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ANALYSIS OF NOME (NEEM OIL METHYL ESTER) FOR BIODIESEL GENERATION

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ABSTRACT

Biodiesel derived from the neem oil has been proved as an alternative fuel sources. Since neem is most common edible and medicinal plant could be grown at any places in India, it was selected for the biodiesel purpose. Selected grades of neem seeds are collected and they are dried for some time. Dried seeds are crushed and the oil was extracted in the oil mill. Collected oil was tested to know their various properties. Since it was found to be more suitable for biodiesel then it was trans-esterified as the acid value was not suitable for the single stage trans-esterification. Hence two stage trans-esterification was done. First stage to reduce the acid value and second stage was a usual methanolysis process. Trans-esterified biodiesel was tested for the various other biodiesel properties. Neem oil biodiesel will be the prominent source for alternate fuel in the future.

KEYWORDS: Biodiesel, Tran-esterification, ASTM testing methods, Neem oil.

INTRODUCTION

Biodiesel extracted from various vegetable oils play a vital role today. Various vegetable oils including both the edible and non-edible oils have been serving as a promising source as an alternative fuel in the market. Biodiesel has numerous desirable fuel properties. It is intrinsically very low in sulphur and tends to be cleaner-burning than fossil diesel as well as reducing engine wear. Many modern vehicles can run on pure biodiesel (B100), but it is more commonly blended prior to sale in ratios up to about 30% v/v (B30). Dissolved in the solvent.Recent trends in the biodiesel have been involving the development and commercial fuel purpose.

Neem oil biodiesel will be a prominent alternative for the commercial fuels without doubt as it was available abundant in the environment at lower cost in the form of boifuel and as seeds. Oil extraction from the seeds doesn't require any major techniques and it is also quite easier. Once the oil was expelled from the seeds it has to be tested for the various properties and then it has to be trans-esterified. After trans-esterification we obtain the biodiesel which also be tested for the various properties. Those properties involve flash point fire point, pour point, cloud point, density, viscosity, calorific value, iodine value, saponification value and cetane number. After testing the properties that biodiesel can be tested on the engine with biodiesel blends with the diesel. Because of the property of the neem oil biodiesel it was not tested as straight vegetable oil in the engine. Biodiesel is one of the most promising alternative fuels to meet these problems. It is renewable, biodegradable, non toxic and has almost very close property to that of diesel fuel [1]. The process of esterification integrates chemical reactions and an external contribution of heat [2]. Muthu et al. [3]. The current trend focuses on search for an alternate fuel for the replacement of fossil fuels due to the increase in the price and environmental concerns [4]. Biodiesel gives also a shorter ignition delay than conventional diesel fuel, this and its higher content in oxygen lead to an increase of NOx emission and combustion efficiency [5]. Neem comprises mainly of triglycerides and large amounts of triterpenoid compounds. It contains four significant saturated fatty acids, of which two are palmitic acid and two are stearic acid. It also contains polyunsaturated fatty acids such as oleic acid and linoleic acids [6]. Transesterification (alcoholysis) is a chemical reaction between triglycerides present in the vegetable oils and primary alcohols in the presence of a catalyst to produce mono-esters (biodiesel) and glycerol [7]. The soyabean and the rapeseed biodiesels are generally used in USA and Europe respectively [8]. American Society

for Testing and Material (ASTM) define biodiesel as a fuel comprises of mono alkyl ester of long chain fatty acids derived from vegetable oil or animal fats [9]. In addition, it can be used in diesel engines alone, or blended with diesel oil [10].

MATERIALS AND METHODS

Extraction of the oil from the neem seeds was done with the oil expelling machine. Initially the seeds are dried for 48hours in the sunlight to remove the water content in the seed if present any. After removing the water content from the seeds they are expelled with the oil mill. A kilogram of the neem seeds can yield upto 400ml of the oil approximately. After extracting the oil, it was filtered or left for the settlement for a period of 24hours. Filtered oil was used for the trans-esterification process. Trans-esterification could be done depending upon the acid value of the oil. Acid value of the oil was tested with titration against the phenolphthalein. If the acid value was less than 2% then a single stage trans-esterification is sufficient. If it was more than 2% a double stage trans-esterification was mandatory. Hence acid value was tested for the biodiesel production and the test results showed 35% of acid value and the two stage trans-esterification was done.

Initially 1 liter of oil was preheated upto 100degree Celsius to remove any water present in the oil. After removing the water content 2% of H_2SO_4 was added and it was stirred constantly. After 30minutes 1:5 molar ratio of methanol was added, And the temperature was maintained at 60degree Celsius as the boiling point of the methanol was 65degree Celsius beyond which the methanol could be evacuated due to higher temperature. Hence the temperature was maintained constantly. Then 2% of KOH was added in v/v ratio to the oil. After 30minutes once again 1:5 molar ratio of methanol was once again added to the oil. The complete mixture was stirred constantly for 60minutes continuously and then left for settlement in a settling flask. After a settling period of 24-48hours two layers will be found in which the upper layer noted as biodiesel and the lower layer was glycerol which is a highly dense fluid. Biodiesel was separated from the glycerol and it was tested for various properties.

RESULTS AND DISCUSSION

Oil extraction from the neem seeds was done with the oil expeller. Expelled oil was tested for various properties. Table 1 shows the properties of the neem oil and comparision with the other oils.

Table1. Properties comparison of neem oil, Karanja oil and sesame oil.

PROPERTIES	NEEM OIL	KARANJA OIL	SESAME OIL
Density(Kg/m^3)@ 30°C	947.4	935.8	920
Kinematic viscosity (mm^2/sec)@ 40°C	36.7	35.8	32.5
Flash point(°C)	234	212.0	260
Fire point(°C)	249	224.0	284
Pour point(°C)	-5	-4	-3.9

The properties of the neem oil biodiesel was mentioned below with comparison with the Karanja and the sesame oil biodiesel and it was tabulated in the table 2. The properties were tested as per the ASTM standards in the laboratory and it was compared with neem oil methyl esters

Table 2. Properties comparison of Neem oil methyl ester with, Karanja and Sesame oil methyl ester

PROPERTIES	NEEM OIL METHYL ESTER	KARANJA OIL METHYL ESTER	SESAME OIL METHYL ESTER	DIESEL
Density(Kg/m^3)@ 30°C	876.7	797	870	835
Kinematic viscosity (mm^2/sec)@ 40°C	4.52	7	4.28	3.9
Flash point(°C)	168	97.8	162	56

Fire point(°C)	178	107.4	171	64
Pour point(°C)	6	-6	-9.5	7
Calorific value(KJ/Kg)	39197	37424	39049	43000

CONCLUSION

Thus the Neem oil methyl ester was found to be more suitable for the IC engines as fuel. It could replace the commercial fuels partially and when utilized properly, it can cut off the cost of commercial fuels. Properties of NOME obtained was compared with standard diesel and other biodiesel and found to be in ASTM Limits. Also that extraction of neem methyl ester from corresponding neem oil was done at high efficiency

REFERENCE

[1] E. Griffin Shay, Diesel fuel vegetable oils, Biomass Bioenergy 4(1993) 227–242.
[2] J. Prakash Maran, B. Priya ,Modeling of ultrasound assisted intensification of biodiesel production from neem (Azadirachta indica) oil using response surface methodology and artificial neural network. Fuel 143 (2015) 262–267.
[3] Muthu H, Sathya Selva bala V, Varathachary TK, Kirupha Selvaraj D, Nandagopal J, Subramanian S. Synthesis of biodiesel from neem oil using sulfated zirconia via transesterification. Braz J Chem Eng 2010;27:601-8.
[4] Azam MM, Waris A, Nahar NM. Prospects and potential of fatty acid methyl esters of some non-traditional seed oils for use as biodiesel in India. Biomass Bioenergy 2005;29:293-302.
[5] Demirbas A. Progress and recent trends in biodiesel fuels. Energy Conversion Manage 2009;50:14–34.
[6] Muthu 1, V. SathyaSelvabala 1, T. K. Varathachary2, D. Kirupha Selvaraj 1, J. Nandagopal 2 and S. Subramanian 1 'synthesis of biodiesel from neem oilusing sulfated zirconia via tranesterification.
[7] F. Ma, A.H. Milford, Biodiesel production: a review, Bioresource Technology 70 (1999) 1–15.
[8] Palit S, Chowdhuri AK, Mandal BK, Environmental impact of using biodiesel as fuel in transportation: are view. Int J Glob Warm 2011; 3(3):232–56.
[9] Ghesti GF, Maccdo JLD, Resck IS, Dias JA, Dias SCL. FT-Raman spectroscopy quantification of biodiesel in a progressive soybean oil transesterification reaction and its correlation with 1H NMR spectroscopy methods. Energy Fuels 2007;21:24: 76-80.
[10] Knothe G, Dunn OR, Bagby OM. The use of vegetable oils and their derivatives as alternative diesel fuels. 1st ed. 1997. New York.
[11] Ayissi Zacharie Merlin a,n, Obounou Akong Marcel , Ayina Ohandja Louis Max, Chabira Salem , Gerard Jean . Development and experimental investigation of a biodiesel from a non-edible woody plant: The Neem ,Renewable and Sustainable Energy Reviews 52 (2015)201–208
[12] J. Prakash Maran , B. Priya . Modeling of ultrasound assisted intensification of biodiesel production from neem (Azadirachta indica) oil using response surface methodology and artificial neural network, Fuel 143 (2015) 262–267.
[13] Eriola Betiku, Oluwasesan Ropo Omilakin, Sheriff Olalekan Ajala, Adebisi Aminat Okeleye, Abiola Ezekiel Taiwo, Bamidele Ogbe Solomon. Mathematical modeling and process parameters optimization studies by artificial neural network and response surface methodology: A case of non-edible neem (Azadirachta indica) seed oil biodiesel synthesis, Energy xxx (2014) 1-8.
[14] Claude Valery Ngayihi Abbe , Robert Nzengwa , Raidandi Danwe , Zacharie Merlin Ayissi , Marcel Obonou. A study on the 0D phenomenological model for diesel engine simulation: Application to combustion of Neem methyl ester biodiesel, Energy Conversion and Management 89 (2015) 568–576 .
[15] Md. Hasan Alia, Mohammad Mashud, Md. Rowsonozzaman Rubelb, Rakibul Hossain Ahmad. Biodiesel from Neem oil as an alternative fuel for Diesel engine, Procedia Engineering 56 (2013) 625 – 630.
[16] Mohammed Takase, TingZhao, MinZhang, YaoChen, Hongyang Liu , Liuqing Yang , Xiangyang. An expatiate review of neem, jatropha, rubber and karanja as multipurpose non-edible biodiesel resources and comparison of their fuel, engine and emission properties, Renewable and Sustainable Energy Reviews 43 (2015) 495–520.

[17] Atul Dhar, Roblet Kevin, Avinash Kumar Agarwal. Production of biodiesel from high-FFA neem oil and its performance, emission and combustion characterization in a single cylinder DICI engine, Fuel Processing Technology 97 (2012) 118–129 .
[18] Ambarish Datta n, Bijan Kumar Mandal. A comprehensive review of biodiesel as an alternative fuel for compression ignition engine. Renewable and Sustainable Energy Reviews 57 (2016) 799–821.
[19] C.N. Anyanwu, C.C. Mbajiorgu, C.N. Ibeto, P.M. Ejikeme. Effect of reaction temperature and time on neem methyl ester yield in a batch reactor, Energy Conversion and Management 74 (2013) 81–87.
[20] Mazloom Shah , Muhammad Tariq , Saqib Ali , Qing-Xiang Guo , Yao Fu, Transesterification of jojoba oil, sunflower oil, neem oil, rocket seed oil and linseed oil by tin catalysts, biomass and bioenergy xxx (2 0 1 4) 1-5.
[21] G. Balaji, M. Cheralathan. Experimental investigation of antioxidant effect on oxidation stability and emissions in a methyl ester of neem oil fueled DI diesel engine, Renewable Energy 74 (2015) 910-916.
[22] Vasanthakumar Sathya Selvabala, Thiruvengadaravi Kadathur Varathachary , Dinesh Kirupha Selvaraj, Vijayalakshmi Ponnusamy, Sivanesan Subramanian, Removal of free fatty acid in Azadirachta indica (Neem) seed oil using phosphoric acid modified mordenite for biodiesel production, Bioresource Technology 101 (2010) 5897–5902.
[23] ShivKumarLohan, T. Ramb, S. Mukesh, M. Ali, S. Arya. Sustainability of biodiesel production as vehicular fuel in Indian perspective, Renewable and Sustainable Energy Reviews 25 (2013) 251–259.