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Preparation of Biodiesel from Crude Karanja Oil by Using KOH Catalyst

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Abstract: Biodiesel was prepared from the crude karanja oil followed by the transesterification process of the oil with methanol in the presence of KOH as catalyst. The molecular weight of the crude oil was determined and found to be 892.7. Both the acid as well as alkaline esterification was subsequently performed to get the final product. Maximum yield of 88% was achieved at 8:1 molar ratio for acid esterification and 9:1 molar ratio for alkaline esterification, 0.5wt% catalyst KOH using mechanical stirrer. Important fuel properties of methyl esters of biodiesel produced from karanja oil like viscosity, flash point, calorific value and ash content was found out and compared to the properties of ASTM.

I. INTRODUCTION

Fossil fuels are one of the major sources of energy in the world due to its easy usability, availability and cost effectiveness. The reserves of fossil fuel are limited but their consumption is higher. Fossil fuels are the essential source of atmospheric pollution in the world today. So efforts are making to find alternative source for this depleting energy source (Singh et al., 2011). New invention have made like solar, wind or tidal energy source but they are not affordable to everyone because they are expensive. So efforts are being made to find the similar sources of energy to the present day fuel so that they can be used as direct substitutes (Bobade et al., 2012). Diesel fuel as a source of energy plays an important role in the transport sector. Vegetables oils and diesel fuel have closer properties so it can be used in diesel engine. It is being considered a research because of existence of various types of oil seeds in huge quantities. Vegetable oil are renewable in nature and these are used on large scale it may generates opportunity for rural employment (Surendra et al., 2008). Various types of crops have been evaluated in many parts of the world such as peanut, sunflower, soybean, rape, coconut, karanja, neem, cotton, mustard, jatropha, linseed and castor which are used for making vegetable oils (Sahoo and Das, 2009). Preference has been given to non-edible oils because they do not effect on food reserves. Karanja is an oil seed-bearing tree, which is non-edible and does not find any other suitable application due to its dark color and odour. Its seeds containing 30-40% oil and considered as alternative source for biodiesel (Thiruvengadaravi et al., 2012). It is a legume tree that grows to about 15–25 meters (15–80 feet) in height with a large canopy which spreads equally wide. It may be deciduous for short periods. The leaves are soft, shiny burgundy in early summer and mature to a glossy, deep green as the season progresses. Flowering starts in general after 3–4 years. The tree is well suited to intense heat and sunlight (Mammilla et al., 2008). The most common way to produce biodiesel is by transesterification of the oils with an alcohol in the presence of an alkaline catalyst. It is a low temperature and low pressure reaction. It is a direct conversion to biodiesel with no intermediate compounds (Sharma et al., 2010). The main factors affecting transesterification are the amount of the catalyst, alcohol, reaction temperature, pressure, free fatty acid and water in oils (Gopal et al., 2012). Karanja oil is composed of the following fatty acids listed in Table 1.

TABLE I (Panigrahi et al., 2014)

S.No	Fatty Acid	%
1	Palmitic	3.7-7.9
2	Stearic	2.4-8.9
3	Oleic	44.5-71.3
4	Linoleic	10.8-18.3
5	Lignoceric	1.1-3.5
6	Eicosenoic	9.5-12.4
7	Arachidic	2.2-4.7
8	Behenic	4.2-5.3

II. MATERIAL AND METHODS FOR BIODIESEL PRODUCTION

Biodiesel is produce by acid esterification follow by base transesterification process due to high FFA

concentration in the karanja oil. Use H_2SO_4 as a catalyst for acid esterification. Methanol and KOH is use as a catalyst for base transesterification

.Instead of methanol and KOH, ethanol and NaOH can also be used for making biodiesel. The crude karanja is extract mechanically with a crushing machine from which a maximum of 31% oil is extract. (Eijick *et al.*, 2009) reported that a maximum of 33% oil was extracted from jatropha seed using a screw press. A systematic of the experimental setup is used for the production of biodiesel is shown in figure 1. The experimental setup consist of a magnetic stirrer with hot plate, beaker, separating funnel, measuring cylinder, flask and washing unit. The crude karanja oil is put in a beaker and heat at a $65-70^\circ\text{C}$. A magnetic stirrer with hot plate is used for heating the oil. A temperature measuring device i.e. thermometer is dipped in the solution for continuous temperature measurement. Separating funnel is used to separate the glycerol and other impurities from biodiesel.

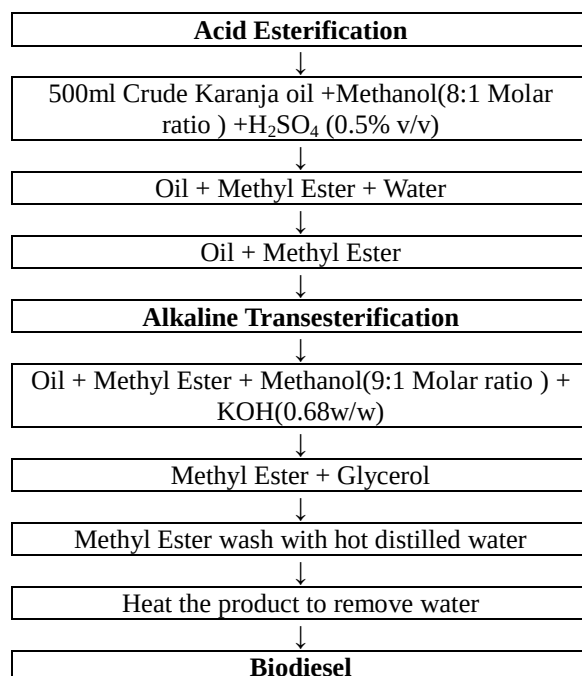
III. ACID ESTERIFICATION

Heat the crude karanja oil to remove excess moisture. The molecular weight of the oil is to be 892.7. The density of the crude karanja oil is to be 0.90kg/l . The acid value of the oil is calculate by titration with KOH and find to be 12.06 mg KOH/g . Researcher have suggested that to reduce the acid value of vegetable oil to less than 6mg KOH/g for alkaline esterification to take place and for better yield . The acid esterification with $1\text{ml H}_2\text{SO}_4$ (0.5% volume of 100ml of oil taken) at 58°C for 30 min at $8:1$ (methanol to oil) molar ratio reduce the acid value of the product from 12.11mg KOH/g to 5.16mg KOH/g . A magnetic stirrer with hot plate is used for heating and mixing the oil and methanol at $400-500\text{ rpm}$. After completion of the reaction the product is transfer to the separating funnel for removal of the excess alcohol with impurities.

IV. ALKALINE TRANSESTERIFICATION

The product of acid esterification is preheat at a 60°C . KOH (0.68wt%) is dissolve as a catalyst in methanol with $9:1$ (methanol to oil) molar ratio is heating and stirring on magnetic stirrer cum hot plate for 30min . After completion of the reaction the product is transfer to the separating funnel and allowed to settle down overnight. The upper layer contains karanja oil methyl ester and the lower layer contains glycerol and impurities. Remove the lower layer and pick the upper layer for washing with hot distilled water to remove soap and catalyst. The yield of 88% is obtained. Density of the product is 0.860kg/l . The acid value reduced to 0.67 mg KOH/g . The viscosity of the KOME is 6.2 centistokes at 40°C .

Figure 1



V. RESULT AND DISCUSSION

The fuel properties of karanja oil and diesel are shown in Table 2. The kinematic viscosity of karanja oil at 40°C is more than diesel fuel. The calorific value of the karanja fuel is less than diesel fuel .The flash point of karanja fuel is more than diesel fuel. Due to high flash point storing and handling of karanja fuel is safe and easy .The difference in properties for different vegetable oils is due to variation of fatty acid composition and other

associated compounds such colouring matters, odorant compounds etc.

TABLE 2

Properties	Karanja Biodiesel	Diesel
Viscosity(at 40 °C)	6.2	3.8
Density kg/m ³	.860	.830
Sulphated ash content	-	.001
Specific gravity	.87	.85
Calorific value (KJ/kg)	40840	42800
Flash point	235	56

VI. CONCLUSION

Biodiesel is produced from non-edible crude karanja oil by using base catalysed trans-esterification process. By using KOH catalyst a conversion of 88% is achieved at 58 °C. The fuel properties like viscosity, density, flash point and calorific value of the biodiesel compare well with accepted biodiesel standard i.e. ASTM. Biodiesel can be used as an alternate and non-conventional fuel to run all types of CI engines without engine modification. Karanja is easily available in many parts of the world including India and it is cheaper compared to edible oils.

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