PERFORMANCE AND EMISSION CHARACTERISTICS OF SINGLE CYLINDER DIRECT INJECTION DIESEL ENGINE USING ALTERNATE FUELS

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ABSTRACT

As the cost of conventional fuels goes up, the interest in other fuel sources increase. In this contest an experimental investigation has been conducted on single cylinder diesel engine, fuelled with the blends of alternative fuel and Diesel. This study investigates performance and emission characteristics of a diesel engine which is fuelled with 20% blends of jatropha, neem, karanja, mahua. The fuel properties of four oils and its blend with diesel fuel at different proportions were studied including engine tests. A single cylinder four stroke diesel engine was used for the experiments at various loads and speed of 1500rpm. An exhaust gas analyser was used for the measurements of exhaust gas emissions. However blending of this oil with diesel up to 20% (by volume) can be used safely in a conventional CI engine without any engine modification that could help in controlling air pollution.

INTRODUCTION

An enormous increase in the number of automobiles in recent years has resulted in greater demand for petroleum products. With crude oil reserves estimated to last only for a few decades, therefore, effort are on way to research now alternatives to diesel. Of the various alternate fuels under consideration, biodiesel, derived from esterified vegetable oils, appears to be the most promising alternative fuel to diesel due to following reasons. Biodiesel can be used in the existing engines without any modification. It is an oxygenated fuel; emissions of carbon monoxide and soot tend to reduce. The use of biodiesel can extend the life span of diesel engine because it is more lubricating than petroleum diesel fuel. The high viscosity of vegetable oils and their low volatility affects the atomization and spray pattern of fuel, leading to incomplete combustion and severe carbon deposits, injector choking and piston ring sticking. The methods used to reduce the viscosity are pyrolysis, blending with diesel, transestrification, and emulsification. In this process we reduce viscosity by blending with diesel method. In this investigation mainly focused on the determination of maximum possible diesel replacement by jatropha, neem, mahua and karanja oils with suitable engine operating parameters for 20%(by volume) blend operation.

- By using alternate fuels, Performance increases and emission reduces without any modification in diesel engine.

- To replace the conventional fuels like petrol, diesel.
- To reduce serious air pollutants such as carbon monoxide, hydrocarbon, and oxides of nitrogen.

There has been plenty of research done so far on emissions testing and biodiesel production and performance. Research in the area of biodiesel has shifted towards making it more economically feasible by lowering production costs and increasing the energetic yields from various feed stocks. The research has been lacking is in relatioto the better characterization of the performance of these fuels in all possible diesel applications.The objective of the present work is to investigate the effect of neat vegetable oils blends, biodiesel – diesel blends on compression ignition engine performance, emission and combustion characteristics at constant engine speed and variable load operating conditions. Here the vegetable oils chosen for the investigation are jatropha, neem, karanja and mahua

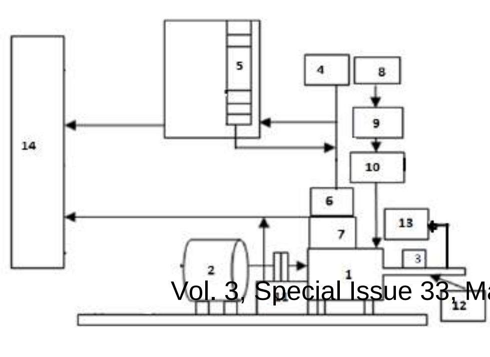
LITERATURE SURVEY

SudiptaChoudhuryet al in the paper**"KARANJA-ITS POTENTIAL AND SUITABILITY AS BIODIESEL"**discussed the physical and chemical properties of karanja oil and suggested that it cannot be used directly as CI engine fuel due to higher viscosity, density which will result in low volatility causing in complete combustion and carbon deposits in combustion chamber. **Pryde** et al. in the paper **"EXPERIMENTAL INVERSTIGATION OF PONGAMIA,JATROPHA AND NEEM AS BIO DIESEL ON C.I. ENGINE"** discussed that durability were encountered with vegetable oils because of deposit formation, carbon buildup and lubricating oil contamination. Thus, it was concluded that vegetable oils must either be chemically altered or blended with diesel fuel to prevent premature engine failure.

Siddalingappaet al (2011) investigated the performance and combustion characteristics of a single cylinder, naturallyaspirated water cooled diesel engine with karanja oil blends at various proportions. The blends were prepared on the volume basis. It has been reported that the karanja oil and its blends have high viscosity, flash point, fire point, density and lower calorific value than the diesel engine. It has been further reported that the 15% blend of karanja oil gives comparable brake thermal efficiency and better combustion.**DeepakAgarwal** et al (2008) investigated the use of various vegetable oils like mahua oil, linseed oil in a compression ignition engine. It has been reported that the straight vegetable oils possessed operational and durability problems when subjected to long term usage in CI engine.

METHODLOGY

Bi–fuelling or blending is the simplest technique for admitting low cetane fuels in high compression engines. According to this method the fuel selected for investigation is mixed with standard diesel oil in various proportions on volume basis and its properties such as calorific value and viscosity were evaluated before admission.



1.Engine	8.Air filter
2.Alternator	9.Air box
3.Thermocouple	10.U-tube manometer
4.Fuel tank	11.Speed sensor
5.Burette	12.Exhaust pipe
6.Fuel filter	13.Gas analyser
7.Fuel pump	14.Computer withdata acquisition

ENGINE SPECIFICATIONS

MANUFACTURER	**KIRLOSKAR**
Model	AV1
Type	Single cylinder, four stroke, direct injection engine
Power	3.7kW (5HP)
Bore	80mm
Stroke	110mm
Cubic capacity	0.553 litres
Compression ratio	16.5:1
Rated speed	1500 rpm
Cooling type	Water cooling

The test engine is coupled with an eddy current dynamometer through a load cell. It is integrated with a data acquisition system to store the data for the off-line analysis. Cooling water is circulated separately to the engine and the dynamometer at the required flow rates. Necessary provisions were made to regulate and measure coolant flow rates of air, fuel. The engine is operated on diesel baseline mode at a constant speed of 1500 rpm at various intervals of load. According to this method the fuel selected for investigation is mixed with standard diesel oil in various proportions on volume basis. At each load, the engine performance parameters were recorded. A Wahum Cubic five Gas analyser was used to measure the exhaust emissions.

RESULTS AND DISCUSSION

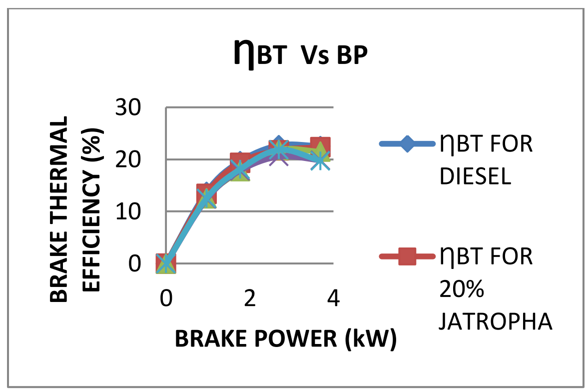


Fig.1—Variation of brake thermal efficiency with brake power for various blends of alternate fuels

The variation of brake thermal efficiency with brake power for different fuel blends are shown in figure. In all the cases brake thermal efficiency is increased due to heat loss with increased in brake power. The maximum efficiency obtained in this experiment was 22.33% (J20) and 21.46% (N20).

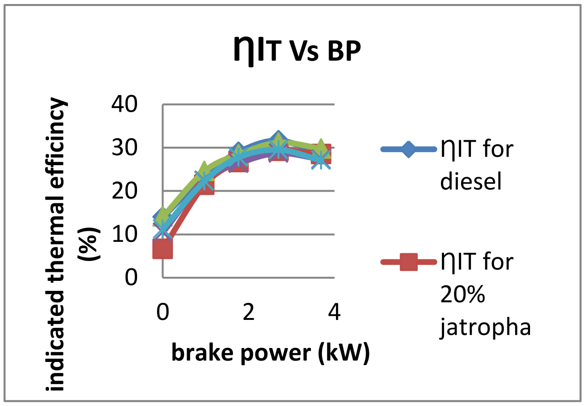


Fig.2—Variation of indicated thermal efficiency with brake power for various blends of alternate fuels

The variation of indicated thermal efficiency with brake power for different fuel blends are shown in figure. The maximum efficiency obtained in this experiment was 28.03% (J20) and 29.56% (N20).

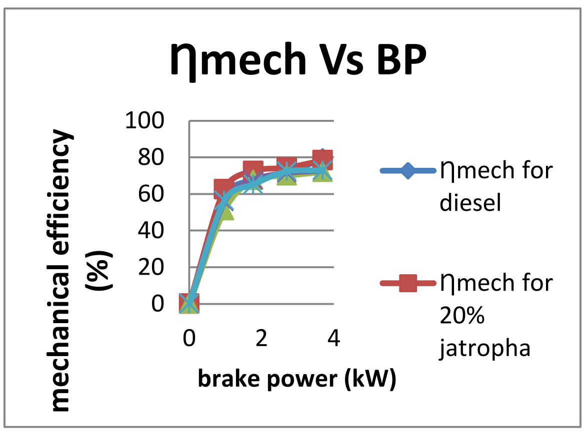


Fig.3—Variation of mechanical efficiency with brake power for various blends of alternate fuels

The variation of mechanical efficiency with brake power for different fuel blends are shown in figure. In all the cases mechanical efficiency is increased due to heat loss with increased in brake power. The maximum efficiency obtained in this experiment was 79.18% (J20) and 73.63% (M20).

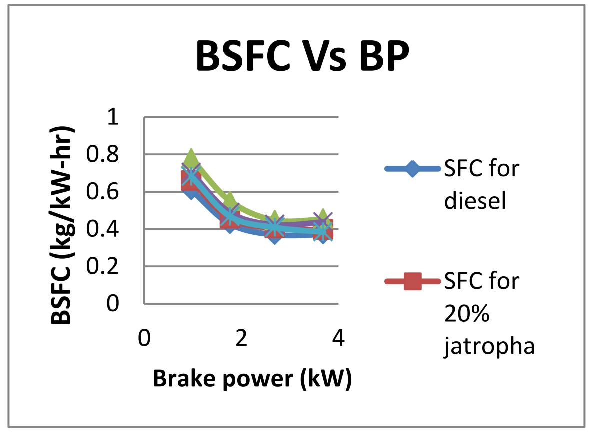


Fig.4—Variation of brake specific fuel consumption with brake power for various blends of alternate fuels

The variation of BSFC at different fuels as shown in figure. For all cases BSFC reduces with increase in brake power. SFC at different brake power with all blended fuels was found slightly varied from diesel and SFC of mahua is lower than the other three fuels. In SFC, mahua was reduced from0.6844 kg/kW-hr to 0.4027 kg/kW-hr.

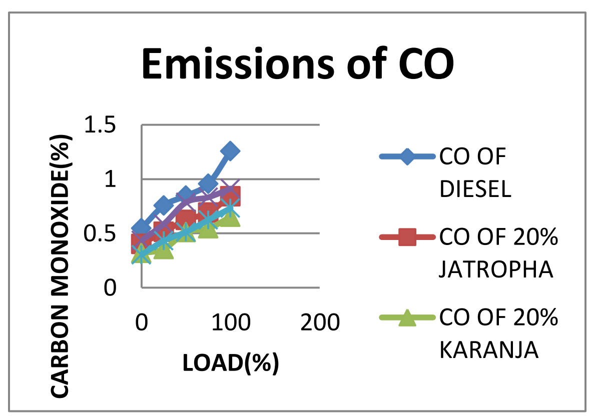


Fig.5—Emissions of Carbon monoxide for various blends of alternate fuels

Carbon emission depends upon combustion efficiency and carbon content of the fuel, which during combustion undergo a series of oxidation and reduction reactions. Carbon content of fuel is oxidised with O_2 available in the air to CO and then to CO_2 which is not converted to CO_2 will come back as CO in the exhaust. For all the fuels, CO emission is lower than that of the diesel (0.652% karanja), and (mahua 0.732%) gives better CO emission compared to other two fuels

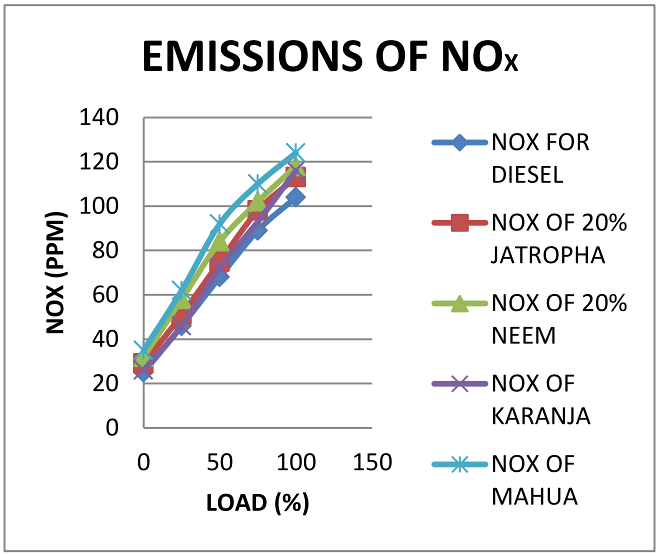


Fig.7—Emissions of oxides of nitrogen for various blends of alternate fuels

NOx are formed inside a diesel engine due to high flame temperature, peak pressure inside the cylinder, nitrogen content of the parent fuel and the residence time of the fuel inside the cylinder. Figure shows that he NOX emission of various fuels blends are higher than standard diesel operation at all loads. This may be due to the cetane suppressing property of various fuels. Usually low cetane fuels offer longer ignition delay and release more heat during the pre-mixed phase of combustion. This causes higher combustion temperature and enhances the reaction between oxygen consequently yields more NOX compounds. The maximum NOX obtained (Mahua=124ppm, Neem =118ppm, Karanja=116ppm, and Jatropha=113 ppm) for full load conditions.

CONCLUSION

Finally, we concluded from the above experiments the Jatropha fuel is best in both performance and emission side, next to that Neem is better on performance side and karanja is better on emissions side compared to other alternate fuels. Properties are quite comparable with diesel and hence it is believed that these oils will also perform well in the direct injection diesel engine.

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