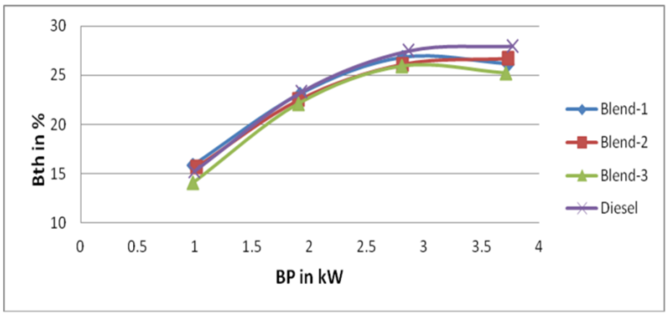


Figure 1. Brake Thermal Efficiency V/S Brake Power

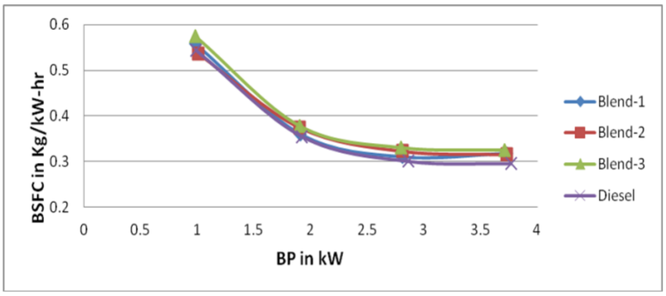


Figure 2. Brake Specific Fuel Consumption V/S Brake Power

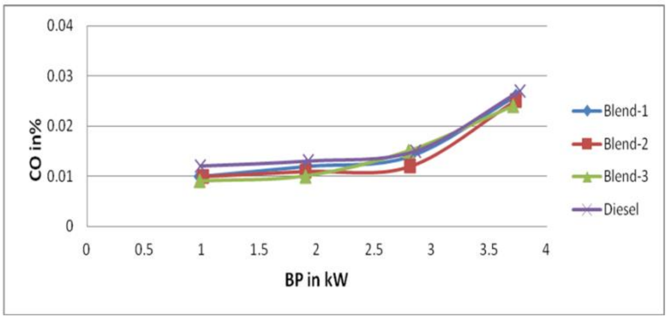


Figure 3. Carbon Monoxide V/S Brake Power

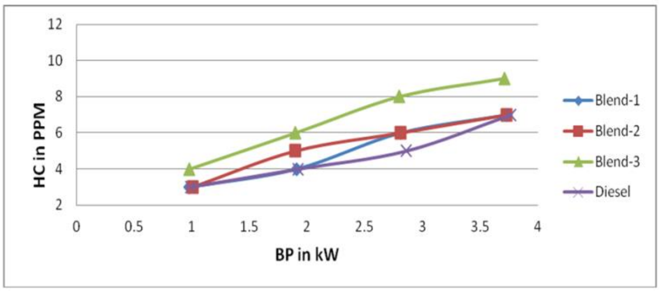


Figure 4. Hydro Carbon v/s Brake Power

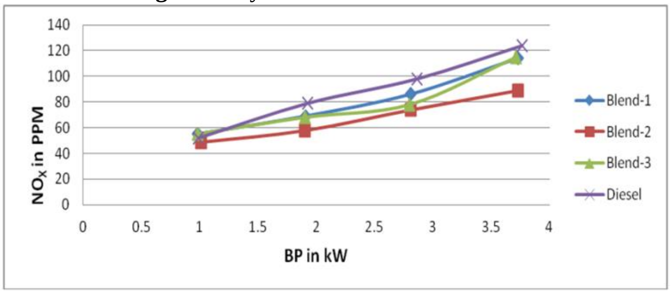


Figure 5. Nitrogen Oxide v/s Brake Power

IV. CONCLUSION

From the experiment, use of a three biodiesels blend with diesel. i.e. Jatropha, Soybean and Rice bran biodiesel is considered as a possible source of alternative fuel for CI engine.

- The thermal efficiency of pure diesel is found higher compared to all biodiesel blend, this is because of low heating values of biodiesels.
- The brake specific fuel consumption of diesel and Blend-1 are marginally closer to each other. Blend-3 has highest brake specific fuel consumption rate Because of low heating value and high viscosity of fuel.
- The carbon monoxide emissions of biodiesels blend are found to be lower, when compared to pure diesel under investigation.
- The Hydro carbon emission is found to be increased with increase in brake power. In standard injection timing, hydro carbon emission of blend-3 and blend-2 are found higher than pure diesel.
- Nitrogen oxide emission is found to be increased with increase in brake power. Biodiesel blends have low nitrogen oxide emission compared to pure diesel operation.

V. REFERENCES

[1] Hasan Serin, Kadir Aydin, Mustafa Ozcanli and Abdulkadir Yasar, “EmissionCharacteristics of Tea Seed/Soybean/Cotton Seed Biodiesel Blends”. IPCBEE vol. 73 (2014).

[2] Mustafa Ozcanli, Hasan Serin, “Evaluation of soybean/canola/palm biodiesel mixture as an alternative diesel fuel”. Journal of Scientific & Industrial Research, Vol. 70, pp. 466-470,(2011).

[3] Subhan Kumar Mohanty, “A Production of biodiesel from rice bran oil and experimenting on small capacity diesel engine”. International Journal of Modern Engineering Research (IJMER), Vol.3, Issue.2,(2013).

[4] Selvaraj K, Shanmugam A, “ Study of performance and emission characteristics of diesel engine fueled with blends of ethanol and dual biodiesel(jatropha, pongamia pinnata) with diesel”. Journal of Chemical and Pharmaceutical SciencesISSN: 0974-2115.

[5] Swapna G.K, Dr. M. C. Math, “Investigation of Fuel Properties of Mixture of Jatropha and Pongamia Pinnatta Methyl Ester and Their Blends with Diesel to assess their Usefulness as Compression Ignition Engine Fuel” IJESIT, Vol3, Issue3, May 2014

[6] Dhruva D, Dr. M C Math, “Investigation of Fuel Properties of Crude Rice Bran Oil Methyl Ester and Their Blends with Diesel and Kerosene”. International Journal of Engineering Science Invention, Vol.3, Issue 6,(2014).

[7] Chetan, Arunkumar Jeergi,Omprakash Hebbal, “Experimental Investigation On The Single Cylinder Diesel Engine With Multi-Blend Biodiesel”. International Journal of Engineering Research & Technology (IJERT), Vol. 2 Issue 7, July – 2013.

[8] Amit Pal, “An Experimental Investigation of Jatropha Biodiesel Blends in a Multi Cylinder CI Engine: Performance and Emissions Study”. International Journal of Current Engineering and Technology, ISSN 2277 – 410 (2013).

[9] Hariram V, Shanil George Chandy, “Influence of injection timing on combustion and heat release parameters using biodiesel of Neem, Rice bran and Pongamia in a direct injection compression ignition engine”. International Journal Of Engineering And Science, Vol.2, Issue 11 (2013), Pp 36-43.

[10] N. Ravi Kumar, Rajesh Guntur and Y.M.C. Sekhar, “Performance and Emission Characteristics of a Slow Speed Diesel Engine Fueled With Soybean Bio Diesel”. International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Vol. 2, Issue 4,(2012).