Experimental Investigation on performance and emission of Mosambi peel pyro oil bending with Orange oil

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ABSTRACT:
Pyrolysis method of thermal degradation of carbonaceous of waste material extracts the pyro oil from the waste bio-mass like Mosambi peel pyro oil (MPO) in the without oxygen. In this procedure, the temperature at 750°C. The pyro oil obtained from Mosambi peel bio-mass can then blended with orange oil Diesel in three dissimilar ratios. Bio-oil blend DMO10 (80%Diesel oil +10%MPO+10%Orange oil), DMO20 (70%Diesel oil +20%MPO+10%Orange oil), and DMO30 (60%Diesel oil +30%MPO+10%Orange oil) they can prepare with the given volume. The blended of oil is mixed from a Mechanical Agitator rapidity of 950 rpm for 30 min. The properties of all the blends they can investigated as the Flash point, Fire point, Density, Viscosity, Calorific value, and FTIR analysis all these blends. Among these three samples, the best sample DMO10 was close to the properties of Diesel fuel. The results show that Brake Thermal efficiency is increased to DMO10 Bio-fuels and reduced Specific fuel consumptions and lesser the exhaust gas temperature. Emission shows that the considerable reduction for the Smoke, UHC, and CO emission and Nox they slightly increased when compared to Diesel fuel. The usage of Diesel fuel DMO10 blends of pyro oil can be used without any modification in the Diesel fuel Engine.

Index Terms – Bio-oil, Mosambi peel bio-mass, Orange oil, Diesel Engine, Performance, Emission.

1. Introduction:
All over the world energy is a resource for all development of a country. All energy survey reports that the energy consumption is increasing steadily. World energy’s survey reports shows that the consumption of the energy is increase progressively every year by 2 per cent in the year of 1990–2000, and it is world energy will be double by 2050 from now and triple by the end of the Century. The rise in price, solid availability, and dispute on Global warming due to harmful gases from automobile sand industrial sectors pay more care to the search for alternative fuel. India has a enormous potential of producing orange peel oil of 27,600 ton from the orange fruits. Now, 2–3 tons of orange oil are produced for food and cosmetic Industries. As the large quantity of orange oil for fuelling in internal combustion engines, the form for orange peel collection may be higher. The concentration
temperature for orange oil is 175°C, Mosambi peel pyro oil is 150°C and for Diesel fuel is 45°C. It was observed that 10% Orange oil blended with diesel fuel, which are desirable for Compression Ignition engines. In the present work, experiments were conducted to study the Performance and Emissions of 30% MPO, blend of orange oil (10%) with Diesel fuel.

2. **Proximate and Ultimate Analysis**

Proximate analysis of a fuel provides the gaseous state volatile matter, in the solid-state fixed carbon, and the percentage of inorganic waste material ash. From table 1 shows that all the fuel analysis composite groups are similar to diesel fuels.

<table>
<thead>
<tr>
<th>properties</th>
<th>Diesel fuel</th>
<th>MPO fuel</th>
<th>Orange oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Ash content</td>
<td>0</td>
<td>12</td>
<td>20.4</td>
</tr>
<tr>
<td>Volatile matter</td>
<td>100</td>
<td>78</td>
<td>61.2</td>
</tr>
<tr>
<td>Fixed carbon</td>
<td>0</td>
<td>12</td>
<td>18.4</td>
</tr>
<tr>
<td>Carbon</td>
<td>86.50</td>
<td>58</td>
<td>84.28</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>13.20</td>
<td>11.30</td>
<td>12.47</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0</td>
<td>10.70</td>
<td>3.05</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0</td>
<td>8</td>
<td>0.19</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0.30</td>
<td>0</td>
<td>0.007</td>
</tr>
</tbody>
</table>

3. **Oil Preparation**

Tween80 can be mixing the with Cashew shell pyro oil and diesel fuel. Bio-oil blends DMO10 (80%Diesel oil +10%MPO+10%Orange oil), DMO20 (70%Diesel oil +20%MPO+10%Orange oil), and DMO30 (60%Diesel oil +30%MPO+10%Orange oil) they prepared with the given volume. The homogenous mixture was formed, the stirrer speed was maintained at 1000 rpm. The blending of oil was found that up to 30% of DMO bio-oil blend Diesel fuels, without any separation for a long time. DMO10, DMO20 and DMO30 blends of pyro oil have comparable properties to diesel fuel. All the below properties of blend cashew shell pyro oil are closer to that of diesel fuel. Table -2 shows that all the properties of blended fuel related to diesel fuel values. DMO10, DMO20
and DMO30 of all the properties are also slightly higher than that of Diesel fuels.

Table-2 MPO and Orange oil blends properties compared to diesel fuel

<table>
<thead>
<tr>
<th>Properties</th>
<th>Diesel fuel</th>
<th>MPO fuel</th>
<th>Orange oil</th>
<th>DMO10</th>
<th>DMO20</th>
<th>DMO30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density(kg/m3)</td>
<td>820</td>
<td>879</td>
<td>818</td>
<td>837</td>
<td>857</td>
<td>869</td>
</tr>
<tr>
<td>Cetane number</td>
<td>48.5</td>
<td>56</td>
<td>47</td>
<td>52</td>
<td>55</td>
<td>58</td>
</tr>
<tr>
<td>Viscosity(cSt)</td>
<td>2.87</td>
<td>3.96</td>
<td>3.53</td>
<td>3.24</td>
<td>3.45</td>
<td>4.21</td>
</tr>
<tr>
<td>Heating value(MJ/kg)</td>
<td>42.31</td>
<td>43.20</td>
<td>34.65</td>
<td>42.78</td>
<td>41.25</td>
<td>40.25</td>
</tr>
<tr>
<td>Flashpoint</td>
<td>50</td>
<td>56</td>
<td>74</td>
<td>54</td>
<td>56</td>
<td>58</td>
</tr>
<tr>
<td>Fire point</td>
<td>56</td>
<td>61</td>
<td>84</td>
<td>59</td>
<td>61</td>
<td>63</td>
</tr>
</tbody>
</table>

4. **Experimental set up**

A four-stroke single Cylinder Kirloskar Diesel Engine of AV-l Model, Direct injection, naturally aspirated water-cooled Engine was utilized to examine these all-blended fuels study.

![Figure1. Photographic view of Engine Setup](https://www.edxjl.com/ijiar)

The engine Specifications are logged in table 3. The Diesel Engine was directly attached with an eddy current dynamometer and data acquisition system, so that the data can be saved. The AVL model Five gas analyzer is used to measure the Emissions characteristics like smoke opacity has been measured using the AVL-444 Smoke meter. The engine was functioned on diesel fuel first and then all blended pyro fuel.

Table: 3 Engine specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Kirloskar make Diesel Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>662 CC</td>
</tr>
</tbody>
</table>
Bore × stroke | 87.5 mm × 110 mm  
--- | ---  
Compression | 17.5:1  
Speed | 1500 rpm  
Rated power | 3.7 kW  
Injection Timing | 27° BTDC  
Injection Pressure | 210 bar

5. Results and Discussions

5.1 Brake Thermal Efficiency

The Brake thermal efficiency reveals how efficiently an Engine is able to convert the chemical energy to useful work. Figure 2. Show the variation of BTE trend for the tested fuels with BP. BTE increases (non-linearly) with the increasing BP conditions due to the corresponding increment of the heat energy produced in cylinder. At maximum BP condition, the BTE of the (DMO) blend is 29.5, 31.5, 28 and 26 is Diesel, DMO10, DMO20, and DMO30 respectively. This is because of the higher calorific value, lower density and viscosity values of the (DMO10), which enhances the finer atomization, quick vaporization and better mixing of the air-fuel mixture.

![Figure 2 Brake Power vs Brake thermal efficiency](image)

5.2 Brake Specific Fuel Consumption
The BSFC is experiential to be decreasing with increase power outputs. At the maximum power, BSFC for DMO10 is 0.22 kg/kW-hr and is 22.7%, 13.6%, 36.3%, 54.5% and 68.1% higher than Diesel, DMO10, DMO20, and DMO30 respectively.

![Figure 3 Brake Power vs Specific fuel Consumption](image)

This was mainly due to the occurrence of the DMO increases surface volume ratio, reduces the physical delay and thus allows additional amount of fuel to counter with air resulting in better and complete combustion. DMO affinity towards the water vapor which gives rise to the liberation of hydrogen which also improves the quality combustion of the fuel. DMO10 required 1.66% less BSFC than the DMO30 due to the presence of the oxygenated methanol.

### 5.3 Exhaust Gas Temperature

Measurement of EGT reflects the heat energy utilization (thus reveals the energy losses to exhaust). During the engine operation, only a part of (up to 20%) the fuel will be converted to useful work and the remaining will be lost to the ambience in the form of waste heat. Figure 4 depicts the difference of EGT with increasing BP and, can be observed that with increasing BP output, EGT also increases. This is maybe because of additional amount of fuel drawn in, to produce the Power output. At the maximum BP conditions, EGT for DMO10 is 255°C and is 8.3%, 4.3%, 11.9%, 8.3% and 11.9% lower than Diesel, DMO10, DMO20, and DMO30 respectively. This is due to the lower viscosity, and quality combustion of DMO10. Owing to the slow and late burning nature of MO present in DMO10, slightly more combustion occurs during diffusion stage which results in higher EGT for DMO10 over diesel.
6. Conclusion

When using orange oil mixing instead of straight diesel, there is a noticeable gain in brake thermal efficiency, especially at high power outputs. At all power levels, orange oil induction greatly reduces smoke. In addition, with orange oil mixes, NO emission is marginally enhanced at all power settings. However, the growth is considered minor. The emissions of hydrocarbons and carbon monoxide are observed to be higher. Based on the findings, orange oil can be combined with mosambi peel pyro oil fuel to reduce smoke and NO emissions while improving brake thermal efficiency in a compression ignition engine running on DMO.

7. References


