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Performance Analysis on Compression Ignition Engine Using Moringa Oleifera as Biofuel

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Abstract: In this experimental study the suitability of Moringaoleifera as a resource of renewable fuel alternating petro-diesel in compression ignition engine. The method of getting biodiesel from varied sources and mixing them with diesel is adopted in several economically developed and developing countries around the world. In this paper, blends from moringaoliferabiodiesel are investigated in performance characteristics on compression ignition engineand results are compared with pure diesel. The performance and combustion characteristics of MOB10, MOB15 and MOB20 blends of moringaoleifera biodiesel with diesel fuel under completely different load condition (0%, 20%, 40%, 60%, 80%, and 100%) and constant engine running speed are studied and it's seen that the blends of biodiesel with diesel might substitute within the place of pure diesel. The performance parametersbrake thermal efficiency, brake mean effective pressure, specific fuel consumption, brake power, air fuel ratio, and mechanical efficiency is evaluated and final conclusion is drawn.
Keywords: Moringaoleifera, blends, biodiesel, load condition, performance parameters.

I. Introduction

Day by days dependency of fuel is increasing owing to the increasing range of fossil fuel primarily based vehicles. These vehicles running on fossil fuels and there's instant increase in pollution in our atmosphere. Now a day's the main possible substitute fuels are vegetable oils and animal fats and their derivatives like as biodiesel are used.The unconventional energy sources of fossil fuels in addition as hydro, wind solar, geothermal hydrogen, nuclear and biomass. Out of those one among the most effective energy resources is biofuel. Biofuel derived from biomass, vegetables oils, as well as biodiesel, alcohol and biogas.Vegetables oils consist of different types of edible and non-edible oils such as palm oil, castor oil, silk cotton seed oil, jathropa oil, karanja oil, moringaoleifera and animal fat. The most unfavourable properties of these oils are their highly viscosity, low volatility, reduced atomization, improper fuel combustion and auto-oxidation. Biodiesel is most capable substitute fuel sources as a result of they are renewable, non-toxic, pollution free, biodegradable, and environmental friendly.The objective of this experimental study is to observe the performance analysis of blends of moringaoleifera biodiesel in compression ignition engine.The performance parameters of different blends by volume (MOB10, MOB15, and MOB20) are investigated experimentally on compression ignition enginerated at 1500 rpm with completely different load conditions. Analyse the experimental data from compression ignition engine fuelled by blend of biodiesel and diesel and compared comparative analysis performance characteristics.

II. Experimental Set Up

An experimental test rig a single cylinder, four strokes, water cooled, diesel engine used to test performance characteristics of Compression ignition engine fuelled with Moringaoleifera biodiesel and its blends with diesel. The speed of engine was fixed at 1500rpm and compression ratio of the engine 18:1.The "EnginesoftLV" was run on the computer and enters value of density and calorific value of fuel. Start water pump, adjust the flow rate of rotameter was 250LPH and Calorimeter was 75LPH by manually. Start the engine at no load 4-5 minutes. Gradually raising the load on engine by rotating dynamometer loading unit cell and engine was run at 10-15 minutes before the data collection. The performance parameter of diesel engine checked by 0%, 20%, 40%, 60%, 80%, 100% under steady state conditions. The different types of fuels such as diesel fuel, Moringaoleifera biodiesel blends with diesel (MOB10, MOB15, and MOB20) were tested one by one. The experimental setup is shown in figure 1.

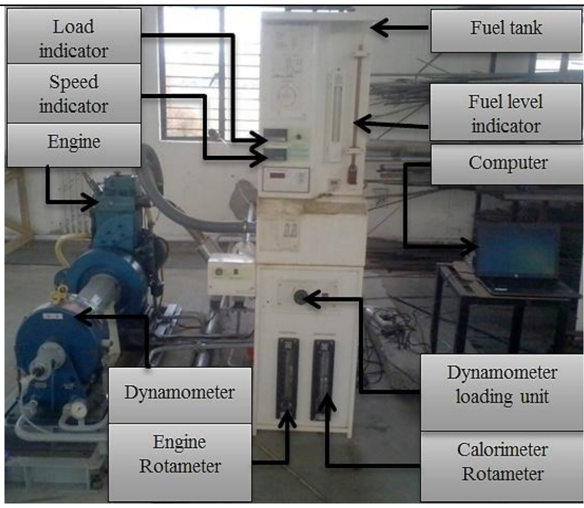

Fig.1: Experimental setup

Table 1. Specifications of test engine

Maker	Kirloskar
Model	TV1
Details	Single cylinder, Four stroke, Diesel
Bore and Stroke	87.5mm and 110mm
Compression ratio	17.5:1
Cubic capacity	0.661 liters
Rated power	3.5 KW @ 1500rpm
Cooling type	Water cooling
Inlet valve open	4.50 before TDC
Inlet valve close	35.50 after BDC
Exhaust valve open	35.50 before BDC
Exhaust valve close	4.50 after TDC
Fuel injection starts	23^0 before TDC
Dynamometer	Type eddy current, water cooled, with loading unit
Rotameter	Engine cooling 40-400 LPH; Calorimeter 25-250 LPH
Load indicator	Digital, Range 0-50kg, supply 230 VAC
Load sensor	Load cell type strain gauge, range 0-50Kg
Software	"EnginesoftLV" Engine performance analysis software

III. Result And Discussion

All the experimental results are discussed with the help of graph. The main objective of the study was to access the performance parameters like brake power, brake specific fuel consumption (BSFC), brake specific energy consumption (BSEC), brake thermal efficiency, mechanical efficiency, mean effective pressure, airfuel ratio.

Brake thermal efficiency: The difference between brake thermal efficiency and load for different fuel is presented by figure 2. In all the cases break thermal efficiency increased with increased value of different load conditions. This is may be attributed to reductions in heat losses and increase in power with increase in load. At full load conditions the brake thermal efficiency of MOB10, MOB15 and MOB20 was 29.2%, 29.29%, 29.35% respectively. At 100% load the Moringaoleifera biodiesel and its entire blend have higher brake thermal efficiency than diesel. This is because Moringa biodiesel have 10-11% more oxygen contain than diesel which help for better combustion in engine and advanced injection of fuel due to high bulk modulus and density of Moringaoleifera biodiesel. At 60% load diesel and Moringaoleifera biodiesel have same break thermal efficiency and MOB10 and MOB20 also have same thermal efficiency but at 75% load the brake thermal efficiency of Moringaoleifera biodiesel recorded less value this is because low calorific value of

Moringaoleifera biodiesel than diesel and premixed combustion region lesser than diesel also contributed to it. The higher break thermal efficiency may be due to additional lubricity provided by blends i.e. MOB10 and MOB20.

Brake mean effective pressure: The variation brake mean effective pressure vs different load conditions was shown in figure 3. The brake mean effective pressure was increased with increase in load. The friction loses was increased due to reduce the friction loses. The brake mean effective pressure value was 5.1 bar, 5.18 bar, 5.19 bar, 5.2 bar for diesel, MOB10, MOB15, and MOB20 at full load conditions. The brake mean effective pressure was slightly increased than that diesel fuel due to temperature and pressure on piston increased with increase in load which in turn increasing the thermal energy releasing rate. The brake mean effective pressure is directly proportional to thermal heat release rate, therefore BMEP also increases.

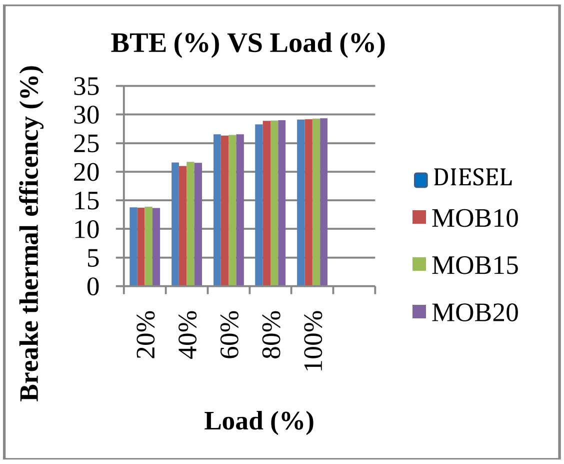

Fig.2: Brake thermal efficiency vs Load (%)

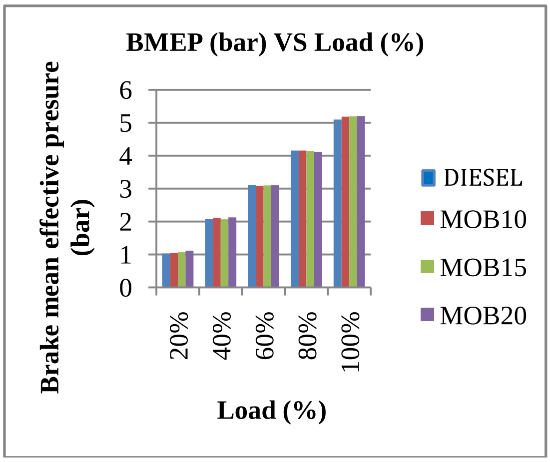

Fig.3: Brake mean effective pressure vs Load (%)

1. **Brake power (kw):** The brake power was increased with increase in load. The brake power was maximum value (4.3KW) for MOB15 at full load condition. The brake power was maximum due to better combustion and high amount of heat content in the biodiesel. The brake power value for diesel, MOB10, MOB15, MOB20 were 4.17kw, 4.27kw, 4.3kw. The BP value of moringa oelifera biodiesel blends was maximum than that of diesel.

2. **Air fuel ratio:** The variation of fuel air ratio for different load and fuels was shown in figure 5. Fuel air ratio was played very important role in engine performance. The fuel air ratio was increased with loading condition. For all loading condition MOB10 was recorded higher value than all other Moringaoleifera biodiesel blend and pure diesel the reason behind this the higher density of Moringaoleifera biodiesel and lower calorific value than diesel.

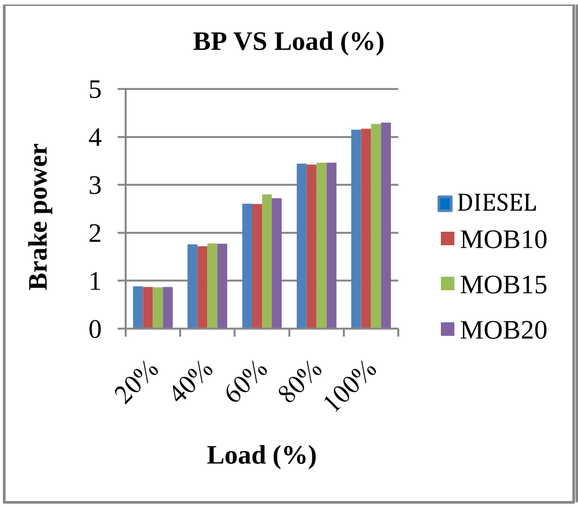

Fig.4: Brake Power vs Load (%)

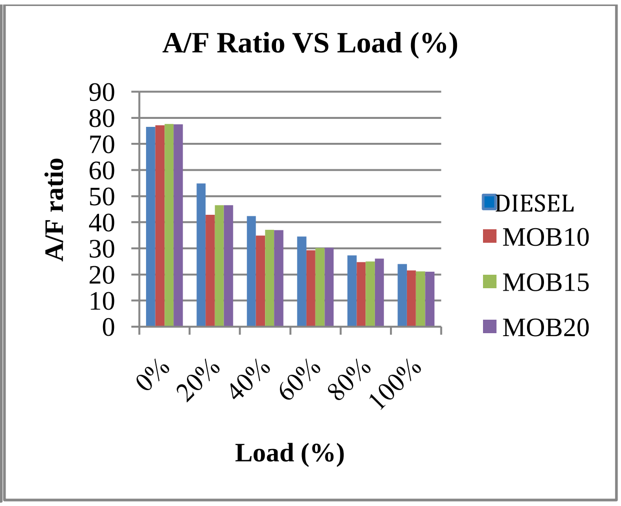

Fig.5: Air Fuel Ratio vs Load (%)

3. **Brake specific fuel consumption:** The specific fuel consumption was decreased for different load conditions. The specific fuel consumption value was slightly higher than that of diesel fuel for MOB10; MOB15 but MOB20 value was lower than that of diesel fuel at full load condition. Specific fuel consumption value was lower because of high amount of oxygen content present in the biodiesel they lead to proper combustion and decrease the specific fuel consumption value.

4. **Mechanical efficency (%):**The variation of mechanical efficency vs different load conditions was shown in figure 7. the mechanical efficency was increased with increased in load. The mechanical efficency was maximum for MOB20 at full load conditions than that of diesel fuel. The mechanical efficency eas increased due to reduced the friction loses in the engine parts and decreased the heat loses. The mechanical efficency was increased for 4-5% for MOB20 at full load conditions than that of diesel fuel.

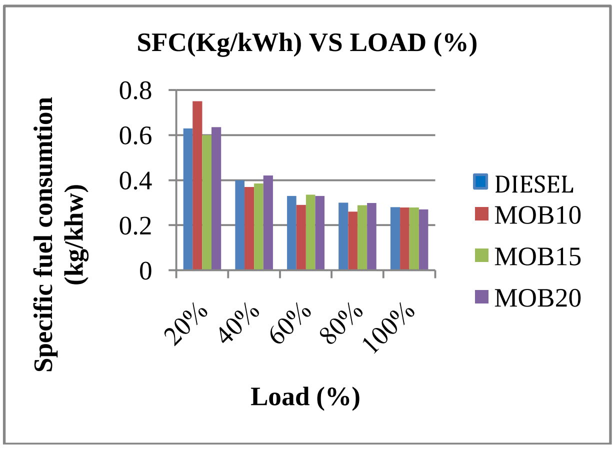

Fig.6: Brake specific fuel consumption vsLoad (%)

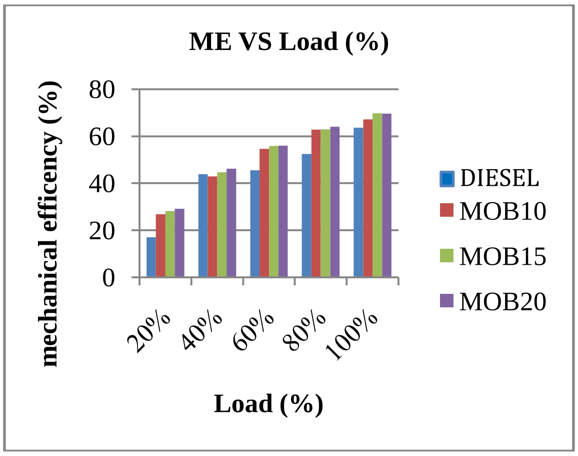

Fig.7: Mechanical efficiency vs Load (%)

IV. Conclusion

On the basis of analysis of the experiments results on single cylinder direct injection diesel engine fuelled with moringaoleifera biodiesel-diesel fuel blends, the following conclusions have be carried out, The Moringaoleifera biodiesel have 10-12% more oxygen content which contribute to good combustion but even than at all load condition heat release rate is less than diesel because of low calorific value, density and higher viscosity. Due to high density and viscosity result in inferior atomization and vaporization which lead to reduction in fuel air mixing rate. MOB10 and MOB15 was recorded higher brake thermal efficiency than diesel. The reason for it proper combustion and advanced injection of fuel and high oxygen content than diesel. At full load MOB10 and MOB15 have 5% to 10% brake thermal efficiency. Higher indicated thermal efficiency at all loads condition for MOB10 and MOB15 was recorded than others fuels. MOB10 have higher BSFC than diesel for all load condition than diesel. But MOB15 was recorded less BSFC than diesel. MOB15 have recorded less fuel air ratio than diesel for all load condition. Higher the specific fuel consumption was recorded for MOB10, MOB15 and MOB20 at part load conditions than that of diesel. The specific fuel consumption was decreased for MOB20 at full load conditions compared than that of diesel.

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