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Production and Characterisation of Bio-Diesel from Neem Oil Production and Characterization of Bio-Diesel from Neem Oil: A Review

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Abstract—*The Biodiesel sources are classified as Edible and Non-Edible oils. Neem oil is a non-edible oil and have great potential for being a source for biodiesel. Biodiesel is defined as mono alkyl ester of long chain fatty acids. In this paper, the production and characterization of Biodiesel extracted from Neem oil is discussed. The bio-fuel is an alternative source of energy which is produced from edible or non-edible vegetables oils. It can not only improve the economy but it has very big significance on environment. The bio-diesel is totally biodegradable and it is safe. When biodiesel fuel was used, it was also revealed that the chemical characteristics reduced the levels of toxic and reactive hydrocarbon species. Rapid increase in fuel price is also a big issue for developing countries like India which import 70% of its demand. Depletion of fossil fuel make scientists and government to think an alternative way through which problem of energy crisis may resolved and they have started working on renewable resources of energy like solar energy , wind energy, hydro power etc. , but it is clear that it is even more feasible to strengthen energy security using domestic non-edible oils. Economic benefits include enormous benefits of employment opportunities in support to agriculture sector, plantation and processing. Neem grows in eroded soil and is known as a living plant requiring only a hot weather and less water to survive. Neem is basically used for medicinal purposes and it can produce a large amount of waste (used) and can be converted to biodiesel. Generally. A country like India, which has a huge amount of Neem tree, requires little plantation. This is a strong reason tostrengthen the development of biodiesel plants.*

1. INTRODUCTION

The bio-fuel is an alternative fuel or source of energy which is produced from edible or non-edible vegetables oils. It can not only improve the economy but it has very big significance on environment. The emission of CO_2, CO, THC and PM is reduced by a great percentage. The bio-diesel is totally biodegradable and it is safe. It is also consider as better lubricant. When biodiesel fuel was used, it was also revealed that the chemical characteristics reduced the levels of toxic and reactive hydrocarbon species. Rapid increase in fuel price is also a big issue for developing countries like India which import 70% of its demand. depletion of fossil fuel make scientists and government to think an alternative way through which problem of energy crisis may resolved and they have started working on renewable resources of energy like solar energy , wind energy, hydro power etc. , but it is clear that it is even more feasible to strengthen energy security using domestic non-edible oils. Economic benefits include enormous benefits of employment opportunities in support to agriculture sector, plantation and processing. Neem grows in eroded soil and is known as a living plant requiring only a hot weather and less water to survive. Neem is basically used for medicinal purposes, the demand for herbal medicine is very high. It can produce a large amount of waste (used) and can be converted to biodiesel. Generally. A country like India, which has a huge amount of Neem tree, requires little plantation. This is a strong reason to strengthen the development of biodiesel plants.

2. PURPOSE OF USING BIO-FUELS

Biofuel is not only a relief for polluted environment but also for the economy who invest a large amount to the import of fossil fuel. Only 5% blending of biodiesel saves 800 million INR.As soon as the level of fossil fuel depleted. A stressed is induces to the Government and scientist and it motivates them to work on renewable resources of energy. Biodiesel is a clean and green energy source. Using biodiesel as an alternative of diesel reduces the emission of toxic gases to environment. .The transportation of biodiesel is also self. But it is an irony that the developing country like India who needs alternative resource of fossil fuel more than any other country imports biodiesel more than any other country in spite of agriculture based economy. India has good resources which basically our main motive to use those crude plant which is converted to bio-fuel in a simplest way and to find mechanism which is not sophisticated. Our one other intention is to increase the proportion ofbio-fuel into fossil fuel .We found that there is a great chance to work on Neem oil for its conversion into bio-fuel since there is not lot of research taken place on this. [1]

3. INTRODUCTION OF NEEM

Scientific Name –Azadirachta Indica

Family-Meliaceae

Also known as Neemtree and Indian Lilac.[2]

Seeds of Neem having or containing of 15-30% oil.

Source of renewable energy.

Decrease environment pollution.

Alternative fuel which is abundantly available, biodegradable and environment friendly.

Oil is light to dark brown, strong odor and bitter.[3]

It is found in India and also in Indian subcontinent or neighboring countries like Bangladesh, Nepal, Srilanka, Pakistan of which it is mostly or largely grown in Bangladesh.Their seeds and fruits are the major source of Neem oil.It is grown in various tropical and semi-tropical regions.Also found in southern part of Iran.[4]

The trees of Neem are growing fast which reaches to (15-20) meters and about (50-60)feet tall , also sometimes (35-40)meters , (115-132)feet .It is evergreen and lots of domestic and medicinal advantages.In country like India it occurs throughout the country and can grow very well in agricultural fields or their climatic zones except in cold regions and sites of Dam .Farmers are practicing of planting these trees to meet their local demands for fodder, timber, fuelwood, and also for medical purposes.It is highly grown from the southern tip of Kerala state to Himalayan regions.In the states of Uttar Pradesh, Bihar , WestBengal, Delhi, Orissa, Gujarat, Andhra Pradesh, Maharashtra, TamilNadu, and Madhya Pradesh.It becomes leaf-less for very short period in Feb-march.[5]

4. CHARACTERISTICS OF NEEM OIL

The characteristics of a non-edible biodiesel depend on the type of starting material, their chemical compositions, and the fatty acid compositions that affect the engine performance and the emission. The physicochemical properties of Neem oil are summarized and are explained below. The color of the Neem seeds is light to dark brown, while the color of the Neem oil is dark green. The taste is bitter and it has a very strong odour. Neem oil consists of saturated and unsaturated fatty acids. Fatty acid plays an important role in the determination of properties (chemical and physical properties) .One oil consist of triglycerides. It consists of a large amount of triterpenoids, which is the reason by which the taste of Neem is bitter. Well after looking of all physicochemical properties Neem oil is one of the most suitable oil for biodiesel. [6]

Density - These physical properties, which are used to calculate the exact amount of fuel required for sufficient combustion. Neem oil are denser and less compressible. The density of azadirachta Indica is 912-965 kg / m ^ 3, which is higher than jatropha, rubber oil and karanja oil.

Flame point - The flame point of the Neem oil is 34 to 285 degrees. The firing point of Neem oil is lower than jatropha and gum seed oil. Flash point is a temperature at which biodiesel ignites when exposed to flames and sparks. Normally, biodiesel has a higher firing point than diesel.

Cetane number (CN) - The Cetane number of the Neem oil is 51, which is higher than rubber oil and lower than Karanja oil and somehow equal jatropha. Higher CN indicates a shorter ignition delay which is a shorter time between ignition and injection of the fuel injection.

Viscosity - The viscosity of Neem oil is 20.5-48.5 mm ^ 2 / s. Neem oil has a very high viscosity, which is higher than the other oil. Viscosity is the ability of the material to flow. It affects the fuel injection and the spray automation.

Heating value - Neem oil has a moderate calorific value. It is 33.7-39.5 j / kg at. [7]

5. BIODIESEL PRODUCTION METHODS

The present study is based on biodiesel production, which consists of the reaction in which one ester reacts with alcohol to form another ester and another alcohol. Esters here are vegetable oil (Neem oil), which consists of triglyceride. There are four possibilities to use cultivated oils in the diesel engine [10-13]:Direct use or mixing in diesel fuel, Micro-emulsions in diesel fuel, Thermal cracking of vegetable oils, Trans-esterification.

From the four methods, trans-esterification is the most popular and best way to use regular vegetable oils [14]. It was carried out as early as 1853 by the scientists E. Duffy and J. Patrick, many years before the first diesel engine became functional [14]. For the production of soaps, this process was developed in the 1940s to improve the separation of glycerol [16]. Acid catalyst is used for the esterification and the alkali catalyst (KOH

Table 1: Properties

Properties	Diesel	NOME (100%)	B20	B30
Viscosity *@25* ℃	6.8	8.8	7.2	7.4
Density(g/cc) *@25* ℃	0.85	0.82	0.844	0.841
Heating Value(MJ/kg)	43	40	42.4	42.1
Cetane no.	49	51	49.4	49.6
Flash point(℃)	70	125	81	87
Fire point(℃)	76	130	87	92
Carbon mass(wt.%)	86.8	76.7	-	-
Hydrogen(wt.%)	13.1	12.1	-	-
Oxygen wt.	0.00	11.15	-	-
C/H ratio	6.63	6.63	-	-

or Noah) has been used for the trans-esterification reaction. The formation of methyl esters by trans-esterification of vegetable oil requires crude oil, 15% methanol and 5% sodium hydroxide on a mass basis. On a mole basis, one mole-glyceride reacts with three mole-methanol in the presence of a catalyst (KOH or Noah) to produce methyl esters. A temperature of 55-65 ° C. is required for the equilibrium state of the reaction. In most cases, the temperature is maintained below the normal boiling point of the methanol (65 ° C) so that the reactor does not need to be pressurized. First, to achieve the equilibrium conditions at a temperature of 55-65 ° C. Secondly, the product mixture was continuously stimulated for glycerol separation and allowed to settle under a gravity in a separator funnel [3, 16]. Two different layers form after the abbreviation for 24 hours. The upper layer was ester and the lower layer was glycerin. The lower layer was separated. The separated ester contains 3% to 6% methanol and usually some soap. If the soap gap is low enough (300 to 500 ppm), the methanol can be removed by evaporation and this methanol will usually be dry enough to return directly to the reaction. After removal of methanol, the biodiesel must be washed to remove residual free glycerin, methanol, soap and catalyst. It is often prior to creating emulsion of impurities itself. Biodiesel was treated with slightly warm water (about 10% volume ester)to remove the catalyst present in ester and allowed to settle under gravity for another 24h. The catalyst gets dissolved in water, which is separated and removed the moisture. The washing process is usually done multiple times until the wash water no longer picks up soap.[8]

6. LITERATURE REVIEW

It is verified that petroleum fuels dwindling quickly and environmentallyfriendly renewable replacements must be identified. In recent years, serious efforts have been made by several researchers to use different oils as fuel in existing diesel engines. It will check the current status of vegetable oils. As a possible replacement for diesel fuel from Peterson in 2006. [10] It has been reported in the literature that from various methods to reduce viscosity, trans-esterification is one of the most reliable and most common techniques for producing biodiesel from oil is seed from Ma Hanna a year 1999. [11] The impact of process variables on the acid-catalyst trans-esterification of soybean oil from Canakci and Gerpen in 1999 was investigated. [12] Various parameters of the final product of Sarin R were determined in 2007 [13]. [13] Various ways to reduce the viscosity of vegetable oils such as dilution, pyrolysis of Alencar JW and Billaud F in 2007 [14, 15], micro-emulsification by Schwab in 2007 [16] and trans-esterification.Treaty methods of trans-esterification with alkalis And acids as catalysts [17, 18, 19] and enzymatic trans-esterification with lipases both in the presence and in the absence of solvents were reported [20, 21, 22] in 2007. The results obtained show a good agreement with previous work, in which the maximum conversion of Saka S in 2007 was achieved. [23] It was estimated that some other vegetable and forest-derived oils in 2007 have a strong production potential of Agarwal AK. [24] Murayama et al. [25] evaluated waste vegetable oils as a raw material for biodiesel production. Eliminate the significant improvement in engine performance and emission characteristics for the biologically-powered engine compared to aero-engine powered diesel engine in 2007. [26, 27] Policy document states that biofuels in 2006 are an efficient, environmentally friendly and 100% natural energy alternative to petroleum fuels. [28] The properties of vegetable oils are investigated by Barnwal BK in 2007. [29] Methanol is preferred to others because of its low cost of Ramadhas AS in 2008. [30] The high-quality and low-cost bio diesel was received by Xu in 2008. [31] The use of heterogeneous catalyst, CaO, was tested by Grandos in 2008. [32]It was investigated the performance characteristics of neem methyl ester in single-four-act Kirloskar engine and it was found that BTE of B10 and B20 mixtures of Karmakae in 2009. [33] Tests with a diesel engine with low heat dissipation from Prasad a year 2010. [34] The performance of a diesel engine is evaluated with plant oils and methylesters from Rao & Goapalkrishnan in2010. [35] The tests are carried out on a single cylinder with constant diesel engine from Bajpai in 2010. [36] The tests are conducted using pure pole oil and its blends with petroleum diesel on a single cylinder four-stroke air-cooled diesel engine from Devan & Mahalakhmi in 2010. [37] Trans-esterification has been widely used to reduce the viscosity of triglycerides from Barnwal & Sharma in 2010. [38, 39] The engine performance and its characteristics are examined by Agarwal in 2010. [40] The abilities of lipases in the trans-esterification with short-chain alcohols to alkyl esters were investigated by Nelson in 2010. [41] The use of sunflower oil as a renewable energy source has been investigated by Bruwer in2010. [42] The biodiesel production of neem is very profitable in 2012 by Ganapathi. [43] The study carried out the production of biodiesel from non-edible neem oil as a viable alternative to Sekhar's diesel fuel in 2012. [44] SathyaSelvabela esterified free fatty acids in neem oil with a modified phosphoric acid-modified catalyst in 2012. [45] Aims to reduce costs, organized plantation and systematic collection of neem oil, the potential bio-diesel substitutes will reduce the import burden of crude oil.

7. FUTURE SCOPE

As soon as the pollution and green-house effect is increasing rapidly and there is a sharp deduction in the storage of fossil fuel the focuses of government and scientists are increased on renewable sources of energy. Biodiesel is one of the renewable resource of energy which is not only advanced but a need of present and future generations. Indian biodiesel association aimed that till 2017 the blending percentage of biodiesel in fossil fuel would increase from 5% to 20% but not a 1% has achieved yet. But the current Indian government

is very focused on green energy and they are forcing the biodiesel sector to rise in India Jatropha is considered as main feedstock of biodiesel but it is too costly the production cost of

biodiesel produced from jatropha is three times the price of diesel. As for as NOME is concerned if the waste Neem oil is considerd as the feedstock it would be most economical feedstock. A very large amount of waste Neem oil is simply wasted due to less awareness. India needs thousands gallon of biodiesel which do not fulfill by Indian biodiesel market due to high production cost. The 5% blending of biodiesel saves 800 crores rupees of India just think if India achieve her objective of 20% blending a big stress can be remove from Indian economy.

8. CONCLUSION

Well if you compare Neem oil with other bio-diesel feedstock oil then Neem oil could be proved a better feedstock because BTE and BSEC of B20 and B30 is severally close to Diesel. The LCV of NOME is evaluated to 38.7which is only 7.46% lower than that of diesel .The Biodiesel produced from Neem oil is one of those biodiesel which after blending , There is sharp reduction in NOx emission. Well the high viscosity of NOME is a disadvantages but it provide a good lubricating property. The emission characteristics of blending of biodiesel produced from Neem oil is better than other biodiesel blending. It is also suggested that the enzyme and heterogeneous catalyst would perform better in trans-esterification process. The stability of NOME is moderate comparatively other biodiesel. The physic-chemical properties of biodiesel is much closer to diesel. Hence NOME could be proved a good alternative of biodiesel.

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