Experimental Investigation on Performance of karanjaand mustard oil: Dual Biodiesels Blended with Diesel on VCR Diesel engine

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ABSTRACT

The world faces the crises of energy demand, rising petroleum prices and depletion of fossil fuel resources. Biodiesel has obtained from vegetable oils that have been considered as a promising alternate fuel. The researches regarding blend of diesel and single biodiesel have been done already. Very few works have been done with the combination of two different biodiesel blends with diesel and left a lot of scope in this area. The present study brings out an experiment of two biodiesel blends of pongamiapinnata oil (karanja oil) and mustard oil with diesel. They are blended with diesel at various mixing ratios, B5, B10. B15, B20, and B25. The effects of dual biodiesel in engine and performance were examined in a single cylinder, water cooled compression ignition diesel engine at variable compression ratio 17, and 18. The high speed diesel engine is operated at various engine loads from 0, 2, 4, 6, & 8 kg, with constant engine speed of 1500 rpm.

Keywords: Alternative Fuel, Biodiesel, Dual Biodiesel, Performance Analysis.

I INTRODUCTION

Biodiesel is an alternative fuel for diesel engines that is produced by chemically reacting vegetable oil or animal fat with an alcohol such as methanol. These reaction are requires a catalyst, usually a strong base, such as sodium or potassium hydroxide, and produces new chemical compounds called methyl esters. These esters have come to be known as Biodiesel.**Dubey et al. (2016)** present work has tried to use dual fuel, Jatropha biodiesel and turpentine oil in a compression ignition diesel engine, eliminate the use of standard diesel completely and without any modification[1].**Krishnan et al (2017)**performance and emission characteristics of multifuel variable compression ratio engine fueled with karanja oil biodiesel and diesel blends have been investigated and compared with that of standard diesel [2].**Azad et al (2012)** present work has experiment on different mustard oil bio-diesel blends the following conclusions are given below. At starting condition or low load condition the bio-fuel blends have higher BSFC than diesel. But for B30, after 10.0 kg load BSFC becomes lower than any other fuel in the experiment.[3]**Prasad et al. (2016)** conducted experiment on the single cylinder VCR diesel engine ran successfully during tests on dual biodiesels blends of pongamia oil, cotton seed oil. The blends of diesel and the dual biodiesels of pongamia oil and cotton seed oil were characterized for their physical, chemical and thermal properties.[4]**Anbumani et al.(2010)**study on butyl ester of mustard oil at 20% blend with diesel gave best performance in terms of low smoke intensity, emission of HC and NO_x, Cetane number, total fuel consumption, specific energy consumption, specific fuel consumption, brake thermal efficiency, and cylindrical peak pressure were almost equal when engine was run on pure diesel [5].

II MATERIAL AND METHODOLOGY

The two biodiesels (karanja oil and Mustard oil) are prepared by the transesterification process. The dual biodiesel blends were prepared in different proportions as: Blend A-Diesel 95%, KME 2.5% and MEE 2.5% by volume basis; Blend B- Diesel 90%, KME 5% and MEE 5% by volume basis; Blend C-Diesel 85%, KME 7.5% and MEE 7.5% by volume basis; Blend D-Diesel 80%, KME 10% and MEE 10% by volume basis; Blend E-Diesel 75%, KME 12.5% and MEE 12.5% by volume basis.

The various properties like kinematic viscosity, density, calorific value of two biodiesel mixed blends were determined by using IS 1448P methods and compared with diesel properties. The effects of dual biodiesel in engine was examined in a single cylinder, water cooled compression ignition diesel engine at variable compression ratio 17, and 18. The high speed diesel engine is operated at various engine loads from 0, 2, 4, 6, and 8 kg, with constant engine speed of 1500 rpm.Fuel consumption and exhaust gas temperatures were also measured.

III RESULTS AND DISCUSSION

The various properties of the dual biodiesel blends karanja and mustard oil are found and compared with the standard diesel fuel. The performance of the engine was evaluated using several parameters such as brake thermal efficiency (BTE), BSFC and EGT.

3.1 Calorific value : The digital bomb calorimeter has used to find out the calorific value of fuels. IS 1448P-6 procedure has followed to analyze the calorific value of different test fuels. TheCalorific value is decreasing with increase in the percentage of blend of dual biodiesel (karanja and mustard oil). Diesel is higher calorific value than dual biodiesel blends

3.2 Specific gravity of the fuel: One of the important parameters, measurement was performed via a hydrometer.. Measurement temperature was stated as $15^{o}C$ in the related standard. At this temperature, density of the biodiesel should be around 800-900 kg/m^3 according to IS 1448P-32. Experimental method is performed according to IS 1448P-32. The blends A, blends B and t specific gravity of the fuels are 0.833 and 0.837 and pure diesel are 0.829. the density is increases with increase the percentage of dual biodiesel blends in Diesel, The maximum density is pure dual biodiesel.and Minimum density for the pure diesel.

3.3 Kinematics Viscosit: Calibrated Redwood viscometer has used for determining the kinematic viscosity. IS 1448P-25 procedure was followed to. Analyze the viscosity of fuels. The kinematics viscosity is increases with increase the percentage of dual biodiesel blends in diesel, the maximum viscosity is pure dual biodiesel (50%karanja and 50% mustard oil) and minimum kinematics viscosity for the pure diesel. The blends A, blends B, blends C kinematic viscosity are 3.46, 3.53 and 3.67 and diesel fuels kinematics viscosity 3.15

IV PERFORMANCE PARAMETERS

4.1 Brake thermal efficiency: Brake thermal efficiency (BTE) of the engine indicates the fraction of fuel energy converted to useful power output. BTE is typically used for evaluating the performance of an engine. Brake thermal efficiency with load. The dual fuel blends have lower BTE at no load to full load conditions than standard diesel fuel. BTE improved is due to the reduction in friction losses and increases in brake power with the increase in load. The lower volatility and higher viscosity of dual biodiesel resulted in the poor fragmentation and combustion characteristics. But oxygen molecules present in the dual fuel blends slightly improves the combustion characteristics. Therefore, BTE was found to be lower for all dual fuel blend compared to conventional diesel fuel.

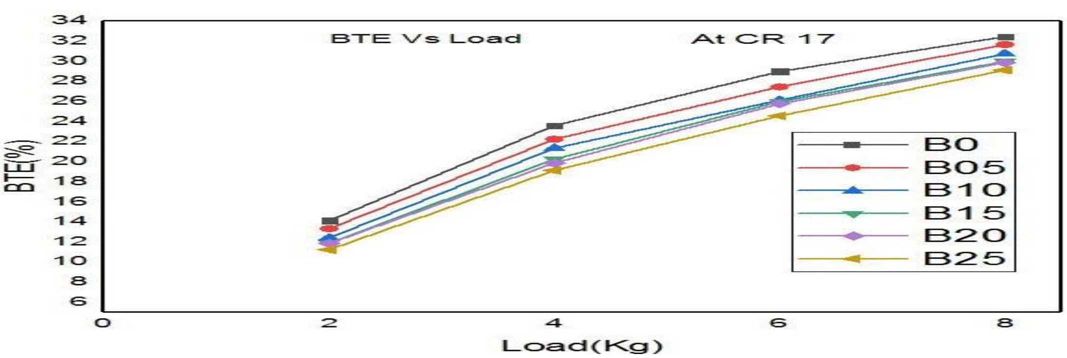

Fig.4.1. BTE Vs Load at CR 17

The compression ratio are increases temperature inside the cylinder increases then the viscosity of dual biodiesel has reduced its give the good vaporizations of dual biodiesel fuel, leads to better combustion of the fuel, increases brake thermal efficiency.AT a full load BTE of blends blends A, blends B, blends C, blends D, and blends E, are 31.96%, 31.76%, 31.63%, 31.41%, 30.96% which is lower than the diesel fuel BTE 32.65% at the CR 18.

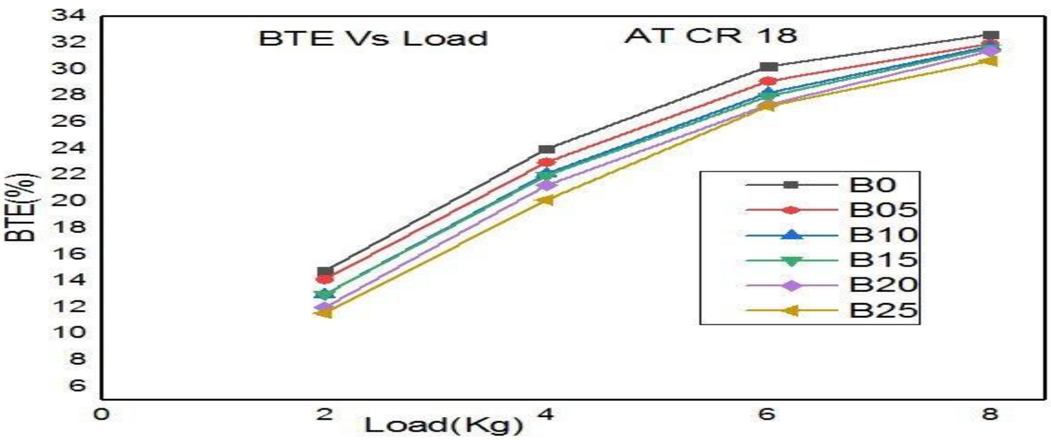

Fig.4.2 BTE Vs Load at CR 18

4.2 Brake specific fuel consumption: In this case the load increases brake specific fuel consumption (BSFC) reduces. But higher specific fuel consumption for dual biodiesel, because due lower calorific value of blends. At low load condition the brake specific fuel consumption is higher for the dual biodiesel fuels but the load start increasing an adverse effect is seen. The reason is that at the higher load Temperature inside the cylinder increase, due to increase of the temperature viscosity of the dual fuel decreases which case proper atomization of the fuel. At higher load, break power of the engine increase &hence at higher load BSFC decreases.

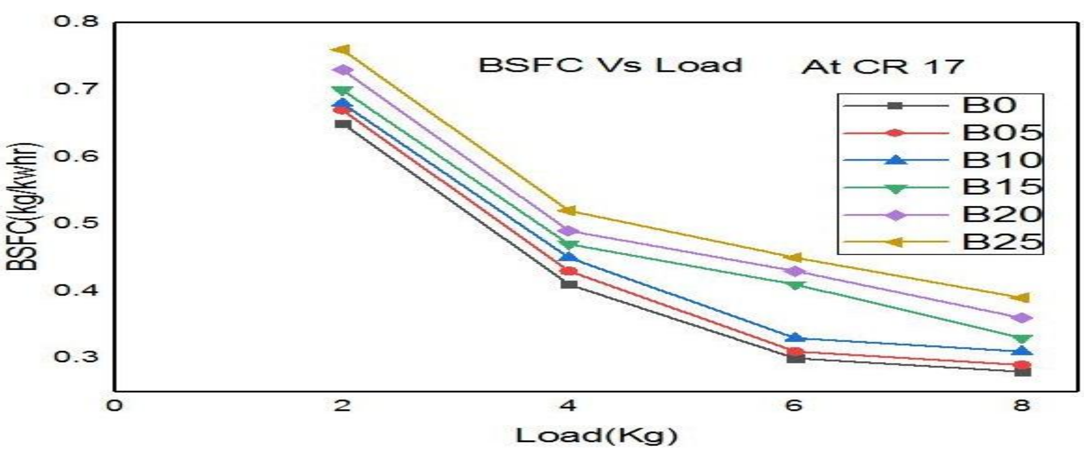

Fig.4.3. Variation of BSFC Vs Load at CR 17

AT a full load BSFC of blends blends A, blends B, blends C, blends D, and blends E, are 0.28, 0.27, 0.3, .32, .36 which is higher than the diesel fuel BSFC 0.28 at the CR 18.The compression ratio (CR) increases from 16 to 18, decreased of BSFC observed because of the increase the CR the engine produce comparatively higher break power than the low compression ratio

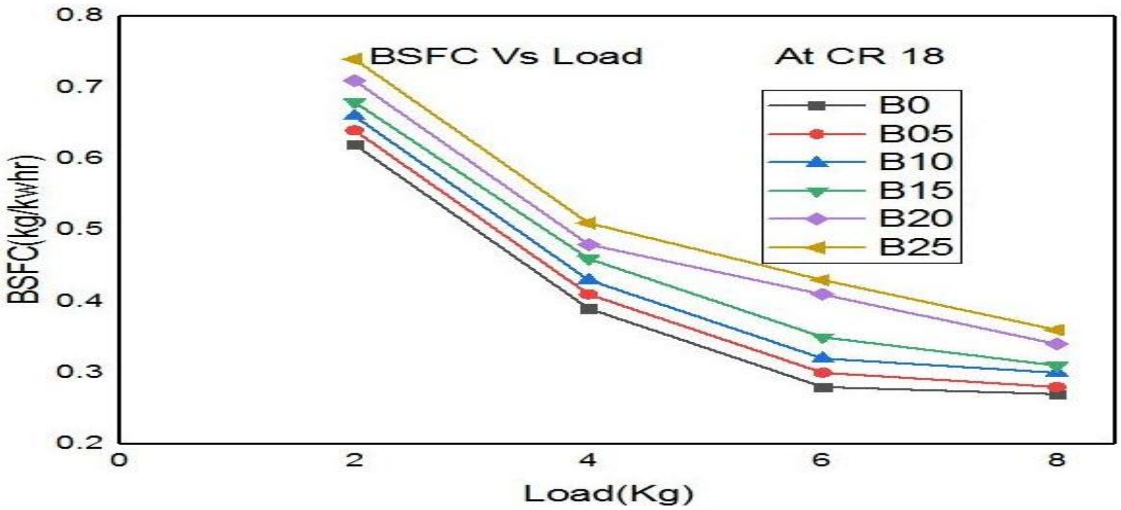

Fig.4.4. Variation of BSFC Vs Load at CR 18

4.3 Exhaust gas temperature: The exhaust gas temperature(EGT) is indicative of the quality of combustion in combustion chamber. The EGT increases with the increase in the load. This is Because of more amount of fuel is required by engine for produce the extra power. Thisis also needed to take the additional loading, at the same time; all blends are having less exhaust temperature than the diesel values for any brake power. Due to its lower calorific value and the improved oxygen content provided by the dual biodiesel which increases better combustion.

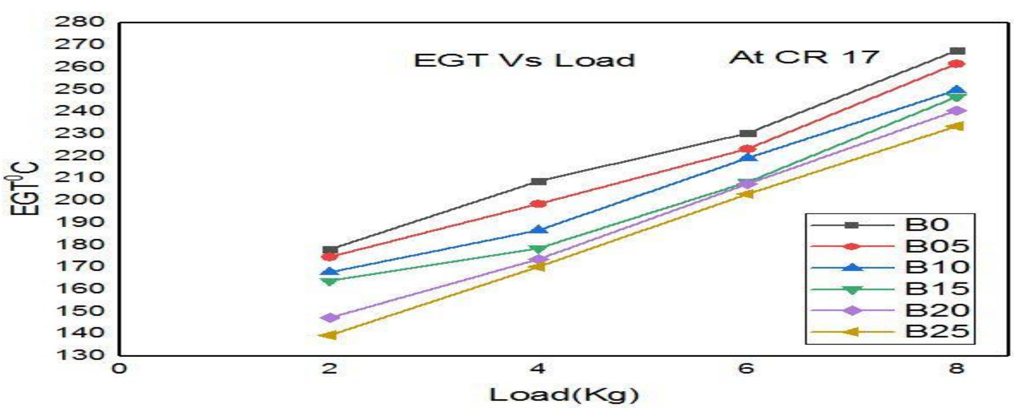

Fig.4.5. Variation of EGT with Load at CR 17

As Increases the compression ratio the combustion become better inside the cylinder. it is leading to it is increase the pressure which further increase the temperature inside the cylinder the rate of combustion increases and the temperature of gas coming out after expansion then EGT Increases. At a full load EGT of blends blends A, blends B, blends C, blends D, and blends E, are 267.63, 260.45, 249.34, 245.38, 243.23which is lower than the diesel fue, EGT 272 at the CR 18.

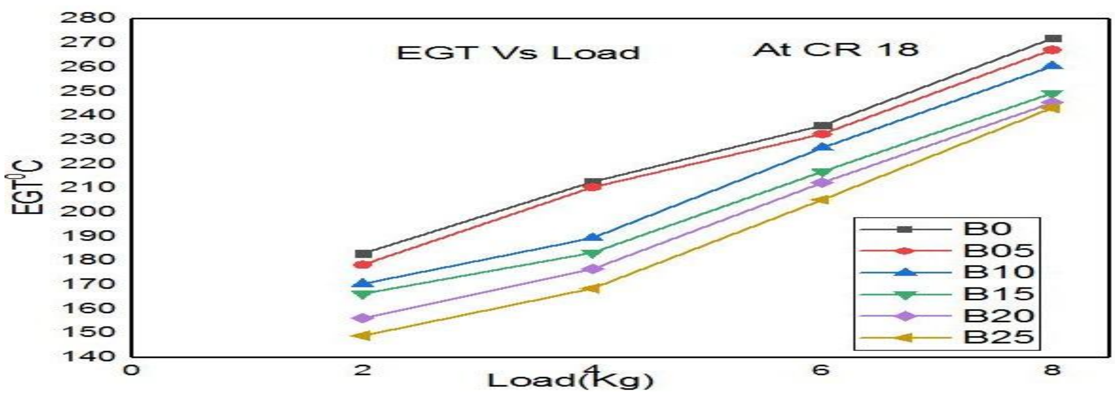

Fig.4.6. Variation of EGT with Load at CR 18

V CONCLUSION

- Brake thermal efficiency of dual biodiesel karanja and mustard oil and its blends decreases with increases in percentage of dual biodiesel blends because of decreasing the calorific value as well as increasing the viscosity and density. BTE for all blends is lower than diesel.
- BSFC are found to be higher for increasing dual biodiesel blends as compared to diesel fuel because of lower calorific value.
- Exhaust gas temperature (EGT) are found to be decreasing with increasing dual biodiesel blends because of the decrease in calorific value.

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