

Study of Biodiesel based on Algae and Palm Oil Properties and Characteristics for Enhancing Performance of 4 Stroke CI Engine

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Abstract - Now a days various biodiesels are being tested and used in various industries over the globe. Moreover, there is a huge scope in the enhancement of fuel efficiency, performance and ignition characteristics of these biodiesels. These biodiesels can be used in cars, trucks and airplanes. In this research paper, our aim is to investigate performance characteristics of non-edible oil, palm oil and algae oil biodiesel which is extracted by esterification, demosturization, transesterification process with oil and identify the properties of these hybrid blends such as calorific value, density, cetane no, flash point, fire point etc. In this study B9, B18, B27, B36 blends are used.

Key Words: Biodiesel, Esterification, Demoisturization, Transesterification, calorific value, cetane number, flash point, fire point.

1. INTRODUCTION

A biodiesel is an alternative fuel has attracted considerable attention during past decade as a renewable, biodegradable and non-toxic fuel [2]. It is derived from the different types of vegetable oil (edible and non-edible oil) and animal fats through Transesterification; it is also called alcoholysis. The commonly used alcohols for the Transesterification include methanol, ethanol, Methanol particularly due to its low cost. It is safe alternative fuel to replace traditional petroleum diesel. It has high lubricity, is a clean burning fuel and can be a fuel component for use in existing, unmodified diesel engines. Biodiesel produces less air pollution and it is a safer for the environment. There for the non-edible oils like palm oil and algae oil has been found most suitable for this purpose [1].

Algae fuel, algal biofuel, or algal oil is an alternative to liquid fossil fuels that uses algae as its source of energy-rich oils. Also, algae fuels are an alternative to commonly known biofuel sources, such as corn and sugarcane. Algal oil methyl ester was synthesized by methyl transesterification of algal oil feedstock's using previously synthesized potassium impregnated zinc oxide. Palm oil is an edible vegetable oil derived from the mesocarp (reddish pulp) of the fruit of the oil palms. The differences are in color (raw palm kernel oil lacks carotenoids and is not red), and in saturated fat content: palm mesocarp oil is 49% saturated, while palm kernel oil and coconut oil are 81% and 86% saturated fats.

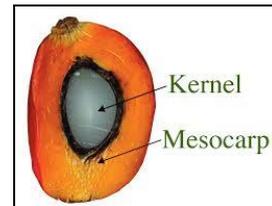


Fig -1: palm oil fruit

1.1. METHODOLOGY BIODIESEL PRODUCTION

Considerable efforts have been made to develop vegetable oil derivatives that approximate the properties and performance of hydrocarbons-based diesel fuels. The problem with substituting triglycerides for diesel fuel is mostly associated with high viscosity, low volatility and polyunsaturated characters. These can be changed in at least four ways: Pyrolysis, micro emulsion, dilution and transesterification.

2. Biodiesel setup

The reaction was carried out in Biodiesel Redley Reactor equipped with reflux condenser, magnetic stirrer and thermometer. It consists of water jackets, external heater and condenser. The suitable mixing and turbulence for accelerating the reaction was done by supplementary impeller, attached mechanically to spindle.

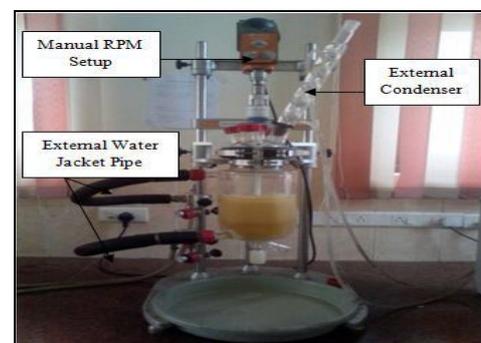


Fig -2: Biodiesel setup

2.1. Filtration: Filtration is a physical, biological or chemical operation that separates solid matter and fluid from a mixture with a filter medium that has a complex structure through which only the fluid can pass. Solid particles that cannot pass through the filter medium are

described as oversize and the fluid that passes through is called the filtrate [1].

2.2. Demoisturization: It is the process which removes the water contents which are preset in the biodiesel by heating up the oil. After water washing our biodiesel has an orange juice color to indicate it's full of water. To obtain fastest drying we heat the air over the biodiesel where the water content will get move out from oil.

2.3. Esterification: It is the reaction of an acid (condensation of the carboxyl group of an acid) with an alcohol (the hydroxyl group of the alcohol) in the presence of catalyst. The chemical reaction that takes place during the formation of the ester is called esterification. Esterification is the process of combining an organic acid (RCOOH) with an alcohol (ROH) to form an ester (RCOOR) and water; or a chemical reaction resulting in the formation of at least one ester product. Ester is obtained by an esterification reaction of an alcohol and a carboxylic acid.

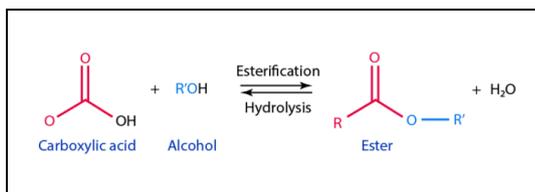


Fig - 3: chemical reaction of esterification

2.4. Transesterification: This transesterification process is like alkali transesterification, only ratio of catalyst and solvent stirring time different, and in this transesterification we have used lipase catalyst. The process is explained in the following figure.

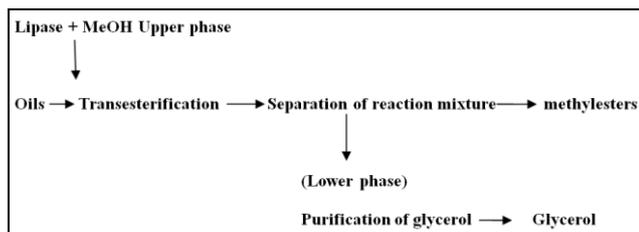


Fig - 4: Transesterification process

Lipases are known to have a propensity to act on long-chain fatty alcohols better than on short-chain ones. Thus, in general, the efficiency of the transesterification of triglycerides with methanol (methanolysis) is likely to be very low compared to that with ethanol in systems with or without a solvent.

I. Transesterification method:

Biodiesel which is consider as possible substitute of conventional fuel, composed of fatty acid methyl esters that can be prepared from triglycerides in vegetable oils by

transesterification process. It contains phospholipids, sterols; water which more harmful to the diesel engine. To overcome this problems the oil required slight chemical modification mainly Transesterification, Pyrolysis. Transesterification also called alcoholysis is the displacement of alcohol from an ester by another in a process similar to hydrolysis, except than alcohol is used instead of water. This process has been widely used to reduce the high viscosity of triglycerides.

Transesterification is one of the reversible reactions and proceeds essentially by mixing the reactants. However, the presence of catalyst (Base or acid) accelerates the conversion. This reaction is carried out by two major steps.

II. Transesterification reaction:

The major components of vegetable oils and animal fats are Triglycerides. To obtain biodiesel, the vegetable oil or animal fat is subjected to a chemical reaction termed as transesterification.

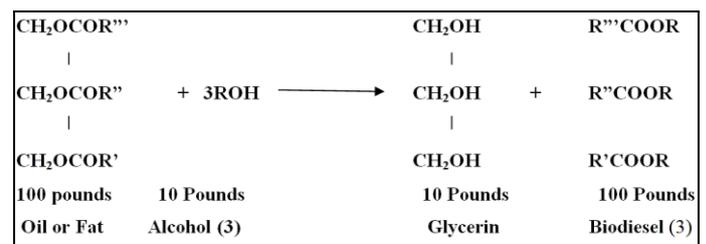


Fig -5: Chemical reaction of transesterification

2.5.Setting up oil and separation:

After completing above processes, we give time to set-up the biodiesel and this gives us two major products: glycerin and biodiesel.



Fig -6: Setting up of the oil and separation

Each has a substantial amount of the excess methanol that was used in the reaction. The reacted mixture is sometimes neutralized at this step if needed. The glycerin phase is much denser than biodiesel phase and the two can be gravity separated with glycerin simply drawn off the bottom of the settling vessel. In some cases, a centrifuge is used to separate

the two materials faster. After the separation process we get impure from of oil and remaining is Glycerol.

2.6. Hot water washing:

Further we mix the biodiesel obtained from above separation and with hot water and get two layers as biodiesel and water due to density difference between them. Water has higher density, so it will be settled down at lower position and then you can remove the water. After removing the water, we can get quality as well as clear solution of the biodiesel [3].

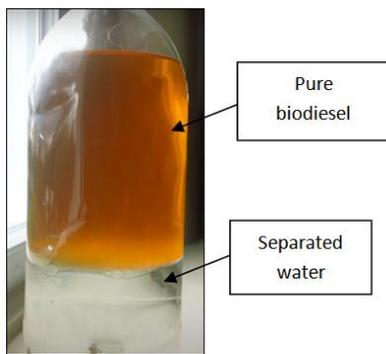


Fig -7: After hot water washing

3. Result and analysis

Below are few properties which have observed during the testing of biodiesels considered in this study. The properties are compared with the existing diesel in the below mentioned results.

Sr.	Test Description	Ref.std. ASTM 6751	References		Diesel	Hybrid oil biodiesel blends				
			Unit	Limit	B00%	B09%	B18%	B27%	B36%	
1	Density	D1448	gm\cc	0.800-0.900	0.831	0.834	0.836	0.837	0.840	
2	Calorific Value	D6751	MJ\kg	34-45	42.50	42.41	42.38	42.11	42.00	
3	Cetane no.	D613	-	41-55	49.00	49.22	49.40	49.60	49.90	
4	Moisture	D2709	%	0.05%	NA	NA	NA	NA	NA	
5	Flash point	D93	-	-	67.00	67.00	70.00	76.00	88.00	
6	Fire point	D93	-	-	71	76.00	82.00	92.00	103.00	

Fig – 8: Result analysis of the biodiesel samples with existing diesel

3. CONCLUSION

Results obtained after conducting several property tests confirmed that, all biodiesels categories have better properties compared with that of the existing diesel. This will improve the overall engine performance. Biodiesel derived from palm and algae oil is a potential renewable and minimum carbon content alternative to petroleum fuels. However, it faces issues such as limited supply and higher

processing cost which prevents it from becoming a good replacement for petroleum fuels. As petroleum fuel rises in its cost day by day and its supplies decrease, biodiesel will surely fulfill its requirement [4].

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REFERENCES

- [1] Mrunay Jadhav, Shailesh Pawar, Pratik Salunke, Shantanu Yadav, Prof.V.K Mehtre, Dr.S.N.Bobade, "Characterization of Mexicana methyl ester on single cylinder four stroke diesel engine" IJRSET, Volume: 04 Issue: 06 April -2017, ISSN(Online) : 2319-8753, ISSN (Print) : 2347-6710.
- [2] Daming Huang, Haining Zhou, Lin Lin, "BIODIESEL: AN ALTERNATIVE TO CONVENTIONAL FUEL" SciVerse Science Direct, Energy Procedia 16 (2012) 1874 – 1885.
- [3] Ayoola A.A, Oresegun O R, Oladimeji T. E & Lawal S. A, "TREATMENT OF BIODIESEL WASHING WATER", BEST Journals, ISSN (P): 2348-0513, ISSN (E): 2454-471X, Vol. 4, Issue 3, Mar 2016, 27-34.
- [4] Onkar S. Tyagi, Neeraj Atray, Basant Kumar & Arunabha Datta, Indian Institute of Petroleum, "Production, characterizat on and development of standard biodiesel-a review", MAPAN-Journal of Metrology Society of India · September 2010 DOI: 10.1007/s12647-010-0018-6.