

Comparision of Performance and Emission Test Using Biodiesel from Simarouba and Waste Cooking Oil in CI Engine

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Abstract: *The depletion of world petroleum reserves and increased environmental concern have stimulated the search of alternative fuel which is to be environment friendly. Bio-fuels have the potential to become alternative fuel for fossil fuels. Biodiesel is renewable, reliable, biodegradable and regarded as a clean alternative fuel to reduce exhaust emissions. In recent years, much research has been carried to find suitable alternative fuel to petroleum products. In the present investigation experimental work has been carried out to analyze the performance and emissions characteristics of a single cylinder compression ignition DI engine fuelled with the blends of mineral diesel and biodiesel. The simarouba biodiesel is considered as alternative fuels to diesel. A large amount of tree borne oils and fats are available for biodiesel production in developing and under develop countries. Simarouba glauca oil is one of these oils. The utilization of liquid fuels such as biodiesel produced from waste cooking oil by transesterification process represents one of the most promising options for the use of conventional fossil fuels. However, as the biodiesel is produced from vegetable oils and animal fats, there are concerns that biodiesel feedstock may compete with food supply in the long-term. Hence, the recent focus rely on using waste cooking oil as the substantial feed stocks for biodiesel production.*

Keywords: Diesel, Biodiesel, Simarouba biodiesel (SOME), Waste cooking oil biodiesel (WCOME), transesterification, Performance, Emission Charecteristics

1. Introduction

Biofuels are a serious option to compete with oil in the transport system compared to other technologies such as hydrogen, because biofuel technologies are already well developed and available in many countries. Bioethanol and biodiesel can be mixed with the petroleum products (gasoline and diesel) they are substituting for and can be burned in traditional combustion engines with blends containing up to 10 per cent biofuels without the need for engine modifications.

India is a diesel-deficit nation and demand has far out striped supply. India's diesel production will not be able to keep pace with the rapidly growing demand. Government's pricing policy now allows oil companies to decide prices. Diesel is not much cheaper than petrol any more. Diesel demand in the country is growing at an annual rate of 8%. At this rate India will need a brand new 9 Million Tons per year refinery every year. The automobiles industry has estimated that the share of diesel vehicles, in overall vehicle sales has crossed the 40% mark. The price of fuels is now going to be in line with price of crude oil. Hence the Petrol and Diesel prices are now in line with international price levels, which makes biofuel economically attractive.

India's biodiesel processing capacity is estimated at 600,000 tons per year. The government owned Oil Marketing companies have now floated a tender again to buy 840 million liters of Biodiesel. However there are few interested suppliers. They prefer to export, rather than selling in India.

Biofuel development and use is a complex issue because there are many biofuel options which are available. Biofuels, such as ethanol and biodiesel, are currently produced from the products of conventional food crops such as the starch, sugar and oil feedstocks from crops that include wheat, maize, sugar cane, palm oil and oilseed rape. Some researchers fear that a major switch to biofuels from such crops would create a direct competition with their use for food and animal feed, and claim that in some parts of the world the economic consequences are already visible, other researchers look at the land available and the enormous areas of idle and abandoned land and claim that there is room for a large proportion of biofuel also from conventional crops.[5,7,9,10]

2. Material and Methodology

A. Common Process of Biodiesel Production:

Biodiesel derived from biological resources is a renewable fuel, which has drawn more and more attention recently. A fatty acid methyl ester is the chemical composition of biodiesel. Transesterification is widely used for the transformation of triglyceride into fatty acid methyl ester. The manufacturing process is based on the transesterification of triglycerides by alcohols to fatty acid methyl esters, with glycerol as a byproduct. The base catalyzed production of biodiesel generally has the following processes.

Transesterification: This is most commonly used process in production of biodiesel. It is most commonly used and important method to reduce the viscosity of vegetable oils.

In this process triglyceride reacts with three molecules of alcohol in the presence of a catalyst producing a mixture of fatty acids, alkyl ester and glycerol. The process of removal of all the glycerol and the fatty acids from the vegetable oil in the presence of a catalyst is called esterification.



Figure 1: Transesterification

B. Properties of biodiesel

Properties	diesel	SOME B20	COME B20
Flash point(°c)	57	60	59
Fire point(°c)	63	64	62
Density(Kg/m ³)	830	837.4	838.2
Viscosity (Cst)	2.9	3.28	3.24
CV(KJ/Kg)	42500	41960	41500

2.1 Experimental Setup



Figure 2: Engine Setup

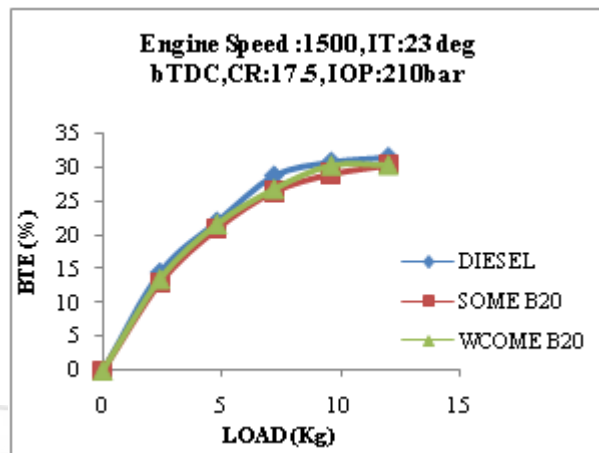
Table 2: Engine Specification

Product	VCR Engine test setup 1 cylinder, 4 stroke, Diesel (Comp.)
Engine	Make Kirloskar, Type 1 cyl. 4 stroke Diesel, water cooled, power 3.5kW at 1500rpm, stroke 110mm, and bore 87.5mm. 661cc, CR17.5, Modified to VCR engine CR 12 to 18. with electric start arrangement, battery and charger
Dynamometer	Type eddy current, water cooled,
Load sensor	Load cell, type strain gauge, range 0-50 Kg
Compression ratio	17.5:1

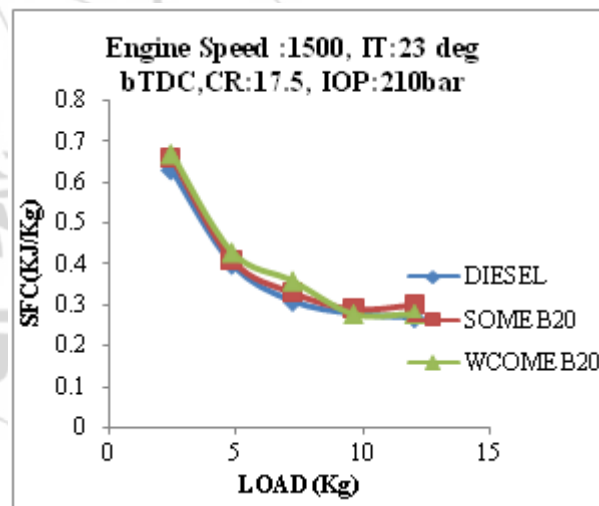
3. Result and Discussion

Comparison of Biodiesels

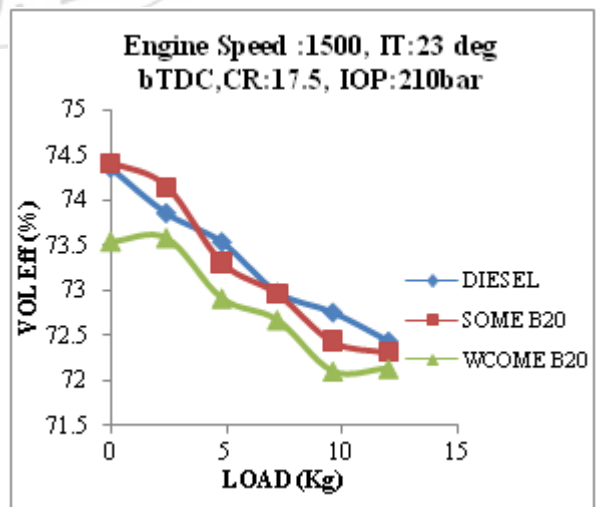
3.1 LOAD VS BTE



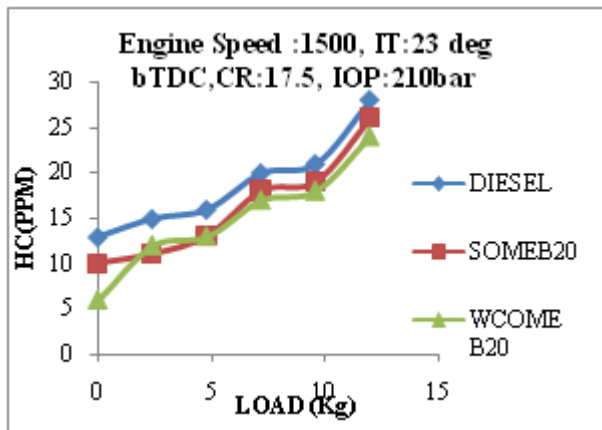
3.2 LOAD VS SFC



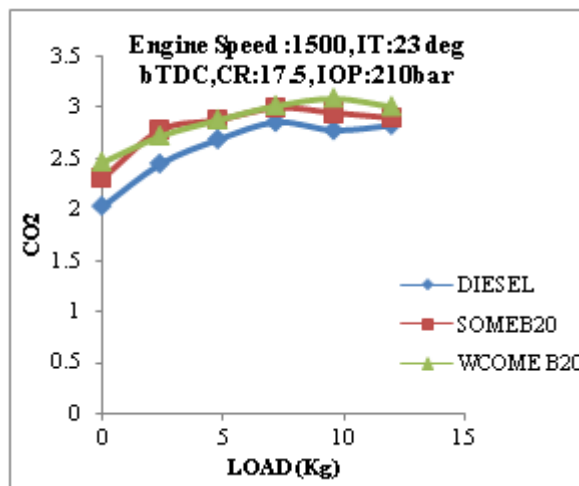
3.3 LOAD VS VOL Eff



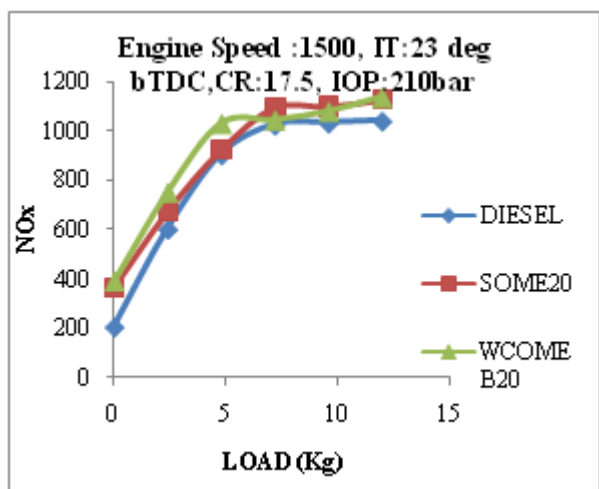
3.4 LOAD VS HC



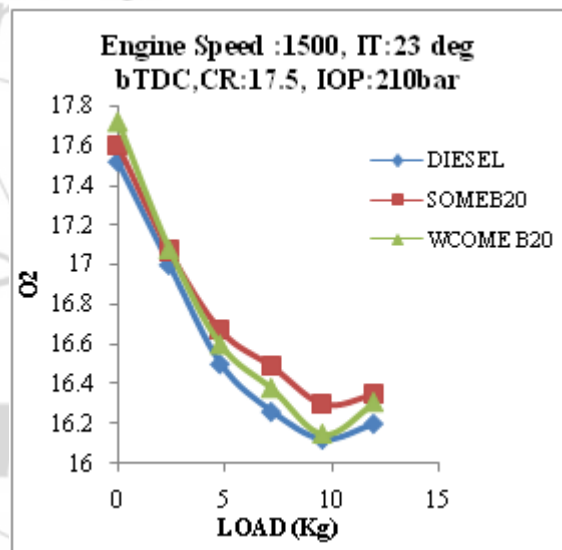
3.7 LOAD VS CO₂



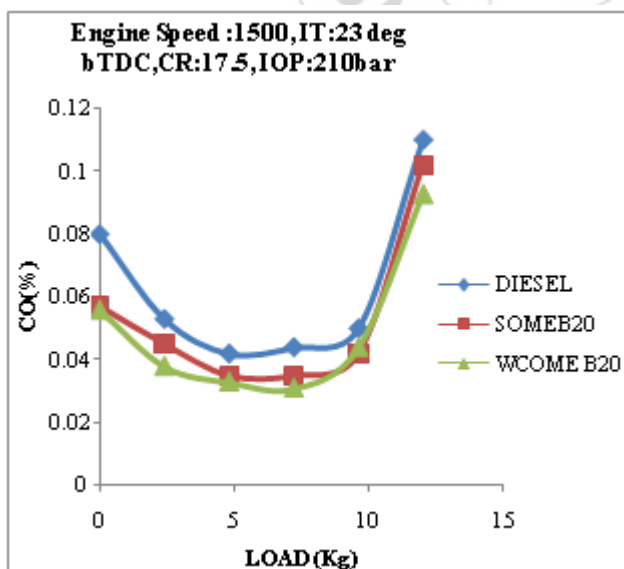
3.5 LOAD VS NO_x



3.8 LOAD VS O₂



3.6 LOAD VS CO₂



4. Conclusion

- 1) Performance, combustion and emission characteristics of WCOME B20 blend are better than SOME B20 blend. And efficiency of WCOME B20 is well compare with the diesel. The maximum brake thermal efficiency of WCOME B20, SOME B20 and DIESEL are respectively 31.67%, 30.95% and 30% .
- 2) The BSFC decreased with an increase in engine load. For biodiesel and its blends the BSFC are higher than that of diesel fuel. The BSFC values for biodiesels , SOME B20 and WCOME B20 blends are 0.28 and 0.30 respectively, which is higher than diesel fuel.
- 3) The NO_x emission is higher than diesel fuel for all modes of test fuels. This is due to higher oxygen content of biodiesel, which would result in better combustion and maximum cylinder temperature. The maximum value of NO_x emission is 9% of wcome and 8% of some at full load conditions, which is higher than diesel fuel.
- 4) For biodiesel and its blends, it was found that CO and HC emissions were lower than that of pure diesel. The lowest CO and HC emissions were obtained for neat biodiesel (B100).The maximum reduction in CO and HC

- emission with neat biodiesel and at full load are 16% and 20% respectively which is lower than diesel fuel.
- 5) On the whole, the methyl esters of Simarouba biodiesel and waste cooking biodiesel and its blends can be used as an alternative fuel in diesel engines without any engine modifications. It gives lower HC, CO emission when compared with the diesel fuel. But the addition of higher percentage of biodiesel blend with diesel fuel which decreases brake thermal efficiency and increases specific fuel consumption.
 - 6) The best blending ratio is 20% SOME and 20 % WCOME which gives the best performance which is closer compared to diesel fuel and less increase in the NO_x emissions as compared with other SOME and WCOME blends.
 - 7) It is found that CO₂ emissions are more for simarouba and wastecooking biodiesel than that of diesel. Higher CO₂ emissions reduce harmful CO emissions. The percentage reduction in HC emissions for simarouba and waste cooking biodiesel is about 60% as compared to that of Diesel. Due to higher NO_x emissions with pure Simarouba and waste cooking biodiesel, suitable blends can become a striking balance between NO_x emissions on one end and all other emissions along with performance on the other hand.
 - 8) Taking the analysis of all above graphs we are finding that ,SOME and WCOME both the biodiesels are best alternative fuels for CI engine .By comparing both the biodiesels performance and emissions characteristics we are concluded that WCOME biodiesel is gives a best performance with compare to SOME biodiesel.
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