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Honne Oil Biodiesel Production – Comparison of Transesterification and Thermal Cracking Methods

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ABSTRACT

The world is confronted with serious problems like the fossil fuel depletion and environmental degradation. Fossil fuels in near future will become rare due to its indiscriminate extraction and consumption. Therefore, biodiesel is considered as a promising option as they are clean renewable fuels and best substitute for diesel fuel in any compression ignition engine. There is a best source as a raw material that is calophyllum inophyllum (honne) oil for biodiesel production. As the oil yield of various oil sources for biodiesel feedstock Palm oil has potential of high productivity about 5950 liters per hectare, and followed by honne oil which have productivity of about 4500 liters per hectare. Our study is focused on the production of biodiesel by tranesterification and by thermal cracking and comparing the properties of these.

Keywords : Biodiesel, Honne Oil, Transesterification, Thermal Cracking, Physio-Chemical Properties, CI Engine

I. INTRODUCTION

The continuous rise in global prices of crude oil, increasing threat to environment due to exhaust emissions, the problem of global warming and the threat of supply fuel oil instabilities have adversely impacted the developing countries, more so to the petroleum importing countries like India. From the point of view of long term energy security, it is necessary to develop alternative fuels with properties comparable to petroleum based fuels.

Among the many alternative to minimize the fossil fuel dependency, like, the air engine is an emission-free piston engine that uses compressed air as a source of energy, Battery Electric Vehicles (BEVs), also known as All-Electric Vehicles (AEVs), are electric vehicles whose main energy storage is in the chemical energy of batteries, A solar car is an electric vehicle powered by solar energy obtained from solar panels on the car, Ammonia motors, using ammonia as a working fluid, The principle is similar to that used in a fireless locomotive, but with ammonia as the working fluid, instead of steam or compressed air, Biodiesel are considered as a most desirable fuel extender and fuel additive due to its high oxygen content and renewable in nature. Alternative fuel termed as Biodiesel is obtained from non-edible oil seeds, vegetable oil, and Animal fats., and can be grown and produced domestically.

It can be directly used in the compression ignition engine. Biodiesel fuel is a clean burning alternative fuel that comes from 100% renewable resources. Many people believe that Biodiesel is the fuel of the future. Sometimes it is also known as Bio-fuel. Biodiesel does not contain petroleum, but petroleum can be mixed to produce a biodiesel blend that can be used in many different vehicles. Pure biodiesel fuel though, can only be used in diesel engines. Biodiesel is biodegradable and non-toxic.

Problem Statement

The biodiesel can be produced by the various methods, like Blending, Transesterification, Micro emulsion, Pyrolysis or thermal cracking etc. There has been plenty of research done so far on emissions testing and biodiesel production.

The problem statement for the present work is, the research has been lacking in relation to the better characterization of the performance of these fuels, which produce by different method may may give different characteristic of performance due to varying properties of biodiesel depending on production method. \

Objective

The objectives of this work is,

- To produce biodiesel from hone oil by trans esterification method
- To produce biodiesel from hone oil by thermal cracking method
- To compare the physio-chemical properties of biodiesel and identify the best method of biodiesel production.

II. METHODS AND MATERIAL

The Feed Stock used to produced biodiesel is hone oil Tree It is a broad leaved evergreen tree occurring as a littoral species along the beach crests, although sometimes occurring inland and adjacent lowland forest. It has been widely planted throughout the tropics and is naturalized in the main Hawaiian Islands. The tree is valued for its hardiness and beauty as an ornamental tree. Oil from the nuts has been traditionally used for medicine and cosmetics and is today being produced commercially in the South Pacific. The tree grows best in direct sunlight, but grows slowly. Annual yield of 20-100 kg/tree of whole fruits have been reported. Trees begin to bear significantly after 4-5 years. The nut kernel contains 50-70% oil.

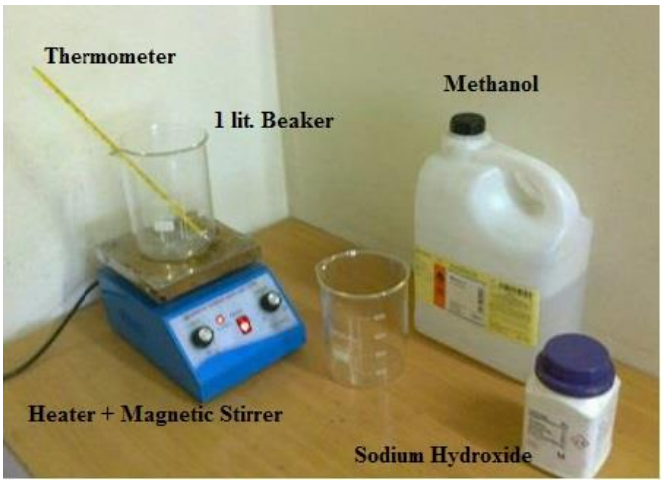
TRANSESTERIFICATION METHOD

Honne oil methyl ester is produced by chemically reacting honne oil with an alcohol (methyl), in the presence of catalyst Sodium Hydroxide. A two stage process is used for the trans esterification of honne oil.

The first stage of the process is to reduce the free fatty acids content in oil by esterification with methanol and acid catalyst sulfuric acid in one hour time at 57 °C in a closed reactor vessel. The oil is first heated to 50 °C then 0.7% by weight of oil sulfuric acid is to be added to oil and methyl alcohol about 1:6 molar ratio is added. Methyl alcohol is added in excess amount to speed up the reaction. This reaction was proceeding with stirring at 650 rpm and temperature was controlled at 55-57 °C for 90 min. The fatty ester is separated after natural cooling.

At second level, the separated oil from the separating funnel has to undergo transesterification. Methanol & sodium hydroxide is added with the above ester and heated to 65°C. The same temperature is maintained for 2 h with continuous stirring, and then, it undergoes natural cooling for 8 h. Glycerol will deposit at the bottom of the flask, and it is separated out by a separating funnel. The remnants in the flask are the biodiesel. The separated biodiesel from the above-mentioned method contains various impurities like traces of glycerol, unused methanol, soap particles, etc. Water washing is carried out to remove all impurities. Air bubble wash is one of the methods normally recommended in the laboratory level. In this method, the impure biodiesel is placed in a beaker initially. Water is added slowly through the side wall of the beaker (both are immiscible). It is ensured that the equal amount of water is added above the level of biodiesel. Air is made to pass through the biodiesel and the water from the bottom of the beaker with the help of a bubbler (electrically operated).

The air will then take away all impurities from the biodiesel; they will move up as the bubbles move up, and they are added in the water. The unused methanol will be diluted in water. The traces of glycerol and soap particles make the water to become like soap water. Once the water becomes like soap water, the bubbler is stopped. After allowing some time for impurities to settle, the biodiesel is drained from the separating funnel.

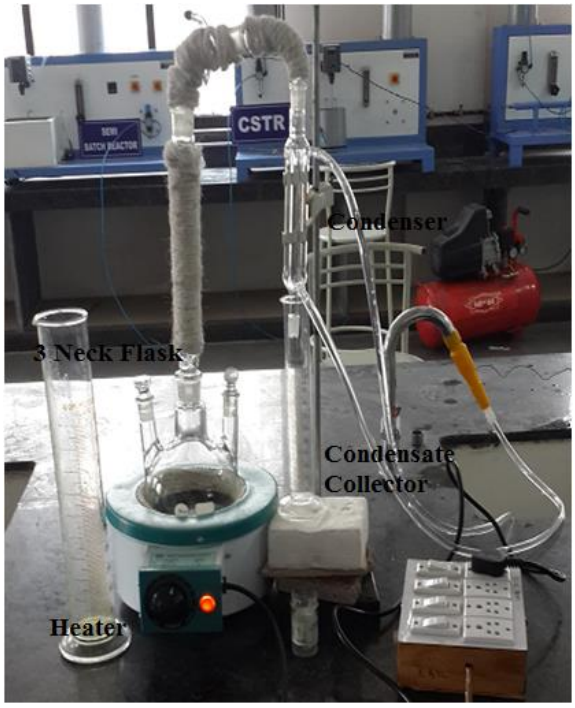


THERMAL CRACKING METHOD

Cracking is the process of conversion of one substance into another by means of heat or with the aid of catalysts. It involves heating in the absence of air or oxygen and cleavage of chemical bonds to yield small molecules. The pyrolyzed material can be vegetable oils, animal fats, natural fatty acids and methyl esters of fatty acids. The Pyrolysis of fats has been investigated for more than 100 years, especially in those areas of the world that lack deposits of petroleum.

Thermal cracking involves the breaking of C-C bonds in alkenes, converts heavy fractions into higher value products, thermal proceeds via a free radical mechanism, catalytic proceeds via a carbonation (carbonium ion) mechanism.

The honne oil is pour into the 3-neck flask and it is heated about 550°C, the fumes evolved are condensed in condenser, the condensate is collected in to the open flask. The uncondensed gases are escape to atmosphere, and the condensate form a two layer in flask, the bottom layer of glycerol and top layer is of biodiesel. The biodiesel is separated from glycerol and may used directly or as blend with the diesel.



III. RESULTS AND DISCUSSION

Diesel, Honne Oil and Biodiesel by the method of transesterification and thermal cracking are tested for their properties as per the standards IS-1448, the test result tabulated as below,

PHYSICO-CHEMICAL PROPERTIES

Parameter	Test Method	Diesel	Raw Honne Oil	Biodiesel by Transesterification	Biodiesel by Thermal Cracking
Density at 15°C (Kg/m^3)	IS 1448 (P16) 2007	835	936.3	865.3	760
Kinematic Viscosity at 40°C (cst)	IS 1448 (P25) 2007	3.5	51.58	1.744	4.3
Calorific Value (MJ/Kg)	IS 1448 (P6) 2007	43.00	40.27	25.36	38.73
Flash Point °C	IS 1448 (P69) 2013	44	220	8.5	52

IV. CONCLUSION

The conclusion of present work is,

1. Successfully biodiesel is prepared from the Honne Oil by trans esterification and thermal cracking processes.
2. The properties of biodiesel produces by both the methods approximately match the properties of diesel fuel, so that we can use it in replacement of diesel.
3. The property of raw Honne oil shows the closest calorific value to diesel, but its direct used is not possible due to major problem of its higher viscosity.
4. Among both the method, calorific value of biodiesel produced by thermal cracking gives higher value, thus for better performance of engine, thermal cracking method is best.
5. Other properties of thermal cracked biodiesel match the diesel more closely than transesterified biodiesel.
6. Hence it is conclude that the thermal cracking method for biodiesel of honne oil is best situated

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BIOGRAPHIES

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