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Performance Analysis of Bio-diesel Blends in DI Diesel Engines

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ABSTRACT

In this paper, experimental investigation has been carried out to analyze the performance characteristics of a direct injection (DI) compression ignition engine using biodiesel obtained from cotton seed oil with blends of diesel fuel by B5, B10, B15 and B20 on volume basis. Engine tests have been carried out on 4.4 kW, constant speed at 1500 rpm, compression ratio 18.1, single cylinder water-cooled 4-stroke Diesel engine by varying the load for different blends with 2 hole nozzle at 140 psi. The results show that the engine performance parameters for various blends of diesel and these parameters are compared along with pure diesel and it is evident that biodiesel as a alternative fuel to diesel fuel.

Keywords: biodiesel, performance, parameters, CI engine.

1. INTRODUCTION

Bio-energy is an essential alternate energy source for diesel engines and it is renewable in nature. Biodiesel derived from various edible and non-edible seed oils are transesterified [1-4]. Increase in population limits the use of edible oil usage which increases the cost. It is suggested that the use non-edible oil from various resources like biomass derived sources and seeds to reduce the cost and effective utilization [5]. In the present situation, rice bran oil was chosen and its combustion characteristics of DI diesel engine were investigated. The brake fuel consumption rice bran oil blend was found to be higher than that of diesel [6]. The experimental work carried out on a DI multi-cylinder diesel engine with diesel methanol blend and neat karanji oil derived biodiesel under constant speed and varying load conditions. The result shows that delayed ignition increases a thermal efficiency by 4% [7]. Methyl Esters of refined vegetable oil is transesterified to produce biodiesel by varying the injection pressure, blends and various loading. The brake thermal efficiency of refined biodiesel is slightly higher than that of diesel fuel [8]. The experiments were conducted on a water-cooled single-cylinder Direct Injection (DI) diesel engine for various blends of ethanol. The results indicate that brake thermal efficiency and specific fuel consumption increased with increase in ethanol contents in the blended fuel and Co and Nox emissions reduced for ethanol blends but HC increases when compared to diesel [9]. Straight vegetable oils with higher viscosity used in stationary engines with dual tank arrangements. For high viscosity oils preheating is done by exhaust gases, but straight vegetable oils reduce Nox emissions which is the major concern of the environment [10].

The Diesel like Fuel is produced from waste engine lubrication oil purified from dust, heavy carbon soot, metal particles, gum-type materials and other impurities. Then the fuel is tested in CI engine without any modification. The test results shows that the torque, brake thermal efficiency and brake mean effective pressure increases and decreases brake specific fuel consumption of the engine for full power of operation[11]. Mahua oil and its blends with diesel was prepared by transesterification. B5 and B20 blends results higher efficiency compared with neat biodiesel and substitute for diesel in diesel engines in transportation and agricultural sector [12].Simarouba oil based methyl ester is blended with diesel (B10, B20, B30 and B100) were tested in DI diesel engine by varying brake power. B30 gives higher brake thermal efficiency, brake fuel consumption and exhaust gas temperature in comparison with diesel. Emissions such as HC are reduced as compared to diesel and NOx emissions increases when fueled with diesel [13-20].

2. EXPERIMENTAL WORK

2.1 Biodiesel production

Cotton seed oil is extracted from non-edible cotton seed by crushing the oil seeds in the machine before it was dried at a temperature 40-60degree C to remove moisture from it. Then the oil is purified and transesterified with the presence NaOH catalyst to produce esters of cotton seed oil and a byproduct of Glycerol.

The mixture is stirred continuously and then allowed to settle under gravity in a funnel. Then the upper layer is washed and esters of oil in the lower layer is mixed with warm water to remove the catalyst present in the oil and is allowed to settle for 24 h. the ester was then blended with neat diesel to conduct experiments.

2.2 Experimental set up

The present study was carried out to investigate the performance characteristics of methyl ester of cotton seed oil and its blends to determine the performance parameters such as brake torque, brake power, brake mean effective pressure, brake specific fuel consumption and thermal efficiency. It is necessary to calculate the above parameters, fuel and air consumption's, heating capacity of the fuel, load and speed is to be measured. The 4Stroke diesel engine with 4.4 kW, 1500 rpm water cooled engine with electrical loading was used to conduct the performance test. The experiment was conducted for different blends (B5, B10, B15 and B20) for different loads.

3. RESULTS & DISCUSSION

Brake thermal Efficiency (Ƞbt)

The brake thermal efficiency and performance of the cotton seed oil as shown in

It is observed that, at 1.8kW and 1.2kW the thermal efficiency of B15 is slightly higher than pure diesel the higher thermal efficiency is due better atomization of fuel and spray characteristics and higher oxygen content increases the thermal efficiency.

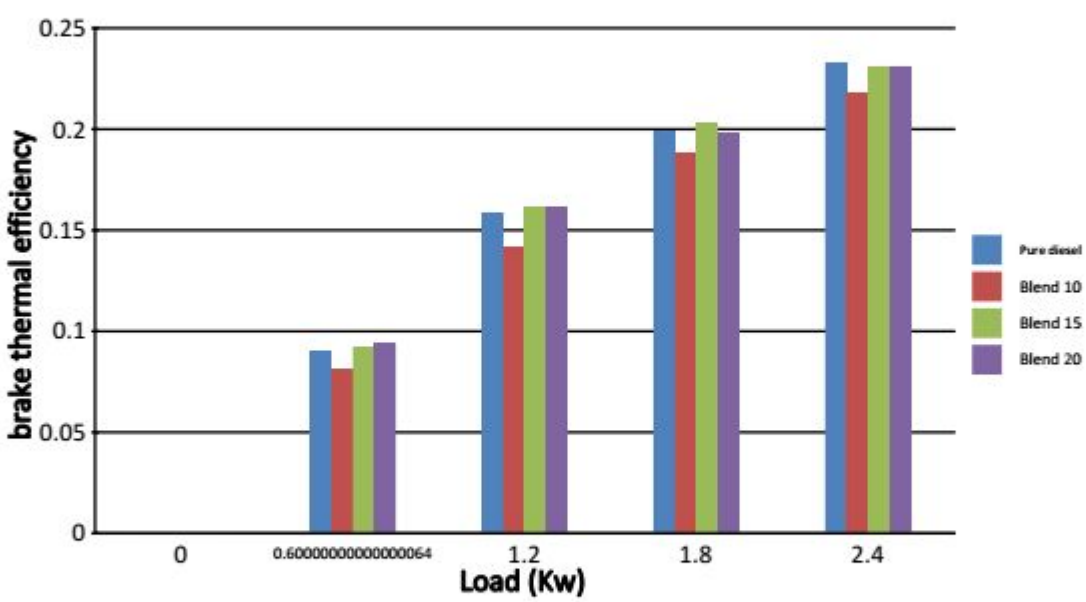

Fig-1

Brake specific fuel Consumption

The brake specific fuel consumption of the various blends at different loads compared with diesel as shown in fig-2. For the blend B10 the fuel consumption was more than the diesel at all loads. This is due poor atomization of fuel. Fuel consumption was lower at lower loads and higher at higher loads for all blends except B10. Fuel consumption for other blends are slightly higher than diesel due to higher density of the fuel.

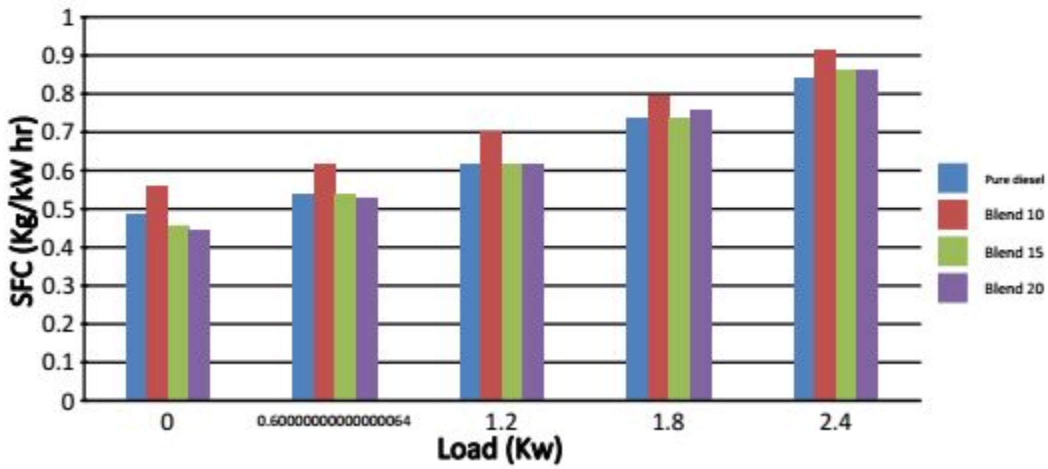

Fig-2

Volumetric efficiency

The volumetric efficiency for the various blends with different loads as shown in fig-3.as the volumetric efficiency of the diesel is slightly higher than biodiesel as the load increases the volumetric efficiency increases. The induction air increases the volumetric efficiency as the load increases.

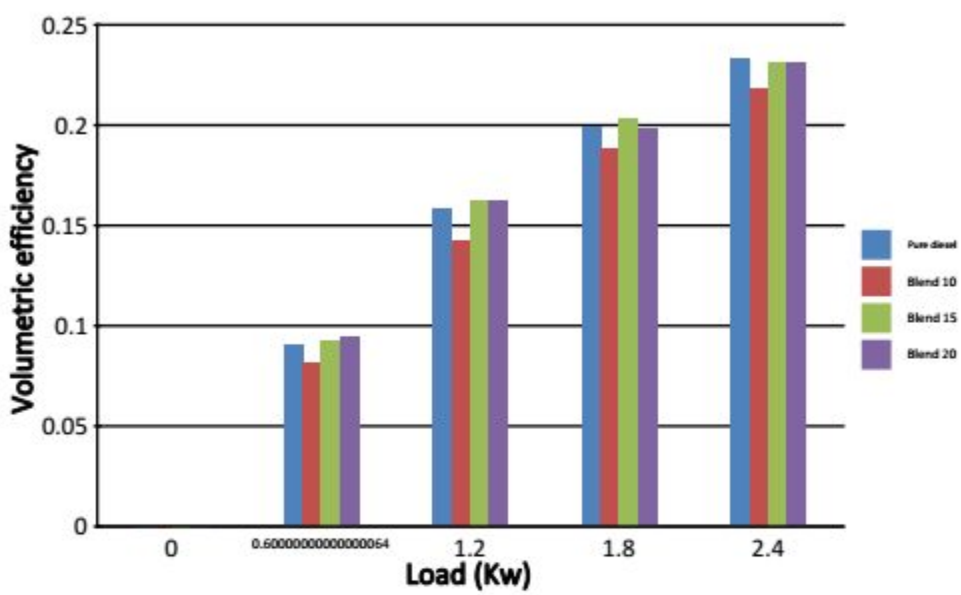

Fig-3

Air-fuel mixture

At lower loads blends B15 and B20 consumes more Air-fuel mixture due to poor oxidation and poor atomization when compared with pure diesel. The Air-fuel mixture for B10 is lower in all the loads when compared diesel, due to better mixing and lower viscosity. In all the blends air-fuel mixture is slightly lower than diesel due to longer ignition delay.

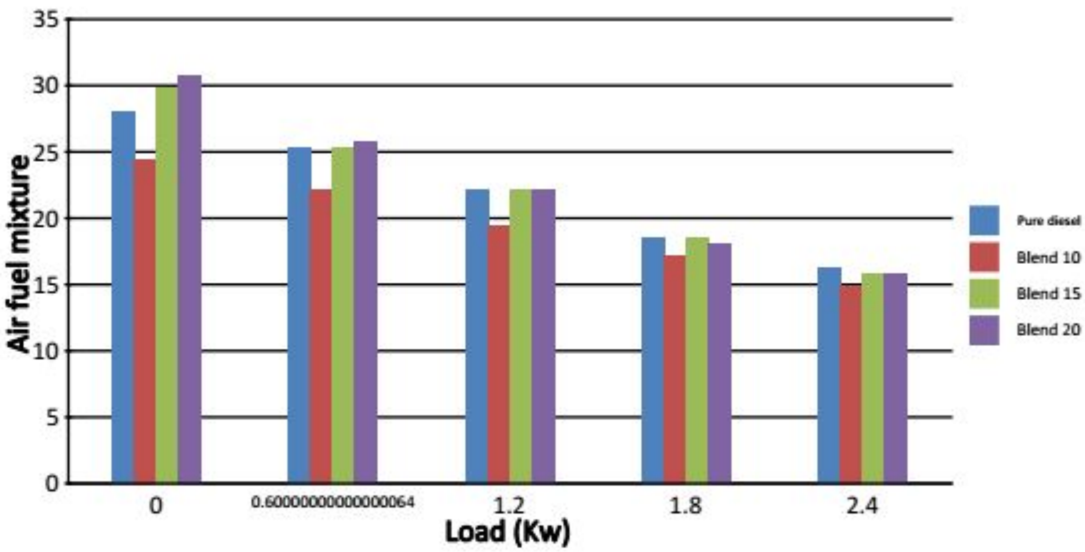

Fig-4

4. CONCLUSION

The performance characteristics of a 4.4kW DI compression ignition engine fuelled with cotton seed oil and its blends have been analyzed and compared to the pure diesel. The specific fuel consumption increases with increase in the blend due to lower calorific value. The brake thermal efficiency decreases with increase in percentage of blended fuel. Increase in oxygen content in the fuel and its blends reduces the fuel requirements and results in better combustion. Among the blends, B15 gives better results as Brake thermal efficiency, brake specific fuel consumption and Exhaust gas temperature without any modification in the diesel engine. In view of the petroleum fuel shortage, B15 blend biodiesel can certainly be considered as a potential alternative fuel.

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