International Journal of Engineering Research and General Science Volume 3, Issue 5, September-October, 2015
ISSN 2091-2730

PREAPARATION OF BIODIESEL FROM NON EDIBLE ANIMAL FAT

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Abstract— Energy crises, resulted into studies of various non-traditional bio-oriented fuels, biodiesel can be used as additives for diesel engine. Researches on ethanol show better replacement of diesel without any modification of engine to some extent for ethanol. Further advancement in technology explored the chances of ethanol as alternative fuel for diesel engine. It is seen that the addition of biodiesel is valuable to remove diesel-ethanol phase separation which validated the use of its blends on the diesel engine .In this study, biodiesel which is defined as a fuel comprised of mono-alkyl esters of long-chain fatty acids has produced from animal fat oil by transesterification process and its different properties are calculated and studied and also compared with the properties of diesel and ethanol. Blends of biodiesel, ethanol and diesel are made on the percentage of volume basis. In these blends, biodiesel used 5-15%, ethanol 15-30% and remaining was the percentage of diesel.

Keywords—Biodiesel, Animal fat, Transesterification, Diesel, Blends.

1) INTRODUCTION:

Diesel fuel has limited resources which available for us upto 2098. The combustion of diesel fuels causes environmental problems and human health problems, emission like CO_2, NOx, CO product which caused for global warming. As the diesel price increasing and resources decreasing, it required some attention to find other alternative fuel that cheaper and renewable. Research on reducing emissions resulted from diesel engines and studies on decrease fuel consumption are being founded worldwide. There are many works on reliable researching and implementations and useful results are came to exist. Research and developing alternative diesel engine fuel is one of these studies. The alternative diesel fuels must be technically acceptable, economically competitive, environmentally acceptable and easily available. Continuing depletion of the reserves of non-renewable petroleum, price volatility, feedstock availability concerns have caused an intensified search for alternative sources of energy. Biodiesel derived from biological sources, among them lipid materials such as fats and oils have received increasing attention. [1]

Researches on biodiesel derived from vegetable oils and animal fat are being used as alternate fuels to petroleum based diesel fuel. It has been concluded by many studies that as an alternative fuel biodiesel reduce the emissions of carbon monoxide (CO), hydrocarbon (HC), sulphur dioxide (SO2), but NOx to increase in the exhaust compared with diesel fuel. Biodiesel has higher cetane number than diesel fuel, contains high oxygen by weight, non-toxic, biodegradable is its attractive properties. Although biodiesel has many advantages, higher cetane number, more calorific value etc. [2]

2) LITERATURE REVIEW:

P. Shreenivas et.al [3], has investigated method of producing biodiesel from castor oil (treated with mineral turpentine oil) by transesterification of the crude oil with methanol in the presence of NaOH as catalyst. This paper mainly involves "Esterification". Factors effecting the biodiesel production (reaction temperature, reaction rate & catalyst) are analyzed. The esterification procedure converts castor oil to its methyl esters. Important fuel properties of methyl esters of biodiesel produced from castor oil like viscosity, flash point, fire point, calorific value etc., was found out and compared to the properties of Indian standard biodiesel. This paper study supports the production of biodiesel from castor oil as a viable alternative to the diesel fuel.

Gerhard Knotheet.al. [4], 2010 described the preparation of biodiesel from mutton fat. The use of MgO impregnated with KOH as heterogeneous catalyst for the esterification of mutton fat with methanol has been evaluated. In this process >98% conversion of fats into biodiesel in 20 minutes is become possible. At 0.02% weight of moisture and free fatty acid 0.002% with methanol completely converted into biodiesel but additional 1% weight of moisture result in soap formation. MgO-KOH-20 (MgO with 20% KOH) catalyst found to tolerate additional 1% of water in the fat.

Shaoyang Liu et.al [5], 2010 Paper described efficient biodiesel production from beef tallow was achieved with radio frequency (RF) heating. A viscosity of biodiesel products from beef tallow was 5.23±0.01 $mm^2\ s^{-1}$, meeting the specification in ASTM D6751. RF heating has a higher energy dissipating rate than conventional heating. There are several obstacles, e.g. high viscosity, incomplete combustion and carbon build up, preventing vegetable oil and animal fat to be directly used in modern diesel engine. Among them, high viscosity may be the most important one. The viscosity will remarkably decrease after the conversion from oil/fat into biodiesel.

Cengiz Oner et.al. [6], 2009 had describes biodiesel production from inedible animal tallow and its usability was investigated as pure biodiesel and its blends with petro diesel fuel in a diesel engine. Due to lower heating value of biodiesel, the addition of biodiesel to diesel fuel decreases the thermal efficiency of engine and increase specific fuel consumption. However, the effective engine power was comparable to diesel fuel. B100 were reduced emissions of CO, NOx, SO_2 and smoke opacity around 15%, 38.5%, 72.7% and 56.8%, respectively. For B20, lowest CO, NOx emissions and the highest exhaust temperature were obtained among all other fuels. The reduction in exhaust emission made tallow methyl ester and its blends, especially B20 a suitable alternative fuel for diesel engine and thus could help in controlling air pollution.

Dhiraj darunde et.al. [7], Oct. 2012, has discuses fuel production, fuel properties, environmental effects including exhaust emissions and co-products. This also describes the use of glycerol which is the by-product in esterification process along with biodiesel. The impact of blending of biodiesel with ethanol and diesel on the diesel engine has described. Mainly animal fats and vegetable oils are used for the production of biodiesel. Several types of fuels can be derived from triacylglycerol-containing feedstock. Biodiesel which is defined as the mono-alkyl esters of vegetable oils or animal fats. Biodiesel is produced by transesterifying the oil or fat with an alcohol (methanol/ethanol) under mild conditions in the presence of a base catalyst.

3) EXPERIMENTAL PROCEDURE:

This chapter describes system development with the help of used material and instrument for experiment. Also, the methodology used for standardization of transesterification process for animal fat oil. It studies characteristic fuel properties and experimental procedure adopted to evaluate performance of biodiesel-diesel-ethanol (BDE) (5-15%v/v+85-55%v/v+15-30%v/v) with comparison of diesel fuel on the diesel engine. Tests were performed at the I.C Engine laboratory of PRMIT & R, Badnera. The laboratory consists of engine test rig coupled with rope brake dynamometer, smoke meter. Exhaust temperature was measured with the help of thermocouple.

Animal fat is one of the main feedstock for the production of biodiesel. About one-third of the fats and oils produced in the United States are from animal fats. This includes beef tallow, pork lard, and chicken fat. Animal fats are attractive feed stocks for biodiesel because their cost is substantially lower than the cost of vegetable oil. This is partly because the market for animal fat is much more limited than the market for vegetable oil, since much of the animal fat produced in the U.S. is not considered edible by humans

Figure 3.1: Heating animal fat

There are various methods to produce biodiesel; transesterification is the method that we have used for the production of biodiesel from animal fat oil. Fatty acid methyl ester of animal fats as biodiesel fuel was prepared by base-catalyzed transesterification of tallow with Methanol in the presence of kOH as base-catalyst. The properties of tallow methyl ester, diesel fuel, ethanol and its blends were determined at Chemistry Department of Dhamangaon Engineering college, Dhamangaon Rly, Amrawati, Maharashtra, India. The petroleum diesel fuel was purchased from a local commercial supplier (Indian Oil fuelling station, located near badnera, Amrawati, Maharashtra). Animal fats was purchased from city meat market, Amrawati. Methanol (99.9% pure) was purchased from Shreeganesh Chemicals, Rajkamal squre, Amrawati. Pottasium hydroxide (kOH) with purity of 98%, provided from Chemistry Department of Dhamangaon Engineering college, Dhamangaon Rly, Amrawati, Maharashtra, India. The transesterification reaction conditions used in this study were as described by [8,9]

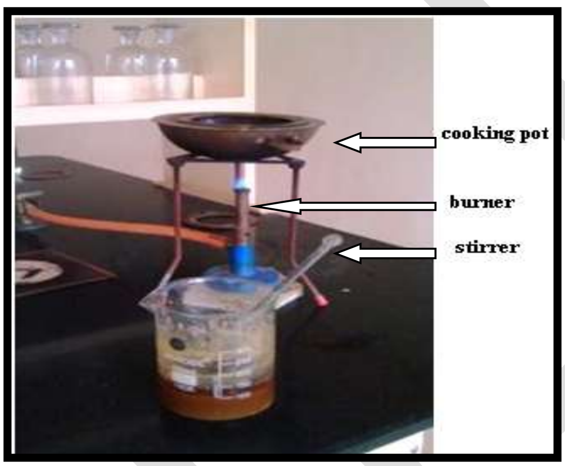

Figure3.2:- Tranesterification of biodiesel

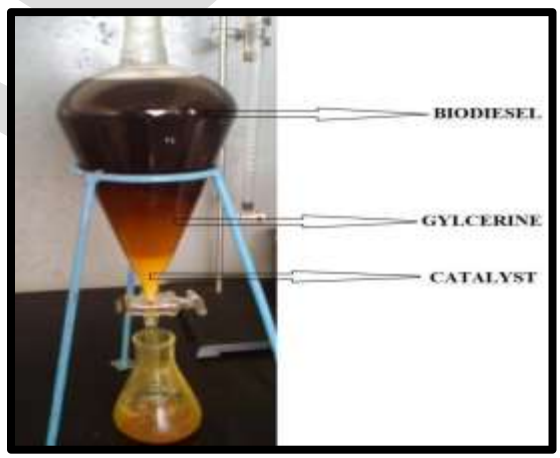

figure3.3:- Separating biodiesel and byproduct

Before transesterification, animal fats was heated at 105-110oC for 1hour and then strained the sediment out of the fat with cloth filter. Impurities and bubbles formed on surface of tallow were picked during heating process. After this process, the weight of tallow reduced about 5% to 6%. A sample of 400g of animal fat oil was placed in a 1000 ml flat-bottom flask equipped with a stirrer-heater and thermometer. This oil was heated to 60 ‘C slowly. In another beaker, 89.3g of methanol (6:1 molar ratio ethanol /fat oil) was mixed with 2g of KOH (0.5% by weight assuming 98% pure KOH), until all of the KOH was dissolved in methanol. This mixture was then added to the melted fat, stirred and further heated to 60 ^{0}C, for about 15 to 20 minutes. The mixture is allowed to cool to room temperature for 12 hour, and the ester and glycerol layers were separated in a separator funnel. We have produced biodiesel about 2 liters as per the requirement. [10,11]

4) PROPERTIES OF BIODIESEL:-

Table 3.4, Shows the fuel properties of the blends at different ratios of diesel, biodiesel and ethanol. It can be observed that the density of the blends decreased with an increasing of the percentage of ethanol in the blends. This is attributed to the fact that ethanol has lower density and as such will lower the density of the mixture. But, when the percentage of biodiesel was increased, the density increased, which is due to the fact that biodiesel has a higher density than the other two components. Normally, it is recognized that higher density leads to higher flow resistance of fuel oil, resulting in higher viscosity. This finding suggests that the higher viscosity can lead to inferior fuel injection.

Table 4.1: Properties of diesel, ethanol and biodiesel:

Properties	**Diesel**	**Ethanol**	**Biodiesel**
Density(kg/m^3) 15^{o}C	833.9	716.8	880
Viscosity (CSt) at 40^{o}c	3.67	1.4	14.3
Calorific value (kj/kg)	42,800	29,700	39242.03
Cetane number	47	8	69.52
Flash point, ^{0}C	58	13	52

Heat of combustion is one of the most important fuel properties. The heat of combustion of BDE blends decreased, when greater amounts of ethanol and biodiesel were added, which is due to the lower heating value of biodiesel and ethanol. Lower heating value of a fuel has a direct influence on the power output of an engine. Fuel was prepared by mixing considered volume.

Table 4.2: Composition of the Test Fuel:

Diesel	Biodiesel	Ethanol
80%	5%	15%
75%	10%	15%
70%	15%	15%
75%	5%	20%
70%	10%	20%
65%	15%	20%
65%	5%	30%
60%	10%	30%
55%	15%	30%
95%	5%	0%
90%	10%	0%
85%	15%	0%

5) CONCLUSION:

An experimental study was carried out to investigate the performance characteristics of animal fat biodiesel (5%, 10%, 15% volume) and its blends with ethanol (15%, 20%, 30%volume) and diesel (95%, 90%, 85%, 80%, 75%, 70%, 65%, 60%, 55% volume) in diesel engine and the results were compared with diesel fuel. Based on the experimental results, the following conclusions can be drawn:-

- The calorific value of animal fat biodiesel (39242.03 Kj/Kg) is found to be lower than that of diesel (42800 Kj/kg).
- Cetane number of animal fat biodiesel is 69.52 which are greater than diesel (47).
- Viscosity and density of BDE blends are found to be very close to that of diesel.
- BDE blends can be used without any engine modifications in a direct injection diesel engine. It was also observed that the addition of biodiesel to the diesel fuel decreases the thermal efficiency of engine and increases the specific fuel consumption. This is due to the lower calorific value of biodiesel compared to diesel fuel.

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