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An Analysis on Effect of Mixed Biodiesel fuel on the Efficiency of Diesel Engines.

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I. INTRODUCTION

Fossil fuels produced by underground heat and pressure are consumed more rapidly than being created. Insufficient quantities or unreasonable price of petroleum fuels deeply concerns us, whereas the renewable energy is a promising alternative solution because it is clean and environmentally safe. Due to petroleum fuel, pollution and accelerating energy consumption have already affected equilibrium of the earth's landmasses and biodiversity. Carbon monoxide (produced when combustion is inefficient or incomplete), carbon-di-oxide (a product of the combustion of materials with carbon in them), hydrocarbons (produced as a result of poor fuel ignition), nitrogen oxides (produced when combustion occurs at very high temperatures), sulfur oxides (produced when elemental sulfur is present in the fuel), and particulates that are generally produced during combustion are other specific emissions of concern. So it is time to search for its alternative fuels.

1.1 Definition of Biodiesel

Biodiesel is a domestic, renewable fuel for diesel engines derived from natural oils like soybean oil, and which meets the specifications of ASTM D6751. Biodiesel can be used in any concentration with petroleum based diesel fuel in existing diesel engines with little or no modification. Biodiesel is not the same thing as raw vegetable oil. It is produced by a chemical process which removes the glycerin from the oil (Banapurmath et al. 2008).

1.2 Properties of Biodiesel

- Low content of free glycerin
- High degree of Transesterification
- Low acid number
- No polymers, very clean
- Comparable density with diesel
- Comparable calorific value with diesel
- Higher flash and fire point
- Oxygen content presence up to 11%

1.3 Benefits of Biodiesel

Biodiesel has some clear advantages over vegetable oil: it works in any diesel engine, without any conversion or modifications to the engine or the fuel system (Can Hasimoglu et al. 2008). It also has better cold-weather properties than vegetable oil, but not as good as diesel. It has as well many advantages over diesel.

1.4 Drawbacks of Biodiesel

- Increase in NOx emission.
- Decrease in an fuel economy on energy basis.
- Thickens more than diesel fuel in cold weather.
- More expensive, it can be reduced only when entered into mass production.
- Higher viscosity

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1.5 Characterization of Biodiesel

The following are the important characteristics of good vegetable oil required to substitute diesel fuel.

A. Ignition Quality

Satisfactory combustion demands self-ignition of the fuel as it is sprayed near TDC into the hot swirling compressed cylinder gas. Long ignition delay is not acceptable as it leads to knock. Therefore, the cetane number of the substitute fuel should be high enough, which is a measure of the knock tendency of the fuel. Satisfactory fuels must have a cetane number between 40 and 60. Viscosity Fuel viscosity plays an important role in combustion. The direct injection in the open combustion chamber through the nozzle and pattern of fuel spray decides the ease of combustion and thermal efficiency of the engine. Too low a viscosity can lead to excessive internal pump leakage and the system pressure will reach an unacceptable level and will affect injection during the spray atomization. The effect of viscosity is critical at low speed or light load conditions.

B. Heating Value

Although the diesel combustion chamber system can accept fuels with wide variations in heating value, the one with a higher calorific value is better suited. This helps to reduce the quality of fuel handled and maximizes the equipment operating range. It is always desirable for the vegetable oil to have a calorific value nearer to that of diesel.

C. Important Temperature

Pour point and cloud point are important for cold weather operations of the IC engine. For satisfactory working, the values of both should be well below the freezing point of the oil used.The Flash point is an important temperature from a safety point of view. This temperature should be as high as possible. Typical values of commercial vegetable oils range between 50 and 110oC.

D. Other Properties

The sulphur content, carbon residue and ash are responsible for the corrosion and forming a residue on the engine parts which will affect the engine life. These values should be as small as possible. Practical values are 0.5% sulphur, 0.27% carbon residue and 0.01% ash.

III. EXPERIMENTAL INVESTIGATION ON A DIESEL ENGINE FUELED WITH BLENDS AND NEAT MIXED BIODIESEL

A. Brake Thermal Efficiency (BTE)

The variation of BTE with brake power for different blends of mixed biodiesel is shown in Figure 1. The BTE increases with all loads for all blends of biodiesel. From the graph, it is noticed that MB20 has given maximum BTE when compared to other blends and minimum for MB100.

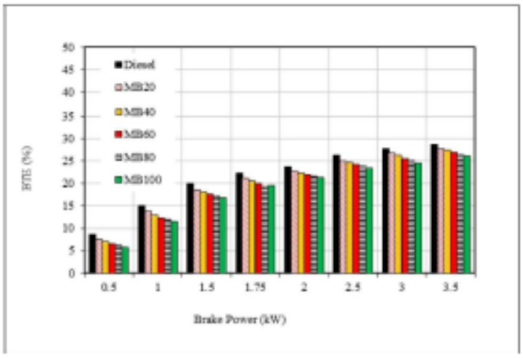

Figure 1 Variation of BTE with brake power

The BTE values for MB20, MB40, MB60, MB80, MB100 are 27.8%, 27.4%, 26.9%, 26.43% and 26.13% respectively, whereas 28.7% for diesel at full load. At full load, the BTE of MB100 is found to be lower by 8.95% compared to that

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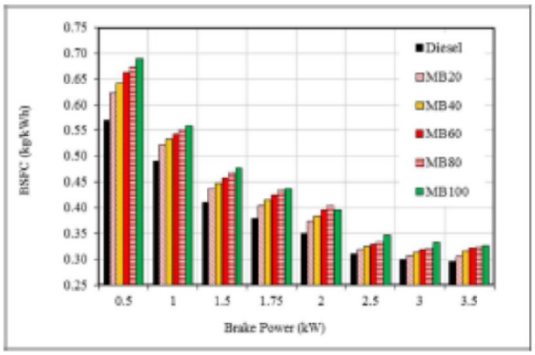
of diesel. For MB20, the BTE is lower by 3.13% than that of diesel. This is due to lower calorific value and low viscosity of the fuel blends.

B. Brake Specific Fuel Consumption (BSFC)

The variation of specific fuel consumption with brake power for different blends of mixed biodiesel is shown in Figure 2. From the chart, it is found that the BSFC of mixed biodiesel is higher than that of diesel. BSFC decreases with increase in brake power for all blends.



At the maximum load, the BSFC for MB20 and MB100 is found to be higher by 5.08% and11.86% respectively when compared to diesel. It is noticed that BSFC values for blends such as MB20, MB40, MB60, MB80, 69 and MB100 are 0.307 kg/kWh, 0.317 kg/kWh, 0.322 kg/kWh, 0.324 kg/kWh and 0.327 kg/kWh respectively, whereas 0.295 kg/kWh for diesel This is due to more viscosity and specific gravity and lower heating value of MB20 compared to diesel and the same results were obtained for the others blends also.

IV. PERFORMANCE CHARACTERISTICS

The variation of BTE with brake power for different injection pressure is presented in Figure 3. From this figure, it is concluded that the BTE increases with increase in brake power and also increases with injection pressure. The BTE for mixed biodiesel is lesser than diesel for all injection pressures. Maximum brake thermal efficiency is achieved for 230 bar injection pressure, but it is lower than that of diesel. The lower brake thermal efficiency is obtained for 200 bar injection pressure. When the injection pressure increases from 200 bar to 230 bar, the brake thermal efficiency is increased from 25.7% to 28.1% at full load. It is lower by 6.27%, 3.83%, 2.79%, 2.09% for 200 bar, 210 bar, 220 bar, 230 bar respectively when compared to diesel. At full load the efficiency is closer to diesel for mixed biodiesel for different injection pressure. This is because of improved atomization and better mixing.

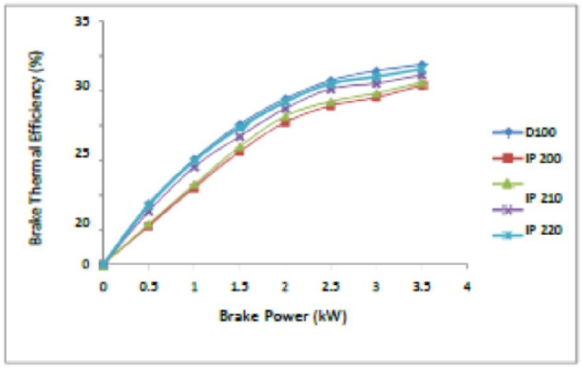


Figure 3 Variation of Brake Thermal Efficiency with Brake Power

The variation of EGT with brake power for different injection pressure is presented in Figure 4. Exhaust gas temperature is increased when the load increases. The exhaust gas temperature is minimum for diesel and higher for mixed bio fuel. When the injection pressure is increased from 200 bar to 230 bar, the exhaust gas temperature is increased. At IP 200 bar,

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the exhaust gas temperature is higher than diesel at full load and increases when the injection pressure increases. The EGT is higher than diesel by 13.4%, 16.84%, 35.31% and 42.78% for 200 bar, 210bar, 220 bar and 230 bar respectively at maximum load. This is due to the oxygen content present in the mixed biodiesel, which improves the combustion and thus increases in EGT.

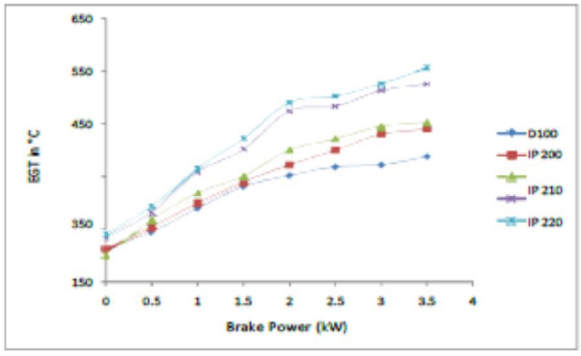

Figure 4 Variation of EGT with Brake Power

The variation of BSFC for mixed biodiesel and diesel for various injection pressures with different loads are given in Figure 5. It is noted that mixed biodiesel consumes more fuel than that of diesel. This is due to lower heating value and higher density of mixed biodiesel when compared with diesel. When the load and injection pressure increases, BSFC reduces but it is higher than diesel. Maximum BSFC obtained for mixed biodiesel at maximum load for IP 200 by 22.03% higher than that of diesel. When the injection pressure increases from 200 bar to 230 bar, the BSFC reduces from 22.03% to 5.08% at full load.

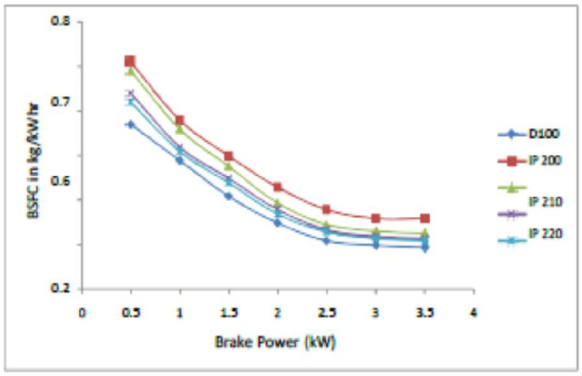

Figure 5 Variation of BSFC with Brake Power

VI. CONCLUSION

It was observed that performance and emission characteristics of CI engine fuelled with mixed biodiesel was improved by increasing the injection pressure and injection timing compared to that of designed injection pressure and timing.
The experiment were conducted on direct injection compression ignition engine using mixed biodiesel and the diethyl ether used as an additives are added to mixed biodiesel in 5%,10% and 15% and the following results are obtained at 15% in the maximum load.

- Brake thermal efficiency is increased by 1.87%
- BSFC is decreased by 5.10%
- EGT is increased by 16.91%
- CO, HC and smoke emissions are reduced to 44.44%, 22%, and 16.22%, respectively.
- CO2 emission is increased from 6.17% to 29.63%.

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