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Review Article

REVIEW OF PERFORMANCE AND EMISSION ANALYSIS OF B-20 A PROMISING ALTERNATIVE FUEL BLEND

R M Ghodke[1*] and N S Bhalkikar[1]

Corresponding Author: **R M Ghodke, ✉ ravindra.ghodke@yahoo.in*

Biodiesel is defined as the mono alkyl esters of long chain fatty acids derived from renewable lipid sources. It is a term used to describe a methyl or ethyl ester made from vegetable oils, animal fats, and used cooking oils and fats. It is oxygenated, non-toxic, sulphur-free, biodegradable and renewable fuel. The scarcity and increase in the crude oil prices have forced everyone to think on the use of biodiesel as an alternative fuel source. Also, it is important that unlike the traditional fuels which emit green house gases and particulate matter, the biodiesel is greener and hence less polluting. More than 350 oil-bearing crops identified, among which some only considered as potential alternative fuels for diesel engines. The focus of this study is to review the effect of using B-20 (a blend of 20% biodiesel and 80% diesel fuel) on engine performance and exhaust emissions in a CI engine.

Keywords: Biodiesel, Alternative fuels, B20, Emission characteristics, Performance analysis

INTRODUCTION

Biodiesel is one of the best available sources to fulfil the energy demand of the world. The petroleum fuels play a very important role in the development of industrial growth, transportation, agricultural sector and to meet many other basic human needs. However, these fuels are limited and depleting day by day as the consumption is increasing very rapidly. Moreover, their use is alarming the environmental problems to society. Hence, the scientists are looking for alternative fuels. India is importing more than 80% of its fuel demand and spending a huge amount of foreign currency on fuel. Biodiesel is gaining more and more importance as an attractive fuel due to the depleting nature of fossil fuel resources. The purpose of transesterification process is to lower the viscosity of the oil. The main drawback of vegetable oil is their high viscosity and low volatility, which causes poor combustion in diesel engines. The transesterification is the process of removing the glycerines and combining oil esters of vegetable oil with alcohol. This process reduces the viscosity to a value comparable to that of diesel and hence improves combustion. Biodiesel emits fewer pollutants over the whole range of air–fuel ratio when

[1] MIT, Aurangabad, Maharashtra, India

compared to diesel. Biodiesel can be produced by using different techniques such as ultrasonic cavitation, hydrodynamic cavitation, microwave irradiation, response surface technology, two-step reaction process etc. The researchers have tested a number of different raw and processed vegetable oils like rapeseed oil, sunflower oil, palm oil, soybean oil, Jatropha, PME, food grains, Karanja, Mahua, etc. In this paper, the results of some of the researchers have been compared and summarized.

PERFORMANCE OF B-20

The following paragraphs show relevant results from studies conducted on the performance and exhaust gas emission of compression engines, fueled with diesel fuel, pure biodiesel (B100) and its blends with diesel fuel reported in the literature.

V Nagaraju *et al*. (2008) carried out study to determine the effect of using B-20 (a blend of 20% soybean methyl ester biodiesel and 80% ultra low sulfur diesel fuel) on the combustion process, performance and exhaust emissions in a High Speed Direct Injection (HSDI) diesel engine equipped with a common rail injection system. The engine was operated under simulated turbocharged conditions with 3-bar indicated mean effective pressure and 1500 rpm engine speed. The experiments covered a wide range of injection pressures and EGR rates. The heat release trace is analyzed to determine the effect of biodiesel on fuel evaporation, auto ignition and combustion reactions. In parallel to the data analysis based on the physiochemical combustion, a statistical analysis tool called Minitab was used to achieve quantitative analysis of biodiesel impact on emissions and engine performance. It is observed that ISFC was higher with the B-20 as compared to B-00. Is has been observed that emission of Nox is lower than B-00 by 4%.and the incomplete combustion products of HC, CO and soot are lower for B-20 than for B-00. B-20 decreases smoke and HC (10% lower smoke and 9% lower HC) relative to B-00. B-20 decreased CO emissions slightly (3%).

M K Ghosal *et al*. (2008) has conducted a performance of a compression ignition engine (direct injected, 4-stroke 2-cylinder engine) by using mahua methyl ester from non-edible vegetable oil (Madhuca indica) and its blends with diesel fuel. The engine performance tests were conducted using four different blends of mahua methyl ester oil with diesel fuel from 20% to 100% by volume at three fuel temperatures (30, 50 and 700-C) and at two injection pressures (17640 kPa and 24010 kPa). The performance of engine with blend fuel (20% mahua methyl ester and 80% diesel) was found tobe better than the other blend fuels. The values of power output, BSFC, BThE and ExGT in case of blend fuel B20 were observed to be respectively 3% more, 9% more, 12%more and 0.5% less than the diesel fuel at -70°C temperature and 24010 kPa pressure. The mahua methyl ester (blends of B20) can be used as an alternative diesel fuel replacement with little sacrifice in brake specific fuel consumption. Mahua methyl ester can be used as a substitute for diesel fuel in compression ignition engine with lower percentage of emissions and engine wear compared to diesel.

F K Forson *et al*. (2004) carried out tests on a single-cylinder direct-injection engine operating on dieselfuel, jatropha oil, and blends of diesel and jatropha oil in proportions of 97.4%/2.6%;80%/20%; and 50%/50% by volume. The test showed that jatropha oil could be conveniently used as a diesel substitutein a diesel engine. The test further showed increases in brake thermal efficiency, brake power and reduction of specific fuel consumption for jatropha oil and its blends with diesel.

Venkateswara Rao T *et al*. (2008) carried out experimental investigations to examine properties, performance and emissions of different blends (B10, B20, B40) of pongamia methyl esters (PME), jatropha methyl esters (JME) and neem methyl esters (NME) in comparison to diesel. Results indicated that B20 have closer performance to diesel and B100 had lower brake thermal efficiency mainly due to its viscosity compared to diesel. However its diesel blends showed reasonable efficiencies, lower smoke, and CO and HC emissions.

Rakopoulos C D *et al*. (2008) conducted experimental investigation to evaluate the use of sunflower and cotton seed oil methyl esters (bio-diesels) of Greek origin as supplements in the diesel fuel at blend ratio of 10/90 and 20/80 in a fully instrumented, six-cylinder, turbocharged and after-cooled, direct injection (DI), Mercedes – Benz, mini-bus diesel engine installed at the author's laboratory. The results show that smoke density was reduced with the use of the above fuel blends with the engine working at two speed and three loads. Reduction is higher, the higher the percentage of biodiesel in the blend. The NOx emissions were slightly increased with all biodiesel blends with respect to those of the neat diesel fuel, with this increase being higher the higher percentage of biodiesel in the blend. The CO emissions were reduced with the use of all biodiesel fuel, with this reduction being higher, the higher percentage of biodiesel in the blend. The engine performance with the biodiesel blends of sun flower or cottonseed oil biodiesels was similar to that of the neat diesel fuel, with nearly the same brake thermal efficiency and showing high brake specific fuel consumption.

Nagarhalli M V *et al*. (2011) carried out the investigation experimental work to analyze the emission and performance characteristics of a single cylinder 3.67 kW, compression ignition engine fuelled with mineral diesel and diesel-biodiesel blends at an injection pressure of 200 bar.The performance parameters evaluated were break thermal efficiency, break specific energy consumption (BSEC) and the emissions measured were carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbon (HC), and oxides of nitrogen (NOx).The results of experimental investigation with biodiesel blends were compared with that of baseline diesel. The results indicate that the CO emissions were slightly higher, HC emissions decreased from 12.8 % for B20 and 2.85 % for B40, NOx emissions decreased up to 39 % for B20 and 28 % for B40. The efficiency decreased slightly for blends in comparison with diesel. The BSEC was slightly more for B20 and B40.And concluded that B-20 and B-40 blend can be used as alternative fuel for CI engines.

DUTRA L M *et al*. (2009) Have done a comparative analysis of performance and emissions ofan engine operating with palm oil methyl and ethylesters and their blends with diesel. Test results indicate that commercial diesel fuel shows the lowest specific fuel consumption, followed bymixtures B20, B50, and finally, B100. It can also be observed that increasing the percentage of biodiesel in the mixture with commercial diesel, causes an increase in specific consumption. On maximum load, the average specific consumption of biodiesel and its blends is 6% higher compared to commercial diesel. This occurs because the biodiesel have less energy than the diesel. Nitrogen oxide is an inert gas that takes part in the combustion process. But, in presence of high temperatures, nitrogen and oxygen are combined forming oxides of nitrogen

(NOx). Therefore, NOx emission is directly related to the temperature of combustion chamber.

B K Venkanna *et al*. has been worked on Rice bran oil is used as diesel fuel to investigate experimentally the performance, exhaust emission and combustion characteristics of a direct injection (DI) diesel engine, typically used in agricultural sector, over the entire load range when fuelled withrice bran oil and diesel fuel blends, RB10 (10% rice bran oil + 90% diesel fuel) to RB50. The performance, emission and combustion parameters of RB20 were found to be very close to neat diesel fuel. No problem was faced at the time of starting the engine and ran smoothly over the range of rice bran oil percent in fuel blend. For short term applications, this work establishes that 20% rice bran oil in the fuel blend can be used on direct injection diesel engine without any modification.

CONCLUSION

1. ISFC was higher with the B-20 as compared to B-00. Increased fuel consumption with B-20 can be attributed to its lower heating value and late release of energy in the expansion stroke.
2. It is accepted commonly that CO emissions reduce when using B-20 due to the higher oxygen content and the lower carbon to hydrogen ratio in biodiesel blend compared to diesel.
3. The vast majority of literatures agree that NOx emissions will increase when using B-20. This increase is mainly due to higher oxygen content for biodiesel. Moreover, the cetane number and different injection characteristics also have an impact on NOx emissions for B-20.
4. It is predominant viewpoint that HC emissions reduce when B-20 is fueled instead of diesel. This reduction is mainly contributed to the higher oxygen content of biodiesel.
5. It can be concluded from the limited literatures that the use of B-20 favors to reduce carbon deposit and wear of the key engine parts, compared with diesel. It is attributed to the lower soot formation, which is consistent to the reduced PM emissions of biodiesel, and the inherent lubricity of biodiesel.
6. It can be concluded that the blends of biodiesel (B-20) with small content by volume could replace diesel in order to help in controlling air pollution and easing the pressure on scarce resources to a great extent without significantly sacrificing engine power and economy.

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