Performance and emission Analysis of Diesel Engine with Biodiesel Blended with Diesel

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ABSTRACT

Now-a-days crude oil prices have been increasing continuously as the fossil fuels are depleting. Biodiesels, due to their vegetable origin, so these are able to reduce the net carbon monoxide, hydrocarbon, and carbon dioxide emissions to the atmosphere. It can be blended in any proportion with mineral diesel and can be used in diesel engines without any modification. The objective is to evaluate the Albizia seed oil to be used as an alternative fuel. Albizia seed oil shows fuel properties similar to diesel. Albizia seed oil is blended with diesel in various proportions such as 10%, 15%, 20% and tested in a single cylinder diesel engine. The performance and emission characteristics are calculated in according to ASTM standards. The Brake power and Brake thermal efficiency are higher for 20% blends compared to other blends however the Brake specific fuel consumption of 20% blends are lower than that of other blends. This experimental analysis revealed that the combined blend of ALME20 showed that superior performance and emission than the blend of ALME10 & ALME15

Index Terms - Alternate Fuel, DI Diesel Engine, Albizia Seed Oil Methyl Ester (ALME), AVL Analyzer

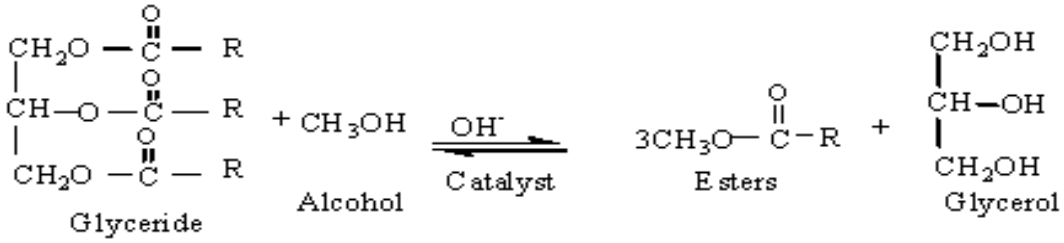
I. INTRODUCTION

The diesel engine is an internal combustion engine that uses compression ignition, in which fuel ignites as it is injected in to the air inside the combustion chamber. The engine works using the Diesel cycle named after German engineer Rudolf diesel , who invented it in 1892 , based on the hot bulb engine. Diesel and earlier experimented with the use of coal dust as a fuel in a similar design of engine. At the bequest of the French Government the Otto company demonstrated it at the 1900 Exposition Universal (world‘s fair) using peanut oil. The French governments were looking at using peanut oil for a locally produced fuel in their African colonies Diesel later extensively tested the use of plant oils in his engine and began to actively stimulate the use of these fuels.

It is possible Rudolf diesel was not the first to invent the diesel engine. His patent (No.7241) was filed in 1892. However , Herbert akroyd stuart and Charles Richard Binney had already obtained a patent in 1980 entitled : Improvements in Engines Operated by the Explosion of mixtures of Combustible Vapour and Air which described the world‘s first compression ignition engine. Akroyd stuart build the first compression ignition oil engine in Bletchley, England in 1891 and leased the rights to Richard Hornsby & sons , who by July1892, five years before Diesel‘s prototype, had a diesel engine operating for Newport Sanitary Authority. By 1896, diesel tractors and locomotives were being construct in some quantity in Grantham. Importantly , Diesel‘s air blast injection system did not become part of subsequent diesel engines , with direct injection (DI) (as found in Akroyd Stuart‘s engine) used instead, developed by Robert Bosch GmbH in 1927.

II.METHODOLOGY

The Vegetable oils are extracted from fruit or seeds. The vegetable oil usually contains free fatty acids (FFA), water, sterols, phospholipids, odorants and impurities. Its can cause number of problems in diesel engines. It also increased viscosity, and poor cold flow properties. These leads to severe engine deposits, piston ring sticking etc. Bio-diesel can be produced by following four ways: Pyrolysis, Micro emulsification, Dilution and Tran’s esterification. In this work Tran’s esterification process is used to prepare bio-diesel from albizia oil. It is the process of using an alcohol like methanol, ethanol etc.. in the presence of a catalyst, such as sodium hydroxide, to break the molecule of the raw renewable oil chemically into ethyl esters of the renewable oil, with glycerol as a secondary product. This is reaction of Tran’s esterification process for the vegetable oil:



2.1 PREPARATION OF BIODIESEL

In esterification process, esterified albizia biodiesel is react with methanol in the presence of catalyst sodium hydroxide (NAOH) to produce glycerol and fatty acid ester. The 250 ml methanol and 17g of sulphuric acid were taken in a round bottom

flask. Then this solution was mixed with 1000ml esterified albizia oil. The mixer was heated 60ºC and held at that temperature with constant speed (600) magnetic stirring for 2 hours. Then it was permitted to cool and settle in a separating flask for 12 hours. Two layers were formed in a separating flask. The bottom layer was glycerol and upper layer was methyl ester.

Fig.2.1 (a) Biodiesel

Fig.2.1 (b) glycerol

2.2 PREPARATION OF BLENDS

The biodiesel blends were prepared in different proportions and the blends were prepared by volume basis. The biodiesel blended with diesel by volume as B10 (10%ALME, 90% Diesel) is prepared. As first 90% (800ml) of diesel fuel was taken in reactor vessel then 5 % (100ml ALME) biodiesel was introduced in the same vessel. The mixture is then stirred (550rpm) at 40oc for 15min. The same procedure for B15 blend and B20

B0 - Diesel 100%
B10- Diesel 90%+ALME 10%
B15- Diesel 85%+ALME15%
B20- Diesel 80%+ALME 10%

2.3 PROPERTIES OF BLENDED ALBIZIA FUELS

Table.2.3 properties of blended albizia fuels

FUEL BLEND	VISCOSITY AT 40C	DENSITY	FLASH POINT	FIRE POINT
UNIT	**CSt**	**kg/m3**	**ºC**	**ºC**
DIESEL	2.9	840	63	72
ALBIZIA OIL	37.2	913	-	-
BIODEISEL	12.09	898	79	96
B10	4.1	840	69	78
B15	4.7	821	68	79
B20	5.1	846	70	82

III. EXPERIMENTAL SETUP

The experiments were conducted on a single cylinder four stroke diesel engine with electrical loading and the performance and emission feature were compared with diesel. Tests were conducted at a constant speed and at varying loads for all blends. Engine speed was sustained at 1500 rpm (rated speed) during all experiments.

IV. RESULT AND DISCUSSION

4.1 PERFORMANCE ANALYSIS

4.1.1 MECHANICAL EFFICIENCY

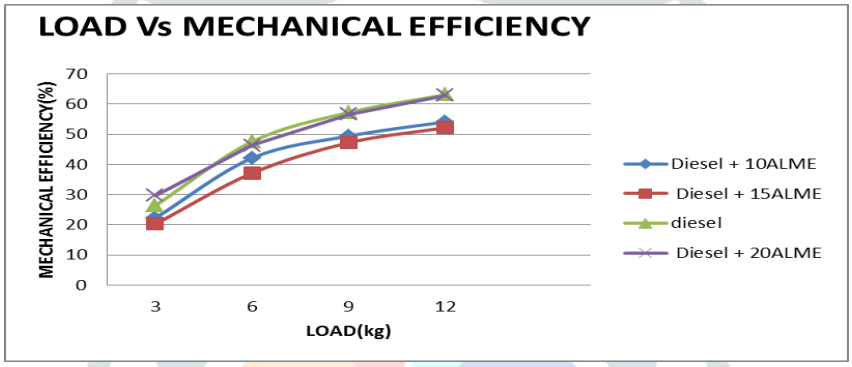


Fig.4.1.1 Load Vs mechanical efficiency

Fig.4.1.1 shows the SFC values for every applied load were plotted for biodiesel diesel blends shows that, mechanical efficiency increase with increase in load. Mechanical efficiency of biodiesel blend B20 is similar to that of diesel.

4.1.2 BRAKE SPECIFIC FUEL CONSUMPTION (BSFC)

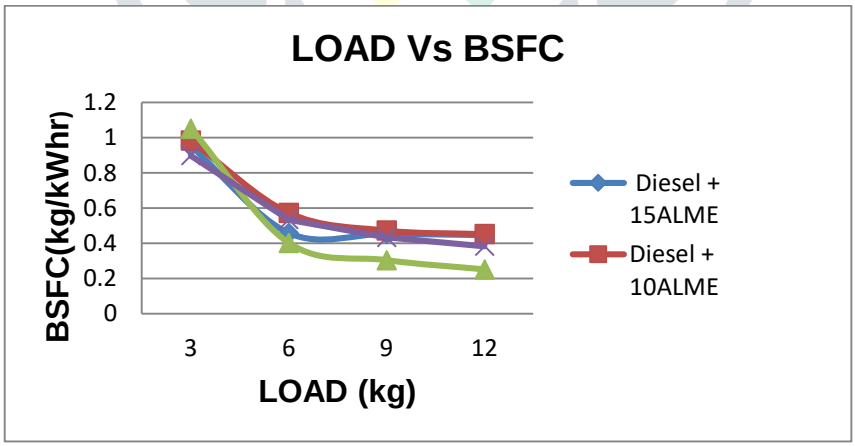


Fig.4.1.2 Load Vs BSFC

The Fig.4.1.2 shows the BSFC values for every applied load were plotted for biodiesel diesel blends shows that, Brake Specific Fuel Consumption (BSFC) decreases with increase in load. BSFC of biodiesel blend B20 is similar to that of diesel . BSFC decrease at higher concentration of biodiesel above 20%.

4.1.3 BRAKE THERMAL EFFICIENCY

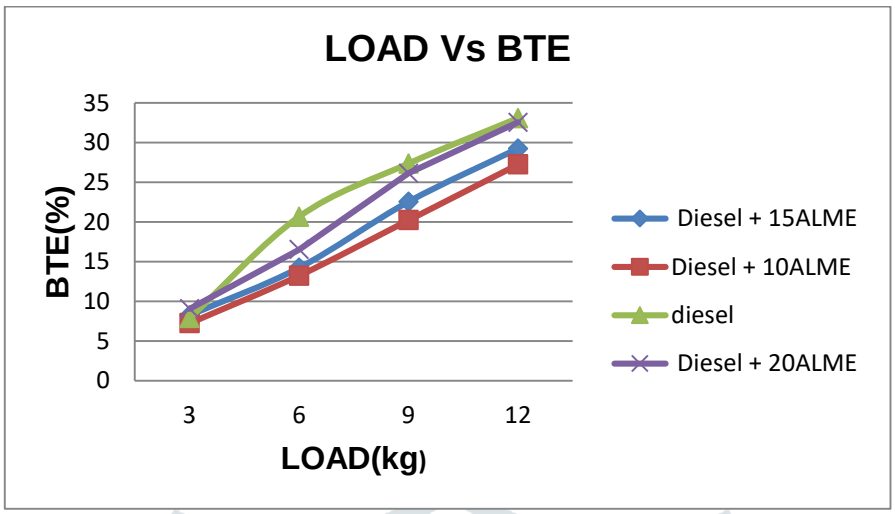


Fig.4.1.3 Load Vs bte

Fig.4.1.3 show the variation of brake thermal efficiency with applied load for B10, B15, B20 blends in comparison with diesel. The brake thermal efficiency intimates the ability of the combustion system to accept the experimental fuel and provides comparable means of assessing how efficiently the energy in the fuel was converted into mechanical output. For all the blends, the brake thermal efficiency increases with increase in applied load. It is noteworthy to recapitulate that the thermal efficiency of the engine relies on fuel consumption and calorific value of the fuel. Fig shows the variations of Brake Thermal Efficiency for the blends are nearly comparable to that of diesel and so the percentage of diesel consumption (i.e., volume) can be reduced by 15% and 20% for B15 and B20 respectively.

4.2 EMISSION ANALYSIS

4.2.1 HC EMISSION

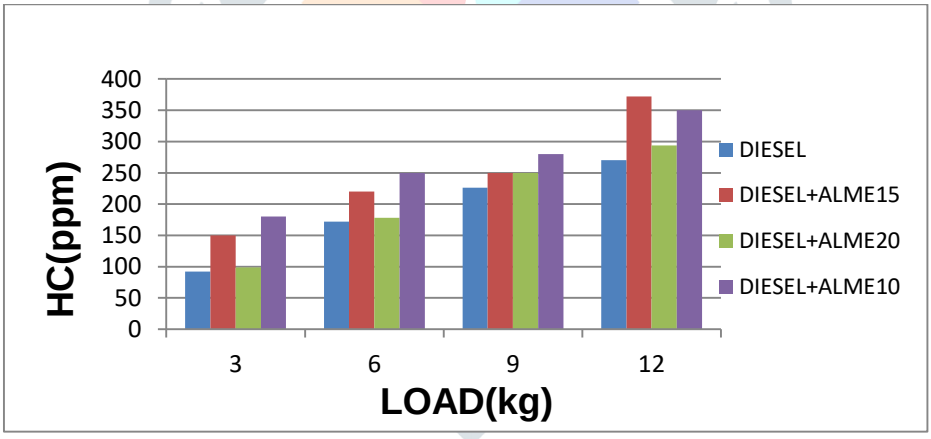


Fig.4.2.1 Load Vs HC

The figures.4.2.1 shows the variation of HC emission for the various ALME biodiesel at different blend percentages and compared with the HC emission of base fuel diesel.

4.2.2 NOx EMISSION

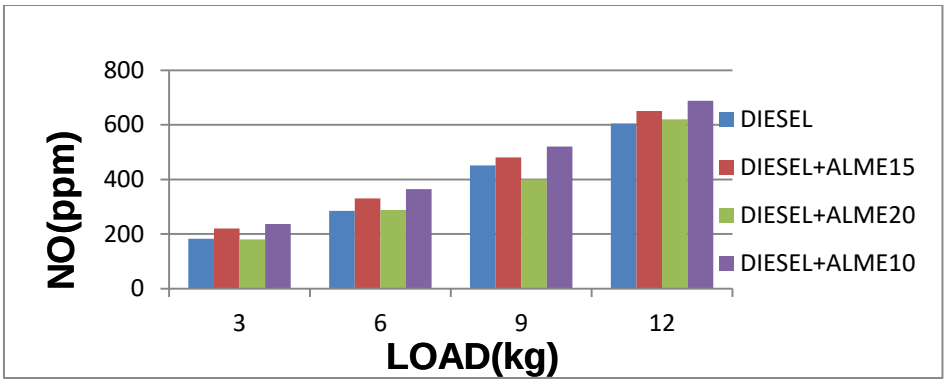


Fig.4.2.2 Load Vs NOx

The figures.4.2.2 shows the variation of NO_X emission for the various ALME biodiesel at different blend percentages and compared with the NOx emission of base fuel diesel

4.2.3 CO EMISSION

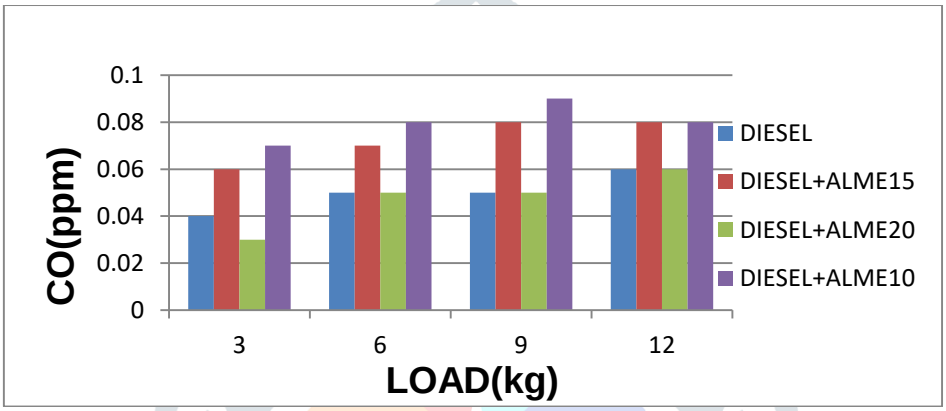


Fig.4.2.3 Load Vs CO

The fig.4.2.3 shows the variation of CO emission for the various ALME biodiesel at different blend percentages and compared with the CO emission of base fuel diesel.

V. CONCLUSION

In this experimental study, a Biodiesels from albizia blended with Diesel at various mixing ratio (ALME10, ALME15 and ALME20). The fuel properties of the blends were tested for its Related to accept in accordance with ASTM standards. The performance tests were done with two blends (10%, 15% & 20%) at various loads with constant engine speed of 1500 rpm and the results) were compared. The performance characteristics observed for 20% blends are similar to that of diesel. The Brake power and Brake thermal efficiency are higher for 20% blends compared to 15% blends. However the Brake specific fuel consumption of 20% blends are lower than that of 15% blends. This experimental analysis reveal that the combined blend of ALME20% shows superior performance than the blend of ALME20. Biodiesel up to 20% blend with diesel shows nearly equal performance feature compared with diesel. So B20 blend could consider as commercial applications. Biodiesel up to 20% blend with diesel shows nearly equal emission characteristic compared with diesel. So B20 blend could consider as commercial applications.

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