Experimental Investigation of Performance Characteristics of Stationary C.I. Engine Fueled With Biodiesel

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***Abstract*- Increasing oil prices and global warming activates the research and development of substitute energy resources to maintain economic development. Due to gradual depletion of world petroleum reserves and the impact of environmental pollution, there is an urgent need for suitable alternate fuel for use in diesel engines. The resources of alternative energy are environment friendly but they require to be explored on different situations for their advantages, disadvantages and specific application. Thus this experiment was performed to investigate the performance characteristics of stationary diesel engine using blends of Jatropha oil, Kerosene and Diesel. The outcomes under various parameters were believed to be close to that of diesel fuel only. Different diesel engine parameters such as brake power, brake thermal efficiency, brake specific fuel consumption, brake mean effective pressure, volumetric efficiency etc. have been determined and they were compared with diesel fuel.**

I. INTRODUCTION

Diesel engines are widely used in more or less every walk of life these days like transport, agriculture, industrial sectors etc. It is commonly used due to higher efficiency and easy operation. Fast diminishing fossil fuels has forced the researcher across the world to search alternative substitute of diesel or to reduce the consumption of fossil diesel. Biodiesel is used in compression ignition (diesel) engines to enhance engine combustion performance, improve engine lubrication and reduce air and water pollution caused by the exhaust.

Biodiesel is clean burning alternative fuel produced from domestic, renewable resources. It has potential to take the position of fossil diesel. The biodiesel fuel properties are very near to petrol diesel. Further biodiesel has slightly lower energy content than diesel but it can be utilized neat or its blend with diesel without appreciable engine modification.High oil viscosity is seriously constrained to replace the diesel which causes longer ignition lag, incomplete combustion, poor fuel atomization and carbon deposits on the injector and valve seats.The resources of alternative energy are environmental friendly but they require to be explored on different situations for their advantages, disadvantages and specific application. Due to continuous exhaustion of world natural petroleum storages and the effect of environmental pollution, there is an immediate requirement of proper substitution of fuels for use in diesel engines and this experiment is a little contribution in this direction.

It is necessary to consider diesel's characteristics to auto ignite, which is quantified by fuel's cetane number, where higher cetane number indicates quick or fast auto ignition. Cetane number for diesel ranges from 40 to 52 while that of kerosene is around 49. The cetane number of fuel indicates the auto ignition capability of the fuel and has a direct effect on delay in ignition. For shorter ignition delay, cetane number must be high and vice versa. The high cetane number of the fuel ensures early and smooth ignition and combustion of fuel. Since these properties are comparable to a blend of diesel with kerosene and jatropha oil, this blend can be used in the engine.

The major aim of this experimental work is to find out the effect of kerosene and Jatropha oil blend on diesel engine performance and further this work may be extended. Each performance characteristic is drawn and compared with diesel and explained as per the plot obtained.

II. MATERIALS AND METHODS

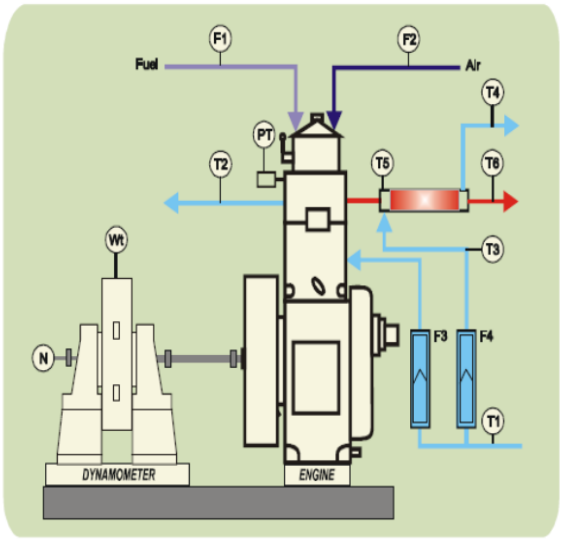
A. *FUEL USED*

The Jatropha oil, Kerosene and diesel used in this experimental investigation were purchased from the local market which is easily available. Pure diesel which is denoted by D100 was purchased from local fuel station and was considered as baseline fuel. Five mixtures of diesel-jatropha oil- kerosene namely B10, B20, B30, B40 and B50 were used in this experimental investigation. The properties of samples used are noted below in tabular form.

S.N.	Fuel (Diesel: Kerosene: Jatropha oil) (by percent)	Density (kg/cubic metre)	Calorific value (kJ/kg)
1.	Diesel (100:0:0)	875	42500
2.	B10 (90:5:5)	820	41900
3.	B20 (80:10:10)	826	41460
4.	B30 (70:15:15)	829	40870
5.	B40 (60:20:20)	832	40240
6.	B50 (50:25:25)	838	39580

B. *TEST ENGINE*

The experiment was conducted in a single cylinder four stroke diesel engine available in the college. The setup consists of single cylinder, four stroke VCR (Variable Compression Ratio) Diesel engine connected to eddy current type dynamometer for loading. The setup has stand- alonepanel box consisting of air box, two fuel tanks for duel fuel test, manometer, fuel measuring unit, transmitters for air and fuel flow measurements, process indicator and engine indicator. Rotameters are provided for cooling water and calorimeter water flow measurement. The schematic arrangement of the test engine along with its specification are provided in the following table.



Schematic arrangement

Engine Type	Make Kirloskar AK234
Stroke Length of Piston	110 mm
No. of Cylinder	1
No. of Stroke	4
Type of cooling	Water cooled
Rated Power	3.5 kW at 1500 RPM
Engine Capacity	553cc
Compression ratio	17.5
Variable CR range	12.5 to 17.5
Orifice diameter	20 mm
Dynamometer arm length	185 mm

C. *TEST PROCEDURE*

Give the necessary electrical connections to the panel. Check the lubricating oil level in the engine. Check the fuel level in the tank. Allow the water to flow to the engine and the calorimeter and adjust the flow rate to 250-300 lpm and 175-200 lpm respectively. Release the load if any on the dynamometer. Open the three way cock so that the fuel flows to the engine. Start the engine by cranking. Allow to attain the steady state. Note the reading and repeat the experiment for different loads. After the completion, release the load and then switch off the engine. Allow the water to flow for few minutes and then turn it off. Repeat the experiment by using biodiesel as fuel and analyze the performance characteristic of the stationary CI engine.

III. RESULTS AND DISCUSSIONS

Fig.1 presents the plot between the load and the brake specific fuel consumption. The rate of brake specific fuel consumption is same for diesel and B10 for the load ranging from 5.2 kg to 7.4 kg. For lower value of load (upto 5.2 kg), it is found that the brake specific fuel consumption for all the test samples is more than that of diesel. The brake specific fuel consumption is continuously decreasing with increase in load for the various test samples.

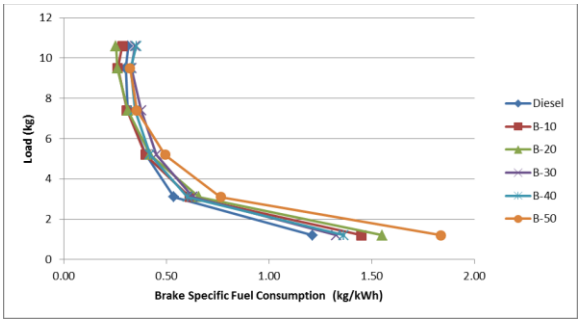


Fig. 1 Load vs Brake Specific Fuel Consumption

Fig.2 shows the plot between the load and the Brake power. Brake power increases with increment in the load for diesel alone as well as the other test samples. The value of brake power for various loads is almost same for all the test samples apart from the values against load ranging from 6 kg to 9 kg. The plot for B50 and diesel alone are found to be almost overlapping for all load values.

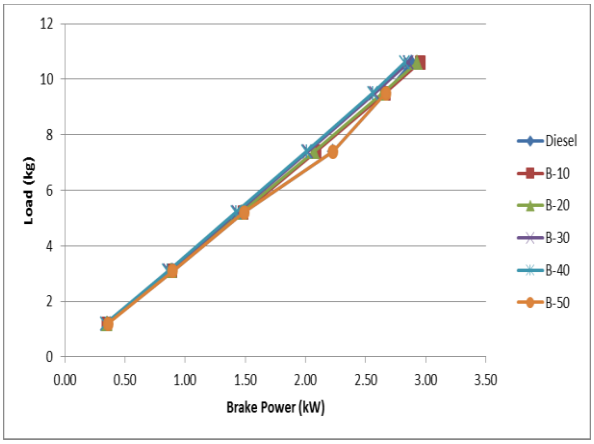


Fig.2 Load vs Brake Power

Fig.3 demonstrates the plot between the load and the brake mean effective pressure. Here also, the plot for the case of diesel alone and the various test samples are found to overlap each other. As the load increases, the brake mean effective pressure also increases.

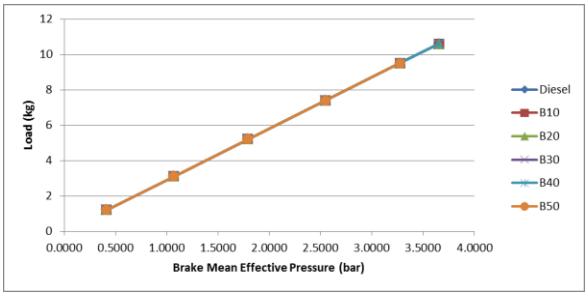


Fig.3 Load vs Brake Mean Effective Pressure

Fig.4 shows the plot between the load and the brake thermal efficiency. The brake thermal efficiency of diesel alone is greater than all test samples for load less than 5.2 kg but then decreases eventually in comparison to B10 and B20. As the load is increased, the brake thermal efficiency also increases except for load beyond 9.5 kg. The brake thermal efficiency of diesel alone and B50 are found to be same for load of 9.5kg

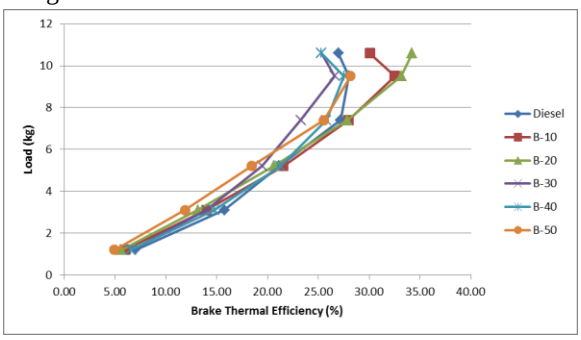


Fig.4 Load vs Brake Thermal Efficiency

IV. CONCLUSION

The experimental analysis on four stroke single cylinder diesel engine attached with eddy current dynamometer with various blends of Jatropha oil, Kerosene and diesel at different load conditions was performed and following results were concluded. As the load is increased, it is observed that there is increase in the brake power, brake mean effective pressure and the brake thermal efficiency whereas the brake specific fuel consumption decreases with increase in load. The best performance is for B50, means the blend of 25% by volume of Jatropha oil and kerosene each with diesel. Brake power and brake mean effective pressure of B50 and diesel alone are found to be almost same. Also, the values of brake thermal efficiency of B50 and diesel are found to be comparable at higher loads. Hence, among all blends of Jatropha oil and kerosene with

diesel, it is found that B50 reflects characteristics comparable to that of diesel.

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