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Performance and Emission Analysis of Jatropha Bio-Diesel Blends with Diesel Oil Using Single Cylinder Diesel Engine

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ABSTRACT: Now a day's world is facing fuel problems due to increasing in automobiles, power plant and industries, increasing of these automobiles, power plant produce more emission like CO, HC and NOX. This situation leads to seek an alternative fuel for diesel engine .biodiesel is found as an alternative fuel for diesel engine .The ester of vegetable oil and animal fat are known as bio diesel .This paper investigates the prospect of making bio diesel from jatropha oil. Jatropha curcas is renewable and non edible plant. Jatropha is wildly grown in drought areas of the country on degraded soils having less fertility and moisture content. Jatropha bio diesel is an oxygenated fuel; it has more oxygen and can be used diesel engine without any modification. In present work studied the emission characteristics of jatropha biodiesel the blends of jatropha methyl ester and diesel in the proportion B10, B20, B60, B80 and B100 are prepared analysed and their performance and emissions characteristics compared with the performance and emission characteristics of diesel. And obtained the emissions like CO, HC, NOX and CO2.The results are compared with pure diesel.

Keywords: *biodiesel, jatropha curcas, diesel, non edible oil.*

1. INTRODUCTION

The present work is aimed to explore the technical feasibility of jatropha biodiesel in C.I engines.

Jatropha curcas is non-edible oil being singled out for large scale for plantation on waste lands. It is drought-resistant, perennial plant, leaving up to 50 Years and has capability to grow on marginal soils. It requires very little irrigation and can grow in all types of soils.

The production of jatropha is about 0.8 kg per square metre per year. The oil content of jatropha seeds ranges from 30% to 50%.Fresh jatropha oil is slow drying odourless and colourless oil, but it turns yellow after aging jatropha seeds are nontoxic and press cake cannot be used as animal folder, it can be used as organic manure. The main characteristics of biodiesel are its use doesn't require any modifications to the existing diesel engine. Bio-diesel has high cetane number, no aromatics and contains 10% to 11%oxygen by weight. These properties of biodiesel reduce the emissions of carbon monoxide (co), unburned hydrocarbons, particulate matter in exhaust.

Jatropha curcas seeds contain 27-40% oil [1] that can be processed to produce a high-quality biodiesel fuel that is usable in a standard diesel engine, especially if the oil of the seeds is well extracted. Biodiesel has an energy content of about 12% less than petroleum-based diesel fuel on a mass basis. It has a higher molecular weight, viscosity, density, and flash point than diesel fuel.

Interestingly, the plant is cherished for its medicinal purposes and does not produce any toxic or harm to the environment, instead, it purifies theses environment. It was discovered that 23 per cent of carbon dioxide (CO2) in the area where Jatropha curcas is planted is absolved by the plant per annum. Apparently, none of the plant part is wasted, all the plant parts has its usefulness. After extraction of the oil from the plant seed, the oil undergoes different processes in which trans-esterification is the major process of refining the oil to biodiesel, thus this biodiesel could be used alone or mixed with petro diesel and use to power any diesel engine [4]

Figure 1.1jatropha seed.

II. MATERIALS AND METHODS

The jatropha bio-diesel is prepared by Trans etherification processes because of their FFA level is less than 1%. Transesterification retort was completed for 100ml of raw oil by adding 30ml of CH_3OH and 0.5gms of sodium hydroxide with retort instant of 60 minutes and temperature is $50℃\ to\ 65℃$. Jatropha bio-diesel blends were arranged by mixing B20, B40, B60, B80 and B100 respective bio-diesel with diesel oil on volume basis.

IV. EXPERIMENTAL SETUP

The engine performance and emission test were conducted on single cylinder diesel engine. First the engine was run with diesel and reading were recorded, then the biodiesel blends with diesel in different proportion like B20, B40, B60, B80, B100 was used and reading were recorded.

Figure 3.1singal cylinder 4-stroke diesel engine

Table3.1 Engine Specification

Parameter	Details
Made	Kirloskar
Number of strokes	4
Number of cylinder	1
Fuel used	Diesel
Diameter of cylinder	0.0875m
Cylinder stroke	0.11m
Cooling system	Water cooled
Lubrication	Forced type
Output	5.2kw at 1500rpm
SFA	251g(k-w-h)
Dynamometer	Eddy current

IV. RESULTS AND DISCUSSION

A. Properties of Jatropha And Their Blends

- *Effect of Viscosity*

The figure 4.1 shows the comparison of viscosity of various test samples used. It indicates that the viscosity of crude biodiesel is very much higher compare to all other samples. Increasing the addition of biodiesel to diesel increases the viscosity.

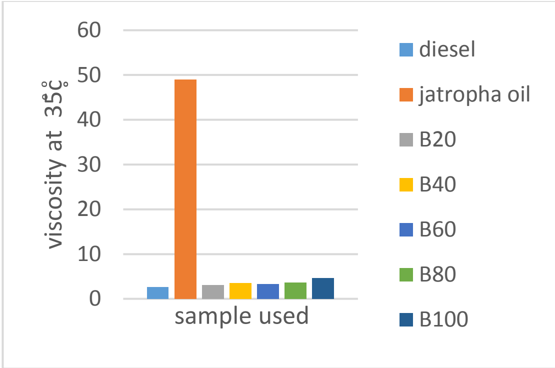

Figure 4.1 viscosities of jatropha oil, biodiesel and its blends

Here the sample B20 is having nearer viscosity to the diesel viscosity value when compare to all other samples. So B20 sample will match the property of diesel through viscosity and it is having less viscosity compare to all other blends.

- *Effect of specific gravity*

Figure 4.2 shows comparison of specific gravity of various test samples used. Specific gravity increases by increasing the percentage of bio diesel blends. Specific gravity of diesel is comparatively nearer to B100. Specific gravity of jatropha oil has highest value compared to all other blends

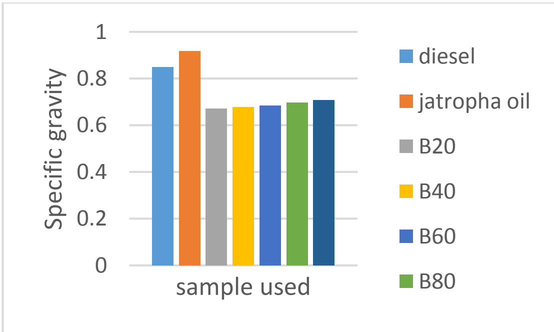

Figure 4.2 specific gravity of jatropha oil, biodiesel and its blends

- *Flash point*

Figure 4.3 shows characterization of flash point various test samples used. Flash point of B100 is more compare to other all blends and diesel has lower flash point than jatropha oil.

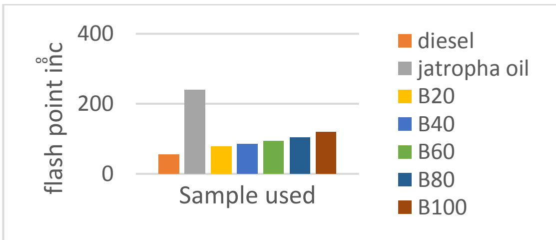

Figure 4.3 flash points of jatropha oil, biodiesel and its blends

- *Fire point*

Figure 4.4 shows characterization of fire point of various test samples used. Fire point increases with the increase in percentage of biodiesel in the blends. Jatropha oil is having more fire point with associated to biodiesel. The fire point of pure biodiesel is more than diesel.

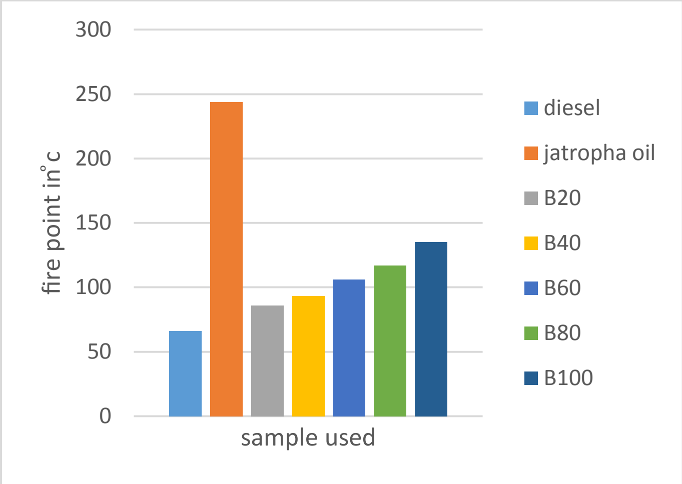

Figure 4.4 fire point of jatropha, biodiesel and its blends

- *Effect of heating value or calorific value*

Figure 4.5 shows the evaluation of calorific value of various samples used. Calorific value of fuel decreases with increase in the addition of biodiesel to diesel. B100 is having less calorific value compared to all other blends.

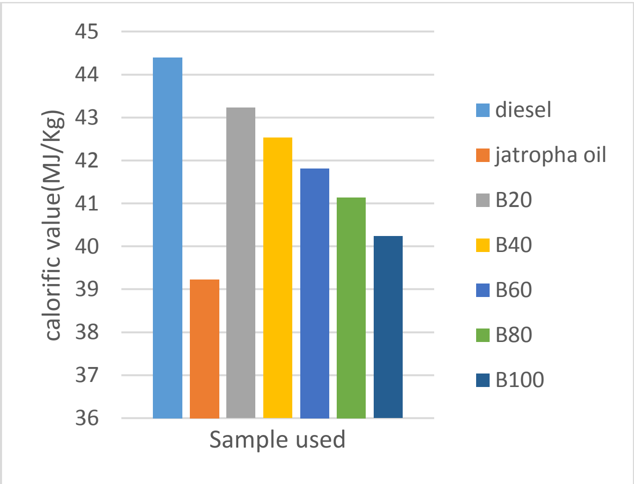

Figure 4.5 calorific value of jatropha oil, biodiesel and its blends

- *Effect of Density*

Figure 4.6 shows the deviation of density values of various test samples used. Density of jatropha oil is more than diesel, biodiesel and their blends .Increase in addition of biodiesel to diesel increase the density of fuel.B20 shows less density than all other blends. Maximum density was found to be 918 kg/m^3 for jatropha oil and minimum density was found to be 671kg/$m^3$for B20.

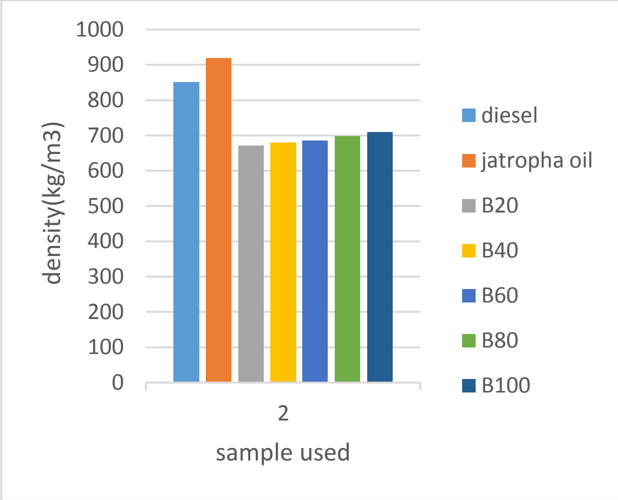

Figure 4.6 density of jatropha oil, biodiesel and its blends.

B. Engine Performance

The basic engine performance measuring parameters are BTE, Mechanical efficiency, SFC has been obtained from different blends and results are compared with pure diesel.

- *Effect of Load on BTE*

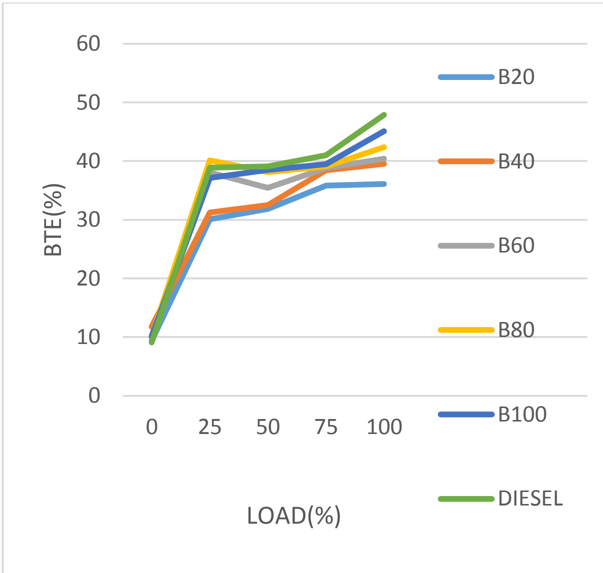

Figure 4.7 Variation of BTE with respect to Varying Load

The figure 4.7 displays the deviation of Brake Thermal Efficiency by varying the load.

It shows that the Brake Thermal Efficiency increases as the load increase. The B20is having highest BTE at maximum load compare to all other blends.

- *Influence of Load on Specific Fuel Consumption (SFC)*

The consequence of varying load on Brake Specific Fuel Consumption in (kg/kW-min) has shown in the figure 4.8.

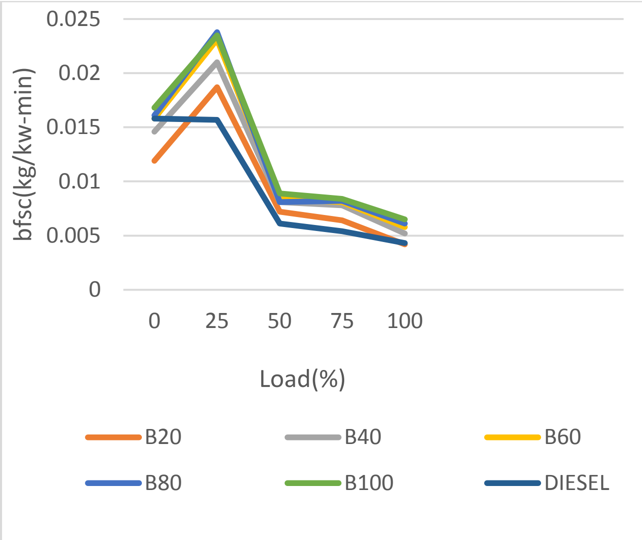

Figure 4.8 Variation of BSFC with respect to Varying Load

The figure 4.8 shows the variation of BSFC according to change in load. The graph indicating that the amount of brake specific fuel consumption decreases as load increases. SFC increased with increases in percentage of biodiesel blends. B20 have specific fuel consumption near to diesel.

- *Influence of Load on Exhaust Gas Temperature*

The change in Exhaust Gas Temperature in terms of degree Celsius due to the effect of varying load is as shown in the figure 4.9.

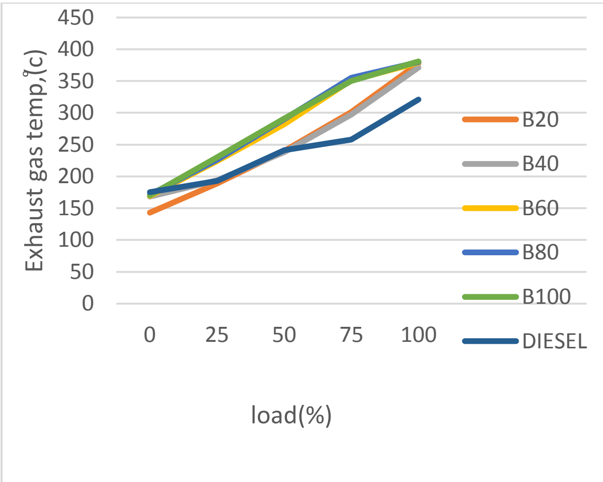

Figure 4.9 Results of Exhaust Gas Temperature with Varying Load

C. Engine Emissions

The emission test is major section of biodiesel project. Because of the emission of pollutants. So it is necessary to reduce the emission of harmful emission of gases. The major emissions are hydrocarbon (HC), carbon monoxide (CO), Nitrogen oxide (NOX) and carbon dioxide (CO2). The hydrocarbon (HC) is produced due to the incomplete combustion of the fuel. The carbon monoxide (CO) is formed due to partial supply of oxygen and Nitrogen oxide (NOX) is released due to the high temperature of the engine.

- *Effect of load on CO emission*

Figure 4.10 shows the effect of load on CO emission when engine was made to run with B20, B40, B60, B80 and B100 and diesel. Figure 4.10 shows that CO emission increases with increase in the percentage of load and decreases with increase in the biodiesel blends because of high oxygen content in the biodiesel that make the combustion clean. As the load increases the cylinder temperature also increases.

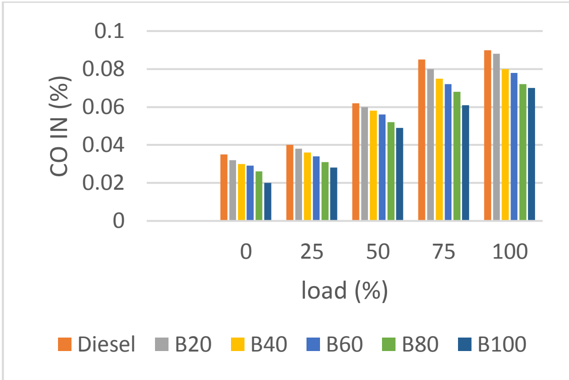

Figure 4.10 Variation of load with CO emission when diesel engine runs on B20, B40, B60, B80, B100 and Diesel.

- *Effect of load on CO2*

The figure 4.11 shows the variation of CO2 emission with load when diesel engine made to run with B20, B40, B60, B80, B100 and diesel. The lower percentage of jatropha methyl ester blends release less quantity of CO2 than diesel. Blend B20 releases less quantity of emission shown in figure 4.11. It is noted that higher the content of jatropha biodiesel blends will increases the CO2 emission because of incomplete combustion.

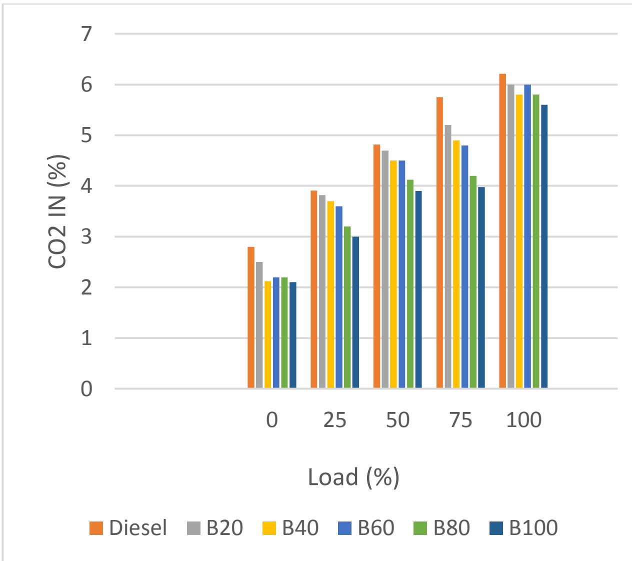

Figure 4.11 Variation of load with CO2 emission when diesel engine runs on B20, B40, B60, B80, B100 and Diesel

- *Effect of load on HC*

Figure 4.12 shows the effect of load on HC emission when diesel engine is made to run with B20, B40, B60, B80, B100 and diesel. It shows that HC emission increases by increasing on load and decreases by increasing proportion of biodiesel. B100 has minimum HC emission at all loads. B20 has maximum HC emission than all blends at full load but lower than diesel.

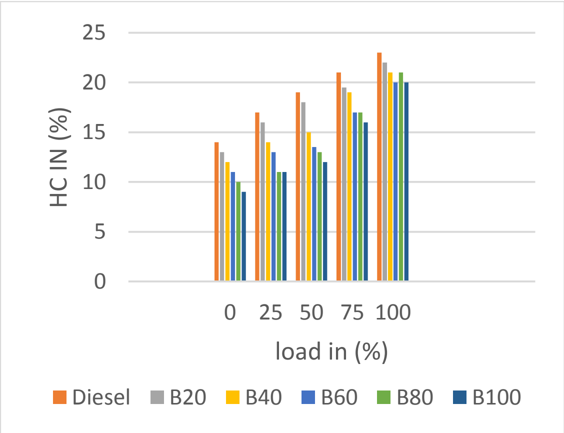

Figure 4.12 Variation of load with HC emission when diesel engine runs on B20, B40, B60, B80, B100 and Diesel.

- *Effect of load on NOx*

Figure 4.13 shows the effect of load on N0X emission when diesel engine was made to run with B20, B40, B60, B80, B100 and diesel. And also show that NOx emission increases by increasing proportion of biodiesel. B20 has minimum NOx emission at no load condition. B100 has maximum NOx emission. With increase in jatropha methyl ester percentage in blend the oxygen content increase and hence higher blend shows higher NOx emission compared to diesel.

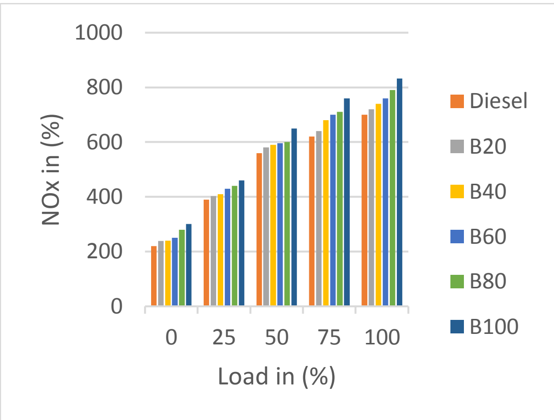

Figure 4.13 Variation of load with NOx emission when diesel engine runs on B20, B40, B60, B80, B100 and Diesel

V. CONCLUSION

The following conclusions obtained from the present work.

• Jatropha oil can be successfully converted into methyl ester by using transesterification process.

• Transesterification process reduces the viscosity of the jatropha oil and it improves the properties like viscosity, flash point, fire point of the jatropha methyl ester

.The properties of B20 sample are close

to the diesel properties and hence it gives better performance

• Smooth running of engine is observed with esterifies jatropha oil compared with that of diesel.

• Brake thermal efficiency of B20 is nearer to diesel.

• Specific fuel consumption of B20, is close with the diesel.

•Emission of CO is minimum when compare with diesel.

• Highest HC emissions in diesel and B20 has maximum emission at full load, B100 has minimum HC emission at all loads.

• From this study it is conclude that the B20, B40 gives optimum performance where B100 gives the lower emission of HC and CO.

• Present experimental work shows that jatropha methyl ester oil gives good engine performance and less co emission.

• Finally concluding B20 could be used as a viable alternative fuel to operate single cylinder diesel engine with injection pressure at 180 bars.

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