IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Performance Improvement in Bio-Diesel Operated Diesel Engine By Using Operating Parameters : A Review

Shail Doshi[2], Bihag Vyas[3], Hussain Agarwala[4], Akash Patni[5]

Prof. Madhusudan Barot[1]

[2-5]Students in Department of Mechanical Engineering IITE INDUS UNIVERSITY, AHMEDABAD, INDIA
[1]Assistant Professor in Department of Mechanical Engineering IITE INDUS UNIVERSITY, AHMEDABAD, INDIA

Abstract: The consumption of fuels in the world is increasing rapidly and it affects the Global economy of all the countries so this factor forced all the countries to find the alternative fuel to reduce and even replace the usage of petroleum in regard to alternative energy production of Biodiesel will be next choice for replacement of fossil fuel. It is well known fact that diesel engines when operated with biodiesel leads to lowering of Global warming issues and emission levels. In the present scenario Biodiesel production using blends of different oils like coconut oil, neem oil, cotton seed oil, rice bran oil made from transesterificaton process. Many studies have been conducted to assess the impacts of biodiesel use on CI engine operatio. This review paper discusses some results of recent studies on different biodiesel production, their physicochemical properties, and also, on the influence of the use of diesel–biodiesel blends in CI engines: combustion characteristics, performance, and emissions. By the discussions the brake thermal efficiency for Biodiesel was found slightly higher than the high speed diesel at various load condition. Also the specific fuel consumption and exhaust temperature increased with increased biodiesel blends. In the matter of emissions observed that all the emission gases reduced by increased biodiesel blends except NOx gas it is increases by increased biodiesel blends.

Keywords

Diesel Engine, Biodiesel, Transestrification, Crude Rice Bran Oil, Performance, Emissions.

1.Need for Alternate Fuel

Energy is very important for life quality and social development of people as well as economic growth. Fossil fuels have been an important conventional energy source for years. Energy demand around the world is increasing at a faster rate as a result of on going trends in industrialization and modernization. Most of the developing countries import fossil fuels for satisfying their energy demand. Consequently, these countries have to spend their export income to buy petroleum products. The transport sector is an important component of the economy which has an impact on the development and the welfare of the population. Internal Combustion (IC) engines are mainly used for transportation in this era. Fuel depletion and environmental pollution due to IC engines force the researchers to find

various alternate fuels and effective pollution control methods. Biodiesel has received much attention in the past decade due to its ability to replace fossil fuels,which are likely to run out within a country. Especially, the environmental issues concerned with the exhaust gas emissions by the usage of fossil fuels and also encourage the usage of biodiesel, which has to be ecofriendly for more than fossil fuels.

1.1 Effect of Bio-Diesel blend on Performance and Emission

Avinash Kumar et al. [1] have reported that Brake specific fuel consumption for biodiesel and its blends was higher than mineral diesel but brake thermal efficiency of all the biodiesel blends was lower than mineral diesel. Brake specific CO2, CO and Hydrocarbon emissions for biodiesel fuelled engine operation were lower than mineral diesel but NO emissions were higher for bio- diesel blends. Rahemam et al.[2] have reported that BSFC and EGT of the 10.3-kW diesel engine when operated with biodiesel blends as compared with HSD at different engine loads were found to increase by 2.49% to 5.62% and 4.44% to 5.2%, respectively, whereas BTE was found to decrease by 1.48% to 3.22% with an increase in biodiesel concentration in the fuel blends. Wail M. Adaileh et al.[3] have reported that the B20 produced significant reductions in the CO, HC, and smoke emissions compared with standard diesel and B5. The biodiesel increased volumetric fuel consumption due to its chemically bound oxygen content. In contrast the petroleum derived fuels showed about the same consumption results. Overall, vegetable oil is an attractive alternative for diesel fuel in the frame of Single Fuel Policy. M Aldhaidhawi et al.[4]According to the numerical study, the results show that effective power and effective torque was lower, while BSFC was higher when using biodiesel B15 in comparison with diesel fuel, at all injection timing. Brake thermal efficiency was improved with biodiesel B15 when using a retarded injection timing. Concerning exhaust gas emissions, biodiesel B15 produced lower soot emission, while the NOx emissions were higher when compared to diesel fuel. Muhammad Qasim et al[5] have reported that EGT and BSFC of BLF fuel blends were found to increase 1.68– 4.33% and 2.48–6.45%, respectively, as compared to petroleum diesel at maximum load conditions, however, BTE decreased 1.99–4.91% with the increase in BLF concentrations in the fuel blend. BLF15 has a lower fuel consumption value (632.02 g/kW·h), higher BTE (29.91%), and lower EGT (224 °C at minimum engine load) as compared to BLF20 and BLF25 fuel blends.Amar Pandhare et al.[6] The brake thermal efficiency was found to increase with increase in compression ratio and there is no significant difference in the brake thermal efficiency of biodiesel blends and neat diesel.Overall combustion characteristics for all blends were found similar to diesel at all compression ratios. Peak pressure increases with increase in compressionratios for all biodiesel blends and neat diesel. At CR 19.5, ignition delay is shorter for all biodiesel blends than neat diesel due to higher cetane number. G. Venkata et al.[7]The maximum brake thermal efficiency of 28.2% was observed with the blend B10E15.The BSFC of the biodiesel and all the other fuel blends was higher than that of the diesel fuel. The exhaust gas temperature of the blend B10E15 was slightly lower than that of diesel fuel. The CO emissions of the biodiesel and all the other fuel blends were lower than that of the diesel fuel. The minimum CO emissions were observed with the blend B10E15 well below the diesel fuel and the biodiesel. Pushpendra et al.[8] The power output, engine specific fuel consumption (E.S.F.C) and exhaust gas temperature (ExGT) of the engine under test increased and decrease, respectively of the concentration of mahua methyl ester in the blends. Mahua

methyl ester can be used as a substitute for diesel fuel in compression ignition engine. Puhan et al. [9] have also reported that BTE of mahua biodiesel is 26.36% and for diesel is 26.42% at full load. The emissions of CO, HC, NOx and smoke emissions were reduced when compared to diesel but most author mentioned that there would be increase in NOx while using biodiesel. Prabhakar [10] have reported that the diesel engine runs successfully at 20% blends without affecting the engine performance. Among the various vegetable edible oils, nerium biodiesel showed better performance than that of others. The nerium biodiesel showed lower smoke and HC and higher NOx emission.Lin et al. [11] have observed that the various biodiesels such as soybean oil, peanut oil, corn oil, sunflower oil, rapeseed oil, palm oil, palm kernel oil, and waste fried oil have lower carbon, hydrogen, and sulphur content and higher oxygen content, when compared to that of diesel which results in higher BSFC. The smoke emission of biodiesel is 72.73% lower than diesel. However, maximum NOx emission of diesel is 466 ppm and biodiesel is 587 ppm at peak load and is due to enhanced combustion that resulted in higher temperature and pressure during combustion. The diesel engine fueled with vegetable oil methyl ester could potentially shows a reduction in the exhaust gas temperature (EGT), smoke and total hydrocarbon (THC) emission. Liaquat et al. [12] have found that HC and CO emissions were reduced considerably and CO2 and NOx emissions were increased with coconut biodiesel blend ratio than that of diesel. Machanon et al. (2001) have concluded that increase in coconut biodiesel blend ratio decreases the BMEP and increases the BSFC. The coconut blend showed lower smoke and NOx emission than that of diesel fuel.

1.2 Summary:

The literature study certainly proves beyond doubt that biodiesel could be used as the alternative for diesel engine. It has been further reported that while using the properties of biodiesel are almost equal to the diesel but at the same while operating in a diesel engine, it decreases the performance and increases NOx emission. TABLE-1 shows the comparative changes of engine performance such as BTE, BSFC, and engine emissions such as HC, CO, NOx, and smoke emissions in biodiesel operated diesel engine with respect to diesel.

2.Prameters or Techniques to improve performance of the Diesel engine:

Several research have been done to improve the performance of the engine and reduce the fuel consumption and emission of harmful gases. Diesel engine have been developed in numbers of design to get the optimum working performance, many design parameters, fuel properties and several modifications have been done. In modification several parameters of the engine changes. The fuel modification is another technique to improve performance of the engine by changing compression ratio(CR) and by adding additives, biodiesel to improve performance of the engine and reducing the emission except NOx emission. The Design and operating parameters like fuel injection techniques, air management

TABLE-1

Comparative methods, combustion chamber design, improved oil control, adiabatic engine etc. these methods can help in controlling the emission also improve the performance of the CI engine.

Biodiesel Fuel	Performance		Emission			References
	BSFC	BTE	CO	HC	NO_x	
Mahua Oil	Increase	Decrease	Decrease	Decrease	Increase	Puhan [9]
various Vegetable oil	Increase	Decrease	Decrease	Decrease	Increase	Lin et al. [11]
Coconut Oil	Increase	Decrease	Decrease	Decrease	Increase	Liaquat et al. [12]
Nerium, Jatropha, pongamia, neem oil	Increase	Decrease	Decrease	Decrease	Increase	Prabhakar et al. [10]
Rapeseed oil and its Blends (B5, B20, B70, B100)	Increase	Decrease	Decrease	Decrease	Increase	Buyukkaya [18]
Mahua and Simarouba(50-50)	Increase	Decrease	Decrease	Decrease	Increase	Raheman et al. [1]
Waste Cocking oil	Increase	Decrease	Decrease	Decrease	Increase	Wail M. et al.[3]
Transesterified waste transformeroil and waste Canola oil	Increase	Decrease	Decrease	Decrease	Increase	Qasim et al. [5]
15% sunflower oil mixed with 85%Diesel	Increase	Decrease	Decrease	Decrease	Increase	M. Aldhaidhawi et al. [4]
Jatropha oil	Increase	Decrease	Decrease	Decrease	Increase	Amar Pandhare et al. [6]
Diesel-Ethanol Blends	Increase	Decrease	Decrease	Decrease	Increase	G. Venkata et al. [7]
Mahua Methyl Ester	Increase	Decrease	Decrease	Decrease	Increase	Pushpendra et al. [8]

2.1 Effect of working parameters:

Balakrishnan [16] have observed that the BTE is increased upto 28.1% and BSEC is decreased upto 12.81%MJ/kWh for biodiesel with producer gasata CR of 20. The emission reduction ensures the suitability of mixed fuel at higher CR with out any modifications in the engine. Harikudeetal.(2014) have found that the variation of CR showed improvement in the BTE and BSFC for waste fried methyl ester. Further, the CO and PM emissions decreases while NOx emission increases with increase in CR for waste fried methyl ester than that of original CR. Jindal et al.[14] have found that the combined effect of CR and injection pressure(IP) increases the BTE and reduces the BSFC and also lowers the emission for jatropha biodiesel. The optimum CR was 18 and injection pressure(IP) was 250 bar for the jatropha biodiesel. Sayin et al.[15]have found that the BSFC and NOx emission increases while the BTE, smoke, CO and HC decreases with increase of the percentage of EKO biodiesel blend. Further, the BSFC and BTE increases with increase of CR, IP and injection timing(IT). It has been found that the increase of CR, IP and IT leads to decrease

in various exhaust emissions.Cenk et al.[17] have carried out tests using three different CRs (17, 18, and 19/1), ITs (15°, 20°, and 25° CA BTDC) and IPs (18, 20 and 22 MPa) at 20 N m engine load and 2200 rpm. The results showed that brake specific fuel consumption (BSFC), brake specific energy consumption (BSEC), and nitrogen oxides (NOx) emissions increased while brake thermal efficiency (BTE), smoke opacity (OP), carbon monoxide (CO) and hydrocarbon (HC) decreased with the increase in the amount of biodiesel in the fuel mixture. G. Venkata et al.[7] have stated that Brake thermal efficiency increases with increasing of brake power, while brake specific fuel consumption decreases with increase of brake power. This reduction is because percentage of increase in fuel consumption. As load increases the cylinder wall temperature will also increases and leads to reduction in ignition delay.

2.2 Summary:

Studies of the Researchers indicated that the engine modification so as to improve the diesel engine performance with higher blends of biodiesel without drastic change in performance and emission charecteristics. It was found from the Literature Review that the diesel engine efficiency is fairly depends on the Compression Ratio (CR), due to the chemical composition and combustion characteristics**.**

TABLE-2

shows the comparative effect on the diesel engine performance by changing standard Operating Parameters.

Biodiesel fuel	**Type of Operating Parameter**	**Performance**		**Emission**			**References**
		BSFC	**BTE**	**CO**	**HC**	**NO_x**	
Biodiesel with Produce gas	Increases CR	Increases	Increases	Decreases	Decreases	Increases	Balakrishnan et al. [16]
Waste fried methyl ester	Increases CR	Increases	Increases	Decreases	Decreases	Increases	
EKO Biodiesel	Increases CR	Increases	Increases	Decreases	Decreases	Increases	Jindal et al. [14]
Jatropha Methyl ester	Increases CR	Increases	Increases	Decreases	Decreases	Increases	Sayin et al. [15]

3.CONCLUSION:

The Objective of this study to improve the performance and reduction in exhaust emissions from biodiesel operated diesel engine through CR and Operating Parameter.The Majority of the study shows that by using biodiesel in diesel engine reduces the emission of the Carbon Monoxide(CO), Hydrocarbon(HC) and smoke as compare to Diesel engine. Whereas using biodiesel blends in diesel engine increases the emission of the NOx as compare to pure diesel.It can be concluded that use of small percentage of biodiesel blends (B20) can help in improve the performance of the diesel engine and also reduces the emission except NOx. In order to improve the performance of diesel engine operating parameters were changed.It can be conclude that increase of CR with B20 improved the performance and reduction in exhaust emission except NOx emission.

4.FUTURE SCOPE:

The literature reviews shows that the study on variable compression ratio in diesel engine using biodiesel helps to improve the performance of the engine but The effect of the diffrent compression ration on engine performance parameters, emissions and combustion yet to be done.

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