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Performance and Emission Characteristics of Poppy Seed Oil Diesel Blends on Single Cylinder Four Stroke Diesel Engine

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Abstract: ***Now a day, decreasing of fossil fuels and their effects on environment lead to conduct performance test on alternative fuels sources, one of the alternative fuels is vegetable oil i.e., poppy seed oil. The performance test was conducted on pure diesel and blends of poppy seed oil and diesel at different proportions in single cylinder four stroke diesel engine with rope dynamometer at different loads. Their effects on engine performance and emission characteristics were studied. It was observed that B25 blend is more efficient.***

Keywords: Alternative fuel, trans-esterification, diesel engine, poppy seed oil, efficiency and emissions

1. Introduction

In recent years increase of population and vehicles leads to increase of fuel usage. Fuel sources are two types renewable and non renewable sources. Energy sources like hydro, fossil fuels, wind, biomass and wastes are renewable they will extinct soon. As diesel is a fossil fuel it extinct soon, so there is a need to find an alternative fuel source for future generations. Usage of diesel lead to environmental pollution due to release of COX, NOX, SOX and smoke by use of fossil fuels. These emissions will cause green house effects and acid rains. These Negative effects of diesel fuel and decreasing of fuel sources increases the studies on new fuel types that can be used in automobiles vehicles. One of the alternative fuels is vegetable oils. Vegetable oils were first used as fuel in diesel engine by Rudolf Diesel in 1900. Vegetable oils have several advantages such as high flash point, better lubricating properties, high cetane number, and low sulphur content. But there are disadvantages also; they have low volatilities and high viscosity. Due to low volatility, its cause's poor fuel atomization and incomplete combustion. Due to high viscosity it leads to gummy nature and ring sticking in diesel engine. To decrease viscosity the methods such as transesterification, preheating and blending are used. In my study I had transesterified the poppy seed oil and also blended with diesel in different proportions and the performance and emissions characteristics were evaluated.

2. Literature Survey

F. Aksoyetal (referral 1) has concluded by conducting performance test on pure diesel and 50% diesel and 50% diesel fuel mixture on single cylinder, 4-stroke, air cooled and precombustion chamber diesel engine at different speeds and its effects on engine performance and emissions are studied. When compared to diesel fuel on an average engine torque and power decreases at 4% and 5.73. CO and NOX has decreased to 15.5% and 5.9% respectively.

M. P. Sudesh kumaretal (referral 2) has concluded in his paper that the utilization of various vegetable derived biodiesel blends in a diesel engine as alternative fuels is a major improving step to increase diesel engine performance and lowering the emissions.

3. Poppy Seed Oil

Poppy seed oil is edible oil from poppy seeds. Scientific name is papaver someniferum. Poppy seed oil is highly palatable, high in vitamin E and contains opium alkaloids such morphine and codeine in quantities of up to 400m/l. Compared to other vegetable oils, poppy seed oil has a moderate amount of phytotosterols, higher than soyabean oil and peanut oil, lower than safflower oil, sesame oil and rice bran oil. Sterols in poppy seed oil consist almost entirely of campesterol, stigmasterol, sitosterol. Poppy seed oil is high in linoleic acid.Poppy seed oil is carrier oil, having little or no odour and pleasant taste.

This poppy seed oil is converted in to biodiesel by a process trans-esterification. The transesterification is the process of exchanging the organic group R″ of an ester with the organic group R′ of an alcohol. These reactions are often catalyzed by the addition of an acid or base catalyst. The reaction can also be accomplished with the help of enzymes (biocatalysts) particularly lipases.

Figure 1(a): poppy seeds

Figure 1(b): poppy seed oil

Properties of Poppy Seed Oil Blends:

Table 1: Properties of blends

Properties	B0	B10	B15	B20	B25	B30	B35	B40
Viscosity	2.9	3.09	3.2	3.28	3.36	3.63	3.92	4.01
Density	827	831	846	859	871	879	886	894
Calorific value	43350	43296	43208	43157	43104	42972	42553	42366
Flash point	49	51	54.5	56	58	61	64	68
Fire point	56	64	69	76	82	89	97	106

4. Experimental Setup

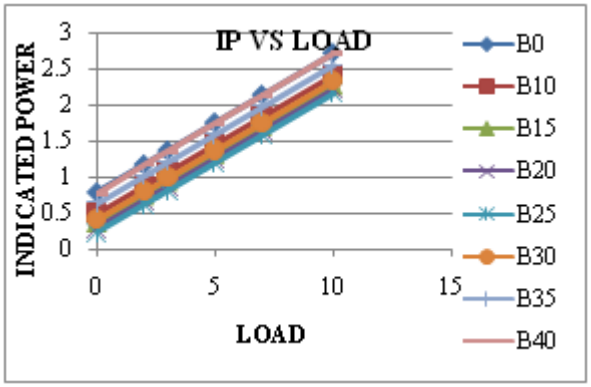
Tests are performed on single cylinder four stroke diesel engine with rope dynamometer with different blends of B0, B10, B15, B20, B25, B30, B35, B40 at speed of 1500rpm and at different loads of 0kg, 2kg, 3kg, 5kg, 7kg and 10kg. After the engine reaches optimum temperature the performance and emission tests are conducted.
Specifications of the engine are tabled as below:

Table 2: Specifications of Engine

Engine type	Four stroke diesel engine
Rated speed	1500 rpm
Bore size	85mm
Length	110mm
Number of cylinders	01
Type of cooling	Water cooling

5. Results and Discussion

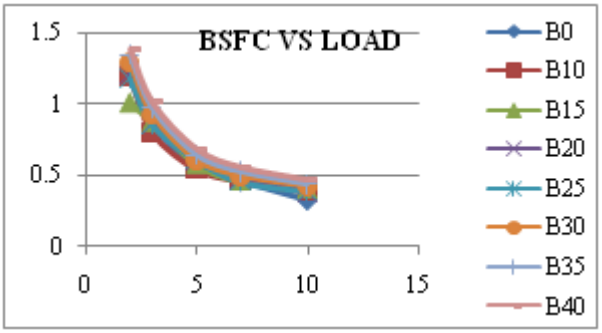
1) Indicated Power:



At all load conditions the indicated power is lowest for B25 and highest for B40 than B0 ie.,pure diesel. This indicates that the frictional losses are less for B25 than all blends and pure diesel.

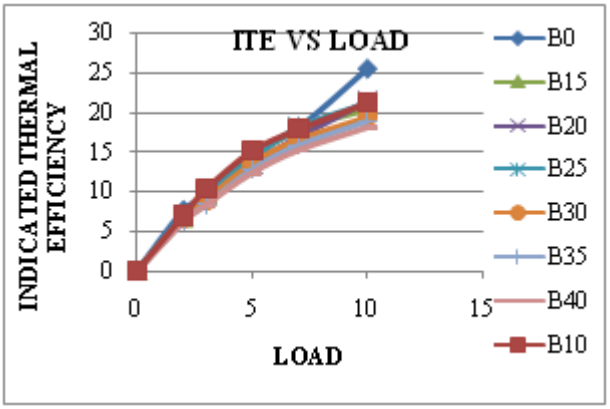
2) Brake Specific Fuel Consumption

The brake specific fuel consumption is almost same and nearer for all blends.



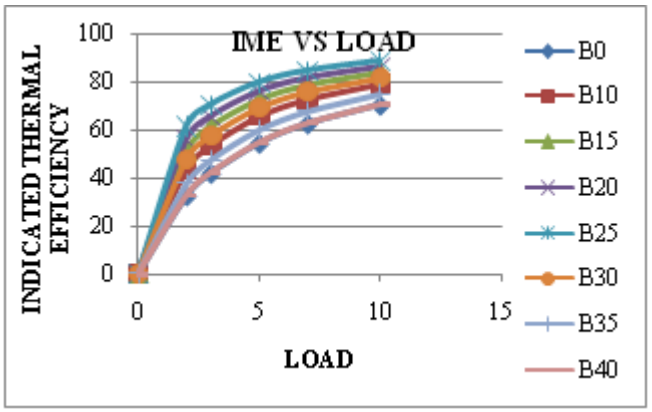
3) Indicated Thermal Efficiency

Indicated thermal efficiency is almost same for B25, B10 and pure diesel. And it decreases for further blends.



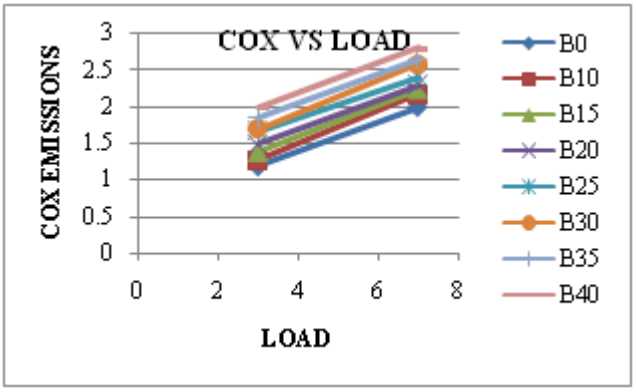
4) Indicated Mechanical Efficiency

The indicated mechanical efficiency is highest for all blends than pure diesel and highest for B25.



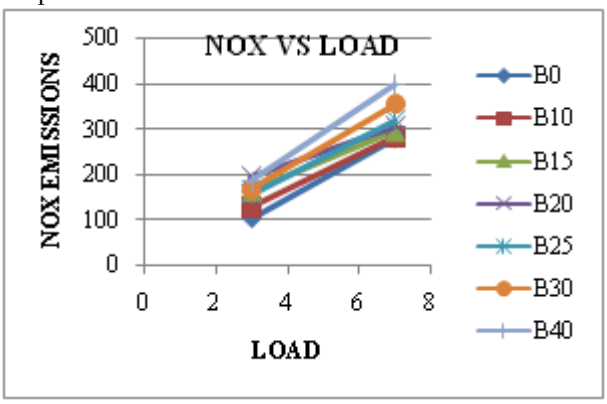
5) COX Emissions

The COX emissions are higher for all blends than pure diesel and highest for B40.



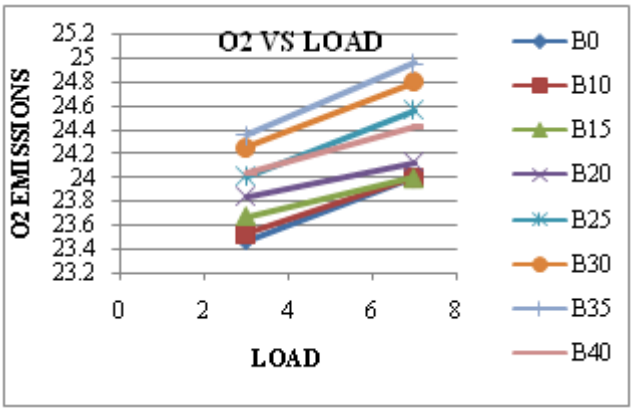
6) NOX Emissions

The NOX emissions are almost same as B0 for all blends except for B40.



7) O2 Emissions

The O2 emissions are highest for B40 blend and almost same for B0, B10, B15, and B20. And a little higher for B25 and B30.



6. Conclusions

- At all loads the indicated mechanical efficiency is higher for all blends than B0 and highest for B25.
- At all loads the indicated thermal efficiency is lower for all blends than B0 and it is almost same for B25.
- At all loads the indicated power is lowest for B25 than all blends this indicates decrease in the frictional power losses.
- At all loads the specific fuel consumption is same for all the blends as pure diesel.
- The NOX emissions are highest for B40 blend and almost same as B0 for all blends.
- The COX emissions at all load conditions is higher for B40.
- The O2 emissions at all load conditions are highest for B40 and almost same for B0, B10, B15 and B20. And a little higher for B25 and B30.

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