PERFORMANCE AND EMISSION ANALYSIS OF DIESEL ENGINE USING JATROPHA OIL WITH SUPER CHARGER

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ABSTRACT

Alternative fuels are the fuels of the present and the future more vehicles are switching over to alternative fuels worldwide. Last two decades in India there has been a tremendous increase in the number of automobiles. Combustion of fossil fuels in the transport sector has led to release of pollutants such as CO, HC,NOx and many harmful compounds in the environment. This specially a huge problem for developing country like India. Transesterified vegetable oil, also called bio-diesel is becoming increasingly important as a fuel for diesel engine due to several reasons. Bio-diesel is a renewable, inexhaustible and a clean burning fuel. Many studies have shown that properties of bio-diesel are very close to petro diesel. Bio-diesel can be used in diesel engine without modification. Bio-diesel has no aromatic, no-sulfur and contains 10-12% oxygen by weight. These characteristics of bio-diesel reduce the harmful emissions of unburned hydrocarbons and CO. The aim of present research work is to use B10, B20, B30, blend of jatropha methyl ester. The effect of super charging also studied and the performance and emission of the engine are evaluated in terms of BSFC, TFC, SEC, brake thermal efficiency and volumetric efficiency, and smoke density. The investigation result shows that the output and brake thermal and volumetric efficiency of the engine with super charger was improved in comparison with naturally aspirated engine.

Keywords: Jatropha, Super Charger, Engine.

INTRODUCTION

Vegetable oils present very promising alternate to Diesel oil since they are renewable and have similar properties. Several research and project in the field of Internal combustion Engine are being focused on reduced Emission, which not only makes commercial sense but also helps benefit the environment reducing harmful emission from diesel vehicles helps improve local air quality which is no becoming increasingly important towards corporate social responsibility. Jatropha an alternate fuel could be attributed to some important facts. Indian climate condition is suitable for Jatropha cultivation. Has no insects, pets and not browsed by animals, can survive long periods of drought. It can grow in saline and alkaline soils, arid and semi-arid condition. Its properties match with that of petroleum diesel. Engine performance can be improved with super charging. Supercharging improves the combustion process in Diesel engine. An increase in air pressure of the engine intake reduces ignition delay, resulting in a better combustion and smooth operation with lower rate of the pressure rise. A reciprocating air compressor has been used for supercharging. An inlet pressure of 2-4kg/cm² is maintained for supercharging condition. Present work aim to show the significance of Jatropha oil utilization in Diesel engine with chosen parameter of supercharging with various blends. Jatropha curcas is a large plant and belongs to the family of Euphorbiaceae occurring almost through India. It has a long productive period of around 40-50 years. It grows as a tree up to the height of 3-5 m. it is a good plantation for Eco-restoration in all types wasteland. India has rich and abundant resources of both edible and non edible oil seeds. Jatropha curcus is a large shrub or tree commonly found thought most of the tropical and sub-tropical regions of the world. Jatropha curcus plant is a drought-resistant, perennial plant living up to40- 50 years it can grow in saline and alkaline soils, arid and semi-arid condition. The production of jatropha seeds is about 0.8 kg/m² per year. The oil content of jatropha seeds50-60% by weight. Fresh jatropha is a slow drying, odorless and colorless oil, and turns yellow after aging. Jatropha an alternate fuel could be attributed to some important facts, Indian climate condition are suitable for Jatropha cultivation. Has no insect, pets and not browsed by animals, can survive long periods of drought. The properties of the methyl ester of jatropha oil summarized in Table 1.

EXPERIMENTAL SETUP

The experimental investigation carried out in a single cylinder 4-stroke water cooled diesel engine developing 3.68 kW at 1500 RPM was used. The engine and compressor details are given in table 2&3. The schematic of the experimental set up is shown in fig 1. An eddy current dynamometer was used for loading the engine. The super charging operation is carried out in a reciprocating single cylinder air compressor at working 4kg /cm². The super charger consist of a air compressor also orifice meter connected to U-tube water manometer for measurement of flow rate of air, surge tank and valve fitted to control the quantity of air being supplied to the engine.
Fig.1. Schematic diagram of the experimental setup

Experimental procedure: The engine was coupled to an eddy current dynamometer to measure the output, fuel flow rates were timed with calibrated burette. Exhaust gas analysis was performed using exhaust gas analyzer. The blends of B10, B20, and B30 of Methyl Ester of Jatropha Diesel was prepared by volume basis and used for experimental purpose. The test was carried out without super charger and with super charger in addition of air supply of 5, 10% compared to naturally aspirated engine. During the experiments engine speed, fuel consumption air consumption was recorded with super charger and without super charger. The effect of air enrichment on various parameters such as Brake Thermal Efficiency, TFC, BSFC, SEC, Volumetric efficiency and emissions CO, HC, NOx, and smoke was determined with various blends of Jatropha oil.

RESULTS AND DISCUSSION

Performance characteristics:

Brake Thermal Efficiency (BTE): The variation of brake thermal efficiency with brake power at various blends of jatropha oil of the base engine is compared with additional air flow rates in fig.2. The condition where atmospheric air was used is designated as normal diesel operation or base engine operation. There is an improvement in the brake thermal efficiency of B10, B20 and B30 blends where the additional air is enhanced. This improvement is may be due to better combustion with additional air supply to the engine.

Brake specific fuel consumption (BSFC)

In fig.3 the variation of BSFC at various blends of jatropha oil of the base engine is compared with super charged engine. There is a fall in the BSFC at all loads when super charged engine. This decrease is due to increase in brake thermal efficiency with super charged engine.

Volumetric efficiency: The variation of volumetric efficiency with brake power shown in fig.4. There is an improvement in the volumetric efficiency in all jatropha blends where the additional air is enhanced.

Emission characteristics:

Carbon monoxide emission: The variation of CO emission with brake power at various blends of jatropha oil is shown in fig.5 CO emission in the exhaust is the indication of an extent of incomplete combustion. With super charging CO emission is slightly increased with B10, B20 and B30 when compared with diesel.

NOx. The variation of NOx emission at various blends of jatropha oil is shown in fig.6 NOx emission significantly increases with increase in air supply.

Smoke Emission: The variation of smoke emission with brake power at various blends of jatropha oil is shown in fig.7 smoke density drastically decrease with increase air supply to the engine at all loads due to better oxidation of soot. The additional air flow rate improves the combustion process which results in less smoke.

Table: 1 Fuel Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Diesel</th>
<th>Jatropha</th>
<th>Methyl Ester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density ( \text{kg/m}^3 )</td>
<td>840</td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>Sp.gravity</td>
<td>0.840</td>
<td>0.870</td>
<td></td>
</tr>
<tr>
<td>Kinematic Viscosity ( \text{c St} ) at 40(^0)C</td>
<td>3.5</td>
<td>5.65</td>
<td></td>
</tr>
<tr>
<td>Flash point (^0)C</td>
<td>56</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Calorific value (\text{kJ/kg})</td>
<td>42926</td>
<td>35717</td>
<td></td>
</tr>
</tbody>
</table>
## Table 2: Engine Specification

<table>
<thead>
<tr>
<th>Make</th>
<th>Kirloskar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>4</td>
</tr>
<tr>
<td>No. of cylinder</td>
<td>1</td>
</tr>
<tr>
<td>Rated Speed (RPM)</td>
<td>1500</td>
</tr>
<tr>
<td>Bore (mm)</td>
<td>80</td>
</tr>
<tr>
<td>Stroke (mm)</td>
<td>110</td>
</tr>
<tr>
<td>Compression Ratio</td>
<td>17.5:1</td>
</tr>
<tr>
<td>Rated Power (kW)</td>
<td>3.68</td>
</tr>
</tbody>
</table>

## CONCLUSIONS

In this experimental investigation performance and emission characteristics of Jatropha oil with supercharger and without supercharger were investigated. The result of the investigation was as follows:

1. Petro diesel and blends of Jatropha oil exhibited similar performance and similar emission characteristics under various operating conditions.
2. With super charging brake thermal efficiency is increases with B10, B20 and B30 when compared to naturally aspirated diesel engine.

3. With no super charging B10, B20 and B30 blends, volumetric efficiency is low compared to super charged engine.

4. There is a fall in the BSFC at all loads when super charged engine. This decrease is due to increase in brake thermal efficiency with super charged engine.

5. CO emission decreased with super charging in all blends. Smoke opacity is significantly reduced.

6. NOx emission significantly increases with increase in air supply.

7. B20 is the best blend with diesel showed better results with brake thermal efficiency. Volumetric efficiency and less CO emission formation.

REFERENCES


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