PERFORMANCE CHARACTERISTICS OF DIESEL ENGINE USING ALTERNATE FUELS

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ABSTRACT

An experimental evaluation of using pongamia oil, neem oil and coconut oil as an alternate Diesel engine fuel has been conducted in the present work. The blends (B30, B40, B60, B80 and B100) of various proportions of these alternate fuels and diesel are used to run a single cylinder, four stroke, water cooled diesel engine and significant improvements in engine performance characteristics are observed. For combustion characteristics, a slightly shorter ignition delay and longer combustion duration were found with the use of alternate fuels under all loading operations. Brake thermal efficiency for B60 (60% pongamia oil and 40% diesel) is higher when compared with other blends. Indicated thermal efficiency for B80 (80% pongamia oil and 20% diesel) is greater when compared with other blends. Mechanical efficiency for N30 (30% neem oil and 70% diesel) is comparatively high when compared with other blends.

Keyword: *Conventional Energy, Alternate Fuels- pongamia oil, neem oil, coconut oil.*

1. Introduction

In recent times, the world has been confronted with the energy crisis due to the application of natural resources and increases the environmental problems. The situation has led to the search for alternate fuels, which should not only sustainable but also environment friendly for developing countries, fuels of bi-origin, such as alcohol, vegetable oils, biomass, biogas, synthetic fuels etc., becoming important. Such fuels can be used directly, while others need some sort of modification before they are substituted for conventional fuels. With an expected growth rate of diesel consumption of more than 14% per annum, shrinking crude oil reserves and limited refining capacity, India will have to depend heavily on imports of crude. From the point of view protecting the global environment and the concern for the long term supplies of conventional diesel fuels, it becomes necessary to develop alternative fuels comparable with conventional fuels. Diesel fuel is largely utilized in the transport, agriculture, commercial, domestic and industrial sectors for the generation of power and the substitution of even a small fraction of total consumption by alternative fuels will have a significant impact on the economy and the environment. Alternative fuels obtained from vegetable oils holds good promise as an eco-friendly alternative to diesel fuel. Diesel and alternate fuels like pongamia, neem oil and coconut oil are used as fuels. The blends of various proportions of these alternate fuels and diesel are used to run the engine and significant changes in engine performance characteristics are observed.

1.1 Pongamia Oil: Pongamia pinnate is botanical name for kanuga in Telugu, Honge in Kannada and karanja in Hindi. These trees can be found abundantly in our country, especially in wastelands. At commonly used densities of more than 100 trees per hectare, many of trees yields 10 to15 tones of seeds per hectare on maturing since 15 to 20 years old trees use soil to more than 10 meters depth (unlike agriculture more than 10 material crops which use only 15 cm of top soil) both survivability during dry periods and annual output per hectare are better than that would be obtained for many agricultural crops. As a matter of fact even goats do not graze kanuga saplings and therefore it does not require any special protection while growing. There is no possibility of total yield failure with trees in many years. Modern silivicultural methods make use of dense planting of saplings to start with kanuga normally in 3 to 4 years it is from fear of theft and disease. Most of the trees based on oil seeds about 25% oil and 70% cake considering 5% losses in the process of oil extraction. The cake has multiple use but it becomes available in large quantities, probably could be used best in industrial ferments to produce biogas (methane).Figure1 shows the blends various proportions of pongamia oil and diesel.

Fig-1: Blends of Pongamia Oil Used

Table-1: Fuel Properties of blends of Pongamia oil

Blends/ Properties	Specific Gravity	Calorific Value (kJ/kg)
P30	0.873	38200
P40	0.88	37600
P60	0.896	36400
P80	0.911	35200
P100	0.927	34000

1.2 Neem Oil: In India Neem tree is a widely grown up termed as a divine tree due to its wide relevance in many areas of study. Biodiesel is a safe alternative fuel to replace traditional petroleum diesel. This study is intended to consider aspects related to the feasibility of the production of biodiesel from neem oil in an attempt to produce biodiesel using the abundantly grown tree naturally as the use of vegetable oils for engine fuels seems insignificant at present day scenario. Neem oil will become a potential supplier of Biodiesel in future. Biodiesel is a mono alkyl ester (methyl or ethyl ester) of long chain fatty acids derived from renewable liquid of neem oil. Biodiesel thus obtained can be used in any compression ignition (diesel) engines without the need of modification and is therefore a good crushed for oil extraction. The Neem grows on almost all types of soils including clay, saline and alkaline conditions. Neem seed obtained from this tree are collected, de-pulped, sun dried and seeds have 45% oil which has high potential for the production of bio diesel. Figure2 shows the blends of various proportions of neem oil and diesel.

Fig-2: Blends of Neem Oil Used

Table- 2: Fuel Properties of blends of Neem oil

Blends/ Properties	Specific Gravity	Calorific Value (kJ/kg)
N30	0.885	39700
N40	0.897	39600
N60	0.920	36400
N80	0.944	39200
N100	0.968	39000

1.3 Coconut oil: Coconut oil is the healthiest oil on Earth is also a great source of clean and renewable energy. Many governments, particularly Philippines, have looked into Coconut Methyl Ester (CME) as a petro diesel quality enhancer, Biodiesel is international name for methyl ester when used as diesel fuel or enhancer, Coconut Methyl Ester is different from the coco-diesel used in the 1970's. Unlike coco-BIO diesel, the crude coconut oil is used in coco-diesel did not undergo esterification. Esterification is the generic name foe a chemical reaction wherein two reactants (normally an alcohol and an acid) from an ester as the reaction product. Figure3 shows the blends of various proportions of neem oil and diesel.

Fig- 3: Blends of Coconut Oil Used

Table- 3: Fuel Properties of blends of Coconut oil

Blends/ Properties	Specific Gravity	Calorific Value (kJ/kg)
C30	0.856	40928
C40	0.865	40404
C60	0.82	39356
C80	0.891	39128
C100	0.918	37260

2. Experimental setup: Figure 4 shows a single cylinder 4-stroke water-cooled diesel engine having 5HP as rated power at 1500 rpm was used for the research work. The engine was coupled to brake drum for mechanical loading. The fuel flow rate was measured on volumetric basis using burette and stop watch. Thermocouples in conjunction with a digital temperature indicator were used for measuring the engine inlet and outlet temperatures.

Fig-4: Experimental setup of 5HP Diesel Engine

Table-4: Engine Specifications

S.No.	Specification	Units
1	Engine type	Kirloskar diesel engine
2	Bore	80mm
3	Stroke length	110mm
4	Engine speed	1500rpm
5	Break horse power	5HP
6	Cylinder capacity	553cc
7	Diameter of brake drum	380mm
8	Compression ratio	16.5:1

3. Results and Discussions

The performance parameters are determined in 5 H.P diesel engine using alternate fuels at different loads.

Fig. 5 shows the variation of brake thermal efficiency with variation of loads. It can be seen from graph that brake thermal efficiency in all cases it increased with increased in load. This is due to reduction in heat loses and increase in power with increase in load. The maximum brake thermal efficiency was obtained at B60 (Pongamia oil 60% + diesel 40%), which is higher than that of diesel and other blends. The improved brake thermal efficiency for low concentration pongamia oil is due to more combustion and additional lubricates of oil.

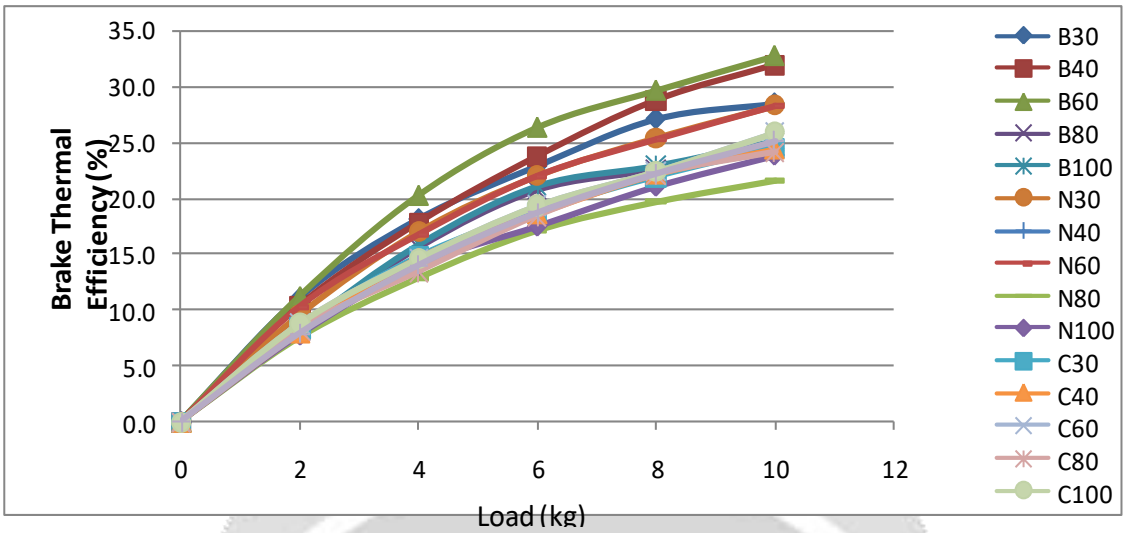

Fig- 5: Brake Thermal Efficiency Vs Load

Mechanical efficiency at various loads of the engine is shown in the figure 6. It can be seen that for N30 (Neem oil 30% + Diesel 70%) at partial loads and maximum loads mechanical efficiency is higher than that of pure diesel and other fuels and blends. This may be due to better lubricating property of the neem oil, which reduces frictional losses.

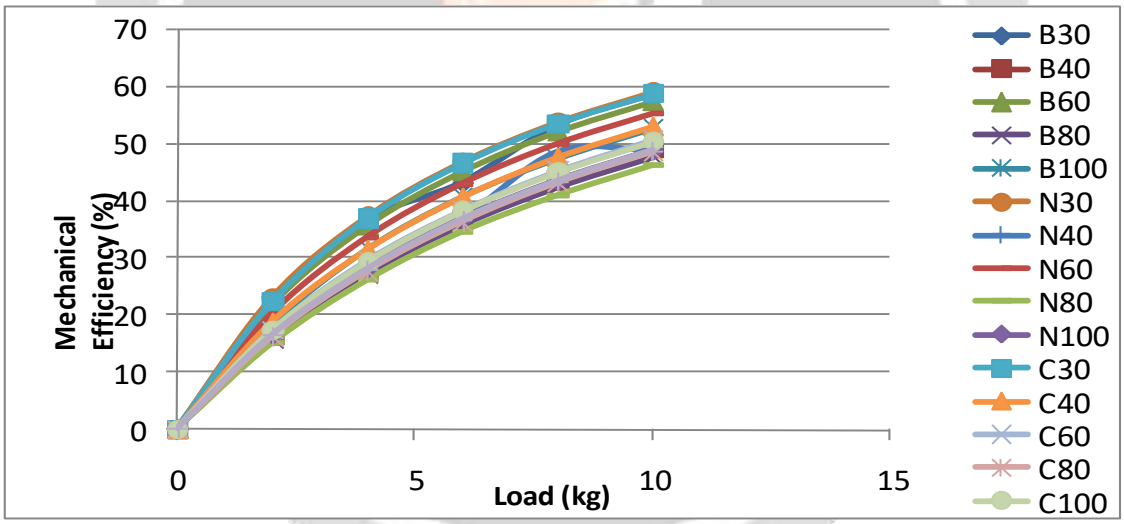

Fig- 6: Mechanical Efficiency Vs Load

Variation of indicated thermal efficiency with load for different fuels and blends is presented in figure 7. It can seen from graph that the indicated thermal efficiency of B80 (Pongamia oil 80% + diesel 20%) is higher than that of other fuels and blends.

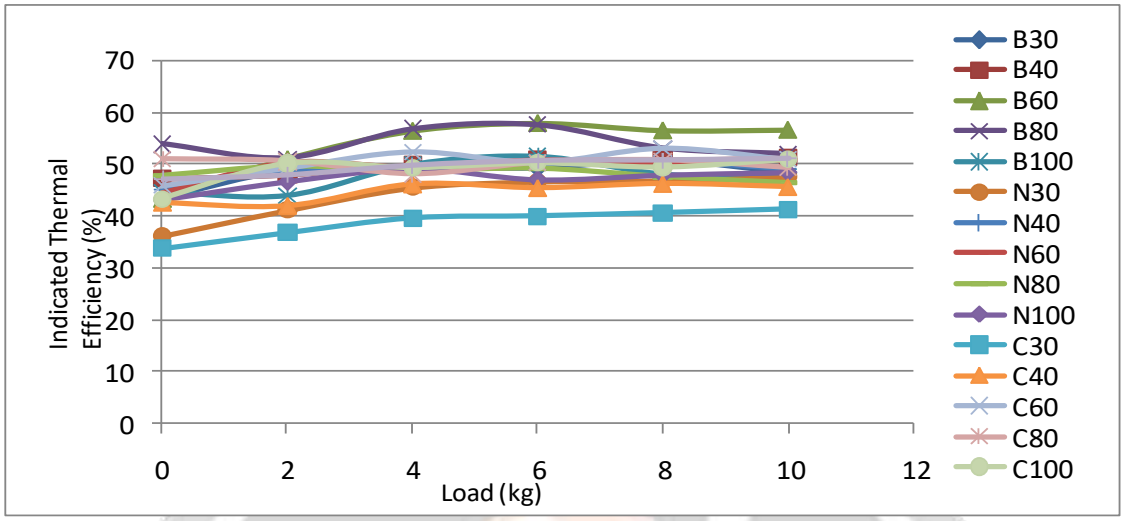

Fig- 7: Indicated Thermal Efficiency Vs Load

4. Conclusions:

The experimental investigation was carried out for different blends of pongamia oil, neem oil and coconut oil. The Diesel engine performance was evaluated and compared with the blends of various proportions of Pongamia oil, neem oil and coconut oil based methyl esters (Biodiesel) can be directly used in diesel engines without any modifications. Brake thermal efficiency for B60 (60% pongamia and 40% diesel) is higher when compared with other blends. Indicated thermal efficiency for B80 (80% pongamia and 20% diesel) is greater when compared with other blends. Mechanical efficiency for N30 (30% neem and 70% diesel) is comparatively high when compared with other blends.

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