International Engineering Journal For Research & Development

E-ISSN No:2349-0721

Volume 2: Issue 2

STUDY ON BIODIESEL PRODUCTION FROM GROUNDNUT OIL

Ashini Bande[1], Prof.Harshani Ganvir[2]
Department Of Chemical Engineering ,Kinkar Institute Of Polytechnic,Seloo,Wardha
[1]ashinibande14@gmail.com

ABSTRACT:

Biodiesel is gaining more and more importance as an attractive fuel due to the depleting fossil fuel resources. Chemically biodiesel is monoalkyl esters of long chain fatty acids derived from renewable feed stock like vegetable oils and animal fats. It is produced by transesterification in which, oil or fat is reacted with a monohydric alcohol in presence of a catalyst to give the corresponding monoalkyl esters. The purpose of this study is to cover the gap in knowledge by extracting the oil, transesterifying it to biodiesel and characterizing it. To achieve this, the ground nut oil which contains high amount of free fatty acid waspretreated with hydrochloric acid as catalyst and anhydrous methanol at a molar ratio of 9:1 to reduce its free fatty acid to 1.5% before tranesterification.

Keywords: Groundnut oil, Automotive gas oil, Transesterification, Ethyl esters, Biodiesel, fuel, diesel engine, Nigeria

INTRODUCTION:

Today it is very essential to use alternative fuel because of energy security, environmental concerns and socio-economic reasons [1]. Over the last few years biodiesel has gained importance as an alternative fuel for diesel engines. Manufacturing biodiesel from used vegetable oil is relatively easy and possesses many environmental benefits [2]. The use of vegetable oils as frying oils produces significant amounts of used oils which may present a disposal problem. Their use for biodiesel production has the advantage of their low price. Used vegetable oil is described as a 'renewable fuel' as it does not add any extra carbon dioxide gas to the atmosphere, opposed to fossil fuels, which cause changes in the atmosphere [3]. From the point of view of chemical reaction, vegetable oil from plant sources is the best starting material to produce biodiesel because the conversion of pure triglyceride to fatty acid methyl ester is high and the reaction time is relatively short [2].The most common way to produce biodiesel is by transesterification, which refers to a catalyzed chemical reaction involving vegetable oil and an alcohol to yield fatty acid alky esters (i.e., biodiesel) and glycerol [4]–[6]. Groundnut oil was mechanically extracted from groundnut the extracted oil was trans-esterized with ethanol using potassium hydroxide as catalyst in a two-step trans-esterification process to yield ethyl esters and glycerol. The fuel properties of groundnut oil and its ethyl ester were determined according to American Society for Testing Materials (ASTM) standard methods.

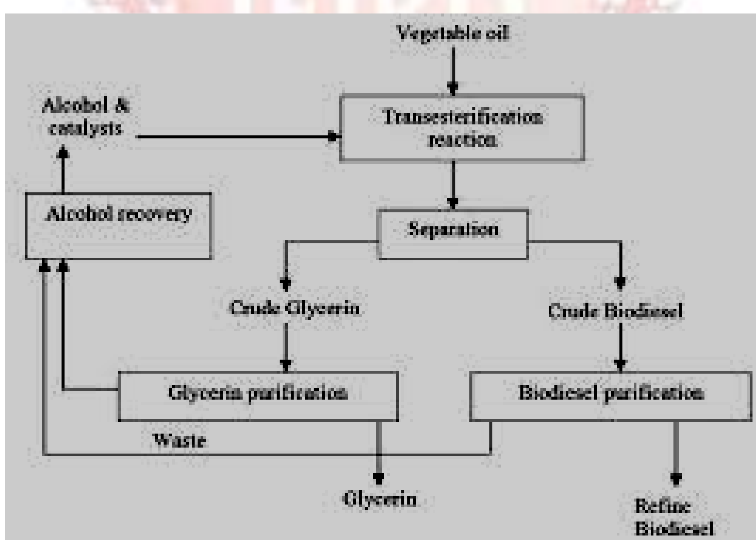
Groundnut (*Arachis hypogea, L.*) belongs to the Leguminosae family and it propagates itself by self pollination. Nigeria is the third largest producer of groundnut after China and India (SATRENDS, 2001). In 1994, 1,453,000 tons of groundnut were produced in the country. While in 1998, 2,227,000 tons of the crops were produced in the country (CBN, 1998). The Nigerian oil mill company in Kano, Kano State, The Nigerian oil mill company in Kano, Kano State, Nigeria crushes between 100–120 tons of groundnut seeds a day during their oil production season (SATRENDS, 2001). In addition, there are numerous oil mills (both large-scale and low-scale industries) which ensure the production of groundnut oil throughout the year.

LITERATURE REVIEW:

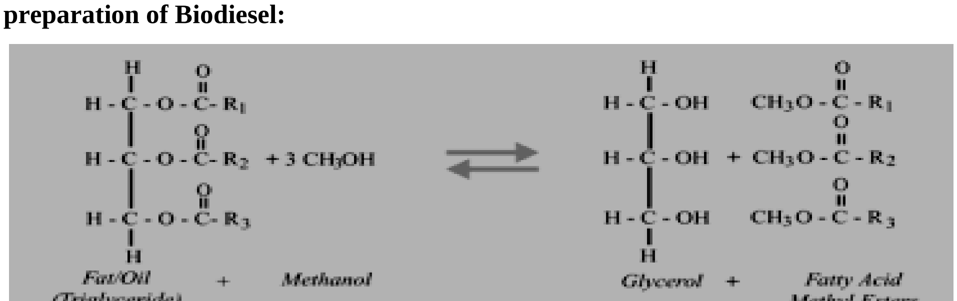
Hobbs, 2003; Faupel and Kurki, 2002; Elsbett and Bialkowsky, 2003. Biofuels increase safety in storage and transport because they are non-toxic and bioegradable (Hobbs, 2003; Faupel and Kurki, 2002; Elsbett and Bialkowsky, 2003). Van Gerpen et al. (1996) had found that the cetane numbers of biodiesel depend on the fatty acids profile of the original oil or fat in which it is produced. Biofuels have been described as safe fuels, because the flash point is more than 100□F higher than that of diesel and was given as 160□C which showed that it can be classified as a non-flammable liquid; the toxicity is at least 15 times less than diesel (Peterson et al., 1994). Rakopoulos et al. (2006); Faupel and Kurki (2002); Mohammed et al. (2002) gave a number of disadvantages

encountered when using biodiesel in compression ignition engine. They observed that biodiesel fuels havehigher viscosity, higher pour point, lower heating valueand lower volatility than petroleum diesel fuel. Ahouissoussi (1995) has noted that although biodiesel have higher total costs than diesel fuel, they have the potential to compete with compressed natural gas and methanol as fuels for urban transits buses. Also, it is noteworthy that Krawczyk (1996) identified biodiesel as a possible replacement to fossil's fuels as the world's primary energy source.

FLOWSHEET FOR PREPARATION OF BIODIESEL FUEL:



Reaction for preparation of Biodiesel:



Material & Methods:

The mechanism of the transesterification process

The reaction temperature of 60ºC was selected as suggested by Alamu et al. (2007). Potassium hydroxidewas added to ethanol to form potassium ethoxide. The ethanol-KOH mixture (potassium ethoxide) was poured into the groundnut oil in a transesterification reactor, andthe following transesterification reaction occured The mixture of potassium hydroxide and ethanol in the flask was stirred vigorously. The ethanol catalyst mixture was poured into the oil in the main reactor and stirred rapidly settle for 48 h. After settling and completion of separation, glycerol which is the heavier liquid collected at the bottom, while the ester product was at the top. The glycerol layer was drained off and the ester layer remained as shown in Figure 2.

The Washing process

The method used for washing consists of two steps developed by Peterson et al. (1996), is described as follows: a) The glycerol layer was re-mixed with the ester layer after initial settling has occurred, then 15% water was added and the entire mixtures were restirred for 10 min and allowed to settle for 48 h. b) The ester product was washed after draining off the glycerol layer. The ester was washed with water at about 30% of the ester volume. The water was stirred into the ester with mechanical stirring using a blender. After 10 min, the stirring was stopped, and the water was allowed to settle out for two days. At this point, the process was complete and the crystal clear product was the groundnut oil ethyl ester.

The fatty acid profile of groundnut oil

The fatty acid profile of groundnut oil is presented in Table 3. It was observed that groundnut oil contains 11.69% palmitic acid, 41.64% oleic acid and 32.04% linoleic acid, while the remaining acids are in negligible percentages. The result showed that groundnut oil comprised of 75.03% unsaturated fatty acid with mainly 41.64% oleic acid and 32.04% linoleic acid.

Table The fatty acid profile of groundnut oil

Component	Formula	Percentage Composition	Name	Type
C 16:0	$C_{16}H_{32}O_2$	11.69	Palmitic acid	Saturated.
C 18:0	$C_{18}H_{36}O_2$	3.84	Stearic acid	Saturated.
C 18:1	$C_{18}H_{34}O_2$	41.64	Oleic acid	Unsaturated.
C 18:1	$C_{18}H_{34}O_2$	0.46	Oleic acid	Unsaturated.
C 18:2	$C_{18}H_{32}O_2$	32.04	Linoleic acid	Unsaturated.
C 20:0	$C_{20}H_{40}O_2$	1.84	Arachidic acid	Saturated.
C 20:1	$C_{20}H_{38}O_2$	0.89	Arachidoleic acid	Unsaturated.
C 22:0	$C_{22}H_{44}O_2$	4.05	Behenic fatty acid	Saturated.
C 24:0	$C_{24}H_{48}O_2$	1.53	Saturated fatty acid	Saturated.

The composition of groundnut oil was similar to rapeseed oil (64.1% oleic acid, 22.5% linoleic acid and others), *Jatropha* oil (42.1% oleic acid, 30.9% linoleic acid and others), sunflower oil (44.0% oleic acid, 10.7% linoleic acid and others), palm oil (43.1% oleic acid, 10.4% linoleic acid and others), neem oil (41.3% oleic acid, 16.4% linoleic acid and others) and karanja oil(53.2% oleic acid, 19.1% linoleic acid and others) whichhad more oleic acid than linoleic acid and were found suitable as sources of biodiesel fuels. Based on the fatty acid profile, groundnut oil is expected to provide a suitable source of biodiesel fuels (Van Gerpen, 1996; Rakopoulos et al. 2006; Kinast, 2003).

CONCLUSION:

Ground nut oil can be converted to methyl esters and the properties are within the limits for biodiesel. The pour point is -6oC which means it cannot be used when temperature can fall below this value. The cetane number is just above the maximum for
biodiesel. In view of the similarity of the properties to those of diesel fuel, it can hence be used as alternative fuel for diesel engines.

REFERENCES:

1) A. B. M. S. Hossain and A. N. Boyce, *Biodiesel Production from Groudnut oil as an Environmentally Recycling Process and Renewable Energy*, pp. 312-316, 2009.

2) M. Allen, *Straighter Than Straight Vegetable Oils*, pp. 345-356, 2002.

3)K. Kalisanni, K. Khalizani, and M. S. Rohini, *Analysis of Groundnut Oil a Raw Material for Biofuel Production*, pp. 82-83, 2008.

4)Anon, *A Diesel Replacement Fuel*, pp. 315-318, 1997.

5)A. B. M. S. Hossain, A. N. Boyce, A. Salleh, and Chandran, "*Bio Diesel Production from Waste Soyabean Oil Biomass as Renewable Energy and Environmental Recycled Process*, pp. 4323-4240, 2010.

6)Goodger, E.N (1975): Hydrocarbon Fuels, Macmillan Press Ltd., England.

7)Knothe, G.L.; Van Gerpen, J ; Krahl, J. (2005): The Biodiesel Handbook, AOCS Press, Champaign. Illinois. USA.

8)Ladammatos, N. ; Goacher, J (1995): Equation for Predicting the Cetane Number of Diesel Fuels from their Physical Properties, Fuel vol. 74 no.7 pp. 1083-1092.

9)Laza, T.; Bereczky, C (2010): Basic fuel properties of rapeseed oil-higher alcohol blends, Fuel 20(2):803-810.

10)Ramadhas, A.S.; Jayaraj, S.; Muraleedharan, C(2009): Biodiesel production from high FFA rubber seed oil, Fuel Vol. 84, no.4 pp. 335-340.

11)Van Gerpen, J.V. (2005). Biodiesel Processing and Production, Fuel processing Technology, vol. 86, no.10, pp. 1097-1107.

12)Ahoiussoussi, N. B. C. and M. E. Wetzestein. 1995. Life cycle costs of alternative fuels: Is biodiesel cost competitive for urban buses? U.S. Department of Agricultural Economic Research Service.

13)Alamu, O. J., M. A. Waheed, S. O. Jekayinfa. 2007. Biodiesel production from Nigerian palm kernel oil: Effect of KOH concentration on yield. *Energy for Sustainable Development,*
XI(3): 77-82.

14)Elsbett, G. and M. Bialkowsky. 2003. Engine running on pure vegetable oil as regrowing fuel. Shanghai: Presentation for Shanghai International Symposium on I.C. Engine, pp.1-18.

15)Faupel, K. and A. Kurki. 2002. Biodiesel: A Brief Overview. U.S.A: National Center for Appropriate Technology; ATTRA, 1-800-346-9140.

16)Hobbs, S. 2003. Benefits of Biodiesel. Be Bio-energy.

17)Moreno, F., M. Mumoz, J. Morea-Roy. 1999. Sunflower methyl ester as a fuel for automobile diesel engines. *Transactions of the ASAE*, 42(5): 1181-1185.

18)Peterson, C, G. Moller, R. Haws, X. Zhang, J. Thompson, and D. Reece. 1996. Ethyl ester process scale up and biodegradability of biodiesel. USDA:Final Report Paper No 303.

19)Van Gerpen, J. 1996. Cetane number testing of biodiesel. Proceedings of the Third Liquid Fuels Conference, pp.197-206.