Production of Biodiesel from Neem Seed Oil

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Abstract: **- The ever growing mechanization and motorization of the earth has led to anabrupt rise for the demand of petroleum products. Henceforth, it is essential to search for substitute fuels, which can be indigenized from materials existing within the nation.This scrutinizes biodiesel production using crude neem oil having high acidic value, as a feedstock. The results of some operating variables were determined, and its combustion efficiency was assessed in an internal combustion engine. Due to its high acidic value, the neem oil was treated via two step acid – base transesterification process.**

Keyword: **- Biodiesel, Neem Seed Oil, Transesterification, Production, emission conrol.**

I. INTRODUCTION

Fossil fuels are non-renewable energy resources.Even though, these fuels are contributing widely to the world energy supply, production and use have raised environmental issues and political disputes. It has been illustrated that 98% of carbon emissions are caused from fossil fuel combustion (1). The need of energy is increasing unceasingly due to rapid growth in the number of industries and vehicles owing to sudden rise in the population. The roots of this energy are petroleum, natural gas coal, hydrocarbon and nuclear. The petroleum diesel combustion emits numerous green house gases. Besides from these emissions, petroleum diesel is also major source of these air containments including NOX, SOX, CO, particulate substance and volatile organic compounds(2). Several alternative fuels have been studied to either substitute diesel fuel partially or completely.

According to Shay (1993), the continued and increasing consumption of petroleum diesel intensifies air pollution and magnifies the global warming issues caused by CO_2 and other particulate matters. The growing demand for fuel and the increasing problem for the environment due to the use of fossil fuel have led to the growing popularity of biodiesel as a convenient alternative and ecologically friendly energy resource (Ma and Hanna,1999). It’s advantage over petroleum diesel is its safety, renewability and biodegradability have been reviewed widely.Although, both have similarities in properties and performance parameters, its non-sulfur content makes it a favorable substitute. Biodiesel fuel is currently fascinating increasing attention globally as a blending component ora direct replacement for diesel fuel in vehicle engines (Demirba,2009).When blended with diesel fuel the designation BXX indicates the XX% amount of biodiesel in the blend for example B30 is 30% biodiesel and 70% diesel. It has been stated that blends up to B20 can be used in nearly all diesel equipment and are compatible with maximum storage and distribution equipment (Balat, 2011). These low-level blends generally do not require any engine modifications. However, higher blends or B100 can be used in many engines built with little or no modification (Demirbas, 2007). The amount of oxygen in biodiesel (≈ 10%) advances combustion and reduces CO, soot, and hydrocarbon emissions whereas slightly increasing the NOx emissions. Fukuda et al. (2001) showed that using B20 in trucks and buses would completely eliminate the black smoke emitted during acceleration.

II. BIODIESEL AND ITS RAW MATERIALS

Biodiesel is an alternative liquid fuel that can substantially replace conventional diesel and decrease exhaust pollution and engine maintenance costs. This renewable fuel can be produced from different feedstock containing fatty acids like animal fats, non edible oils (Jatropha oil, Karanji or Pongamia oil, Neemoil, Jojoba oil, Cottonseed oil, Linseed oil, Mahua oil, Deccan Hemp oil, Kusum oil, Orange oil, and Rubber seed oil), and waste cooking oils and by products of the refining vegetables oils and algae (3) & (4). Biodiesel is increased attention as an alternative, non-toxic, biodegradable, and renewable diesel fuel. Biodiesel is usually produced by the transesterification of vegetable oil or animal fat with short chain alcohol such as methanol or ethanol. It has higher oxygen content than petroleum diesel and its use in diesel engines have shown great reductions in emission of particulate matter, carbon monoxide, sulfur, polyaromatics, hydrocarbons, smoke and noise. In addition, burning of vegetable oil based fuel does not contribute to net atmospheric CO_2 levels because such fuel is made from agricultural materials which are produced via photosynthetic carbon fixation.

III. PRODUCTION OF BIODIESEL (METHODS)

There are various processes which can be pragmatic to synthesize biodiesel such as direct use and blending, micro emulsion process, thermal cracking process and the most conventional approach is transesterification process. This is because due to the fact that this approach is relatively simple, carried out at normal conditions, and gives the best conversion efficiency and quality of the converted fuel.

IV. TRANSESTERIFICATION PROCESS

The most common method to produce biodiesel is the transesterification, which refers to a catalyzed chemical reaction includingneem oil and alcohol to yield fatty acid alkyl esters (biodiesel) and glycerol. The reaction needs a catalyst, usually a strong base, such as sodium and potassium hydroxide or sodium methylate (5) & (6) or sulfuricacid-based transesterification processes. Acid catalysts are too slow to be practical for converting triglycerides to biodiesel, however, acid catalysts are quite effective at converting FFAs to biodiesel. Therefore, an acid-catalyzed pretreatment step to convert the FFAs to esters, followed by an alkali-catalyzed step to convert the triglycerides should give an efficient method to convert high FFAs to biodiesel.

Transesterification process helps to reduce theviscosity of the oil. A catalyst is usually used to boost the reaction rate and the yield. Subsequently the reaction is reversible, excess alcohol is used to shift the steadiness to the product side. Especially methanol is used as alcohol because of its cheap price and its physical and chemical benefits. Methanol can quickly bond with neem oil and NaOH can easily dissolve in it. The stoichiometric reaction requires 1 mol of a triglyceride and 3 mol of the alcohol. However, an excess of the alcohol is used to increase the yields of the alkyl esters and to allow its phase separation from the glycerol formed. The triglycerides are reacted with a suitable alcohol (Methyl, Ethyl, or others) in the presence of a catalyst under a controlled temperature for a given span of time. The chemical reaction of the triglyceride with alcohol is shown below. With higher alcohols the chemical equation would change correspondingly.

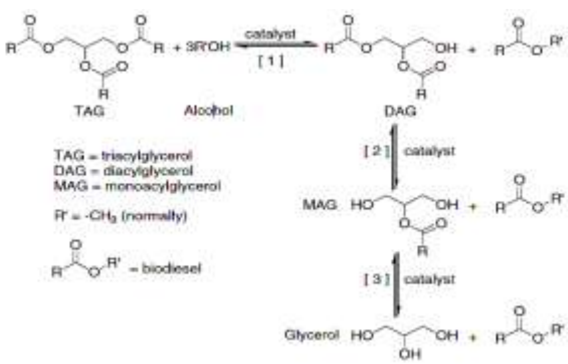

Fig. Biodiesel Production by Transesterification

Procedure and Requirements

- Required Chemicals
    - Methanol
    - Sodium Hydroxide pellets(NaoH)
    - Potassium hydroxide pellets
    - Acetone
    - Phenolphthalein
    - Sulfuric Acid

- Equipment’s and Glassware
    - Magnetic Stirrer
    - Dimmer with Heating Coil
    - Condenser with Joints
    - Thermometer
    - Heating Mental
    - Drying tube
    - Measuring Cylinder
    - Separating funnel.

- Standard Reaction Condition
    - Required Temperature 64^0 temperature
    - Reaction Duration Minimum 2Hrs Maximum 3hrs.
    - RPM 400-500 rpm of magnetic stirrer
    - Catalyst 1% (NaoH)

- Procedure
    1. **1.** 60ml of methanol is taken into 3neck RB.
    2. **2.** 0.94gm NaoH pallets are added in 60ml methanol.
    3. **3.** NaoH pallets are completely dissolved in methanol by stirring.
    4. **4.** 10ml neem seed oil is added in above mixture.
    5. **5.** This RB is kept in paraffin oil heating bath at 64^oCelsius and stirred at 400rpm for 2hrs.
    6. **6.** After 2hrs. this mixture is taken out from RB and poured into a separating funnel and allow to settle under gravity for 24hrs for separating of biodiesel.
    7. **7.** The lower glycerol layer was tapped off after which the biodiesel layer is taken into RB and methanol is separated by using heating mental.
    8. **8.** The remaining mixture was washed with warm water 5 to 6 times for removal of NaoH.

Fig. Transesterification Process

Petroleum diesel versus biodiesel standard fuel property

Fuel Property	Diesel	Biodiesel
Fuel standard	ASTM D975	ASTM D6751
Fuel composition	C10-C21 HCb	C12-C22 FAMEc
Kinematic viscosity, mm2/s (at 40 °C)	1.3 to 4.1	1.9 to 6.0
Boiling point, °C	188 to 343	182 to 338
Flash point, °C	60 to 80	100 to 170
Cloud point, °C	-15 to 5	-3 to 12
Pour point, °C	-35 to -15	-15 to 10

(Kiss et al.,2008); HCb, Hydrocarbons;FAMEc, fatty acid methyl esters.

V. OBTAINED RESULTS

Fuel Property	Biodiesel
Kinematic viscosity, mm2/s (at 40 °C)	4.5
Boiling point, °C	280
Flash point, °C	150
Cloud point, °C	2
Pour point, °C	-8

V. CONCLUSION

Biodiesel has attracted wide attention in the world because of its renewability, biodegradability, nontoxicity and environmentally friendly advantages. It is asignificant new alternative transportation fuel. It can be obtained from different feedstock containing fatty acids such as animal fats, nonedible oils, and waste cooking oils and by products of the refining neem oil and algae. Transesterification is a commonly employed method for its production. The purpose of this method is to minimize the viscosity of oil or fat using acid or base catalyst in the presence of methanol or ethanol. However, the biodiesel production is strongly affected by parameters such as molar ratio of alcohol, reaction temperature,reaction time and catalyst concentration. Hence, this paper concentrates on the development of economically viable as well as ecofriendly substrates for biodiesel production.

REFERENCES

[1]. Arenicola, E. F, Betake, E. Ikhuomoregbe, D.I.O., Ojumu T.V. (2012) Production of biodiesel from crude neem oil feedstock and its emissions from internal combustion engines. "*African Journal of Biotechnology*", 11(22): 6178-6186.

[2]. Kannahi, P.M., Arulmozhi, R. (2013) Production of biodiesel from edible and non-edible oils using Rhizopus oryzae and Aspergillus niger. "*Asian Journalof Plant Science and Research"*, 3(5): 60-64.

[3]. Ogunwole, O.A. (2012) Production of Biodieselfrom Jatropha Oil (Curcas Oil), "*Research Journal ofChemical Sciences"*, 2(11), 30-33.

[4]. Gude,V.G., Patil, P. D., Grant, G. E., Deng,S.(2012) Sustainable Biodiesel Production, Secondworld Sustainable forum,1-14, www.wsforum.org.

[5]. Sarıbıyık,O.Y., Özcan, M., Serin, H., Serin, S., Aydın, K. (2012) Biodiesel Production from Ricinus Communis Oil and Its Blends with Soybean Biodiesel, "*Journal of Mechanical Engineering"*, 56, 811-816.

[6]. Demirbas, A. (2008) Comparison of transesterification methods for production of biodiesel from vegetable oils and fats. "*Energy Conversion and Management"*, 49:125–130.