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Characteristics of a Compression Ignition Engine Using Rice Bran Oil Methyl Esters

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ABSTRACT

The utilization of powers on the planet is expanding quickly and it influences the worldwide economy of the considerable number of nations so this factor constrained every one of the nations to locate the elective fuel to lessen and even supplant the use of oil. In this way utilization of biodiesel from non-consumable oil sources fills in as an option in contrast to this issue. In this exploration paper execution and discharges qualities of a diesel engine filled with rice wheat oil were assessed. B10 and B20 mixes of rice grain methyl esters were tried on the engine and it was reasoned that by using rice bran biodiesel BSFC increments and BTE diminishes. Emanation attributes additionally delineate enhancement other than NOx exhalations.

Keywords: *Rice Bran; Biodiesel; Diesel; Performance; Emissions.*

1.0 Introduction

Education Bio-diesel is an option in contrast to oil based energizes got from vegetable oils, creature fats, and utilized waste cooking oil including triglycerides. Expanding natural concern, reducing oil stores and farming based economy of our nation are the main impetuses to advance bio-diesel as a substitute fuel [1,2]. Biodiesel can be procured from an extraordinary assortment of feedstock's which incorporates most normal vegetable oils (e.g., soybean, cottonseed, palm, shelled nut, rapeseed/canola, sunflower, coconut) and animal fats and in addition squander oils (e.g., waste cooking oils). The decision of feedstock depends to a great extent on accessibility. Biodiesel has a higher cetane number than diesel fuel, no aromatics, no sulfur, and contains 10– 11% oxygen by weight [3,4]. The lower sulfur in the mix helps in the decrease in the sulfur dioxide emanations which creates sulfuric corrosive in our environment and these outcomes in the development of corrosive rain. The nonattendance of harmful and cancer-causing aromatics (benzene and xylene) in bio-diesel implies the gases created because of combustion will have decreased effect on human wellbeing and nature. The high cetane rating of bio-diesel (ranges from 49 to 62) is another proportion of the added substance's capacity to enhance ignition effectiveness. Because of natural worry about contamination originating from vehicle emanation, biodiesel is rising as a creating territory of high concern [5– 9].Generally the immediate utilization of vegetable oils in the diesel engines isn't prescribed because of their high viscosity, which influences combustion. So as to lessen its viscosity so it tends to be utilized in like manner diesel engines without making any change in the engine the transesterification technique is utilized to decrease the high consistency of oil [10–13]. Rice wheat oil positions first among the non-ordinary, reasonable, second rate vegetable oils [14]. Besides, rough rice bran oil is a rich wellspring of high esteem included side-effect. In this manner, utilization of rice wheat oil as crude material for the creation of biodiesel makes the procedure conservative as well as produces esteem included bio-dynamic mixes. Detachment and sanitization of these side-effects make the procedure appealing and gainful. Along these lines, if the side-effects are gotten from unrefined rice bran oil and the resultant oil is utilized as feedstock for biodiesel, the subsequent biodiesel could be very efficient and reasonable. In the present investigation, rough rice bran oil is picked as potential options for delivering

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biodiesel and use as fuel in four stroke diesel engine. The kinematic viscosity of unrefined rice bran oil is anyway a few times higher than that of diesel oil [8] and this prompts issues in siphoning and atomization in the infusion arrangement of a diesel engine so their consistency must be brought down. The joined impact of high viscosity and low unpredictability causes poor ignition, failure to discharge and start delay.

Subsequently, it is important to convey their burning related properties closer to those of diesel oil [4]. The free unsaturated fat (FFA) substance of rough rice grain oil is high relying upon the nature of rice bran from which the oil has been extricated. Due to the high FFA content for rough rice grain oil a 2-organize transesterification process is done which incorporates a corrosive catalyzed transesterification pursued by a base catalyzed transesterification. For refined rice bran oil a solitary stage base catalyzed transesterification was done. The present investigation centers on execution and emanations assessment of rice bran biodiesel as an elective wellspring of fuel.

2.0 Biodiesel Production Methodology

Because of high FFA (15%) for rough rice bran oil transesterification was completed in two phases. First stage is called corrosive catalyzed transesterification in which transesterification response was completed in a water shower shaker and some amount of unrefined rice wheat oil was taken in a cone shaped flagon and it was preheated to the temperature of 60^o C for 30 min. At that point a blend of known amount of sulfuric corrosive (H_2SO_4) as corrosive impetus and methanol was then blended with the preheated raw petroleum. The preheated oil blend was then exposed to 1 h steady mixing at a consistent temperature of 60^o C inside a water shower shaker. After 1 h of steady blending, the blend was filled an isolating pipe for debasements to settle down. After 4– 5 h the settled down polluting influences are isolated from the rest of the oil. After this second phase of transesterification (base catalyzed) begins in which remaining oil amount was estimated and again warmed up to 60^oC. Potassium hydroxide (KOH) as base impetus and methanol was then blended with the remaining preheated oil. The preheated oil blend was of course exposed to 1 h consistent mixing at a steady temperature of 60 C inside a water shower shaker. After 1 h of consistent mixing the blend was filled an isolating pipe for glycerol to settle down. After 2– 3 h settled down glycerol is isolated and evacuated. The rest of the part is methyl ester (biodiesel) of unrefined rice bran oil which is additionally cleaned through washing and drying for evacuation of abundance KOH, methanol and water.

3.0 Experimental Set Up

A single cylinder, small utility diesel engine with a rated power output of 3.73 kW was employed in this study. It was a direct injection, air cooled engine manufactured by Kirloskar Oil India Ltd. Experimentation was done at a constant speed of 1550 rpm. Technical specification of the experimental test set up is illustrated in table 1.

Table 1: Engine Specifications

Parameter	Description
Manufacture	Kirloskar
Engine type	Vertical, 4-stroke
Rated power output (kW)	3.75
Engine cooling	Air cooled
Engine speed (rpm)	1500
No. of cylinder	1
Stroke length, (mm)	110
Bore (mm)	87.5
Compression ratio	16.5 : 1
Displacement volume (cc)	252.9
Injection pressure (kg cm^{-2})	200

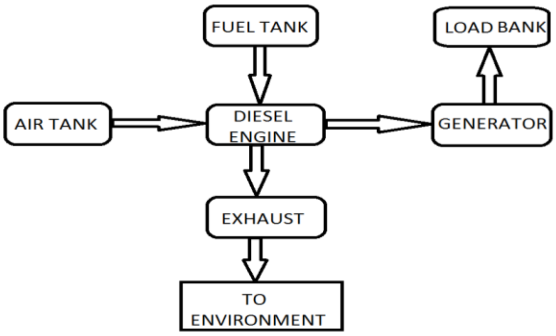
Power output of the engine was measured by an eddy current dynamometer coupled with engine shaft and loaded with help of resistive load bank. An AVL DIGAS 444 N gas analyzer was used to measure the concentration of gaseous emissions such as unburned hydrocarbon, carbon monoxide, carbon dioxide and nitrogen oxides. Digital readings of all the gaseous emissions were obtained by placing the probe in exhaust of cylinder. Smoke meter was used to measure the smoke opacity. Schematic of the engine set up is shown in Fig. 1.

4.0 Results and Discussions

4.1 Brake specific fuel consumption

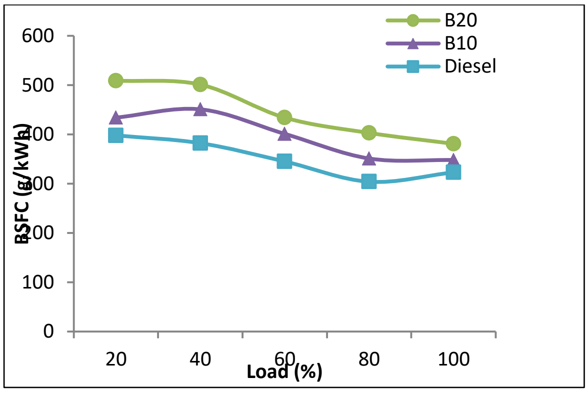
Brake Specific fuel consumption is a crucial criterion, to examine the efficiency with which the fuel is being consumed in an engine. Fig. 2 shows variations of BSFC when engine was fuelled with Rice bran methyl esters compared to baseline diesel. It was observed that with increment in load utilization of fuel decreased for all test fuels. Improved combustion inside the cylinder due to decreased ignition delay, which was result of high cylinder wall temperature at high engine loads, was reason for low BSFC.

Fig 1: Schematic Diagram of Experimental Set up



As quantity of Rice bran biodiesel was increased in fuel blend BSFC was also on higher side which can be owing to more viscosity, low calorific value and high index of hydrogen deficiency of biodiesel.

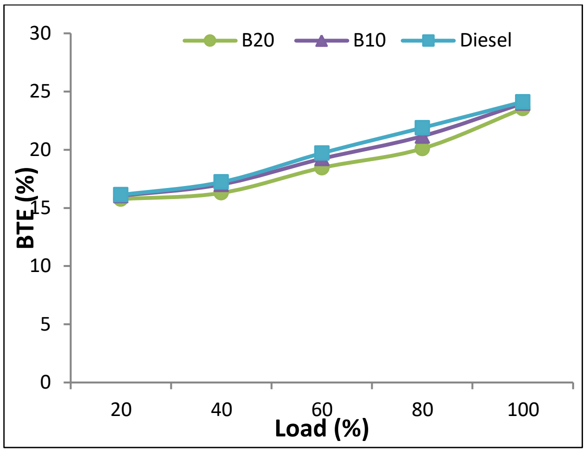
Fig 2: Variation of BSFC with Load



4.2 Effect on brake thermal efficiency

Brake thermal efficiency is the ratio of brake power output to the energy of fuel consumed. It speaks for the combustion quality of the engine. From Fig. 3 it was noticed that BTE was directly proportional to engine load for all fuel blends. It was also found that BTE decreases with addition of Rice bran methyl esters in fuel blends as a result of higher viscosity and lower heating value of biodiesel.

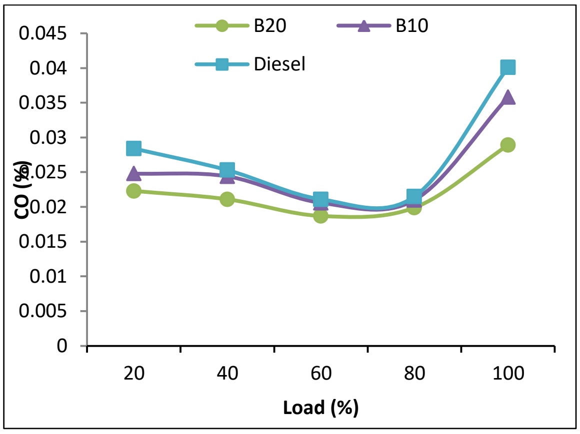
Fig 3: Variation of BTE with Load



4.3 Variation of CO with engine load

Carbon monoxide emissions are the result of incomplete combustion of hydrocarbons available in the fuel. Fig.4 depicts that CO emissions firstly decreases with engine load up to a particular limit and then increase with increase in load. It can also be seen that addition of biodiesel in biodiesel-diesel fuel blends is inversely proportional to CO emissions. It may be due to improved combustion of biodiesel in comparison with diesel, as biodiesel contains lower carbon contents and more oxygen particles.

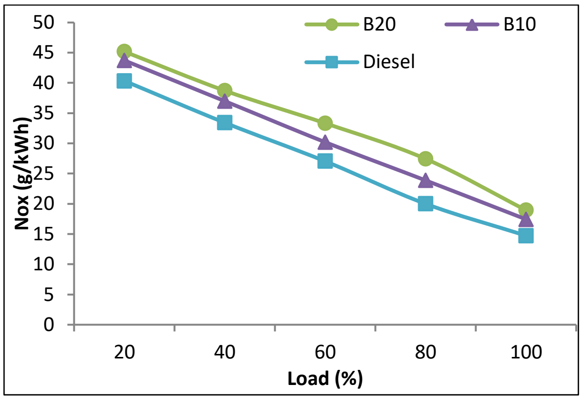
Fig 4: Variation of CO with Load



4.4 Variation of NOx with engine load

Nitrogen Oxides are the consequences of reaction between oxygen and nitrogen particles present in air. It was established from Fig.5 that NOx emissions were more for biodiesel blends as compared to diesel which banks on higher combustion temperature of biodiesel and higher unsaturation degree.

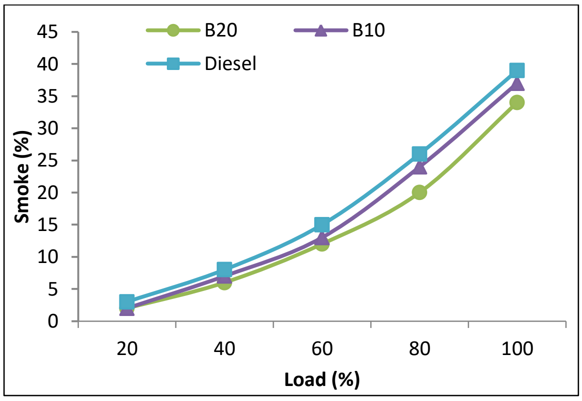
Fig 5: Variation of NOx with Load



4.6 Variation of Smoke with engine load

Incomplete combustion of fuel aids in producing smoke which helps in originating smoke opacity. Fig.6 presents increased trend of smoke emissions with increase in load which is due to high utilization of fuel at higher loads. Fuel blends with biodiesel were having decreased level of smoke emissions than pure diesel owing to higher amount of oxygen in biodiesel which helps in complete combustion of fuel.

Fig 6: Variation of smoke with load



5.0 Conclusions

In this research article biodiesel was prepared from rice bran oil and blended with neat diesel to check its performance and emission characteristics of a diesel engine.

It was reported that BSFC increases while BTE decreases with biodiesel blends in comparison with baseline diesel. Relative to pure diesel, NOx emissions are on higher side whereas a decrement is found for CO and Smoke exhalations.

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