

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

Experimental Analysis of Bio Oil under Transestrification Process by Using Babool Tree Seeds

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ABSTRACT: Nowadays due to the increase in population of vehicle, more amount of fuel is needed. Due to this fact the alternative fuels are needed in the future. In India where fossil fuel resources are very limited, the production and use of biodiesel from vegetable oils and fats may be a feasible solution for supplementing the ever growing demand of diesel in the country. However while selecting the sources of triglycerides for biodiesel production, special attention must be given to utilize the indigenous non-edible oils. In the forests of India, of the south in particular, a large variety of oilseeds bearing trees and shrub species grow well in their natural habitats. The seeds of some of such trees are not normally used for any purpose, productive or otherwise. While searching for oil seeds attracted by babool tree which produces seeds. With a view of utilizing the seeds, it is converted to oil then it make as biodiesel and to examine the feasibility of using them as a fuel for diesel engine.

In this work concentrates on developing an alternative fuel using the babool tree seeds. (*Prosopis juliflora*). The oil taken from babool tree seeds and undergone a various testing to find out its properties. This study helps the babool tree can be used as a source of biodiesel and used in blends with optimum proportion.

KEYWORDS: Biodiesel, Transesterification, Blending, VCR Engine.

I. INTRODUCTION

Since the last decade of last century, biodiesel or methyl esters have become more attractive because of its environmental benefits and the fact that is made from renewable resources. [1]G.Sucharitha, A.Kumaraswamy In a review article, pinto analysed the importance of biodiesel production based on scientific articles and patents of the total number of species with oil producing seeds, 63 belonging to 30 plant families hold promise for biodiesel production. [2] T. Sathya, A. Manivannan Rapeseed-oil-methyl ester was the first type of biodiesel fuel produced commercially, characterized as a single feedstock of then questionable quality. Recent developments have made biodiesel commercially interesting in view of research potential and possibility of improving environmental performance, along with employment generation and empowerment of rural economy.[3] Pranab K. Barua Biodiesel the major challenges of biodiesel are its cost and limited availability of fats and oil resources. The cost of raw materials accounts for 60 to 70% of the total cost of biodiesel fuel. Moreover with the increase of human population, more land may be needed to produce food for human consumption rather than to produce oilseeds for biodiesel production. In this work is to suggest the alternative fuel for the diesel engine. Ayhan Deirbas (Biodiesel: A Realistic fuel alternative for Diesel engines) has researched about the various alternative fuels. This literature has helped this work.

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II. RELATED WORK

The seed from the babool tree is collected. More amounts of seed are needed to get the oil. The seed is completely dried under the influence of sunlight for several days. The shell is removed after drying the seeds. The seeds are dried again after removing the shell. Then the oil is taken from the seed. The oil may contain dirt's so it should be filtered. The filtered oil undergoes Transesterification process. By means of transesterification process the oil's properties can be improved. Then the oil is blended with diesel. The blending ratios are B5 and B10 for the oil taken. The properties of oil were tested. The blend is analysed in the VCR engine. In the VCR Engine the various compression ratio can be used. The details of a VCREngine is given below,

IC Engine set up under test is Research Diesel having power 3.50 kW @ 1500 rpm which is 1 Cylinder, Four stroke, Constant Speed, Water Cooled, Diesel Engine, with Cylinder Bore 87.50(mm), Stroke Length 110.00(mm), Connecting Rod length 234.00(mm), Compression Ratio 16.00, Swept volume 661.45 (cc).

The different loads given to the engine and the efficiencies for the different load are found out. Then compression ratio for the diesel fuel is taken from 16 to 24.

III. METHODOLOGY

The aim of this work to produce the biodiesel using the babool tree seeds. Figure. 1 shows the methodology of the process. The main process is transesterification. Then the property of the oil is tested. Then the engine is operated by using the blended oil.

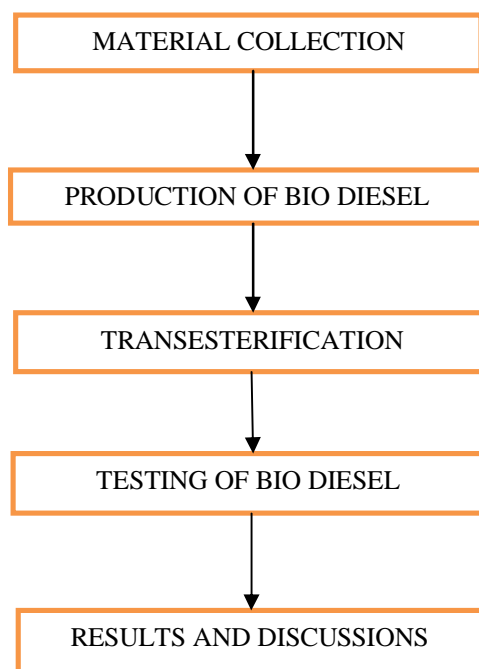


Figure.1 Methodology flow chart

Transesterification is the conversion of a carboxylic acid ester into a different carboxylic acid ester. The most common method of transesterification is the reaction of the ester with an alcohol in the presence of an acid catalyst.

Biodiesel production is the process of producing the biofuel, through the chemical reactions transesterification and esterification. This involves vegetable or animal fats and oils being reacted with short-chain alcohols (typically

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methanol or ethanol).

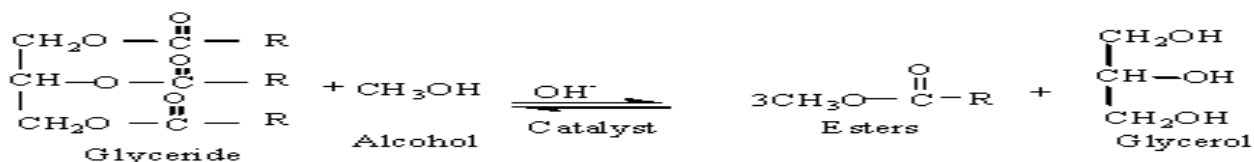
Material Collection& Preparation: The materials required for producing the oil should be collected. The amount of raw material (babool tree seeds) required should be about 5 kgs. In Tamil Nadu, the species grows widely in the districts of Salem, Erode, Dharmapuri and Coimbatore. It is absent in coastal districts and higher hills. The species has been widely planted in tank foreshore plantations under social forestry programmes. The seeds are collected from the trees and the seeds are dried in the sunlight for several hours. Figure. 2 shows the babool tree seeds.



Figure.2 Selecting Materials babool tree seeds

Acid esterification: 100 ml of refined babool tree seed oil is poured into the flask and heated up to 60°C. The 45% v/v methanol is added with the preheated oil and stirred for a few minutes. 0.5% of sulphuric acid is added with the mixture. Heating and stirring should continue about 45min at atmospheric pressure. After completion of this reaction, the mixture is poured into a separating funnel for separating the excess alcohol, impurities and sulphuric acid. The excess alcohol, sulphuric acid and impurities move to the top layer and it's discarded. The lower layer is separated for further processing of Trans esterified into methyl ester. This process reduces the acid value of refined oil to less than 1% of FFA.

Transesterification:The Transesterification of natural glycerides with methanol to methyl esters is a technically important reaction that has been used extensively in the soap and detergent manufacturing industry worldwide for many years. Almost all biodiesel is produced in a similar chemical process using base catalysed transesterification as it is the most economical process, requiring only low temperatures and pressures while producing a 98% conversion yield. The transesterification process is the reaction of a triglyceride (fat/oil) with an alcohol to form esters and glycerol. A triglyceride has a glycerin molecule as its base with three long chain fatty acids attached. The characteristics of the fat are determined by the nature of the fatty acids attached to the glycerin. The nature of the fatty acids can, in turn, affect the characteristics of the biodiesel. This equation 1 shows the transesterification process.



Equation. 1 for transesterification process

Alkaline transesterification: After acid pre-treatment the esterified oil is taken in flask and heated up to 60°C.1% of KOH is dissolved in 30% (6:1 M) methanol. The dissolved solution is poured into flask. The mixture is heated and stirred for 1hr.On completion of reaction, the mixture is poured into separating funnel over 12 hr. The glycerol and impurities are settled in lower layer and it's discarded. The impure biodiesel remain in upper layer. It contains some trace of catalyst, glycerol and methanol. The washing process can be done by the 3/4th of hot distilled water added with methyl ester and gently stirred. The upper layer is pure biodiesel and lower layer is drawn off.

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IV. EXPERIMENTAL RESULTS

Tabulation shows the results of biodiesel. The test results yields the various properties of oil.

VISCOSITY:

Hydrodynamic flow of lubricating oil is called viscosity. The viscosity should remain constant at the temperatures. Viscosity Index is an indication of the change of viscosity of oil with temperature. A high viscosity index means less change of oil with temperature rise. The viscosity is listed below on the table.

FLASH POINT:

Flash point is the temperature at which the oil burns. The flash point of the oil should be sufficiently high so as to avoid flashing of oil vapors' otherwise, the oil will firing at any time. The flash point is listed below in the table

FIRE POINT:

Fire point Is the temperature at which the oil burns continuously at least for 5 seconds. The fire point is listed below in the table

Table. 1 shows the standard values of diesel & biodiesel. Flash point of the biodiesel should be higher than the diesel. The cetane number is also higher for the biodiesel. The general comparison between the diesel and biodiesel can be studied from this table.

Fuel Property	Diesel ASTM D975	Biodiesel ASTM D6751
Lower Heating Value, BTU/gal	129,050	118,170
Kinematic Viscosity @ 40°C, cSt	1.3-4.1	4.0-6.0
Specific Gravity @ 60°C, g/cm ³	0.85	0.88
Carbon, wt%	87	77
Hydrogen, wt%	13	12
Oxygen, by dif. wt%	0	11
Sulfur, ppm	500	0
Boiling Point, °C	180 to 340	315 to 350
Flash Point, °C	60 to 80	100 to 170
Cloud Point, °C	-15 to 5	-3 to 12
Pour Point, °C	-35 to -15	-15 to 10
Cetane Number	40-55	48-65
Lubricity (HFRF), μm	300-600	<300

Table.1 Standard properties of diesel and biodiesel

Table. 2 shows the properties of oil after transesterification with using the penksy martin apparatus and redwood viscometer apparatus. This table is compared with Table. 1. The value of viscosity for the biodiesel is more than the standard value. The value of the flash and fire point is good for the transesterified oil. The values are given below,

KINEMATIC VISCOSITY	20.2 Centistokes @ 40⁰C
FLASH POINT	139⁰c
FIRE POINT	146⁰c

Table.2 Properties for the oil after transesterification

The raw is produced from the seeds. The color of the oil is black. Figure. 3 shows the raw oil. The viscosity of a raw oil is higher than the transesterified oil. The 250 ml of the raw oil is collected from the seeds. The raw oil may contain dirt and impurities so, it should be filtered.

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Figure.3 Raw oil

The raw oil is transesterified by using two methods. They are acid esterification and alkaline Transesterification. Figure. 4 shows the transesterification done on the raw oil. Transesterification is the conversion of a carboxylic acid ester into a different carboxylic acid ester.



Figure.4 Transesterification done on raw oil

The transesterified oil is blended with diesel by 5% and 10%. Figure. 5 shows the oil blended with diesel. The blended oil is operated in the VCR Engine. The blending ratios are generally B5, B10, B20, and B100 (pure oil). For 500ml of diesel 25ml (5% blend), 50ml (10% blend) of oil is mixed.



Figures. 5 5% blend (left) 10% blend (right)

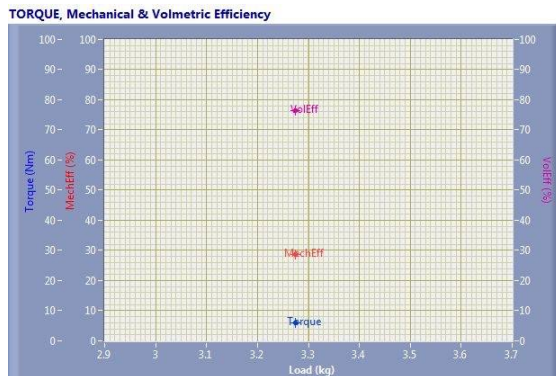
In the VCR Engine the 5% and 10% blends are operated. The volumetric and mechanical efficiency are calculated. Table 3 & 4 shows the efficiencies. The corresponding torque for the Engine is also calculated. The Compression ratio opted in VCR engine is 16:1.

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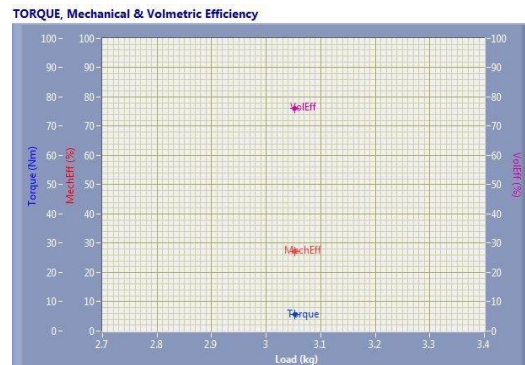
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Efficiency for 5% blend



Efficiency for 10% blend



TORQUE, Mechanical & Volumetric Efficiency

Speed(rpm)	1536.00
Load(kg)	3.27
Torque(Nm)	5.94
Mechanical Efficiency (%)	28.64
Volumetric Efficiency (%)	76.49

Table. 3 Efficiency of 5% blend

TORQUE, Mechanical & Volumetric Efficiency

Speed(rpm)	1539.0
Load(kg)	3.05
Torque(Nm)	5.54
Mechanical Efficiency(%)	27.25
Volumetric Efficiency (%)	76.21

Table. 4 Efficiency of 10% blend

These Tables 3&4 shows the difference between 5 % blend and 10% blends mechanical and volumetric efficiencies. It also shows the speed, Torque and Load. When comparing these tables the efficiency of 5% blend is higher than the 10% blend.

V. CONCLUSION

From the babool trees, the seed is collected and dried. Then the oil is extracted from the seeds and transesterification processes were done. Their properties were found out. Finally, the biodiesel was tested in VCR engine. The volumetric and mechanical efficiencies are found out. And viscosity is found out by using redwoods viscometer. Then the flash point & fire point was found out by using pensky martin apparatus.

This experiment was conducted for loads at 3 kg, 6kg, 9kg by both 5% & 10% blended oil. From the test conducted in VCR Engine the Mechanical efficiency is less on the blended oil. So this oil cannot give more efficiency when compared to the diesel's efficiency.

ACKNOWLEDGMENTS

The support by the Dr. Mahalingam College of Engineering And Technology, Pollachi, Tamilnadu.

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