EFFECT OF DI-CI ENGINE FUELED WITH ETHANOL ADDITIVE IN WASTE VEGETABLE OIL METHYL ESTER

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Abstract—A quest for renewable fuels in current diesel engines, the primitive objective is to reduce the reliance on petroleum /fossil fuels. Biodiesel and alcohols have been researched extensively in many countries all over the globe. The current paper is focused to derive experimentally the performance and exhaust emission characteristics of a DI-CI engine when fuelled with Waste vegetable oil biodiesel (B10, B20,B30) addition of ethanol (E5% and E10%) over the various loading conditions on the engine. The observations made is lesser CO emissions and Exhaust Gas temperatures reduced within increase of % addition of ethanol in Biodiesel and its blends

Index Terms—Waste Vegetable biodiesel ethanol blend, Biodiesel, performance, emissions.

I. INTRODUCTION

The concept using Vegetable Oil as a fuel was introduced by Dr. Rudolf Diesel who developed the first Diesel Engine to run on Peanut Oil. But later due to problems like high viscosity, injection problems and atomization factor the use of vegetable oils reached to near extinct. [2]. The current date focuses on the use of alternates without heavy changes in engine design and here in comes biodiesel who faces challenges like high viscosity, high flash point etc which restricts the combustion scenario and fuel pump lines of automobile in spite of fact that Biodiesel have high the oxygen level in the blend. During the search of biodiesel which can be derived from edible and non edible oils. Using edible oils like sunflower oil, rice brain oil etc has raised a question in comparison ends of Waste vegetable biodiesel and diesel helps in improving of engine ignition as alcohols have lesser flash point in comparison.

Table no 1: Property Table

<table>
<thead>
<tr>
<th>Property</th>
<th>B10</th>
<th>B10E5</th>
<th>B10E10</th>
<th>B20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (g/cm3)</td>
<td>0.86</td>
<td>0.865</td>
<td>0.855</td>
<td>0.870</td>
</tr>
<tr>
<td>Viscosity at 40OC (m2/s)</td>
<td>3.5</td>
<td>3.613</td>
<td>3.49835</td>
<td>3.3837</td>
</tr>
<tr>
<td>Flash Point (°C)</td>
<td>69</td>
<td>78.6</td>
<td>75.67</td>
<td>72.74</td>
</tr>
<tr>
<td>Auto Ignition Temperature(°C)</td>
<td>224</td>
<td>253.6</td>
<td>242.52</td>
<td>251.44</td>
</tr>
<tr>
<td>Pour Point(°C)</td>
<td>1</td>
<td>1.2</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Cetane Number</td>
<td>4.5</td>
<td>9.65</td>
<td>9.6675</td>
<td>9.685</td>
</tr>
<tr>
<td>Acid Value mgKOH/g</td>
<td>0.06</td>
<td>0.076</td>
<td>0.0722</td>
<td>0.0684</td>
</tr>
<tr>
<td>Net heating Value (MJ/kg)</td>
<td>43</td>
<td>42.573</td>
<td>41.789</td>
<td>41.005</td>
</tr>
</tbody>
</table>

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II. EXPERIMENTAL SETUP AND PROCEDURE

The Performance and emission test was conducted on four stroke single cylinder Diesel Engine with Eddy current type dynamometer for various fuels. The specifications are mentioned in table mentioned. The engine used is a Direct Injection Compression Ignition engine. The operating compression ratio used in 17.5. The Output parameters like Thermal Performance parameters and Engine emissions were obtained from varying the input parameters for various loads and Blend of Bio diesel-ethanol-Diesel. The experimental readings which were recorded at a Compression ratio 17.5, injection pressure of 205 bars and injection timing of 23°bTDC. The gas analyser used was 4-way in nature that can measure NOx, HC, CO and CO2.

III. RESULTS AND DISCUSSION

1. Variation of Brake Thermal Efficiency to load

The graph is plotted for variation of load with respect to brake thermal efficiency. As the load increases the brake thermal efficiency also increases. The addition of ethanol increases the brake thermal efficiency. At full load, the rise in
brake thermal efficiency of B30E10 is 12% high in comparison of B30. Also B20E10 yielded a better efficiency of 8.2% with respect of B20. The increase in efficiency is due to quick ignition of ethanol in comparison of Blends of biodiesel which acts as a catalyst which preheats the blends.

2. Variation of Brake Specific fuel consumption to load

It is observed that with increase in loading fossil diesel and all blends provide lesser brake specific fuel consumption. Diesel leads in providing higher with respect to the fuel consumed for producing power required. As the blend percentage increases the bsfc values also increase remarkably. Addition of ethanol additive in blends has increased the brake specific fuel consumption for waste vegetable oil methyl ester and diesel (B10, B20, and B30). The increase in fuel consumption is about 9.7%, which might be due to lesser heating value of fuels in comparison with mineral diesel.

3. Variation of EGT with respect to load

The graph represents the study of variation of exhaust gas temperature from the engine to increasing load. It is observed that as the load increases the temperature of the exhaust gases also increases. Also if the blend percentile of Methyl ester increases the Exhaust gas temperature also increases. It is observed during the experimentation that B30 exhibits the maximum Exhaust gas temperatures. The addition of ethanol depreciates the exhaust gas temperature on a average of 8%.

4. Variation of Carbon Monoxide emission to load

Carbon monoxide emissions occur basically due to incomplete combustion inside the combustion chamber. Also time for combustion plays an important role for CO emissions. During experimentation it was observed that diesel fuel combusted in the engine cylinder gave the maximum readings of CO emissions. The doping of Ethanol in the blends of Methyl ester and diesel reduced the CO emissions by about 11% on an average. The addition of alcohol/ethanol promoted the combustion and better preheating for the biodiesel to undergo combustion. Also the biodiesel has high oxygen content than that of mineral diesel.

5. Variation of Hydrocarbon emission with respect to load

The graph describes the fact that the hydrocarbon emissions for CI engines for the mentioned fuels are increasing with respect to load. The addition of ethanol increases the hydrocarbon emissions. Where as in comparison of mineral diesel and biodiesel the hydrocarbon emission lie on the same loci. Also the to the fact that as biodiesel have high oxygen content than that of diesel the hydrocarbon emission characteristics result in the same values.
6. Variation of Nitrogen Oxide’s emissions with respect to load

Nitrous Oxide emissions are a factor of temperature present in the engine. Higher temperatures promote drastically the formation of nitrous oxide emissions. During experimentation it was observed that the NOx emissions (in ppm) increased gradually as the load increased. The addition of ethanol which promoted the combustion for the blended diesel-biodiesel fuels, hence increasing the NOx by an approx. of 9%

IV. CONCLUSION

The addition of ethanol provides a better thermal efficiency with the regular blend of biodiesel and diesel where in almost a shift in increase of 12% was observed. The brake specific fuel consumption pushed up to higher, decreasing the mileage factor for engines under load conditions. Also the carbon monoxide emissions reduced on addition of ethanol in the blends. The use of biofuels increases the combustion efficiency and lowers CO, HC emissions but increase the cylinder combustions chamber temperature there by increasing the formation of nitrous oxides. Also bio fuels bear the authencity of the heating value being lesser as they contain chain of carbon-hydrogen atoms with oxygen which in due lower the heating value.

REFERENCES