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Thermal Performance and Exhaust Emission Analysis of Single Cylinder CI Engine with Karanja oil, Jatropha Oil Blends with Pure Diesel

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ABSTRACT

Currently, alternative fuels are being investigated in detail for application in compression ignition (CI) engines resulting in exciting potential opportunities to increase energy security and reduce gas emissions. Biodiesel is one of the alternative fuels which is renewable and environmentally friendly and can be used in diesel engines with little or no modifications. The objective of this study is to investigate the effects of biodiesel types and biodiesel fraction on the emission characteristics of a CI engine. A stationary diesel engine is tested with different biodiesel-diesel blends, such as B0 (neat diesel), B10 (10 vol. % biodiesel), and B20 (20 vol. % biodiesel) for performance and emissions under different load conditions by Varying Compression ratio (VCR). Engine performance will be studied by measuring brake specific fuel consumption (bsfc) and fuel conversion efficiency (η_f), Brake mean effective pressure (BMEP). The emission of carbon monoxide (CO), hydrocarbon (HC) and carbon dioxide (CO2) will be measured by using 4- way gas analyzer. This study will focus on usage of biodiesel derived from the oils of Karanja and Jatropha Blends with pure diesel.

1. Introduction

Day by day on international level the concern about environmental pollution is growing due to extensive use of different conventional resources as fuels which are found in earth's crust. The nations are continuously working together to mitigate the effect of pollution on environment. Different alternatives are being proposed to replace the conventional diesel fuels. Biodiesel is considered to be most prominent alternative to replace conventional diesel fuel.

Worldwide Diesel is used as the major fuel in transportation. Diesel Engines (CI Engines) have higher compression ratio than Gasoline engine (SI Engines).Hence, it is more favoured for transportation than SI engine due to higher thermal efficiency. But the combustion of Diesel releases many pollutants like CO2, CO, NOx in atmosphere which are solely responsible for pollution and environmental degradation. In recent years use of biodiesel has attracted attention as alternative fuel for diesel in CI engine. The effect of global warming can be mitigated using biodiesel due to low sulphur content and aromatic hydrocarbons

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2. Experimental Setup

The experimentation was done to check out the performance characteristics of Karanja and Jatropha biodiesel. In this experimental setup it consists of single cylinder four strokes C I engine,And it is attached to eddy current type dynamometer for variable loading. Among different engine parameters we choose varying engine load in proportion of 2,4,6 kg and Diesel-Karanja,Diesel-Jetropha biodiesel blends in the proportion of 20,40,60%. Diesel, Karanja biodiesel its blends K20, K40, K60, also J20,J40,J60were used to test on the engine of the specifications mentioned in Table.2. There is no modifications in C I engine were done.The load was given to the engine by using the Eddy current dynamometer. The engine speed in rpm was sensed using a sensor installed in the dynamometer. And on the control panel of the dynamometer recorded speed was displayed.

Fig -1: Test engine setup

1	Number of cylinder	One
2	No. of strokes	4
3	Type of cooling	Water cooling
4	Bore and Stroke	87.5 mm and 110 mm
5	Combustion Principal	Compression Ignition
6	Direction of rotation	Clockwise
7	Maximum speed	2000 rpm
8	Minimum operating speed	1200 rpm
9	Fuel injection Timing for std.engine	23^0BTDC

Table -1: Technical specification of Engine

3. Methodology

To meet the objective, the subsequent steps must be performed:-Find out suitable Karanja biodiesel, Jatropha biodiesel and check out its properties and compared it with pure diesel. Look after all the parameters to be affected in diesel engine.

- Select the parameter on which experiment should be done.
- Experimental set up is being done.
- It contains various equipment like single cylinder four stroke diesel engine of direct injection type, eddy current dynamometer etc.
- In this experiment used the single cylinder water cooled constant speed diesel engine. The experiment is to be done by using the various fuels like Karanja and Jatropha biodiesel - diesel and its blend at different proportion.
- The experimental analysis engine performance characteristics like Break thermal efficiency BSFC, BMEP, and Volumetric efficiency find out for different blends and analyzed.
- The emission constituent considered for evaluation is Carbon dioxide (CO2), Carbon monoxide (CO), Unburned Hydrocarbon (HC).

4. Result and Discussion

According to the observed data collected from the experiment and the calculations are made following analysis are being done at compression ratio 15 and load of 2, 4,6kg. Graphical comparison of different performance characteristics like Break thermal efficiency, BSFC, BMEP, and Volumetric efficiency or different blends of Karanja and Jetropha biodiesel - diesel with varying load is being done.

4.1 Brake thermal efficiency

A comparison of the variation of BTHE with CR 15 for Karanaja blends and Jatrophaoil biodiesel and its blends with Diesel oil at various loads as shown in figure5.1. It can be observed that BTHE increases continuously with increase in Load. The increasing trend is due to higher air temperature achieved at biodiesel blends due to better combustion of fuel. It is also observed that BTHE is decreased with increase in biodiesel content in the blend at a CR 15. Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

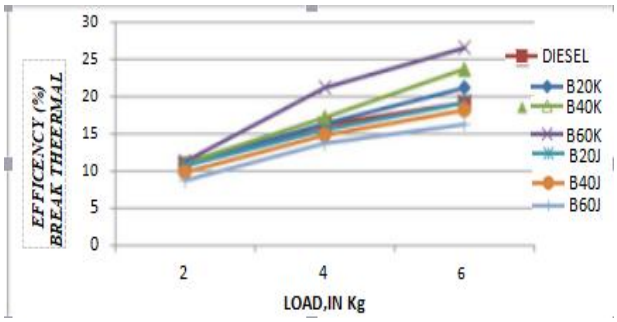

Fig 2 Comparison of Variation of BSFC with Load at CR 15

4.2 Brake specific fuel consumption

It can be observed that as the CR of the engine increases, then BSFC of decreases when load increases and result will obtained nearly B20 Karanja is same BSFC as of pure Diesel but B40 Karanja is less than pure diesel . And in Jatrophaoil biodiesel the BSFC is noticed to be decreases with increases in loads more biodiesel is consumed due to load demand and increasing with the increase in blend ratio shown by figure**3**

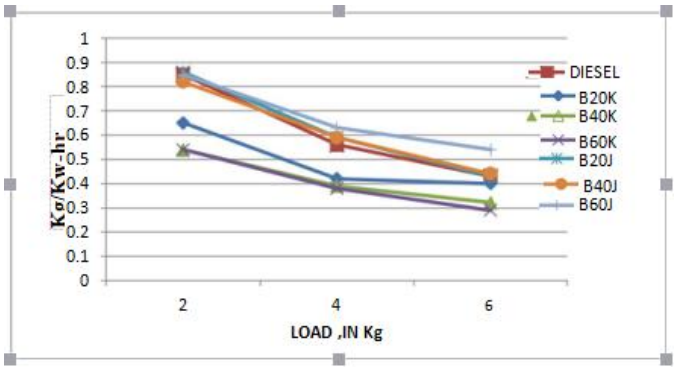

Fig3.Comparison of Variation of BSFC with Load at CR 15

4.3Brake mean effective pressure

It can be observed that BMEP increases linearly with load for all the Karanaja and blends tested. The BMEP at 6kg, CR15 for Diesel oil, B20K, B40K,B 60K, B20J, B40J, and B60J are 1.7, 1.9, 1.9, 2.1, 2.2, and 2.3 bar respectively.

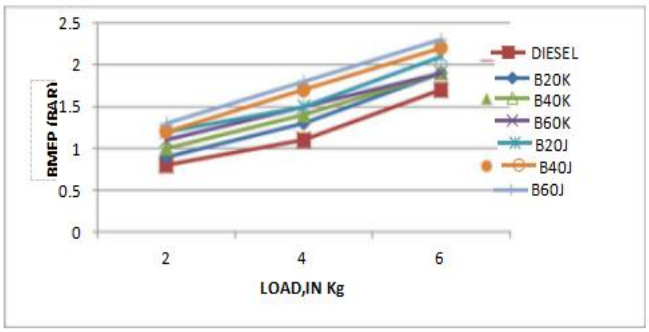

Fig4 Comparison of Variation of Brake mean effective pressure with Load at CR 15

4.4Volumetric efficiency

The performance with Jatrophaoil biodiesel is better than Diesel oil and Karanja blends as fuel in terms of volumetric efficiency. The results are tested are CR 15 and at higher load 6kg for 100% diesel, B20K, B60K, B20J, B40J and B60J are 78.2%, 76.96%, 76.71%, 76.20%, 82.34%, 82.08%, and 83.01% respectively.

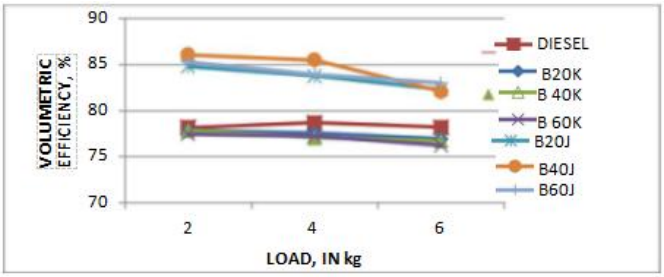

Fig5.Comparison of Variation of volumetric efficiency with Load at CR 15

5. Emission Characteristics

The emission constituent considered for evaluation is Carbon dioxide (CO2), Carbon monoxide (CO), Unburned Hydrocarbon (HC). The variations of the emission constituent with CR15, Load 2, 4,6kg,

5.1CO Emission Analysis

The tested result at CR 15 and 6kg load are 0.02%, 0.02%, 0.015%, 0.015%, 0.018%, 0.012% and 0.011% in volume at 100% Diesel oil, B20K,B 40K, B60K, B20J, B40J, and B60J respectively.

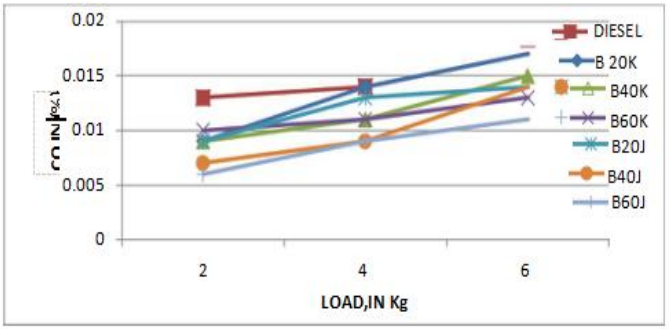

Fig6. Comparison of Variation of CO with Load at CR 15

5.2. CO_2 Emission Analysis

It is observed that CO_2 emission is higher for Jatrophaoil biodiesel compared to Diesel as well as Karanja n at all CRs. The trend may be due to complete oxidation of carbon present in the biodiesel due to its inherent oxygen content. The tested result obtained for CR 15 is 1.2%, 1.3%, 1.3%, 1.4%, 1.2%, 1.6% and 1.8% at 100% diesel oil, B20K, B40K, B60K, B20J, B40J and B60J respectively

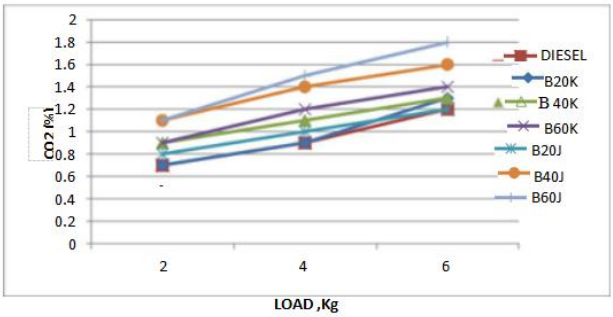

Fig.7 Comparison of Variation of CO2 with Load at CR 15

5.3. HC Emission Analysis

The Percentage of HC is noticed to be increasing with increase of load and decrease with increase in percentage of blend of Jatrophaoil biodiesel and Karanja also.

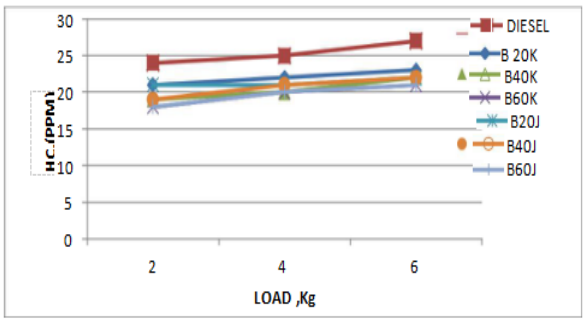

Fig 8. Comparison of Variation of HC with Load at CR 15

6. Conclusion

The main objective of the present investigation was to evaluate the performance characteristic of engine with theKaranja biodisel blends with Diesel oil jatropha biodiesel with Diesel oil. Biodiesel production is mordern and technological area for researchers due to constant increase in prices of petrolium diesel and environmental advantages.

According to the present investigation, it was observed that B20Jshows less brake thermal efficiency while B60K shows more brake thermal efficiency also it was observed that B60K show less specific fuel consumption while B60J shows more specific fuel consumption. It was observed that B60J shows more BMEP while Diesel oil shows less BMEP.

It was observed that B40J & B60J shows less CO constituent than karanja blends Also B40J & B60J shows more CO2 constituent than karanja Diesel oil shows more HC constituent than karanja nd jatropja blends.

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