Scientific Journal Impact Factor (SJIF) : 1.711
International Journal of Modern Trends in Engineering and Research
IJMTER
ISSN (ONLINE) : 2349 - 9745
ISSN (PRINT) : 2393 - 8161

PERFORMANCE AND EMISSION STUDIES IN A DIESEL ENGINE USING DIESEL AND BIO DIESEL (JAMUN SEED OIL)

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Abstract— The energy demand is increasing due to ever-increasing number of vehicles employing internal combustion engines. The world today is facing twin crisis of fossil fuel deflection and environmental degradation. Fossil fuels are limited resources & hence, search for renewable fuels is becoming more and more prominent issue of ensuring energy security and environmental protection. Energy from biomass and more specific bio diesel is one of the opportunities that could cover the future energy demand. The bio diesel is prepared from vegetable oil. Vegetable oil can be directly used in compression ignition engines. However, their performance is inferior to diesel. This is due to high viscosity and carbon residue. The performance of vegetable oil can be improved by transesterification them.

In this percent work, an attempt has been made to analyze the effect of Jamun seed oil at different proportions of biodiesel (B20, B40, B60, B80 and B100) in a single cylinder, four stroke water-cooled, and diesel engine at 1500rpm. The measured performance parameters are brake thermal efficiency, specific fuel consumption and engine exhaust emission of CO, HC, NOx and smoke density. Significant improvements in performance parameters and exhaust emissions have observed by the addition of Jamun seed oil blends with diesel.

Keywords— Biodiesel, Emission, Diesel Engine, Jamun seed.

I. INTRODUCTION

In recent years, there has been a significant increase in research on the use of bio-fuels as a substitute for mineral fuels. This has been spurred on by the fact that the world's current crude oil reserves are set to run out in the next 50 to 60 years, and since bio-fuels are derived from renewable resources they are not likely to run out as long as plants can continue to grow on earth.

Bio-fuels can be split into two main groups, namely bio-diesel and bio-alcohols. Bio-diesels are made by processing vegetable oil into a form that can be used as a direct replacement for mineral diesel with the minimum amount of fuss, the most significant problem being that bio-diesels generally have poorer low temperature properties than mineral diesel. They can also dissolve some polymers, and therefore it is necessary to check that the fuel system of any vehicle in which they are used does not contain any elements that may be dissolved by bio-diesel. Bio-alcohols are alcohols derived from various plants, a significant example being bio-ethanol. This is produced mainly by the fermentation of the sugars and starches found in many agricultural crops.

In this present work is biodiesel produced from Jamun seed oil. Syzygium cumini (Family Myrtaceae) is also known as Syzygium jambolanum and Eugenia cumini. Other com-mon names are

Jambul, Black Plum, Java Plum, Indian Blackberry, Jamblang, Jamun etc. Today these trees are found growing throughout the Asian subcontinent, East-ern Africa, South America, Madagascar and have also naturalized to Florida and Hawaii in the United States of America. The tree fruits once in a year and the berries are sweetish sour to taste. The ripe fruits are used for health drinks, making preserves, squashes, jellies and wine. In association to its dietary use, all parts of the tree and, importantly the seeds are used to treat a range of ailments, the most important being diabetes mellitus.


Fig 1 Jamun fruits


Fig 2 Jamun seeds

II. EXPERIMENTAL SETUP

The experiments diesel with bio-diesel mixture was carried out in DI diesel engine. The test engine is a single cylinder, direct injection, water cooled Compression Ignition engine. The experimental setup is shown in figure 3. Diesel engine was directly coupled to an eddy current dynamometer. The engine was always run at its rated speed. The governor of the engine was used to control the engine speed. The dynamometer was interfaced to a control panel. Experimental tests have been carried out to evaluate the performance and emission characteristics of a diesel engine when fuelled biodiesel (Jamun seed oil) in various percentage B20, B40, B60, B80, B100 and diesel at different load. The emission like HC, CO, and NOx, were measured in the exhaust gas analyzer and smoke density was measured in the smoke meter.

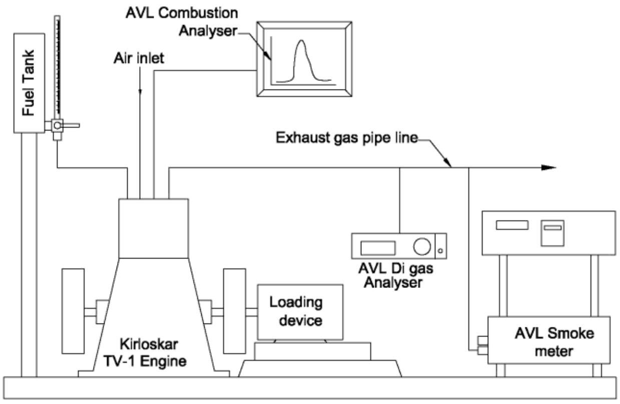

Figure 3 Experimental setup

III. RESULTS AND DISCUSSIONS

3.1 Specific fuel consumption

The variation of specific fuel consumption with increasing brake power is shown in figure 4. The data shows the specific fuel consumption for diesel is less compared to various blends of bio diesel. Also it is evident from the graph that the difference in fuel consumption between diesel and B20 blend is very negligible.

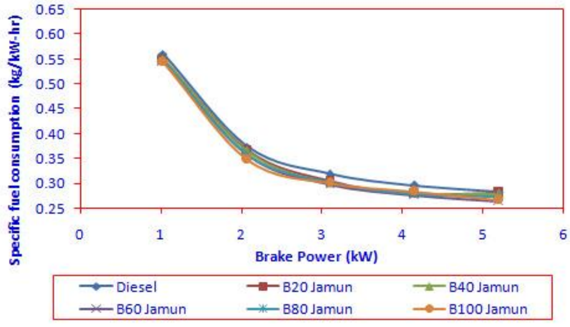

Figure 4 Brake Power Vs Specific fuel consumption

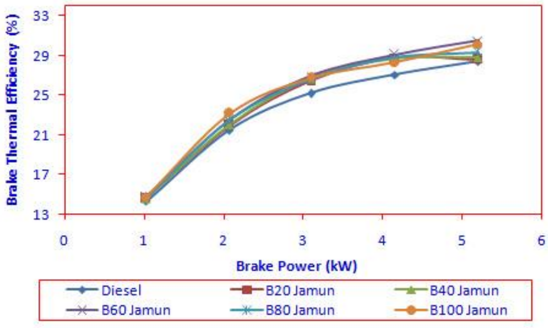

Figure 5 Brake Power Vs Brake Thermal Efficiency

3.2 Brake thermal efficiency

The variation of brake thermal efficiency with respect to brake power is shown in figure 5. It is seen that brake thermal efficiency increases with increase in break power for diesel and biodiesel blends. The brake thermal efficiency of diesel was superior for diesel compared to biodiesel blends. Also from the data, it is noted that the brake thermal efficiency of B20 blend was nearer to that of diesel compared to other biodiesel blends. This variation in brake thermal efficiency for biodiesel blends was due to higher viscosity and lower volatility, which leads to poor mixture formation. This results in decrease of brake thermal efficiency for biodiesel blends.

3.3 Smoke density

From the test data shown in the figure 6, it is observed that smoke density of diesel is higher compared to biodiesel blends. It is evident from the graph that, among the biodiesel bunds the smoke density of B40 blend is lower. Higher thermal efficiency means, better and complete combustion and lesser amount unburnt hydrocarbon in the engine exhaust thus improving smoke density values.

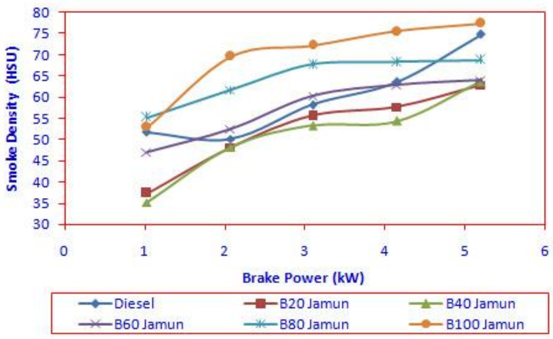

Figure 6 Brake Power Vs Smoke Density

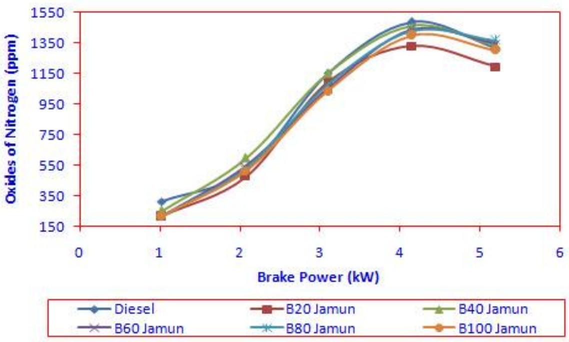

Figure 7 Brake Power Vs Oxides of Nitrogen

3.4 Oxides of nitrogen

Figure 7 shows the variation in the NOx emission of diesel and biodiesel with respect to brake power. The figure clearly illustrates the NOx emission is higher for diesel compared to biodiesel blends. This variation in NOx emission depends on combustion temperature inside the cylinder.

3.5 Hydrocarbon

Figure 8 shows the rate of hydrocarbon emission for diesel and various blends of biodiesel. The data clearly depicts, the emission rate of hydrocarbon is higher for diesel compared to blends of biodiesel. During full load condition, an exception arises, where emission rate is higher for B20, B40 blends of biodiesel. The emission was reduced in biodiesel, because of presence of oxygen in the fuel. The oxygen presences promote complete combustion, thus the reduction in HC emission.

3.6 Carbon monoxide

The variation of carbon monoxide with brake power is indicated in figures 9. The comparison is done for CO emission of diesel and biodiesel. It was clear from comparison the CO emission at all loads for diesel is superior to biodiesel.

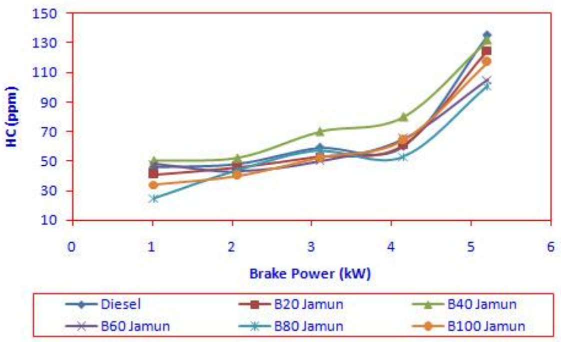

Figure 8 Brake Power Vs HC

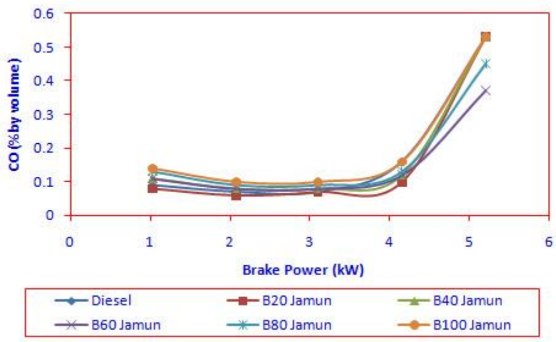

Figure 9 Brake Power Vs CO

IV. CONCLUSION

- Brake thermal efficiency with B20 was found to be comparable with diesel at all loads.
- NOx emission for B20 was found to be comparatively higher than the diesel.
- HC emission levels were more for diesel compare with B20. This reduction in HC emissions was due to the availability of molecular oxygen and increase in HC emissions is due to bad flame diffusion in combustion.
- Smoke density for B20 was found to be lower than diesel.
- CO emission B20 nearly closer to diesel.
- B20 was found to be environmental friendly as far as carbon monoxide and unburned hydrocarbons were considered.

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