EMISSION CHARACTERISTICS STUDIES ON BIODIESEL DERIVED FROM VEGETABLE OIL AND ANIMAL FAT

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Abstract

Bio-diesel is a mono-alkyl esters of vegetable oil or animal fat. Continuous use of petrol having high viscosity fuel or diesel leads to deposits inside the diesel engine. Thus improving the viscosity of vegetable oil or animal fat by blending, pyrolysis and emulsification does not solve the problem completely. But, it has been proved that transesterification is the method to obtain ester from vegetable oil or animal fat. This paper provides a discussion on the fuel production, fuel properties, engine performances, emission characteristics, and impact of fuel. Keywords: Bio- diesel, vegetable oil, animal fat..

Introduction

Carbon dioxide emission through engine exhaust is a big environmental issue. Researchers are focusing their research on this issue (Ghazvini et al., 2019), (Ahmadi et al., 2019), (Kumar et al., 2020). Bio-Diesel is produced from animal fats or vegetable oils. Bio-diesel is a mono-alkyl esters of vegetable oil or animal fat. Several types of fuels can be derived from triglycerides containing feed stock. Bio-diesel is a renewable Bio-degradable and non-toxic fuel. Continuous depletion of the reserves of non-renewable petroleum, price volatility, feed stock availability concerns have caused an intensified search for alternative sources of energy and when using high viscosity fuel or diesel leads to deposits inside the diesel engine. So, improving the viscosity of vegetable oil or animal fat by blending, pyrolysis and emulsification does not solve the problem completely. But, it has been proved that transesterification is the best way to produce ester from vegetable oil or animal fat.

In recent years, Biodiesel has attracted the attention of researchers for it is currently the only renewable energy source which can directly replace diesel in compression ignition engines. Current scenario of alternative arrangements of power generation energy resources and reserve in India is discussed (Kumar et al., 2019).

Vonortas et al., 2005; Mythili et al., 2014; Machado et al. (2012); Reddy et al., 2005 and Sundaramurthy et al. (2014) and Azam et al. (2005) generally observed the petroleum based fuels resulting major environmental problems that led to global warming, emission of CO, SO2 and NOx, etc., Trabi et al. (1999), Hanna et al., 2005, Hansen et al., 2005 and Pramanik et al., 2003 emphasized the combustion product of diesel emission resulting the development of reduction in visibility, climate change, health problems and environmental pollution.

Singh et al. (2014); Anupam Kumar et al. (2017); Ambrisht et al. (2013); Thakur Kumar et al. (2014); Kumar et al., (2014), Prabhjot Singh et al. (2018); Mehta et al. (2012); Praveen Kumar Sharma et al. (2018); Thakur et al., 2018, Suraj et al., 2018 and Amrinder Kaur et al., 2018, observed that alternative fuels are easily available and derived from vegetable and animal fats. Trabi et al. (1999) obtained that bio-diesel produced from less expensive animal fats which are highly viscous fuel result in incomplete combustion. Transesterification process can be employed for animal fats in diesel engine.

Earlier studies Vijay Mishra et al., 2018; Monica et al. (2018), Apurna Joshi et al. (2018), Chander Prakash et al., (2018); VinipKumar Singh et al.; (2017); Amit et al. (2018); Mankar et al. (2018) and Harish Modila et al. (2018) reported that biodiesel have produced from different sources like waste cooking oil and also have determined the density, viscosity, moisture content and acide value of the produced biodiesel. However, in the present work animal fat and vegetable oil has been chosen as raw material taking into consideration of its possible high triglycerides content to produce biodiesel-intensive method of transesterification.

Experimental Method: In the beginning, the round bottom flask heated to remove residual moisture. After that, it was cooled then 200 ml animal fat vegetable oil added in to flask. The oil then heated in a oil bath at 60°C and 200 ml CH3OH were added and continued for 2 h, cooled by water and then continued for 60°C to which 0.5 gm Sodium methoxide added. Now the flask removed and cooled by water, two layers were formed. The top layer was bio-diesel. The bio-diesel was obtained after the top layer was separated and purified.

Source of bio-diesel

Animal fats are attractive feed stocks for bio-diesel because, their cost is substantially lower than the cost of vegetable oil. Since, much of the animal fat produced in the U.S is not considered edible by humans. Animal fat is currently added to pet food and animal feed used for industrial purposes such as soap making. Much of the domestic animal fat supply is exported. Animal fat feed stocks can be made into high quality bio-diesel. Waste fat from animal carcasses are removed and then made into oil using a rendering process. Rendering consists of grinding the animal by-products to a fine consistency and cooking them until the liquid fat separated and pathogens are destroyed. The solids are usually passed through a screw press to complete the removal of the fat from the solid residue. The cooking process also removes which makes the fat and solid.
material stable against vancidity. The end products are fat and a high protein feed additive known as meat and bone meal.

**Results and Discussion**

Experimental set up for the use of bio-diesel in diesel engine can be shown in the Figure1.

### Table 1: The various properties of fuel

<table>
<thead>
<tr>
<th>FUEL PROPERTIES</th>
<th>DIESEL</th>
<th>BIO-DIESEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower heating value</td>
<td>42</td>
<td>36.9</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>0.85</td>
<td>0.88</td>
</tr>
<tr>
<td>Kinetic viscosity</td>
<td>3.05</td>
<td>6.0</td>
</tr>
<tr>
<td>Cetane number</td>
<td>47</td>
<td>56</td>
</tr>
<tr>
<td>Flash point</td>
<td>85</td>
<td>170</td>
</tr>
<tr>
<td>Fire point</td>
<td>76</td>
<td>136</td>
</tr>
<tr>
<td>Pour point</td>
<td>-4</td>
<td>-5 to 10</td>
</tr>
<tr>
<td>Cloud point</td>
<td>-10 to -15</td>
<td>-3 to 15</td>
</tr>
</tbody>
</table>

The various properties of bio diesel obtained by transesterification method are given below in detail.

**Fig. 2 : Engine performance**

The Fig.2 shows fuel utilization of bio-diesel and diesel. From the results it is being observed that fuel consumption is higher for bio-diesel than diesel. Because, there will be one plunger in fuel injection plump, that plunger will discharge more bio-diesel than diesel fuel.

Investigations offour approaches effectively used for bio-diesel, ethanol and diesel in diesel engine individually.

1. **Ethanol + Diesel blends**

   Ethanol mixed with diesel from 0% to 15% in diesel engine. This experiment shows increase of NOx (Nitrous oxide) and CO2 as CO and HC emissions decreases with increased quantity of ethanol in fuel mixture.

2. **Bio-diesel + Diesel blends**

   In this case, we observed that B100 (Pure biodiesel) lowered emissions of CO, NOx, SO2 and smoke opacity 15%, 38.5% and 72.7% and 56.8%. For B20 (Bio diesel 80+diesel 20), lowest CO, NOx emissions and highest temperature were obtained. The B20 is an expected alternative fuel for diesel engine thereby could solve in controlling air pollution.

3. **Bio-diesel + Alcohol blends**

   This combination was used for testing the effect of dilution. When the bio-diesel fuel can be replaced with bio-diesel-alcohol, the harmful effects can be reduced while NOx (Nitrous oxide) reduction increased.

4. **Bio-diesel + Diesel + Alcohol blends**

   In this combination resulted, a mix of 80% diesel, 15% bio-diesel and 5% ethanol considered to be the required ratio. The bio-diesel has lower calorific value 12% as compared to diesel. Flash and fire point are higher which are advantages for fuel transportation. When ethanol blended with diesel result in increase of NOx (Nitrous oxide) and CO2 emission. Cetane number is proportional to density value. Alcohol has low cetane number value when blended with diesel its value will be decreased.

**Conclusion**

The following conclusion can be drawn from the results: The vegetable oil and Animal fat are esterifies with methanol in presence of NaOH and then two layers formed. The upper layer is purified by distillation method, pure solution is obtained. The pure solution is subjected for engine performance. Emission of CO2, carbon monoxide, sulphur dioxide, hydrocarbon are extremely low for bio-diesel prepared from Animal fat and vegetable oil than diesel. Emission of nitrousoxide is slightly low for bio-diesel compared with diesel. When alcohol is blended with bio-diesel and diesel density is decreased cetane number also decreases. The cetane number is responsible for combustion property of bio-diesel. This type of biodiesel is harmless to human beings and pollution free. Further studies can be initiated by modifying this method with use of different combinations of fat and blends to establish the hydrocarbon contents.

**Acknowledgements**

The authors would deeply thank to St. Peter University and Lovely Professional University, the head of school of school of chemical engineering and physical sciences for the encouragement and supports. The author SR express his gratitude to St. Peter University for providing the facilities.

**References**


