Production of Biodiesel from Waste Cooking / Vegetable Oil

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***Abstract*: At many places on a big range the used vegetable oil is thrown out which rises pollution and has no solution, so production of biodiesel from it can be a solution.**

The objective of this project is production of biodiesel as a substitute for natural resources as they are limited as well as demand for the fuels is increasing and they are polluting the environment. To control the pollution, arising due to use of natural resources which can be reduce using Biodiesel instead of them in the existing engines. Also, it will stop pollution arise from thrown used vegetable oil in the environment. Biodiesel is produced by the process known as transesterification. The transesterification process was carried out by mixing methanol (10% of oil weight) with KOH (10% of oil weight). After preparing mixture of methanol and KOH, that solution is added slowly into hot filtered used vegetable oil (600 °C) and then put into water bath sealed with aluminium foil. Then using Burette Glycerol and Biodiesel is separated.

It can be seen as renewable, biodegradable and eco-friendly source of energy which can be used as a substitute for petrol-diesel-kerosene, can reduce the pollution generated from using natural resources as well as reduce pollution generated from used vegetable oil and stop that wastage of vegetable oil.

***Keywords*: Vegetable Oil, Biodiesel, Transesterification, Alcohol, Glycerol**

Introduction

As during this era of tremendously increasing population and changes within the lifestyles within the world today the requirement of fuels has enormously crossed beyond their limit. So, to come back over this demand their indeed need for alternative fuel resources which is the main topic of debate. As the petroleum fuels are having a day today increasing price and which also ends up in pollution which causes adverse effect on the environment and therefore on the global climate, also the most unavoidable factor is that they're a non-renewable source of energy excess use ends up in their extinction. To avoid the extinction of this fuel resources the scientist has come together with various alternative renewable sources of energy production for e.g., solar, wind, hydropower, geothermal, biogas, biodiesels, etc. Among all of those sources of energy most of the interest lies with the biodiesel that demand is increasing at the next rate because it is cheaper in price and ends up in eco-friendly environment. Biodiesel, a sulphur-free, oxygenated, renewable, non-toxic, and eco-friendly biodegradable oil, is chemically alkyl esters of long-chain fatty acids derived from renewable sources, like edible fat oil, animal fat, or waste vegetable oil. Biodiesel derived from edible fat oil or animal fat by transesterification with alcohol like methanol or ethanol, it is suggested to be used as a substitute for petroleum-based diesel. It's renewable, biodegradable and environmentally friendly. Different group of scientists performed different type experiment for the assembly of biodiesel within the experiment alternate forms of oils were used like rape seed oil, oil, fractionated lard & restaurant grease, waste oil, waste vegetable oil, used frying oil, olive oil, vegetable oil, recycled vegetable oil. To be estimated a minimum of 25,000 litres of waste oil is generated from hotels and restaurant per week. Also, at a selected rate waste oil is generated within the industries this a quite well opportunity to use this waste oil and production of biodiesel can be achieved at a larger amount.

The assembly of biodiesel is applied with various different processes like micro-emulsion, transesterification, thermal tracking. From all this methods, transesterification method is kind of efficient by reducing the viscosity of vegetable oils which makes it resemble to Petro diesel. Also, during this process esters are formed (methyl esters/ethyl esters) which cause less effect on engines resulting in very low deposition when burned. Triglyceride formed within the process reacts with alcohol within the presence of strong acid or strong base, producing a combination of carboxylic acid alkyl esters and glycerol. The triglycerides are carboxylic acid molecule which is further broken into methyl esters molecules and glycerine. Using biodiesel within the unmodified diesel engines reduces the wear and tear and tear of engine parts. Also, biodiesel can used for following ways, in lamps rather than kerosene, energy produced by biodiesel will be converted into current which might be accustomed charge our mobile phones, is utilized in existing diesel engines therefore the pollution is up to the mark and also the natural resources are going to be safe. Also, this biodiesel comes with some disadvantages resulting in its feedstock which ends up in quality change, in future this problem is overcome.

Materials

The basic material required for production of biodiesel is waste cooking oil. The chemical compounds required are potassium hydroxide (KOH) and methanol (CH_3OH) as catalyst. The hardware materials required are burette, pipette, conical flask Bunsen burner, filter paper, measuring cylinder, and thermometer**.** And an electronical device used is a water bath.

Method
The process of preparation of biodiesel from waste oil is as follow:

1. The Preparation of biodiesel consists of edible oil, methanol and potassium hydroxide:
Take 1000ml of used cooking oil / vegetable oil, 10 gm of Potassium hydroxide and 100 ml of methanol which will be required to make Biodiesel.

2. The oil should be filtered to remove impurity and heat to 60 °C:
First remove the impurities present in the oil using the process of filtration. Using conical flask and filter paper complete the process. After removing impurities heat the oil on the burner to 60 °C and monitor temperature using thermometer.

3. Mix 10 gm of Potassium hydroxide (KOH) and 100 ml of methanol (CH_3OH) and stair slowly:
Measure 10 gm of Potassium hydroxide and take into conical flask also take 100 ml of methanol in measuring cylinder and add the methanol into the Potassium hydroxide and stair slowly.

4. The heated oil and mixture of potassium hydroxide and methanol keep in conical flask:
Now, transfer the heated oil into another conical flask and then add the mixture of Potassium hydroxide and methanol into the hot oil.

5. The flask should cover with aluminum foil-
Then cover the flask with aluminum foil because it provides the seal.

6. Keep reaction mixture into water bath at 60 °C for 1 Hr.:
Now, keep the reaction mixture in water bath at 60 °C because the purpose is to thermally accelerate the reaction by conducting it at an elevated, controlled temperature and ambient pressure without losing large quantities of mixture.

7. Take the mixture into a burette**:**
Take out the mixture out from water bath and transfer into the burette, two separate layers will be observed. Lower layer is of glycerol and upper is our product i.e., Biodiesel.

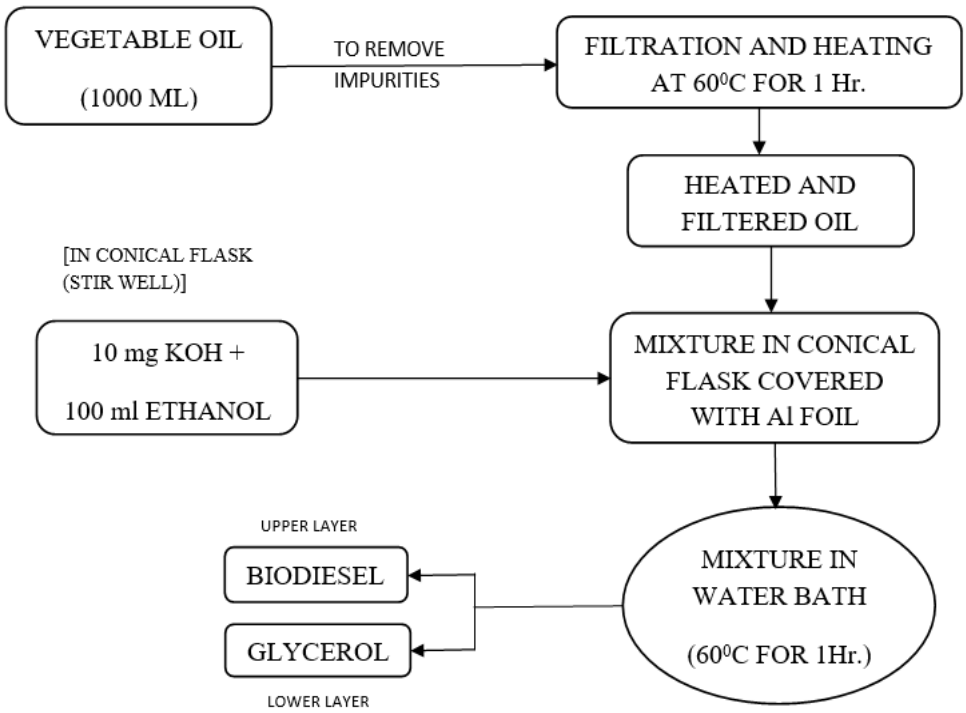
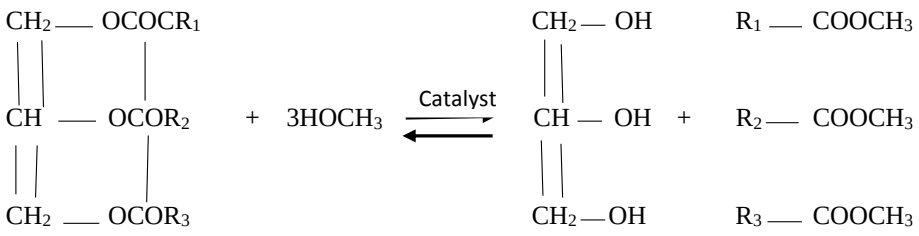


Fig.1. Sequence Diagram

Transesterification Process:
The biodiesel is produced from waste vegetable oil through transesterification process.



Triglyceride (Oil) | Methanol (Alcohol) | Glycerol | Methyl Ester (Biodiesel)

Results and Discussion

After completion of chemical process, in separation tank the biodiesel floats up and glycerol settles down.

Factors Affecting the Process:

1. Water Content

The amount water in vegetable oil affects the production of biodiesel. Hydrolysis reaction can by accelerated by water. If the water content in waste cooking oil is less than 0.5% then, we obtain 90% yield of biodiesel. Water is obtained as byproduct, when acid catalyst is used. The presence of water in product can decrease the efficiency of engines. To remove the water from cooking oil, it is heated above its boiling point before using it for reaction.

2. Alcohol Type

In production of biodiesel, methanol is used. Using methanol, the yield of biodiesel obtained is higher than any other alcohol. The viscosity of biodiesel obtained using methanol is lesser than that of other alcohols. The ethanol form azeotrope with water. This formation of azeotrope makes the distillation process difficult.

3. Catalyst Type

For production of biodiesel from waste cooking oil different catalyst had been used such as sodium hydroxide (NaOH), potassium hydroxide (KOH), sodium methoxide, potassium methoxide. It has been found that from these catalysts, the NaOH is the fastest catalyst and KOH gives highest yield.

4. Yield Analysis

After the transesterification process of waste cooking oil, we obtained the following products that is methyl ester (92%), soap materials (about 1%) and glycerol (up to 6%).

Synthesis of biodiesel is done by heating at a specified temperature of 60 to 65 degrees.

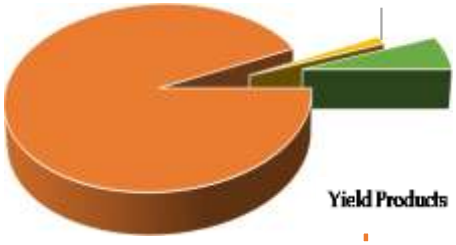


Fig 3 - Yield Analysis

5. Effect of Reaction Time to the Density

This biodiesel testing is carried out in order to determine level of fuel feasibility in the diesel engines. Mass of biodiesel per unit volume at a specific temperature is density.

So, lower the density value better is the biodiesel. From the previous research different results were obtained which ranged from 0.85 to 0.86 g/mL. There are also several factors which affect the biodiesel such biodiesel washing water also triglyceride molecules which are not converted into methyl esters.

After seeing the results, we can observe that biodiesel density obtained meets SNI range of 0.886-0.888 gr/mL. This important because density values with SNI produces perfect combustion.

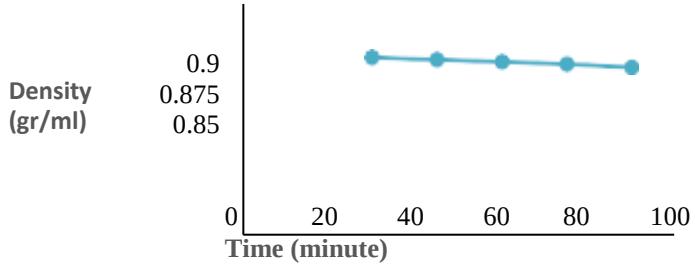


Fig 2 - The effect of reaction time to the density

6. Effect of Temperature

The transesterification process can happen at any temperature. So, we have gathered different results at different temperature. So, synthesis was obtained at 45 °C, 60 °C and 65 °C. From this we yield biodiesel were 77%, 86%, 94% at the given temperatures. However high reaction temperature speeds up the reaction. Increasing temperature increased the conversion from 10 to 15%. However, if temperature was increased above 65 °C there little reduction in conversion. This is due to enhancement in saponification and transesterification reaction because of high temperature.

7. Effect of Viscosity

It is found that if higher the viscosity the thicker and more difficult liquid material to flow. At 90 min of reaction time an increase in viscosity occurs this is due to incomplete biodiesel production. So, it was observed mixing time is 75 min for viscosity.

Based on results that biodiesel viscosity meets SNI 7182-2015 in range of 5.89-6.25 cSt. If high viscosity, is it affect automation of combustion during injection. This also affects the quality of biodiesel.

Conclusion

The properties of biodiesel produce from used vegetable oil with transesterification process were compared with commercial diesel in the lab. The density, surface tension and viscosity of biodiesel from used vegetable oil were closer to that of commercial diesel. Engine modification is not required. Also, volatility rate of biodiesel produce from vegetable oil is less than the commercial diesel which conclude that biodiesel is safer than commercial diesel in case of storage and handling and Biodiesel produce from used vegetable oil will generate less pollution compared with commercial diesel as well as it will save the natural resources and hence environment will be protected.

Further researches are mandatory to detect cetane number, calorific value, and particulate matter. The emission test should be performed and compared to the standard fuels for the analysis of fuel quality.

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