International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 03 | Mar-2018 www.irjet.net p-ISSN: 2395-0072

Sunflower Oil Biodiesel Alternative fuel for CI Engine – A Review

Pravesh Jain[1], Aditya P. Jadhav[1]

[1] SE Mechanical Engineering Students, Pimpri Chinchwad College of Engineering & Research, Ravet – Pune, Maharashtra State, India

---

Abstract - *Biodiesel is an attractive alternative fuel for diesel engines. The feedstock for biodiesel Production is usually vegetable oil, pure oil or waste cooking oil, or animal fats. The largest possible source of suitable oil comes from oil crops such as palm, ripe seed: soya bean or sunflower. The fossil fuel resources are depleting in an alarming way due to the ever increasing demand. The fossil fuel resources are depleting in an alarming way due to the ever increasing demand. Biodiesel provides an alternative solution for fossil fuel. Mostly biodiesel is produced from non-edible oil seed and various vegetables oil like palm oil, rice bran oil, neem oil, groundnut oil, soybean oil, sunflower oil, jatropha, cotton seed etc. Biodiesel is environmental friendly fuel as the emission are less harmful.*

Sunflower is one of the leading oil seed crop, cultivated for the production of oil in the world. There are many ways to prepare biodiesel are supercritical process, ultrasonic reactor method, lipase catalyzed method, transesterification, etc. The most common way today to produce biodiesel is by transesterification of the oils with an Alcohol in the presence of an alkaline catalyst. It is a low temperature and low-pressure reaction. It yields high conversion (96%-98%) with minimal side reactions and short reaction time. It is a direct conversion to biodiesel with no intermediate compounds. In transesterification oil or fat is reacted with a monohydric alcohol in presence of a catalyst to give the corresponding monoalkyl esters. In future Biodiesel will majorly be replacing diesel in CI engines due to its several advantages.

Key Words: *Sunflower oil, Transesterification, Biodiesel, Properties, Diesel Engine Fuel.*

1. INTRODUCTION

The exponential growth of world population would ultimately lead to increase the energy demand in the world. Petroleum is a non-renewable energy source, which means that the resources of this kind of fossil fuel are finite and would be run out upon continuous use.

The use of fossil fuel is increasing in day todays life as per the need of energy production required. Now we are living in the stage at which we should think of new energy resources. Both of the shortage of resources and increase of petrol price have led to the findings of new alternative and renewable energy sources.
Bio diesel is an alternative fuel to conventional to fossil fuel. Over the last few years biodiesel has gained importance as an alternative fuel for diesel engines. "Biodiesel is defined as a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats".

Biodiesel is an attractive alternative to fossil fuels; it is biodegradable, non-toxic and has low emission profiles as compared to petroleum fuels like aromatic compounds. Biodiesel is carbon-neutral, i.e. the amount released CO2 by burning biodiesel is the same amount CO2 absorbed during the formation of the raw material. Mostly biodiesel is produced from non-edible oil seed and various vegetables oil like palm oil, soybean oil, sunflower oil, cotton seed etc. The advantages of vegetable oils compared to diesel fuel are ready availability, renewability, lower Sulphur and aromatic content. Vegetable oil does not harm environment as it does not contain Sulphur and therefore problems associated with sulphurous emissions can be reduced effectively. By using biodiesel as an alternative fuel main advantage is we don't want to modify existing engine designs. Vegetable oil has too high a viscosity for use in most existing Diesel engines as a straight replacement fuel oil. The most common method for production of biodiesel are transesterification of the oils with an Alcohol, lipase catalysed method, ultrasonic reactor method, etc.

2. MATERIAL & METHOD

The most common and commercial method used for the biodiesel production is the transesterification (also called alcoholysis).

The transesterification consists on the reaction of oils or fats (triglycerides between 15 and 23atoms, being the most common with 18) with an alcohol of low molecular weight (usually ethanol or methanol) with the presence of an catalyst, usually a strong base, such as sodium and potassium hydroxide or sodium methylate and / or sulfuric acid based transesterification processes as shown in Fig.1 [5 and 10].

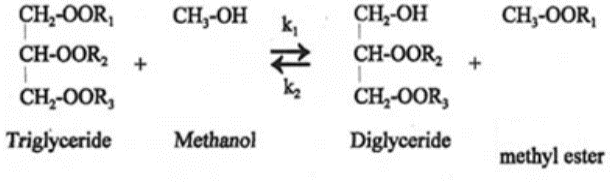

Fig.1.Reaction of triglyceride reacting with methanol

Normally, the reaction takes place at atmospheric pressure and 65ºC of temperature. The process uses constant agitation, during an interval of time between one or twelve hours.

The transesterification consists of three consecutive and reversible reactions. The stoichiometric ratio for the transesterification reaction is three moles of alcohol and one mole of triglyceride. An extra amount of alcohol is added in order to move the reaction to the methyl esters formation. Glycerine is also formed in the reaction [10].

Acid catalysts are quite effective at converting FFAs to biodiesel. An acid-catalysed pre-treatment step to convert the FFAs to esters, followed by an alkali-catalysed step to convert the triglycerides should provide an efficient method to convert high FFAs to biodiesel. Methanol is used as alcohol because of its low cost and its physical and chemical advantages. Methanol can quickly react with vegetable oil and NaOH can easily dissolve in it [5].

The stoichiometric reaction requires 1 mole of a triglyceride and 3 mole of the alcohol.

1 oil/fat + 3 methanol ⟹ 3 methyl esters + 1 glycerine

To remove fats Saponification is used and free fatty acid neutralization are undesirable side-reactions. These side reactions consume the catalyst. The triglyceride reacts with the basic catalyst with formation of soap and water. The saponification takes place only in the presence of hydroxide group (OH). It occurs when the catalyst is potassium or sodium hydroxide. The presence of water or free fatty acid favours the formation of soap. The water can be removed by evaporation, before the transesterification.

The removal the fatty acids from oil is can be done by esterification reaction with an acid catalyst forming methyl ester, as shown in Fig.2 [10].

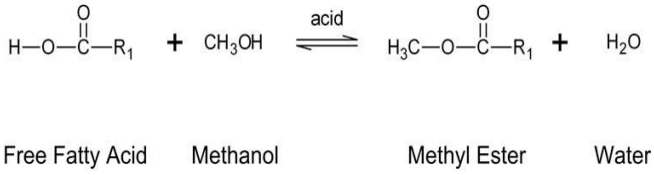

Fig.2.Reaction of Fatty acids reacting and methanol

There are some other ways to remove fatty acids, by neutralization reaction.

One of the main advantages of biodiesel is that the transesterification reaction used for its production can be carried out at -almost any scale – from laboratory scale using a few litres of oil on up to a large industrial scale capable of producing millions of litres of biodiesel per year. In situ transesterification differs from the conventional reaction in that the oil-bearing material contacts with acidified or alkalized alcohol directly instead of reacting with pre-extracted oil and alcohol. That is, extraction and transesterification proceed in one step, the alcohol acting both as an extraction solvent and an esterification reagent. In situ transesterification of sunflower oil with acidified methanol produces fatty acid methyl esters in yields significantly greater than those obtained from the conventional reaction with pre-extracted seed oils [11].

3. RESULTS & DISCUSSION

Yields of methyl esters isolated by conventional transesterification using mechanical stirring as a function of time and NaOH concentration. The best yields were obtained when the catalyst was used at the highest concentration. According to Stravarache [12] by increasing the amount of catalyst, emulsions are formed in the washing step thus hindering the purification. During washing the soap present in the ester phase has the tendency to accumulate at the surface of the two Liquids. The soap molecules, which are collected inside esters, and the water molecules form emulsions. Thus, the yields of isolated esters are very low. In the present Study, this phenomenon did not occur and the increase of catalyst's concentration caused an increase in the yield of the isolated fatty acid methyl esters. Based on the results it can be concluded that acid-catalysed in situ transesterification reaction is slow, requiring about 4 h to reach complete conversion under mechanical stirring [11].

Thus Bio Diesel was prepared from used vegetable oil, the properties resembled closely to that of commercial Diesel. Hence it can be used as an alternate for diesel. It is relatively economic than diesel and emits less pollutants. It can be used for Vehicular use, Railway usage, as heating oil when blended with other fuel oil in proportion. The experimental work carried out in this project shows that bio-diesel of acceptable quality can be produced on a small scale from a number of low-cost raw materials [2].

According to Arjun K.S, Anand Koyili, Harilal .N, Aby Kurian. M [1], bio-diesel was Obtained from the waste sun-flower oil. We blend the biodiesel in various ratios B20 and B30 with diesel. The various results obtained for bio-diesel and its various ratios are recorded below.

Parameters	Diesel	Bio-diesel	B10	B20	B30
Density (kg/m³)	830	890		820	880
Flash point (⁰c)	52	120		58	62
Fire point (⁰c)	60	135		64	70
Viscosity (mm²/s)	2.5	3.5		2.6	2.8

The process for the production of biodiesel is not very complicated and initial investment is also very less. The cost of biodiesel production is directly related to the cost of the seed, expelling cost, seed cake sale, biodiesel production cost and cost recovery from glycerol sale [1].

3. CONCLUSIONS

Biodiesel has attracted wide attention in the world due to its renewability, biodegradability, non-toxicity and environmentally friendly benefits. It is an important new alternative transportation fuel. It can be produced from different feedstock containing fatty acids such as animal fats, non-edible oils, and waste cooking oils and by products of the refining vegetables oils and algae [5].To reduce some additional cost for biodiesel preparation one can use a waste oil, which already has been used in cooking.

Transesterification is a commonly employed method for its production. The purpose of this method is to reduce the viscosity of oil or fat using acid or base catalyst in the presence of methanol or ethanol [5].In transesterification, mechanical stirring is more efficient offering a number of advantages. On the other hand, acid-catalysed transesterification is a rather time consuming method [11].

Rising of yields has a significant effect on the economics of bio-diesel production. Modern technology is giving very high yields; it needs to be demonstrated that the same can be achieved with other raw materials, whereas more information is required on alternative uses for small amounts of glycerol [2].

The chief advantage of Biodiesel for agriculture is cost minimisation. The biodiesel fuel production has gained importance for its ability to replace fossil fuels, its environmental benefits and the fact that it is a renewable source of energy. Since the direct usage of vegetable oils as biodiesel is impractical, many processes have been developed to convert them into a suitable form [2].

ACKNOWLEDGEMENT

Rahul Krishnaji Bawane , Asst. Prof., Mechanical Engineering, Pimpri Chinchwad College of Engineering & Research, Ravet - Pune, Maharashtra State, India

REFERENCES

[1]. Arjun K.S, Anand Koyili, Harilal .N, Aby Kurian. Preparation of Bio-Diesel from Waste Sunflower Oil, Volume: 03 Issue: 04 | Apr-2016.

[2]. M. Thirumarimurugan, V. M. Sivakumar, A. Merly Xavier, D. Prabhakaran, and T. Kannadasan, Preparation of Biodiesel from Sunflower Oil by Transesterification,Vol. 2, No. 6, November 2012.

[3].Mojtaba Mansourpoor and Dr. Ahmad Shariati, Optimization of Biodiesel Production from Sunflower Oil Using Response Surface Methodology, Volume 3, Issue 4 • 1000141

[4] C A Gutiérrez-Zapata, D Blanco Martínez, C A Collazos, H E Castellanos Acuña, J A Cuervo and C P Fernandez, Productions of sunflower oil biodiesel and used cooking oil through heterogeneous catalysts compared to conventional homogeneous catalysts, Conf. Ser. 786 012025.

[5].Alemayehu Gashaw, Tewodros Getachew and AbileTeshita,A Review on Biodiesel Production as Alternative Fuel,ISSN 2325 - 453X.

[6] Sarıbıyık, O.Y., Özcan, M., Serin, H., Serin, S., Aydın, K. (2012) Biodiesel Production from Ricinus Communis Oil and Its Blends with Soybean Biodiesel, Journal of Mechanical Engineering, 56, 811-816.

[7] Demirbas, A. (2008) Comparison of transesterification methods for production of biodiesel from vegetable oils and fats. Energy Conversion and Management, 49:125–130.

[8] Piloto-Rodríguez, R., Melo, E. A., Goyos-Pérez, L., Verhelst, S. (2014) Conversion of by-products from the vegetable oil industry into biodiesel and its use in internal combustion engines: a review. Brazilian Journal of Chemical Engineering, 31(02): 287 – 301.

[9] Antony Raja, S., Robinson smart, D.S., Robert Lee, C.L (2011) Biodiesel production from jatropha oil and its characterization. Research Journal of ChemicalSciences, 1 (1), 81-87

[10]Alejandro Sales Department of Chemical Engineering Royal Institute of Technology (KTH) Stockholm, Production of biodiesel from sunflower oil and ethanol by base catalyzed transesterification, June 2011

[11]K. G. GEORGOGIANNI, M. G. KONTOMINAS, D. AVLONITIS, V. GERGIS, Transesterification of sunflower seed oil for the production of biodiesel: effect of catalyst concentration and ultrasonication.

[12] C. Stravarache, M. Vinatoru, R. Nishimura, Y.Maeda, Ultrasonics Sonochemistry, 12, 2005, 367.

BIOGRAPHIES

Pravesh Jain is pursuing Bachelor of Engineering in Mechanical Engineering from Pimpri Chinchwad College of Engineering & Research, Ravet - Pune

Aditya P.Jadhav is pursuing Bachelor of Engineering in Mechanical Engineering from Pimpri Chinchwad College of Engineering & Research, Ravet - Pune