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PERFORMANCE TEST OF IC ENGINE USING KARANJA BIODIESEL BLENDING WITH DIESEL

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ABSTRACT

Biodiesel production is a modern and technological area for researchers due to constant increase in the prices of petroleum diesel and environmental advantages. This paper presents a review of the alternative technological methods that could be used to produce this fuel. Biodiesel from karanja oil was produced by alkali catalyzed transesterification process. Performance of IC engine using karanja biodiesel blending with diesel and with various blending ratios has been evaluated. The engine performance studies were conducted with a prony brake-diesel engine set up. Parameters like speed of engine, fuel consumption and torque were measured at different loads for pure diesel and various combinations of dual fuel. Brake power, brake specific fuel consumption and brake thermal efficiency were calculated. The test results indicate that the dual fuel combination of B40 can be used in the diesel engines without making any engine modifications. Also the cost of dual fuel (B40) can be considerably reduced than pure diesel.

Keywords: transesterification, IC engine, Karanja, biodiesel.

INTRODUCTION

Biodiesel is the name of a clean burning alternative fuel, produced from domestic, renewable resources. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in compression-ignition (diesel) engines with little or no modifications. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics.

Biodiesel is made through a chemical process called transeterification whereby the glycerin is separated from the fat or vegetable oil. The process leaves behind two products-methyl esters (the chemical name for biodiesel) and glycerin (a valuable byproduct usually sold to be used in soaps and other products [1].

Biodiesel is better for the environment because it is made from renewable resources and has lower emission compared to petroleum diesel.

The transesterification is achieved with monohydric alcohols like methanol and ethanol in the presence of an alkali catalyst. Biodiesel and its blends with petroleum-based diesel fuel can be used in diesel engines without any significant modifications to the engines. The advantages of biodiesel are that it displaces petroleum thereby reducing global warming gas emissions, tail pipe particulate matter, hydrocarbons, carbon monoxide, and other air toxics. Biodiesel improves lubricity and reduces premature wearing of fuel pumps [2]

MATERIALS AND METHODS

Performance evaluation of engine

The engine performance tests were conducted with a prony brake-diesel engine set up. The parameters like speed of engine, fuel consumption and torque were measured at different loads for diesel and with various combinations of dual fuel. Brake power, brake specific fuel consumption and brake thermal efficiency was calculated using the collected test data.

Effect of load on torque

The effect of load on torque for different fuels is presented in Figure-1. The relationship between the load and the torque for various fuels is shown in Figure-1. It can be observed that as the load increases, torque increases to the maximum at 70% load and then decreases for all the fuel samples. When the torque produced by the engine at different loads for the diesel and various mixtures of dual fuel is compared, it is found that the torque increases up to B40 and then it decreases. The increase in torque is due to the higher calorific value of diesel and that of the dual fuel mixtures from B5 to B40, as well as complete combustion of fuels. In the case of dual fuel mixtures from B40 to B100, the quantity of karanja biodiesel increases which results in low calorific value. Because of this low calorific value the torque decreases for the blends from B40 to B100.

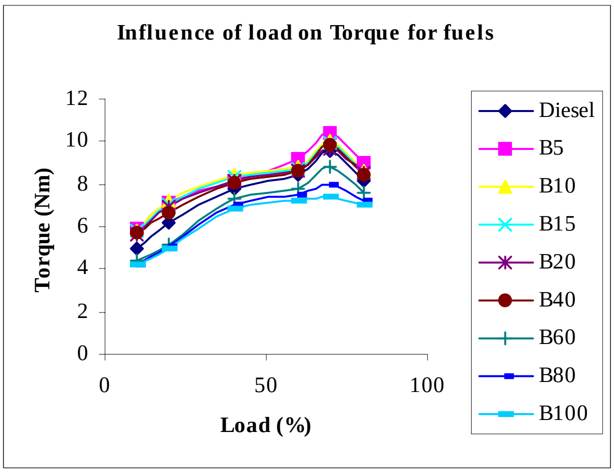

Figure-1. Load and torque for different blending ratios.

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Brake power

The influence of load on brake power for different fuels is presented in Figure-2. It can be observed from the figure that as the load increases, brake power increases to the maximum at 70% load and then decreases for all the fuel samples. When the brake power produced by the engine at different loads for different mixtures of dual fuel is compared, it is found that the brake power increases up to B40 and then it decreases. When the brake power at different loads is compared for diesel and different combinations of dual fuel, it is noted that the brake power is higher for the dual fuel combinations from B5 to B30 than diesel. In the case of B40 the brake power is more or less equal to that of diesel. For the dual fuel combinations from B50 to B100, the brake power is less than that of diesel. Hence it can be concluded that the dual fuel combination of B40 can be recommended for use in the diesel engines without making any engine modifications. At the same time the cost of dual fuel (B40) can be considerably reduced than pure diesel.

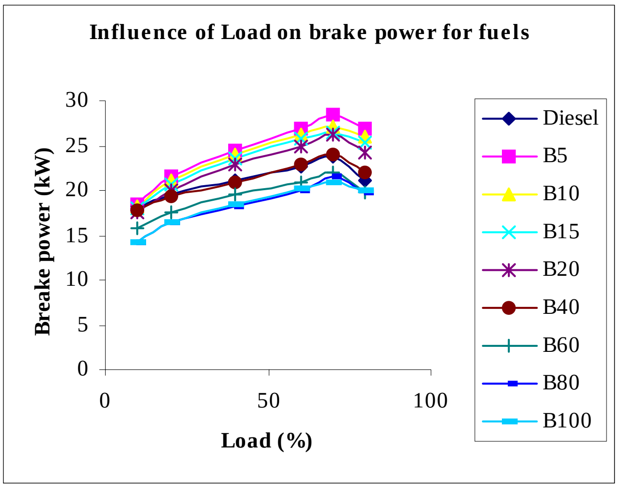

Figure-2. Break power for different loads.

Brake specific fuel consumption

Figure-3 shows that as the load increases, brake specific fuel consumption decreases to the minimum of at 70% load and then increases for all the fuel samples tested. This can be correlated to the test results obtained for the brake power. The specific fuel consumption (SFC) for B5, B10, B15, and B20 are more or less equal to that of diesel. The SFC for B40, B60, B80 and B100 are continuously increasing and they are less than the SFC for diesel. This may be due to the lower calorific value of biodiesel than diesel.

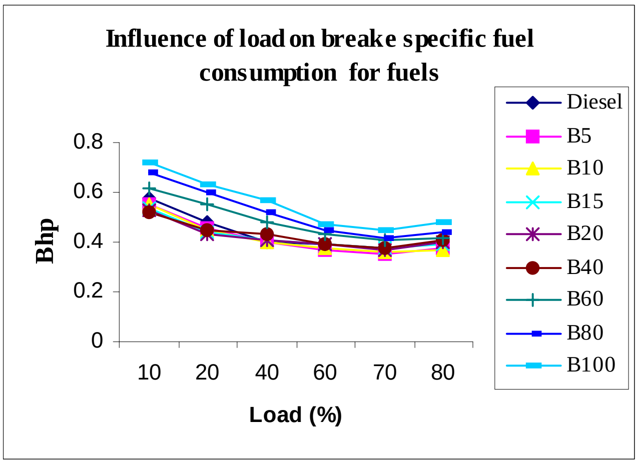

Figure-3. Beak horsepower for different loads.

Brake thermal efficiency

Referring to Figure-4, it is observed that as the load increases, brake thermal efficiency increases up to 70% load and then decreases for all the fuel samples tested. The low brake thermal efficiency for B60, B80 and B100 may be due to the lower HHV and the increase in fuel consumption. Further it is noticed that the brake thermal efficiency for B40 is more or less equal to that of diesel.

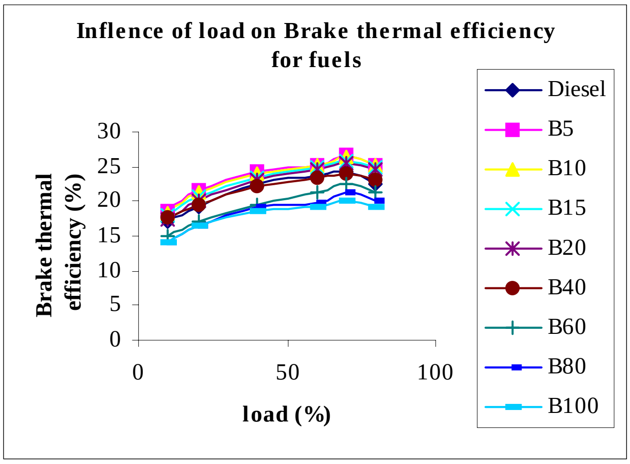

Figure-4. Brake thermal efficiency for different loads.

RESULTS AND DISCUSSION

Engine performance tests using karanja biodiesel and its blends with diesel

As the load increases, torque increases to the maximum at 70% load and then decreases for all the fuel samples. When the torque produced by the engine at different loads for the diesel and various mixtures of dual fuel is compared, it is found that the torque increases upto B40 and then it decreases. The increase in torque is due to the higher calorific value of diesel and that of the dual fuel mixtures from B5 to B40 as well as complete combustion of fuels.

In the case of dual fuel mixtures from B40 to B100, the quantity of karanja biodiesel increases which results in low calorific value. Because of this low calorific value the torque decreases for the blends from B40 to B100. As the load increases, brake power increases to the maximum at 70% load and then decreases for all the fuel samples.

When the brake power produced by the engine at different loads for different mixtures of dual fuel is compared, it is found that the brake power increases upto B40 and then it decreases.

When the brake power at different loads is compared for diesel and different combinations of dual fuel, it is noted that the brake power is higher for the dual fuel combinations from B5 to B30 than diesel. In case of B40 the brake power is more or less equal to that of diesel. For the dual fuel combinations from B50 to B100, the brake power is less than that of diesel. Hence it can be concluded that the dual fuel combination of B40 can be recommended for use in the diesel engines without making any engine modifications. At the same time the cost of dual fuel (B40) can be considerably reduced than pure diesel.

As the load increases, brake specific fuel consumption decreases to the minimum of at 70% load and then increases for all the fuel samples tested. This can be correlated to the conclusion that the brake power increases as the load increases.

The specific fuel consumption (SFC) for B5, B10, B15, and B20 is more or less equal to that of diesel. The SFC for B40, B60, B80 and B100 are continuously increasing and they are less than the SFC for diesel. This may be due to the lower calorific value of biodiesel than diesel

As the load increases, brake thermal efficiency increases upto 70% load and then decreases for all the fuel samples tested. The low brake thermal efficiency for B60, B80 and B100 may be due to the lower HHV and the increase in fuel consumption.

From the above discussions, following conclusions can be drawn.

- For all the fuel samples tested, torque, brake power and brake thermal efficiency reach maximum values at 70% load.
- The dual fuel combination of B40 can be recommended for use in the diesel engines without making any engine modifications. Also the cost of dual fuel (B40) can be considerably reduced than pure diesel.
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