Biodiesel production from vegetable oils

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Abstract— **This paper reviews the production and characterization of biodiesel (BD or B) as well as the experimental work carried out by many researchers in this field. BD fuel has better properties than that of PD fuel such as renewable, biodegradable, non-toxic, and essentially free of sulfur and aromatics. The major problem associated with the use of pure vegetable oils as fuels, for Diesel engines are caused by high fuel viscosity in compression ignition. . Dilution of oils with solvents and microemulsions of vegetable oils lowers the viscosity, some engine performance problems still exist. e. Biodiesel has become more attractive recently because of its environmental benefits. Biodiesel is an environmentally friendly fuel that can be used in any diesel engine without modification.**

Keywords—Bd(biodiesel),renewable ,viscosity,dilution,ignition,. biodegradable

I. INTRODUCTION

The major part of all energy consumed worldwide comes from fossil sources (petroleum, coal and natural gas). However, these sources are limited, and will be exhausted by the near future. Thus, looking for alternative sources of new and renewable energy such as hydro, biomass, wind, solar, geothermal, hydrogen and nuclear is of vital importance. Alternative new and renewable fuels have the potential to solve many of the current social problems and concerns, from air pollution and global warming to other environmental improvements and sustainability issues . Vegetable oil is one of the renewable fuels. Vegetable oils have become more attractive recently because of its environmental benefits and the fact that it is made from renewable resources. Vegetable oils are a renewable and potentially inexhaustible source of energy with an energetic content close to diesel fuel. The vegetable oil fuels were not acceptable because they were more expensive than petroleum fuels. However, with recent increases in petroleum prices and uncertainties concerning petroleum availability, there is renewed interest in vegetable oil fuels for diesel engines. The use of vegetable oils as alternative renewable fuel competing with petroleum was proposed in the beginning of 1980s. The advantages of vegetable oils as diesel fuel

- Liquid nature-portability
- Ready availability
- Renewability
- Higher heat content (about 88% of no. 2 diesel fuel)
- Lower sulfur content
- Lower aromatic content † Biodegradability

The disadvantages of vegetable oils as diesel fuel are:

- Higher viscosity
- Lower volatility †
- The reactivity of unsaturated hydrocarbon chains

II. LITERATURE SURVEY

1.[Study of Biodiesel production from vegetable oils via catalytic and non-catalytic Ayhan Demirbas *

This paper reviews the production and characterization of biodiesel (BD or B) as well as the experimental work carried out by many researchers in this field. BD fuel has better properties than that of PD fuel such as renewable, biodegradable, non-toxic, and essentially free of sulfur and aromatics. The major problem associated with the use of pure vegetable oils as fuels, for Diesel engines are caused by high fuel viscosity in compression ignition. . Dilution of oils with solvents and microemulsions of vegetable oils lowers the viscosity, some engine performance problems still exist. e. Biodiesel has become more attractive recently because of its environmental benefits.

2 [**TECHNICAL ASPECTS OF BIODIESEL PRODUCTION FROM VEGETABLE OILS Janahiraman KRISHNAKUMAR]**

Biodiesel is an alternative fuel made from renewable biological resources such as vegetable oils (both edible and non-edible oil) and animal fats.

Vegetable oils are usually triesters of glycerol with different chain length and degree of saturation. The typical molecular structure of vegetable oil .. It may be seen that vegetable oils contain a substantial amount of O2 in their molecules. Where R, R¢, and R² are parts of the higher fatty acids forming ester with glycerol.

One of the most promising processes to convert vegetable oil into methyl ester (biodiesel) is the transesterification, in which alcohol reacts with triglycerides of fatty acids (vegetable oil) in the presence of a catalyst.

3] Prospects of biodiesel production from vegetable oils in India B.K. Barnwal*, M.P. Sharma

.recent times, the world has been confronted with an energy crisis due to depletion of resources and increased environmental problems. The situation has led to the search for an alternative fuel, which should be not only sustainable but also environment friendly. For developing countries, fuels of bio-origin, such as alcohol, vegetable oils, biomass, biogas, synthetic fuels, etc. are becoming important. Such fuels can be used directly, while others need some sort of modification before they are used as substitute of conventional fuels.

4.[A review analyzing the industrial biodiesel production practice starting from vegetable oil refining Giulio Santori]

We first discuss the technologies for extracting the vegetable oil from the seed, and its subsequent refining and conversion into biodiesel. This study focuses on the characteristics of the production processes currently used in the sector, illustrating the technological options and emphasizing the drawbacks of certain practices and the best choices available. The vegetable oils tend to be processed using procedures that are well established, but oriented more towards obtaining products suitable for the foodstuffs industry, and that consequently use technologies that are sometimes excessive for energetic purposes. The processes for extracting the vegetable oil from the seed generally include a set of steps, the complexity of which depends on the raw material. Basically, the two extraction technologies involved rely on the use of pressure or solvents.

III. HISTORY

Transesterification of triglycerides are in oils is not a new process. Scientists E. Duffy and J. Patrick conducted it as early as 1853. Life for the diesel engine began in 1893 when the famous German inventor Rudolph Diesel published a paper entitled 'The theory and construction of a rational heat engine'. What the paper described was a revolutionary engine in which air would be compressed by a piston to a very high pressure thereby causing a high temperature. Rudolph Diesel designed the original diesel engine to run on vegetable oil. Dr Rudolph Diesel used peanut oil to fuel one of this his engines at the Paris Exposition of 1900 Because of the high temperatures created, the engine was able to run a variety of vegetable oils including hemp and peanut oil. At the 1911 World's Fair in Paris, Dr R. Diesel ran his engine on peanut oil and declared 'the diesel engine can be fed with vegetable oils and will help considerably in the development of the agriculture of the countries which use it.' One of the first uses of transesterified vegetable oil was powering heavy-duty vehicles in South Africa before world war II. The name 'biodiesel' has been given to transesterified vegetable oil to describe its use as a diesel fuel.

IV.MATERIAL AND METHODS

Material

Paddy is the important crop cultivated in India. With the locally available paddy, the rice bran to the tune of around 20,000 tonnes could be available even at conservative rate of 6% of paddy hulled. This surplus bran available locally can be utilized for extraction of oil. At present, India is the largest producer of edible grade rice bran oil with 27,000 tonnes per annum against the potential of 7.5 lakhs tonnes.

Methods

Different methodologies used for the production of bio diesel are blending, micro emulsion, pyrolysis, and transesterification. From various studies, it is found that transesterification is the best way to modify the vegetable oil be compatible diesel engine fuel. The transesterification is further classified into catalytic transesterification, super critical transesterification and non catalytic super critical transesterification. Catalytic transesterification is the current method of choice in this study.

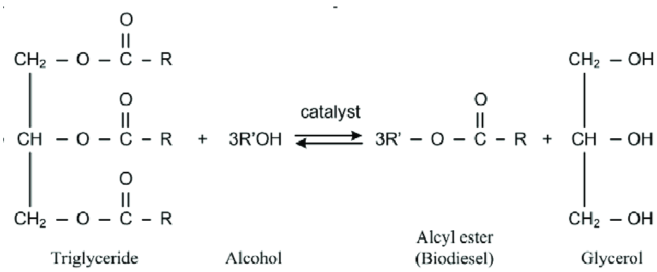
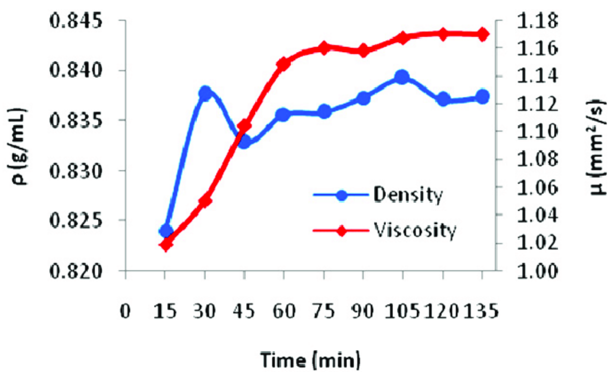


Fig - transesterification reaction

Since transesterification reaction is an equilibrium reaction, where more amount of alcohol is required to shift the reaction equilibrium to right side and produced more esters as proposed product . Methanol and ethanol are used most frequently; especially methanol is preferred because of its low cost and its physical and chemical advantages (polar and shortest chain alcohol). It can quickly react with triglycerides and NaOH gets easily dissolved in it. Ethyl ester and methyl ester almost has same heat content. Viscosity of ethyl ester is slightly higher and pour point is slightly lower than those of methyl ester.phone calls using the GSM module, and answer them by sending the location data from the GPS module.



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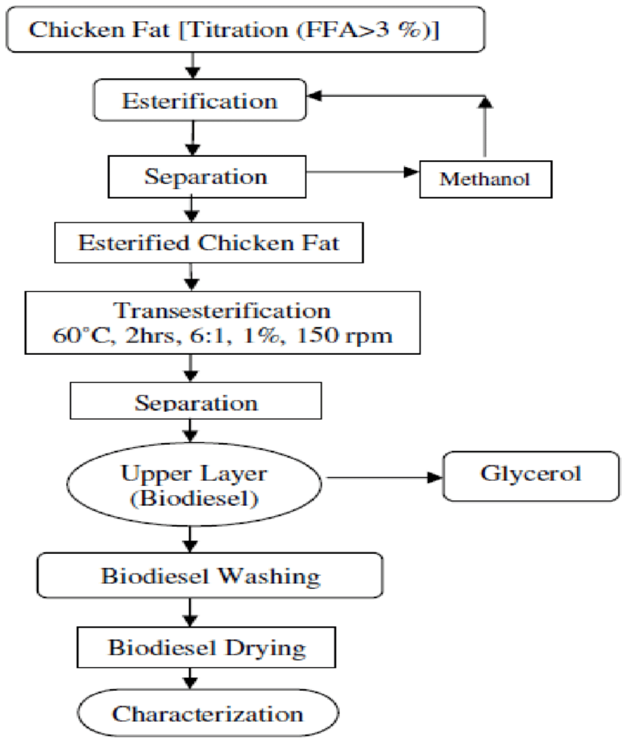

Fig -process flow diagram for biodiesel production

V. EXPERIMENTAL PROCEDURE

Neutralization-

The vegetable oil used for biodiesel production might contain free fatty acids, which will enhance saponification reaction as side reaction during the transesterification process. This will reduce the conversion of vegetable oil into biodiesel and also leads to the formation of soapcausing difficulties in the separation of biodiesel and glycerin.

The vegetable oils contain about 14-19.5% of free fatty acids in nature, it must be freed before taken into actual conversion process. The presence of about 14% of free fatty acid makes the oil inappropriate for industrial biodiesel production..
The dehydrated oil is agitated with 4% HCl solution for 25 minutes and adds 0.82 g of NaOH per 100 ml of oil to neutralize the free fatty acid and is coagulated by the following reaction:

RCOOH + NaOH Æ RCOONa + H2O

Biodiesel production –

In this study, the base catalyzed transesterification is selected as the process to make biodiesel from jatropha oil. Transesterification reaction is carried out in a batch reactor. The reactor has three openings; in that one is at centre and another two are at the side.

A condenser is provided at the centre to reduce the loss of solvent by evaporation and to maintain the pressure in the reactor. One of the side openings is used to provide thermometer, which helps to monitor the temperature of the reaction and the other one is used to pour the reactants. The reactor is placed on the hot plate with magnetic stirrer to heat and stir the reactant mixture For transesterification process, 500 ml of rice bran oil and 500 ml of jatropha oil is heated up to 70 ºC in two separate round bottom flasks to drive off the moisture and stirred vigorously.

Methanol of 99.5% purity, hav ing density 0.791 g/cm3 is used. 2.5g of catalyst NaOH for rice bran oil and 5 g of catalyst NaOH for jatropha oil is dissolved in methanol, in 6:1 molar ratio, in a separate vessel and was poured into round bottom flasks while stirring the mixture continuously. Both the mixture was maintained at atmospheric pressure and 60 ºC for 60 minutes.
After completion of transesterification process, the product mixtures were al lowed to settle under gravity for 24 hours in two separating funnels. The products formed during transesterification were rice bran oil methyl ester (ROME) and glycerol, jatropha oil methyl ester (JOME) and glycerin. The bottom layer consists of glycerin, excess alcohol, catalyst, impurities, and traces of unreacted oil. The evaporation of water and alcohol gives 80-88% pure glycerin, which can be sold as crude glycerin. For further purification, the crude glycerin is distilled by simple distillation..

The top layer consists of methyl ester, residual catalyst, methanol traces and other impurities. For washing and purification of methyl ester, it was mixed, washed with hot distilled water (10% v/v) at 70 °C to remove the unreacted alcohol, oil and catalyst are allowed to settle under gravity for 24 hours. Two layers were formed, the upper layer was the biodiesel and the lower layer was made of water and impurities. This process was repeated until the lower phase had a pH value that was similar to that of distilled water, thus indicating that only water was present and the catalyst is removed completely in the washing. It was found that during washing some ester was lost due to emulsion formation.

Fig – lab experiment 1

VI. RESULTS AND DISCUSSION

Additional experiments were conducted with NaOH as a catalyst to study the effect of different parameters like reaction temperature, molar ratio of alcohol to oil and amount of catalyst on the ester yield as well as the extent of conversion, which can be represented by the viscosity of ester. The stirring speed was kept constant at 500 rpm for all experiments.

.VII. EFFECT OF CATALYST CONCENTRATION

The effect of NaOH concentration was studied in the range of 0.5-1.5% (weight of NaOH/weight of oil), while the other parameters were kept constant. The catalyst concentration increase influences the ester yield in a positive manner up to 0.92% NaOH for jatropha oil after that it decreases. It was found that ester yield for rice bran oil decreases as the amount of catalyst increased from 0.5 to 1.5%. The ester yield decreases drastically as the NaOH concentration was increased above 1% and reduces to almost 50 for 1.5% NaOH concentration.

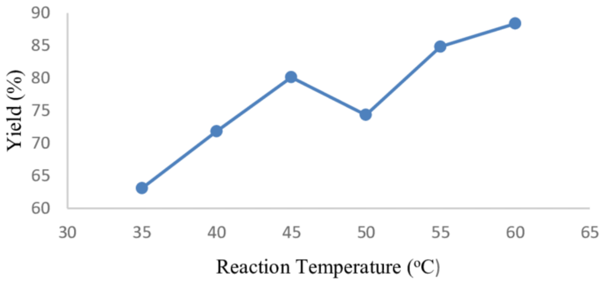

Fig – graph between temp and yield%

VIII. RESULT AND DISCUSSION

Biodiesel is produced from vegetable oils, yellow grease, used cooking oils, or animal fats. The fuel is produced by transesterification a process that converts fats and oils into biodiesel and glycerin (a coproduct).

Fig –lab experiment fig 2

Fig – magnetic stirrer lab experiment 3

IX. CONCLUSION-

In the current investigation, it has enabled us to confirm that jatropha oil as well as rice bran oil may be used as aresource to obtain biodiesel. JOME and ROME have become more attractive to replace petroleum fuel. As per the literature study, most of the transesterification studies have been done on edible oils like rapeseed, soybean, sunflower, and canola by using methanol and NaOH/KOH as catalyst. Rice bran oil and jatropha oil are one of the most potential sources to produce biodiesel in India, which could offer opportunities for generation of rural employment, increasing income, and improving the environment. The above experimental result reveals the alkaline catalyzed transesterification was a promising area of research for production biodiesel in large scale

Effect of different parameters such as temperature, time, reactant ratio, and catalyst concentration on the biodiesel yield was analyzed. The best combination of the parameters was found as (1) 6:1 molar ratio of methanol to oil for both oils (2) 0.92% sodium hydroxide catalyst for jatropha oil and 0.75% for rice bran oil (3) 60 °C reaction temperature for both oils, and (4) 60 minutes of reaction time for both oils. The viscosity of jatropha oil and rice bran oil reduces substantially after transesterification and is comparable to diesel.

Biodiesel is considered as clean fuel since it has almost no sulfur, no aromatic, and has about 10% inbuilt O2 which helps it to burn completely. Its higher cetane number improves the ignition quality even when blended in the petro-diesel. Biodiesel produces lower CO emissions; it reduces CO emission of about 25% to that of diesel fuel. Biodiesel (JOME and ROME) characteristics like density, viscosity, flash point, cloud, and pour point are within the specification of ASTM norms. Finally, it is concluded that based on the field trials and storage, biodiesel from jatropha oil and rice bran oil could be recommended as a fuel if engine performance tests provide satisfactory results.

X. ACKNOWLEGMENT-

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XI. REFERENCES -

1. journal homepage: www.elsevier.com/locate/fuel

   Olivera S. Stamenkovic´, Ana V. Velicˇkovic´, Vlada B. Veljkovic´ ⇑ Faculty of Technology, University of Niš, 16000 Leskovac, Bulevar Oslobodjenja 124, Serbia

2. Ayhan Demirbas, Progress and recent trends in biodiesel fuels, Energy Conversion and Management 50 (2009) 14–34

3. Different techniques for the production of biodiesel from waste vegetable oil Department of Chemical Engineering, Faculty of Engineering, Cairo University, Egypt

4. De Paola, M. G.; Ricca, E.; Calabro, V.; Curcio, S.; Iorio, G. (2009). Factor analysis of transesterification reaction of waste oil for biodiesel production. Bioresour. Tech., 100 (21), 5126-51 31:

5. //www.researchgate.net/publication/307628374_ Design_of_a_Simple_Cell-Phone_Radio-Frequency_Detector

6. https://www.iiste.org/Journals/index.php/ISDE/article/view/31736

7. DEMIRBAS, A., Importance of biodiesel as transportation fuel, Energy Policy, Vol. 35, 2007, p. 4667.

8. CONTINUOUS PRODUCTION OF BIODIESEL FROM VEGETABLE OIL USING SUPERCRITICAL ETHANOL/CARBON DIOXIDE MIXTURES.