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ISSN:2348-2079

MAR-2016

International Journal of Intellectual Advancements and Research in Engineering Computations

PERFORMANCE AND CHARACTERISTICS ANALYSIS OF FOUR STROKE SINGLE CYLINDER DIESEL ENGINE USING COTTON SEED OIL

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ABSTRACT

Biodiesel, derived from the transesterification of vegetable oils or animal fats, is composed of saturated and unsaturated long-chain fatty acid alkyl esters as a renewable, sustainable and alternative fuel for compression ignition engine, biodiesel instead of diesel. The scope of the project is to find the engine performance and characteristics using biodiesel of cotton seed oil like Brake Power (BP), Specific fuel consumption (SFC), Brake Thermal Efficiency (BTE),indicated thermal efficiency and emission test. . The experiments are carried out with cotton seed oil biodiesel with different combinations like 15%, 25%.B15 blended fuel(15%cso+85%diesel) shows better performance which is very close to neat diesel fuel and also increases the BTE and reduces BSFC and having lower emission without any engine in design modifications.

Keyword: Diesel engine, Alternative fuel, Performance characteristics, Cotton seed oil.

INTRODUCTION

Environmental concerns and limited amount of petroleum resources have caused interests in the development of alternative fuels for I.C. Engines. Petroleum resources are finite and therefore search for their alternative is continuing all over the world. The major energy demand is fulfilled by the use of conventional energy resources like coal, petroleum and natural gas. Diesel engines are commonly used as prime movers in the transportation, industrial and agricultural sectors because of their high brake thermal efficiency and reliability. The increasing industrialization and motorization of the world has led to a steep rise in the demand of petroleum based fuels. Due to the depletion of the world's petroleum reserves and the increasing environmental concerns, there is a great demand for alternative sources of petroleum-based fuel, including diesel and gasoline fuels. The kinematic viscosity of vegetable oils is about an order of magnitude greater than that of conventional diesel fuel. High viscosity causes poor atomization of the fuel in the engine's combustion chambers and ultimately results in operational problems such as engine deposits. Biodiesel can be prepared mainly by four methods i.e. transesterification, pyrolysis, micro-emulsion technique or can be used by direct blending. To obtain biodiesel, the vegetable oil or animal fat is subjected to a chemical reaction termed transesterification. In that reaction, the vegetable oil or animal fat is reacted in the presence of a catalyst (usually a base) with an alcohol (usually methanol) to give the corresponding alkyl esters (or for methanol, the methyl esters) of the FA mixture that is found in the parent vegetable oil or animal fat. Biodiesel can be produced from a great

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variety of feedstocks. These feedstock's include most common vegetable oils (e.g., soybean, cottonseed, palm, peanut, rapeseed/canola, sunflower, coconut) and animal fats (usually tallow) as well as waste oils (e.g., used frying oils). The choice of feedstock depends largely on the geography. Depending on the origin and quality of the feedstock, changes to the production process may be necessary. Biodiesel is miscible with diesel in all ratios. In many these blends with diesel are not biodiesel. Often blends with diesel are denoted by acronyms such as B20, which indicates a blend of 20% biodiesel with diesel. Biodiesel, a clean renewable fuel, has recently been considered as the best candidate for a diesel fuel substitution because it can be used in any compression ignition engine without the need of modification. Chemically, biodiesel is a mixture of methyl esters with long-chain fatty acids and is typically made from nontoxic, biological resources such as vegetable oils, animal fats, or even used cooking oils. Vegetable oils are promising feedstock for biodiesel production since they are renewable in nature, and can be produced on a large scale and environmentally friendly. Vegetable oils include edible and non-edible oils. More than 95% of biodiesel production feedstock comes from edible oils since they are mainly produced in many regions and the properties of biodiesel produced from these oils are much suitable to be used as diesel fuel substitute. There are several distinct advantages of biodiesel over diesel fuel. Biodiesel has higher combustion efficiency, it is biodegradable and more than 90% biodiesel can be biodegraded within 21 days. Biodiesel has lower sulphur and aromatic content than diesel fuel and that means it will not emit lots of toxic gas.

EXPERIMENTAL SETUP AND PROCEDURE

TESTING PROCEDURE

Engine was started and warmed up at low idle, checked for any fuel and oil leaks. The engine was run on no-load condition and speed was checked. Experiments were conducted at different loads such as 0 kg, 2 kg, 4 kg and 6 kg. The engine was running and where data collected. For different blends of CSO, performance tests were carried out at with different load.

SPECIFICATIONS OF THE APPARATUS

In the test setup there are several instruments that have been used for the purpose of the experiment. Brief specifications of the instruments are given below.

Manufacturer	:	Kirloskarindia Limited,
Type of Engine	:	4-stroke single cylinder,
Compression ratio	:	16.5:1
Maximum Power	:	5HP
Type of cooling	:	Water cooling
Rated Speed	:	1500 rpm
Bore and stroke	:	87.5 × 110 (mm).

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Table 1: Specification details of the engine with VCR
EXPERMIENTIAL SETUP

S.No	Parameter	Engine specifications
1	Engine type	Single cylinder four stroke diesel engine
2	Bore x stroke	87.5 mm x 110 mm
3	Maximum power Output	5 HP at 1500 rpm
4	Compression ratio	16.5 : 1
5	Cooling	Water cooling
6	Engine speed	1500 rpm
7	Injection	Direct injection
8	Coefficient of discharge	Cd=0.64
9	Compression principle	Compression ignition
10	Sump capacity	2.70 liter

Fig 1: Engine Setup

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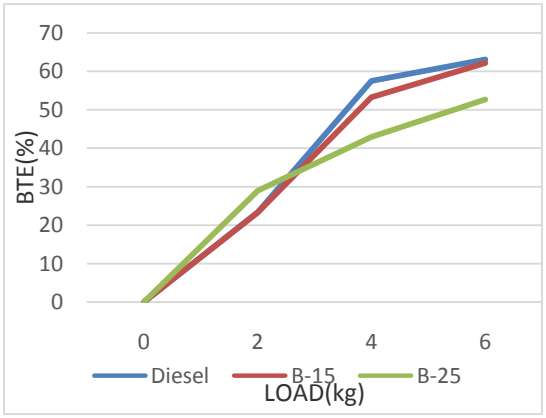
EXHAUST GAS ANALYSER

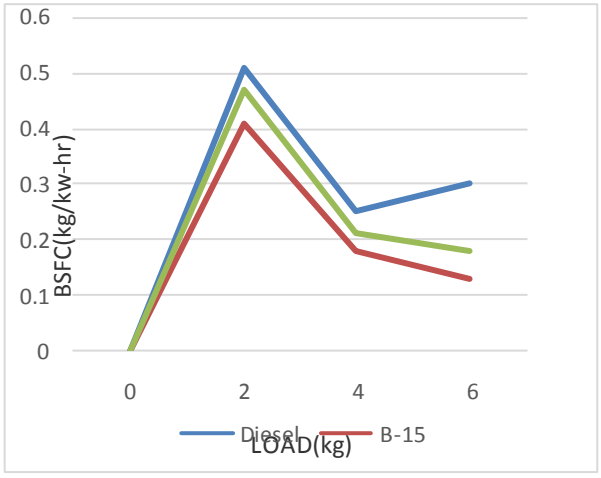
Exhaust gas analyzer is used to determine the emissions such as HC, CO and NO_x.

RESULTS AND DISCUSSIONS

PERFORMANCEAND EMISSION CHARACTERISTICS



Graph shows the variation of BTE for different blends of CSO and neat diesel fuel. It is observed that the BTE gradually increases with increasing load. But there are decreasing brake thermal efficiency for B-25 blended fuel. According to blend ratio, the BTE is reduced with increasing concentrations of biodiesel in the all blend. The BTE for B-15 is higher than that of other blends.



BRAKE SPECIFIC FUEL CONSUMPION (BSFC)

Graph shows the variation of BSFC for different blends of CSO and diesel fuel. At high percentage of blends, the SFC increases. This is due to fuel density, viscosity, and heating value of the biodiesel.

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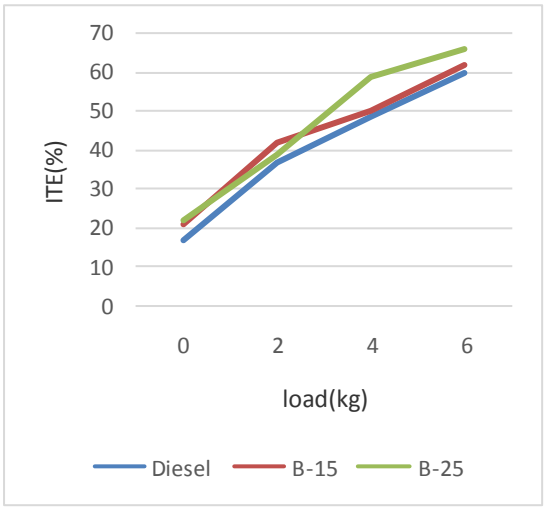
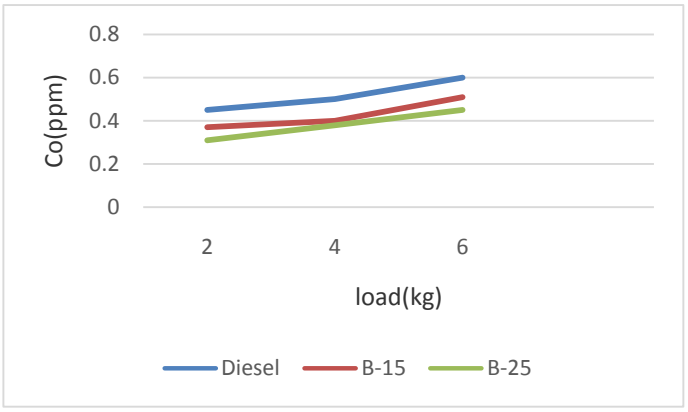
INDICATED THERMAL EFFICIENCY (ITE)



Graph shows the variation of ITE for different blends of CSO and diesel fuel.At high percentage of blends, the ITE increases. Load increases ITE also increases.

EMISSION CHARACTERISTICS

CARBON MONOXIDE (CO)



Graph shows the variation of CO for different blends of CSO and neat diesel fuel. It is observed that the CO gradually decreases with increasing blending ratio of the biofuel. The CO emission for B25 is lower than that of other blends. This is due to presence of additional oxygen content in the biodiesel, which enhances the complete combustion and leads to reduction in CO emission. The carbon monoxide emissions are increased due to more dilution of fresh air with residual gases, lower compression temperature, and poor mixing of fuel and air.

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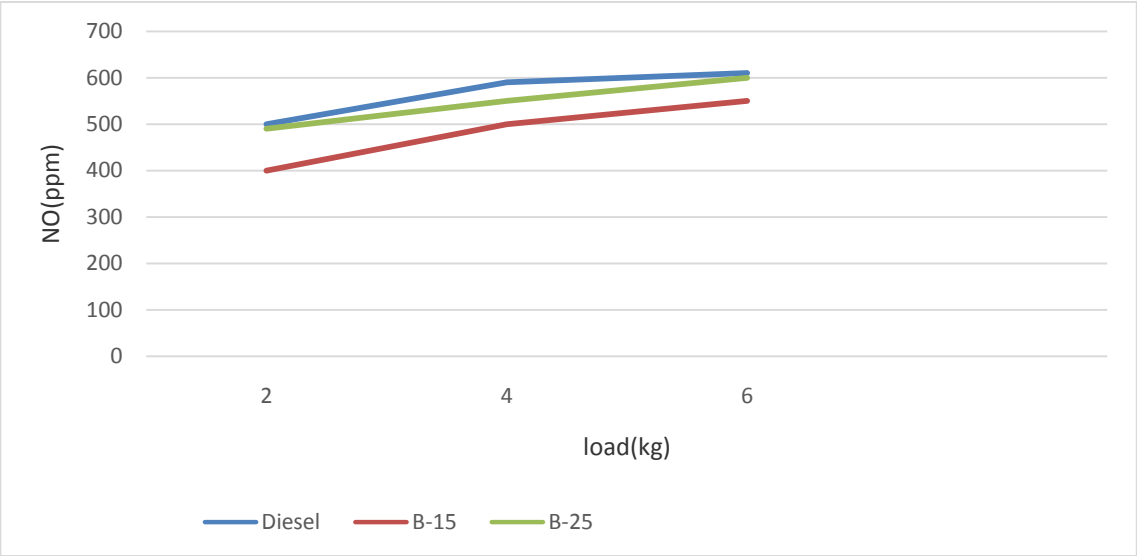
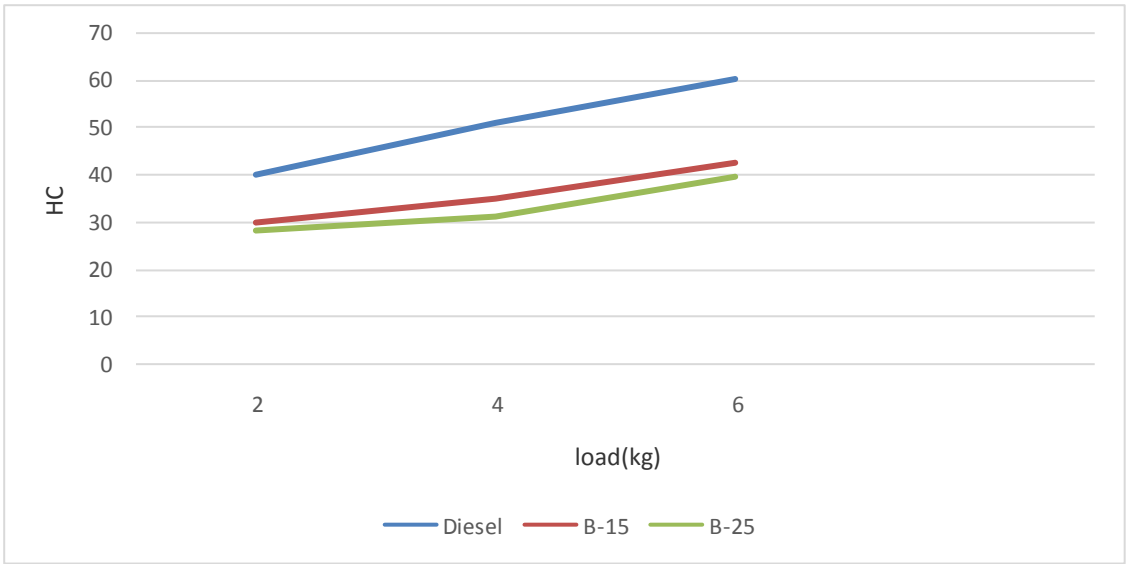
OXIDES OF NITROGEN (NOx)



Graph shows the variation of NOx for different blends of CSO. According to blend ratio, the NOx emission increases with the increasing concentrations of biodiesel in the blend. The NOx emission for B15 is lower than that of other blends under higher full load conditions. This NOx emission increases for all blends due to oxygen present in the biodiesel which may provide excess oxygen for NOx formation.

HYDROCARBON EMISSION (HC)

Graph shows the variation of NOx for different blends of CSO. The HC emission for B-25 is lower than that of other blends under higher full load condition. The HC emissions depend upon mixture strength i.e. oxygen quantity and fuel viscosity in turn atomization. Lower heating value leads to the injection of higher quantities of fuel for the same load condition. Viscosity effect, in turn atomization, is more predominant than the oxygen availability, either inherent in fuel or present in the charge. When compare to diesel, the oxygen availability in the bio diesels is more.



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CONCLUSION

The performance and emission characteristics of different blends of CSO are compared with neat diesel fuel. The summary of conclusions is given below. It is concluded for B15 at maximum load shows better performance and lower emission level when compared to neat diesel fuel and other blends of CSO. The BSFC for B15 is 10% reduction from the neat diesel fuel. The CO, HC, and NO emission reduced. For B25 fuel almost 15% of emission is reduced from neat diesel fuel.

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