



Production of bio fuel from used cooking oil

Nandhini M.

nandhinimuniasamy255@gmail.com

Kalasalingam Academy of Research
and Education, Madurai, Tamil Nadu

Deva Dharshini S.

dharsinisuresh528@gmail.com

Kalasalingam Academy of Research
and Education, Madurai, Tamil Nadu

Kanimozhi R.

kanimozhi@klu.ac.in

Kalasalingam Academy of Research
and Education, Madurai, Tamil Nadu

ABSTRACT

Biodiesels are very good alternatives to diesel oils as they have similar properties. It is one of the best substitutes for the fuels and it has acquired significance due to the shortness of conventional fuels. These biodiesels can also be produced from waste cooking oil by transesterification process. This waste cooking oil is the better options for the conventional fossil fuels. Also, biodiesel can be produced from animal fats and vegetable oils but it may compete the food supply. Waste cooking oils are considered to be a substantial feedstock.

Keywords— Biodiesel, Waste cooking Oil, Vegetable oils
Transesterification

1. INTRODUCTION

Biodiesel has increased attention as an alternative and renewable diesel fuel. It is produced by the transesterification process of animal fats or vegetable oils with alcohols such as methanol or ethanol. The usage biodiesel could decrease the emission of particulate matters such as carbon monoxide, oxides of sulphur, oxides of nitrogen, smoke and hydrocarbons and plays a major role in concerning the environment. The waste cooking oils are used for the biodiesel production since it may face a disposable problem. Also, the usage these oils has the advantage of low cost. As the demand for the vegetable as food has been increased tremendously. These oils can be used as a good source for the production of biodiesel as it may compete in the food supply. These vegetable oils are more expensive to be used as a fuel. This is the only way to reduce the cost of the biodiesel production.

Waste cooking oils are used vegetable oils obtained from cooking food and repeated frying of oils. These oils could not be consumed after frying repeatedly as the free fatty acid content of the oil is too high. This also faces a difficulty in disposing problems like soil and water pollutions. Hence this waste oil can be used as the feedstock for the biodiesel production as this is effective and cost efficient. Conversion of this low-quality sources from waste to commercial grade biodiesel could minimize the environmental damage. The by-product of this waste oils can also be used for the production of soaps and additives for lubricating oils. The most common way for the production of biodiesel is the transesterification

process, which is nothing but a catalyzed chemical reaction involving the vegetable oil and an alcohol to yield fatty acid alkyl esters and glycerol. Oils with free fatty acid content cannot be transesterified. For this the FFA content in the oil should be reduced. The reduction of free fatty acids content in the oil can be done by the pre-treatment of the oil and transesterification is done next to this step with the help of an base. This oil then reacts with ethanol in the presence of an alkaline catalyst and forms esters and glycerols. Biodiesels have high flash points and are less volatile compared to diesel fuels and are easy and safe to transport from one place to another. Due to benefits of biodiesel like renewability, low cost and reduced pollution, it is highly used in developed countries like USA, France, Brazil in different proportions with diesel.

1.1 Feedstock options

As the manufacturer will always look for an ethic of reducing wastes and sourcing locally; therefore, one of the main feed stocks under consideration is local waste vegetable oil (WVO). Typically, WVO refers to used fryer oil/grease from restaurants, animal fats. etc.

1.2 Various non edible oils used by the biodiesel industry in India

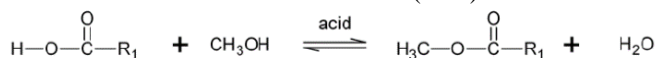
- Palm sterin
- Mahua oil
- Kartanja oil
- Jatropha oil
- Cotton seed oil
- Palm fatty acid distillate
- Rice bran oil
- Spent Earth Extracted oil
- Animal fat
- Acid oil
- Used cooking oil
- Rice bran fatty acid oil
- Rubber seed oil

1.3 Bio-diesel production overview

Biodiesel is produced by a simple chemical reaction between the oils/fats with an alcohol primarily methanol forming biodiesel. Biodiesel is chemically mono alkyl esters of long chain fatty acids which is referred as FAME.

1.3.1 The basic biodiesel reaction

(a) Esterification: Increases the yield of biodiesel. When oil feedstock contains an excess of free fatty acids they have to go through the process of esterification. Esterification is the reaction of an acid (condensation of the carboxyl group of the acid) with an alcohol (the hydroxyl group of the alcohol) in the presence of a catalyst. The Acid Catalyst is Methyl Sulphonic Acid (0.4%) or Sulphuric Acid (0.5%) it depends upon the Acid Value and the Reactant is MeOH (20%).

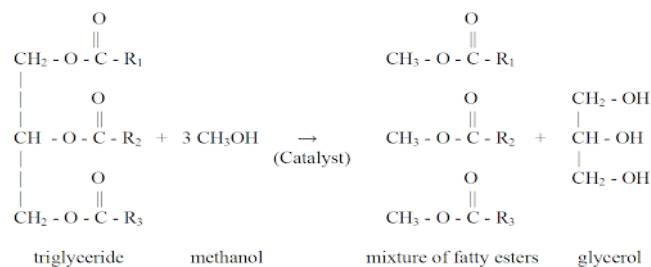


Free Fatty Acid Methanol Methyl Ester Water

(b) Transesterification: The transesterification reaction is base catalysed. Any strong base capable of deprotonating the alcohol will do (e.g. NaOH, KOH, Sodium methoxide, etc.), but the sodium and potassium hydroxides are often chosen for their cost. In the transesterification process, a glyceride reacts with an alcohol (typically methanol or ethanol) in the presence of a catalyst forming fatty acid alkyl esters and alcohol. The base Catalyst is KOH (0.6%) or NaOH (0.3%) it depends upon the Acid Value and the Reactant is MeOH (20%).

Why KOH not NaOH?

- KOH reacts faster than NaOH and requires more amount than NaOH.
- In case, a high acid value oil (i.e. ≥ 5 AV) is used, KOH reduces the soap formation. If NaOH is used it leads to high soap formation.
- KOH cost is higher than NaOH, but dissolves faster than NaOH.
- Glycerine from NaOH reacted oil tends to be much thicker and can even solidify into a thick mess. On the other hand, glycerine from KOH reacted oil is nice and the liquid will be even, when it is cooled to extremely low temperature.



1.4 Process methodology

- Waste oil is collected from hotels/houses. The waste oil is filtered using a filter paper. This oil acid value is 0.3%
- 100 ml of the filtered oil is taken in a conical flask and heated at 60°C
- The magnetic needle in magnetic stirrer helps in uniform mixing and heating of oil.
- 0.4% of Sodium hydroxide pellets are mixed with 10% methanol and the solution is stirred continuously until the pellets dissolve completely and Sodium methoxide solution is formed.
- The sodium methoxide solution and methanol 10% is poured slowly to the heated oil and the mixture is allowed to stir for 1 hour.
- After stirring, the solution is poured into the separating funnel and is allowed to settle for 1 hour.
- After the settling hour, this reaction takes place in three layers (First layer-Methyl ester, Second layer-Soap, Third layer- Glycerol)

- The stopcock at the bottom of the separating funnel drains the glycerine out in a container. When the glycerine is fully drained the valve is shut.
- In the next step, 3% of water is added to the Methyl ester and allowed to settle for 1 hour which then forms three layers (First layer-Methyl ester, Second layer-Soap, Third layer-Methanol and water)
- The second and third layer is separated to dry the first layer
- By drying the methyl ester at 100°C in the packed column distillation, the moisture (methanol and water) is removed.

1.4.1 Process flow diagram

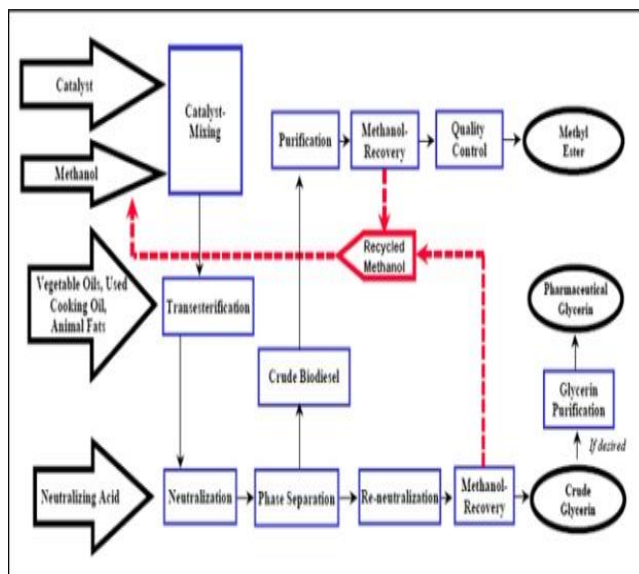


Fig. 1: Flow Chart



Fig. 2: Crude oil



Fig. 3: Transesterification

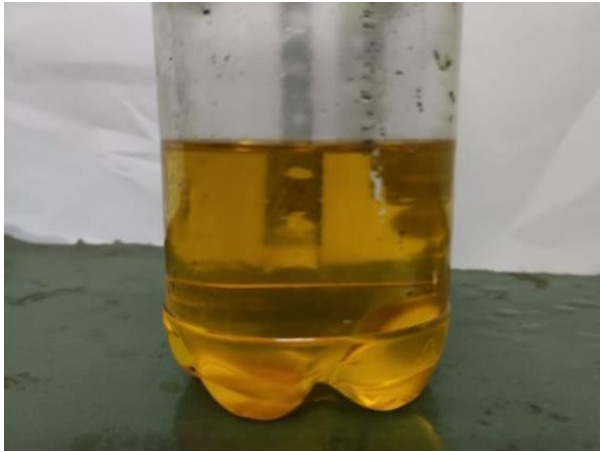


Fig. 4: Bio Diesel

Table 1: Properties of Biodiesel

Particular	Specification	Method of testing
DENSITY@15°C	860 – 900 Kg/m ³	IS 15607: 2005, EN 14214, ASTM D 6751
VISCOSITY@40°C	3.5 – 5.0 mm ² /s	IS 15607: 2005, EN 14214, ASTM D 6752
FLASH POINT	120 ⁰ C Minimum	IS 15607: 2005, EN 14214, ASTM D 6753
POUR POINT	16°C	IS 15607: 2005, EN 14214, ASTM D 6754
ALCOHOL CONTENT	0.2% Maximum	IS 15607: 2005, EN 14214, ASTM D 6755
WATER	500 PPM Maximum	IS 15607:2005, EN 14214, ASTM D 6756
SULPHUR	10 PPM Maximum	IS 15607:2005, EN 14214, ASTM D 6757
ESTER CONTENT	96.5% Minimum	IS 15607:2005, EN 14214, ASTM D 6758
ACID VALUE	0.1 mg KOH/g maximum	IS 15607:2005, EN 14214, ASTM D 6759
MONO GLYCEROL	0.25% Maximum	IS 15607:2005, EN 14214, ASTM D 6760
DIGLYCEROL	0.25% Maximum	IS 15607:2005, EN 14214, ASTM D 6761
TRIGLYCEROL	0.25% Maximum	IS 15607:2005, EN 14214, ASTM D 6762
TOTAL GLYCEROL	0.25% Maximum	IS 15607:2005, EN 14214, ASTM D 6763
PHOSPHORUS	10 PPM Maximum	IS 15607:2005, EN 14214, ASTM D 6764
CETANE NUMBER	51 Minimum	IS 15607:2005, EN 14214, ASTM D 6765
OXIDATION STABILITY@110°C	6 hrs minimum	IS 15607:2005, EN 14214, ASTM D 6766
CONTAMINANTS	24 PPM Maximum	IS 15607:2005, EN 14214, ASTM D 6767

2. CONCLUSION

Biodiesel has extensive significance and are widely used as a source as the diesel fuel. The Cost of biodiesel can also be reduced by using waste cooking oil as feed stock to compete rising food demand. High fatty acid content in waste cooking oil can be reduced by pre-treating waste cooking oil with acid catalyst. Ethanol is also a most suitable alcohol because of its low cost and easy separation from bio fuel. Also the production process for the biodiesel can be further improved economically and by selective more effective catalysts. Hence, the influence of the ethanol and alkaline catalyst and the yield of produced biodiesel were studied.

3. REFERENCES

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