EVALUATION AND COMPARISON FOR FUEL PROPERTIES OF SIMAROUBA AND CALOPHYLLUM BIODIESEL

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ABSTRACT

Diesel engines play a pivotal role in the transportation sector as diesel engines have wide applications in transportation, from railways to waterways to roadways the diesel engine finds an application in every field. It can also be said that Diesel engine is a popular prime mover in rural areas, particularly in the places where electrical power is not available. The rapid depletion of fossil fuel with increased environmental concern has stimulated worldwide efforts to produce alternative to diesel. Biodiesel has recently become very attractive, because of its environmental benefits due to its production from renewable sources. Biofuels have become a matter of global importance because of the need for an alternative energy at a cheaper price and with less pollution. The objective of this paper is to investigate the fuel properties of biodiesel extracted from simarouba and calophyllum seeds. The objective is achieved by transesterifying the oil using transesterification setup. The fuel properties are then investigated by using lab equipments which are validated with ASTM standards.

Keywords: Calophyllum Oil, Simarouba Oil, Transesterification.

1. INTRODUCTION

A lot of work in this field has been already done and in many of the counties biodiesel is commercially in use. There are thousands of edible and non-edible oils that can be extracted on this planet as renewable source, as methyl esters of these oils possess different physical properties and chemical compositions. The esters also changes depending upon the oil as well as type of catalyst whether it is acid or base. The engine parameters like speed, set-up and Engine type will vary with different oil and its blend.

Oil accounts for about 36% of India's total energy consumption. India today is one of the top ten oil-guzzling nations in the world and the third largest oil user in Asia behind China and Japan. The oil production in India today is peaking at 45 million tonnes compared to its demand of 160 million tonnes, thereby relaying heavily on the net oil imports to meet up with the demand. It is estimated that by 2020 India's net imports of oil will be at 92% compared to oil production of 8%. Such dependency on imports for a primary energy source can put India in a vulnerable position in the future, major changes have to be made in order to avoid such situations, and biodiesels are one such option which can help a country like India in reducing its dependency on oil producing countries for its oil needs.

2. OBJECTIVE

The main objective of the study is to produce biodiesel from calophyllum and simarouba and compare the fuel properties for the blends of biodiesel.
3. METHODOLOGY

- Oil extraction from seeds
- Oil filtering
- Estimation of 'FFA' percentage
- Esterification/Transesterification process
- Washing of biodiesel
- Drying of biodiesel
- Evaluation of properties of biodiesel.

3.1 Fuel properties of Diesel, Calophyllum biodiesel and its blends.

Table 1 shows the fuel properties of Diesel and Calophyllum biodiesel and its blends. Biodiesel blends of Calophyllum methyl esters with diesel on 5, 10, 15, 20 and 25% volume basis was prepared and fuel properties are measured following standard procedure.

Table 1: Fuel properties of Diesel, Calophyllum biodiesel and its blends

<table>
<thead>
<tr>
<th>Properties</th>
<th>Units</th>
<th>Diesel</th>
<th>B5</th>
<th>B10</th>
<th>B15</th>
<th>B20</th>
<th>B25</th>
<th>B100</th>
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</thead>
<tbody>
<tr>
<td>Viscosity</td>
<td>Cst</td>
<td>2.32</td>
<td>2.68</td>
<td>2.73</td>
<td>2.82</td>
<td>2.90</td>
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<td>Kg/m³</td>
<td>806.0</td>
<td>812.2</td>
<td>817.9</td>
<td>823.1</td>
<td>827.9</td>
<td>834.9</td>
<td>864.0</td>
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<tr>
<td>Flash point</td>
<td>°C</td>
<td>52</td>
<td>58</td>
<td>61</td>
<td>64</td>
<td>66</td>
<td>69</td>
<td>160</td>
</tr>
<tr>
<td>Fire point</td>
<td>°C</td>
<td>61</td>
<td>66</td>
<td>68</td>
<td>72</td>
<td>75</td>
<td>77</td>
<td>175</td>
</tr>
<tr>
<td>Calorific value</td>
<td>KJ/Kg</td>
<td>43796</td>
<td>42920</td>
<td>42532</td>
<td>42060</td>
<td>41578</td>
<td>41072</td>
<td>37400</td>
</tr>
</tbody>
</table>

3.2 Fuel properties of Diesel, Simarouba biodiesel and its blends

Table 2 shows the fuel properties of Diesel and simarouba biodiesel and its blends. Biodiesel blends of simarouba methyl esters with diesel on 5, 10, 15, 20 and 25% volume basis was prepared and fuel properties are measured following standard procedure.

Table 2: Fuel properties of Diesel, Simarouba biodiesel and its blends

<table>
<thead>
<tr>
<th>Properties</th>
<th>Units</th>
<th>Diesel</th>
<th>B5</th>
<th>B10</th>
<th>B15</th>
<th>B20</th>
<th>B25</th>
<th>B100</th>
</tr>
</thead>
<tbody>
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<td>2.32</td>
<td>2.45</td>
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<td>2.80</td>
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<td>806.0</td>
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<td>827</td>
<td>829</td>
<td>831</td>
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<td>74</td>
<td>78</td>
<td>175</td>
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<tr>
<td>Calorific value</td>
<td>KJ/Kg</td>
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<td>42465</td>
<td>41960</td>
<td>41458</td>
<td>40907</td>
<td>37500</td>
</tr>
</tbody>
</table>

4. RESULTS AND DISCUSSION

The raw calophyllum oil having FFA of 32% is treated with two processes. The first process is esterification in which the Calophyllum oil is treated with concentrated sulphuric acid as catalyst to remove excess % of FFA. After esterification process the FFA of calophyllum is found to be 2.5%. This oil is taken into second process transesterification, where oil is treated with NaOH catalyst. This reduces the FFA to 0.86%. After processing through above two treatments the oil is washed with warm water and heated to 110°C to remove excess water in it. The dried oil is now free from all impurities. Then the processed Calophyllum oil is the biodiesel which further blended with diesel on a 5, 10, 15, 20 and 25% volume basis and fuel properties are determined using standard procedure.

The raw simarouba oil having FFA of 3.08% is treated with one process. The oil is taken into Transesterification process where it is treated with NaOH catalyst reducing to 0.38%. By processing through the above treatment the oil is washed with warm water and heated to 110°C to remove excess water in it. The dried oil is now free from all impurities. Then the processed simarouba oil is the biodiesel which is further blended with diesel on a 5, 10, 15, 20 and 25% volume basis and fuel properties are determined using standard procedure.
4.1 Comparison of properties of simarouba and calophyllum

![Comparision for viscosity of calophyllum and simarouba biodiesel blends](image1)

In Fig 1, the kinematic viscosity of different blends of simarouba and calophyllum biodiesel blends B5, B10, B15, B20, B25 are higher than the viscosity of diesel. But it is observed that the viscosity of calophyllum biodiesel is slightly higher than blends of simarouba biodiesel.

The density of different blends of simarouba and calophyllum biodiesel is increased with the increase in blend percentage as shown in Fig 2. The high density of biodiesel can be reduced by heating. It is clear from above figure that density of calophyllum biodiesel is lesser than that of blends of simarouba biodiesel.

The flash points of different blends of methyl esters are increased with the increase in methyl ester percentage as shown in Fig 3. It is also observed that the flash points of blends B5 and B10 are close to diesel. Also the flash point for different blends of calophyllum and simarouba are very close to each other.
The fire points of different blends of methyl esters are increased with the increase in methyl ester percentage as shown in Fig 4. It is also observed that the fire points of blends B5 and B10 are close to diesel. Also the fire point for different blends of calophyllum and simarouba are very close to each other.
The calorific values of different blends of simarouba and calophyllum biodiesel are lesser than the calorific value of diesel as shown in Fig 5. The biodiesel blends B10 and B20 have calorific values closer to diesel. Calorific value of simarouba and calophyllum blends is almost same upto B15 and calorific value of simarouba is slightly higher than calophyllum biodiesel.

5. CONCLUSION

The engine performance is highly influenced by the factors like viscosity, density and volatility of fuel. For biodiesel, these factors are mainly decided by the effectiveness of the transesterification process. The simarouba and calophyllum biodiesel can provide a useful substitute for diesel thereby reducing our dependency on foreign countries for oil and improving the economic scenario of our country. Based on the experimental investigation the following conclusions can be drawn.

- Simrouba and calophyllum biodiesel blends can be directly used in diesel engines as an alternative fuel without any engine modification.
- The fuel properties of different blends of biodiesel are nearer to the diesel and blends B5 ,B10 ,B15 and B20 is giving good results.
- The fuel properties of biodiesel B100 are not in good agreement with the diesel so it is advisable not to use B100 biodiesel in CI engines.
- The simarouba biodiesel shows better fuel properties than the calophyllum biodiesel up to blend B20.

6. REFERENCES