PERFORMANCE AND EMISSION CHARACTERISTICS OF A SINGLE CYLINDER FOUR STROKE CYCLE DIRECT INJECTION DIESEL ENGINE USING BIODIESEL-DIESEL BLENDS AS FUEL

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Abstract

This paper describes the performance and emission characteristics with biodiesel diesel blends on a single cylinder four stroke cycle direct injection diesel engine. Use of biodiesel diesel blends can conserve diesel. Biodiesel is renewable source of energy and will save foreign exchange in importing the diesel in crores of Indian rupees. The engine was mounted on test bed and fitted with all attachments like hydraulic dynamometer , fuel consumption and air consumption measuring systems. Exhaust gas analyzer was used for measuring emissions. The engine was run in the neat diesel mode and data was collected for power , speed , air and fuel consumption .Exhaust emissions were also measured. The experiments were repeated for 20% , 40% , 60% , 80% and 100% biodiesel substitution. The biodiesel was prepared from karanja oil. It was seen that the power output was improved with biodiesel substitution . There was also reduction in the BSFC and opacity with increased biodiesel substitution in diesel.

Keywords *: Engine , Diesel , biodiesel , Alternate fuels , Experimental , Performance , Emissions*

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Introduction

It is well known fact that the petroleum resources are getting depleted. On the other side the use of petroleum in automotive sector is increasing at an alarming rate. In order to meet future energy demands and to conserve petroleum , other alternative fuels have to be tested and used in vehicles.The present worldwide strategy is to opt for cleaner fuels which are renewable as well as environmental friendly. Biodiesel produced from different sources has been successfully used in diesel engines upto 100% substitution. Biodiesel is presently prepared from different oils including Karanja. Biodiesel is prepared in India from different plants. It can save foreign exchange for our country and being obtained from plants it is a renewable source of energy.Is is observed that biodiesel can produce comparable power in diesel engines. It also reduces the smoke emissions from diesel engines.

Experimental setup.

Test engine

The engine used for the present experiments is a water cooled , 5 H.P , !500 rpm , vertical , single cylinder diesel engine . The major specifications of the engine are given in Appendix 1. The experimental set up is shown in plate no. 1. The fuel metering system consists of a 5 litre tank for diesel / biodiesel-diesel blends. Fuel flow is measured with the help of calibrated burette and stop watch.

The air flow rate is measured with the help of an U-tube manometer and a drum fitted with orifice. The engine is fitted with a constant speed governor which maintains the speed of the engine at 1500 rpm . The engine is lubricated by crankcase lubrication. The speed of the engine is measured by optical digital tachometer.

Engine dynamometer

The test engine is coupled with a hydraulic dynamometer mounted on a cast iron test bed. The dynamometer has sufficient capacity to absorb the maximum power produced by the engine.

Plate No.1: Experimental set up.

The dynamometer is loaded hydraulically by controlling flow rate of water and the torque is measured with the help of a spring loaded meter.

Instrumentation

The instruments used for measuring the basic quantities are described here.

Temperature measurement

Temperatures were measured using dial gauge thermometers.

Smoke meter.

The emissions were measured with the help of smoke meter. The opacity of the exhaust gas was measured in HSU units by inserting the probe in the exhaust manifold .

Test procedure

The basic quantities that were measured during the experimental investigations were, fuel consumption, air consumption, engine speed, torque output, exhaust gas temperature and opacity in HSU units. Comprehensive experiments were carried out for both neat diesel , 20% biodiesel-diesel blend ,40% biodiesel-diesel, 60% biodiesel-diesel blend , 80% biodiesel-diesel blend and 100% biodiesel over a wide range of load on the engine.

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Results and discussion

Effect of load on power

The Fig.1 shows the effect of load on power for neat diesel and biodiesel- diesel blends. It is clear that as the load will increase the power developed also increases.

The bhp is slightly higher for higher percentage of biodiesel fuel as compared to neat diesel. These characteristics are confirming the fact of combustion performance improvement due to biodiesel fuel addition with neat diesel. Biodiesel has higher cetane rating than petro-diesel which improves its combustion characteristics. Although biodiesel has about 9% lesser heating value than petro-diesel but its much higher cetane number as compared to 40 cetane number of petro-diesel helps in maintaining better combustion characteristics with with biodiesel-diesel blends.

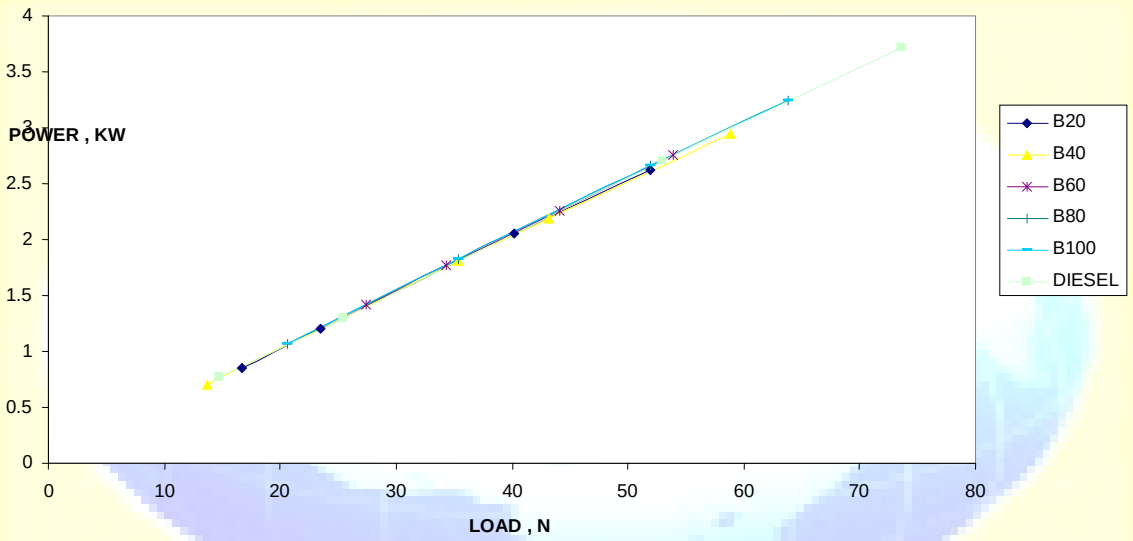

FIG.1 Effect Of Load On Power

Effect of load on bsfc

The Fig.2 shows the effect of load on BSFC for neat diesel and biodiesel-diesel blends. The BSFC decreases with increasing load on the engine. As the load on the engine increases the power developed by engine also increases. The bsfc decreases with load as the power develops at higher rate than corresponding fuel consumption. With increased biodiesel substitution the bsfc is lower than neat diesel as the much higher cetane number of biodiesel helps in developing better power and decreases fuel consumption due to better combustion characteristics.

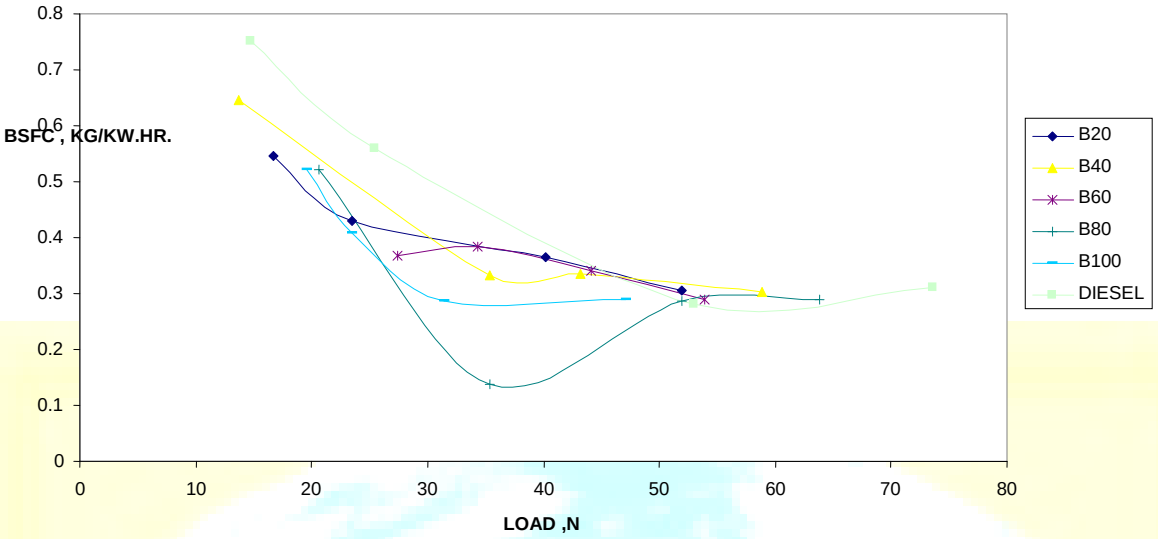

FIG.2 effect of load on bsfc

Effect of load on opacity and emissions

Fig.3 shows the effect of load on opacity for neat diesel and biodiesel-diesel blends. The emissions (opacity) increases as load is increased due to higher rate of fuel consumption at higher loads. The emissions (opacity) are comparatively less for various biodiesel-diesel blends in comparison with neat diesel. It is observed from the graph that with the increase in biodiesel concentration opacity tends to decrease because the favourable chemical composition of biodiesel together with better combustion characteristics due to much higher cetane number helps in reducing opacity.

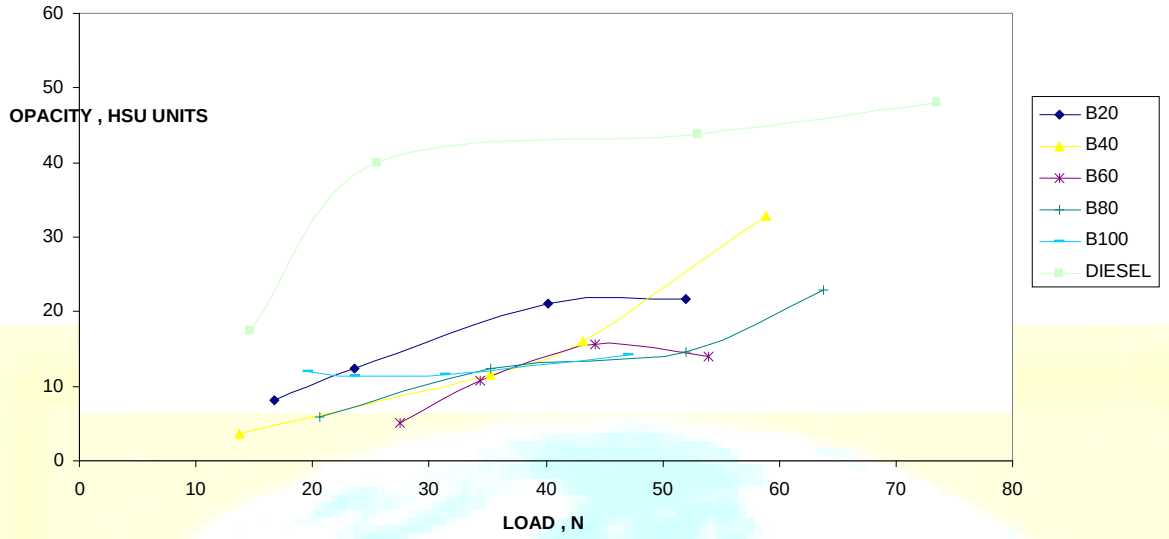

FIG.3 effect of load on opacity (emissions)

Effect of load on exhaust gas temperature

Fig.4 below shows the effect of load on exhaust gas temperature for neat diesel and biodiesel-diesel blends. The exhaust gas temperature increases with load due to higher rate of fuel consumption at higher loads. It can be interpreted from the graph that exhaust gas temperature values are higher for biodiesel-diesel blends due to better combustion because of higher cetane number of biodiesel.

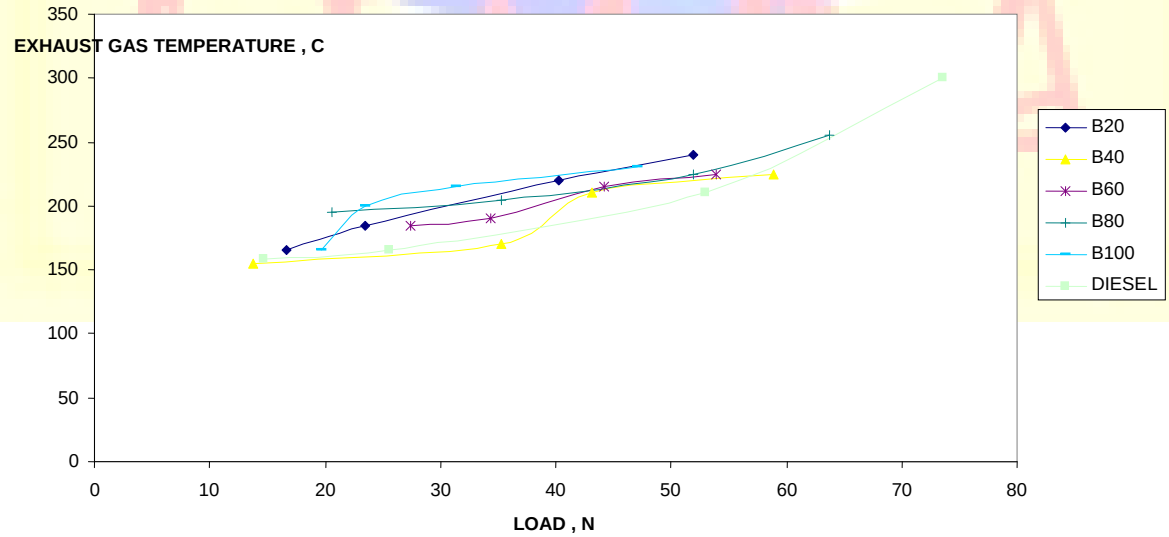

FIG.4 effect of load on exhaust gas temperature

Conclusions

1. For the conservation of petroleum the biodiesel can be safely used in diesel engines upto 100% substitution.

2. Pollution levels with biodiesel-diesel blends are lower.

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Appendix A

Diesel Engine Specifications	
Type	Direct Injection Diesel Engine.
Bore	80 mm
Stroke	110 mm
Cycle of Operation	Four Stroke
Ignition	Compression Ignition.
Compression Ratio	16:1
Number of Cylinders	1
BHP	5
RPM	1500
Cooling	Water Cooled

Appendix B

Table 1: Physico-Chemical Properties of Diesel and Biodiesel

Fuel Property	Diesel	Pongamia (Karanja) Based Biodiesel
Formula	C_8 TO C_{25}	C_{18} TO C_{19}
Molecular weight	200	300
Lower Heating value, 1000 KJ/L	35-37	32
Cetane Number	48	47
Flash Point , C	45	206