THERMAL ANALYSIS OF WASTE COOKING OIL EXTRACTED FROM DIFFERENT EDIBLE OIL SEEDS

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Keywords:

Waste Cooking Oil (WCO), Free Fatty Acid Test (FFA), Transesterification, Biodiesel Production, Calorific Value, Density, Viscosity, Brake Thermal Efficiency, Specific Fuel Consumption.

Introduction:

1. Alternative resource for conventional fuel:
   Due to scarcity of conventional fuel, the use of alternative fuels is encouraged. Cooking oil discarded after cooking can be processed and converted to fuel though it cannot be used in its pure form due to its viscous nature and lower calorific value, but can be used by blending it with conventional diesel.
2. Edible oil as Biodiesel:
   - Financial Benefits: Many hotels, restaurants and food outlets use large quantities of edible oils for cooking. Thus, the left-out oil can be taken for free or with less amount of charges.
   - Environmental Benefits: The consumption of oil reserves are harming the environment. Using oils like edible oil and converting it to fuel is one way of reducing the impact on natural resources like crude oil. The other advantage of using edible oil is that it is renewable, whereas crude oil is not.

Literature Review:

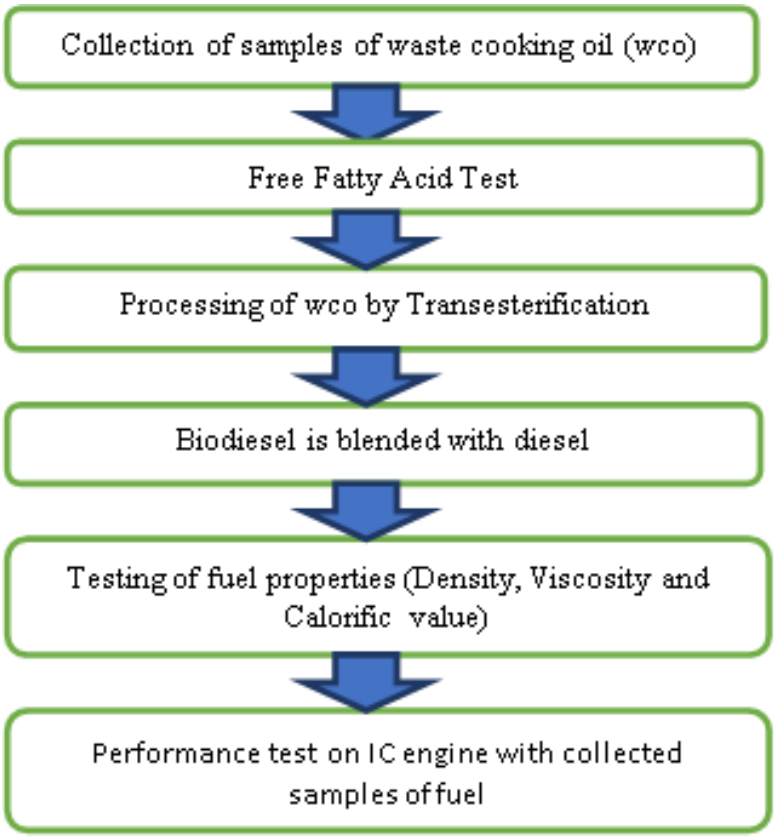
Trans-esterification is a commonly employed method to reduce the viscosity during the production of biodiesel. Biodiesel production from trans-esterification process is strongly affected by molar ratio of alcohol, reaction temperature, reaction time and catalyst. Thermal and thermo-oxidative stabilities of gingelly, coconut, sunflower and groundnut oils were evaluated by simultaneously TGA-DTA analysis in pure air and nitrogen. Thermal stabilities decreased in the order groundnut <gingelly <sunflower <coconut in N2 and groundnut <gingelly <coconut <sunflower in air for refined oils. Used cooking oil as a raw material with a FFA value of 2.9572% can be converted to biodiesel by trans-esterification method directly without going through the esterification method. Heterogeneous catalysts are recommended as the best catalysts in biodiesel production.

Objectives:

1. To compare the characteristics of waste cooking oil extracted from following four edible seeds
    a. Groundnut oil
    b. Sunflower oil
    c. Palm oil
    d. Mustard seed oil
2. To make a comparative study with biodiesel as a fuel in an IC engine in different proportions as a blend with conventional Diesel at different load conditions.
3. To make comparative study between above said biodiesel blends as a fuel at same loads.

Methodology:

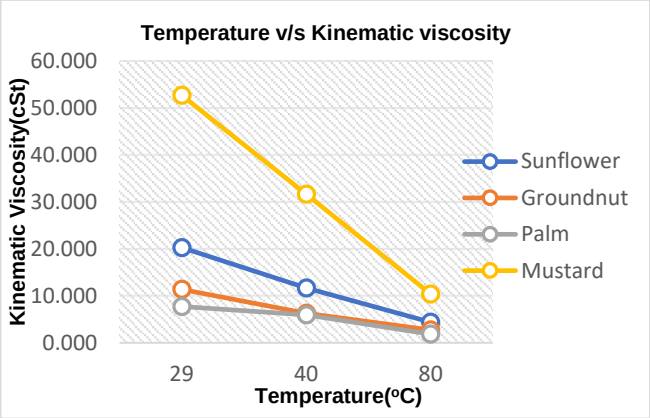
Four different types left over cooking oils namely sunflower oil, groundnut oil, palm oil and mustard oil were, collected. A Free Fatty Acid test on all samples, was, conducted based upon the results obtained, oils are converted to biodiesel by Transesterification method directly without going into Esterification method. In transesterification process used cooking oils are treated with methanol in presence of sodium hydroxide as a catalyst. Glycerol and biodiesel obtained from this process are separated by gravity using settling vessel and excess alcohol is removed by distillation and then it is heated to 110°c to remove traces of water. Biodiesel obtained is tested for their properties such as viscosity, density and calorific values for all the four biodiesel samples. Finally, performance test is carried out in four stroke diesel engine with B10 and B30 as a fuel for each sample.

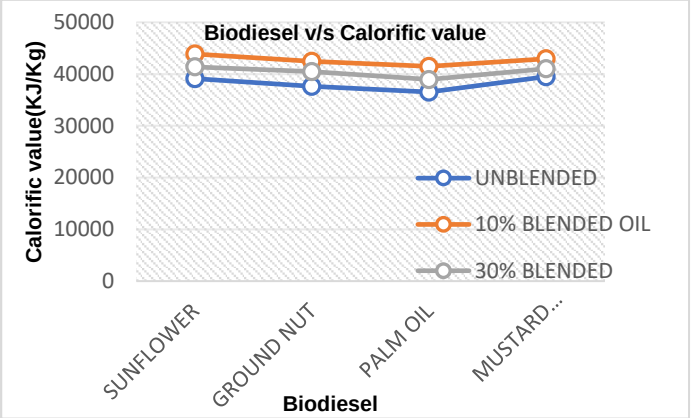


Conclusion:

To begin with free fatty acid test of waste cooking oils was conducted and free fatty acid found negligible, hence biodiesel was separated by glycerine by trans-esterification method and tests on viscosity and calorific values were carried out. From the results obtained no much difference in viscosity between the various biodiesel were seen however, mustard oil had a higher viscosity change in change in temperature and palm oil shows least variation in viscosity. At the same time viscosity of unblended biodiesel were in the range of higher value of 32cSt in case mustard to lower value of 6 cSt in case of palm oil at 40°C while that of diesel at 40°C is approximately 5 cSt.

As per the calorific value is concerned among all the samples of oil taken do not show much variation in calorific value however mustard oil has slightly better calorific value in comparison to the other three oils followed by sunflower oil, groundnut oil and palm oil.





Scope for future work:

Since biodiesel exhibit high viscosity at room temperature hence the ratio of biodiesel to diesel needs to very low. However, this can be increased by preheating the blends using waste heat from the engine exhaust and reduce the viscosity of blends in higher proportion. Also, a study on effects of biodiesel on fuel injectors needs to be analysed.