EVALUATION OF BIODIESEL DERIVED FROM WASTE VEGETABLE OILS

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Abstract: *Research on alternative sources of energy is more relevant than ever as the concerns regarding fuels and their aftermath on the environment is blooming. Biodiesel can serve as an efficient alternative to petroleum diesel as it possesses similar properties. It is renewable and environment friendly as well. In this proposed evaluation, we have derived biodiesel from waste vegetable oil. The method we have used for the purpose is Transesterification reaction. We used waste vegetable oil instead of pure oil to promote reuse and recycle of the waste oil. After preparation of biodiesel, we conducted experiments to calculate its flash point, fire point and calorific value and compared it to standard references. Biodiesel produced from waste vegetable oil demonstrated commendable properties.*

Keywords: Biofuel, Biodiesel, Waste Vegetable Oil, Transesterification.

1. INTRODUCTION

An exponential decline in availability of fossil fuel and rise of global warming have led to several proposals to cut back the dependence on fossil fuels. As a result, environmentally friendlier alternatives allowing energy extraction from non-conventional and renewable energy sources (biomass) with a similar efficiency output have been developed. Compared to other renewable energy sources (hydraulic, wave energy, etc.), biomass has the advantage that its chemical structure can be chemically adjusted, generating a product which is constitutionally similar to petroleum and can replace petroleum-derived fuels for transportation purposes. Fuels synthesized from biomass have several advantages such as no sulfur emission and no particulate matter emission during combustion **[1]**.

Transesterification is the chemical reaction that converts a vegetable oil or animal fat to biodiesel by combining oils and fats (included in the ester family) and an alcohol (methanol or ethanol) to make another ester (biodiesel) and another alcohol (glycerine). All the vegetable oils and animal fats used to make biodiesel consists of chemicals called triglycerides. The triglycerides undergo chemical reaction with alcohol to give biodiesel. Waste oil can also be used to make biodiesel. However, these oils contain impurities such as water and food particles that pose special challenges for biodiesel production so proper filtration is required. Transesterification process may be acid-catalyzed or base-catalyzed. The base-catalyzed transesterification of vegetable oils advances faster than the acid-catalyzed reaction. Alkaline catalysts are less corrosive than acidic catalysts as well **[2]**. Because of these reasons, base-catalyzed transesterification was used for the evaluation.

The most common alcohol used for creating biodiesel is methanol. It is terribly fatal in nature and ingesting even a very little amount will cause visual defect or maybe death. Dangerous exposure may also occur from inhalation or skin contact. The reaction to create biodiesel needs a catalyst as well. A catalyst is sometimes a chemical additional to the reaction mixture to speed up the reaction which isn't consumed during the reaction. In biodiesel production, the compound that catalyzes the reaction is named Methoxide which is prepared by dissolving Sodium Hydroxide (NaOH) in Methanol (CH_3OH) **[3]**.

2. Methodology:

We collected waste vegetable oil from nearby hotels and canteens. The oil was then allowed to rest for 24 hours to settle down all heavy impurities to the bottom. After the sedimentation of heavy particles, the oil was then filtered out in a bottle. We took a small sample of the oil for titration to determine the amount of catalyst (NaOH) required **[4]**. The amount of catalyst needed was calculated to be 3.5 gm per liter. Methanol (100 ml) was taken in a jar and sodium hydroxide (1.75 gm) was added to it. The mixture was stirred until all the sodium hydroxide dissolved in the methanol. Then, the vegetable oil (500ml) was poured into the jar after heating it up to 50° C. The mixture was then stirred and allowed to rest for another 24 hours after which two distinct layers: biodiesel at the top and glycerine at the bottom were observed. The biodiesel was poured out in a bottle.

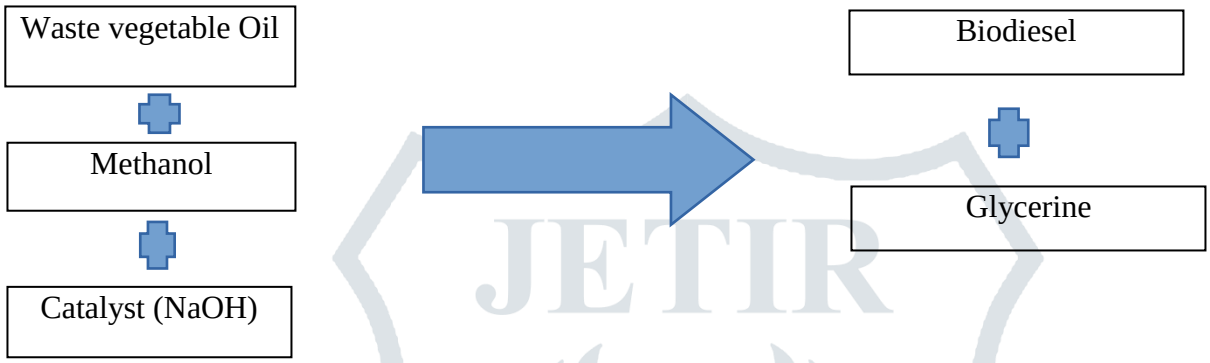

Fig 1: Transesterification Block diagram

The biodiesel was washed with warm water to remove any methanol or sodium hydroxide residues as well as other soluble impurities. The washing was carried out until the water no longer seem muddy or whitish. A portion of the biodiesel was then divided into small samples for different tests. The test carried out on the biodiesel were: density measurement, Combustion test, flash point test, fire point test and calorific value test.

Density was measured by calculating the mass to volume ratio of a small sample of the biodiesel. Combustion test was carried out by spraying biodiesel on a burning flame using a spray bottle. The atomized biodiesel caught fire easily giving the evidence that it was combustible. Flash point test, fire point test and calorific value test were carried out after assuring that the derived biodiesel is combustible. The flash point and fire point tests were carried out using an open cup flash point and fire point apparatus. Calorific value of the biodiesel was determined using a bomb calorimeter. Calorific value of the biodiesel was determined using a bomb calorimeter.

Fig 2: (Waste Oil+ Methanol+ NaOH) mixture Before and after Transesterification process

Fig 3: Washing Biodiesel sample

Fig 4: Open Cup Flash point and Fire Point test apparatus

Fig 5: Bomb Calorimeter Arrangement

3. RESULTS

The biodiesel was subjected to density measurement, flash point test, fire point test and calorific value test using standard laboratory equipment. The results obtained from those tests are as follows:

S. N	Test Performed	Results	Standard Biodiesel Properties **[5][6]**	Remarks
1.	Density test	900kg/m^3	880kg/m^3	Obtained value is close to the standard value.
2.	Flash Point test	128.8°C	130°C	Obtained value is close to the standard value.
3.	Fire Point test	140°C	>130°C	Obtained value is under the parameter of standard value.
4.	Calorific Value tes	21.8MJ/Kg	37.27MJ/Kg	Obtained value is 60% of the standard value.

Table 1: Results from tests performed in Biodiesel

4.FUTURE WORK

We can work with waste vegetable oil in large quantity to produce biodiesel for heat and power generation in a large scale. The raw materials can be required at a very low cost. This can help the nation to become independent regarding power generation and fuel requirements. This will also help to promote a cleaner and greener economy.

5. CONCLUSION

Biodiesel can be prepared using waste vegetable oils available in homes, hotels and industries. There is a great potential in the waste vegetable oils to be converted into biodiesel for heating and power generation purposes. Using biodiesel instead of petroleum-based oil can help in reducing carbon footprint. The processing technique to derive biodiesel from waste vegetable oil isn't complicated and can be carried out easily using proper lab equipment.

6. ACKNOWLEDGMENTS

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