International Journal of Research In Science & Engineering e-ISSN: 2394-8299
Volume: 3 Issue: 6 Nov-Dec 2017 p-ISSN: 2394-8280

BIODIESEL FUTURE FUEL-A REVIEW

Pradeep.U.Gaikwad[1], Bankar.A.J.[2], Santosh Chavan[3], Eshwar Kakade[4]

[1]*Assistant Professor, Department of Mechanical Engineering, JSPMNarhe Technical Campus, Pune, India,**pradeepgaikwad9226@gmail.com***
[2]*Assistant Professor, Department of Mechanical Engineering, JSPM Narhe Technical Campus, Pune, India,**bankaraj15@gmail.com***

[3]*B.E student, Department of Mechanical Engineering, JSPM Narhe Technical Campus, Pune, India,**chavansantosh410@gmail.com***

[4]*B.E student, Department of Mechanical Engineering, JSPM Narhe Technical Campus, Pune, India,**eshwar.kakade@gmail.com***

ABSTRACT

Now a days we have need Biodiesel fuel as instead of diesel fuel,because of made from non-edible Vegetable-oil,fatty acid and fried oil.Using oil blends can be converted to a fuel commonly referred to as "Biodiesel".Biodiesel is aoxygenated fuel and its production is cheap, simple and eco-friendly, as a well as can be produced locally.The climate change is presently an important element of energy use and development. Biodiesel is considered "climate neutral" because all of the carbon dioxide released during consumption had been sequestered out of the atmosphere during crop growth.In this review paper we research on methyl ester blend. The blends is found to give maximum mechanical efficiency at higher compression ratio and it is 14.6% higher than diesel. Also the brake power of blends is found to be 6% higher than standard diesel at higher compression ratio and indicated mean effective pressure of blend is found to be lower than diesel at higher compression ratio. Exhaust gas temperature is low for all the blends compared to diesel.Biodiesel is best substitute for petro-diesel and also most advantageous over petro-diesel for its environmental friendliness.In the present reviewpaper attempt is made to overview the research work done on non edible oilobtained from various blend and its performance in Diesel Engine.. It is clear from thisreview that biodiesel generally decrease in HC, CO and PMemissions compared to diesel. Cetane improver which gives better combustion characteristics reduces ignition delay andmaximum amount of fuel burnt nearer to TDC and nofuel remain for the after combustion stage or exhaust pipecombustion. Lower heating value give less heatgeneration which causes lower exhaust gas temperature. It was reported that a diesel engine without any modification would runsuccessfully without damage to engine parts.
Keywords*: Biodiesel, Fatty acid, Emissions, Transesterification, Methyl ester.*

---

1. INTRODUCTION

Biodiesel is defined as mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats which conform to ASTM D6751 (American Society for Testing & Materials)[12].Biodiesel can be produced from straight vegetable oil, animal oil/fats, tallow and waste cooking oil. Biodiesel is biodegradable, nontoxic, and has significantly fewer emissions than petroleum-based diesel when burned[12].The main commoditysources for bio- diesel in India can be non-edible-oils obtained from plant species such as Jatropha,palm, Curcas, Karanj, Neem, Sunflower etc.Bio-diesel isconsidered clean

fuel since it has almost nosulphur, no aromatics and has about 10% built- inoxygen, which helps it to burn fully [12]. Its highercetane number improves the ignition quality evenwhen blended in the petroleum diesel. Fuel-grade biodiesel must be produced to strict industry specifications in order to insure proper performance. It is better for the environment because it is made from, renewable resources and has lower emissions compared to petroleum diesel. It is less toxic than bank salt and biodegraded have fast have to sugar.
It can be made in India from renewable resources such have Jatropha and Pongamia. Its use decreases our dependence on foreign oil and contributes to our own economy. Dr. Rudolfactually invented diesel engine to run we have myriad of fuel oils including coal dust suspended in water, heavy mineral oil and you guessed it, vegetable oil.Dr.Diesel's first engine experiments were catastrophic failures. But by the time he showed his engine at the World Exhibition in Paris in 1900, his engine was running on 100% peanut oil. Dr. Diesel was statedin "The diesel engine can be fed with vegetable oils and would help considerably in the development of agriculture (farming) of the countries."In 1912, Diesel said that, "the use of vegetable oil for engine fuels may seem insignificant today. But such oil maybecome alternative as petroleum and the coaltar products in the future time" Since Dr. Diesel's untimely death in 1913, his engine has been modified to run on the polluting petroleum fuel we now know as "diesel". Nevertheless, his ideas on agriculture and his invention provide the foundation for a society with clean, renewable, locally grown fuel [2].

The different types of edible vegetable oils and biodiesels assubstitutes for diesel fuels are considered in the different countriesdepending on the climate and soil conditions. For example, soybean oil in the USA, rapeseed (canola in Canada) and sunfloweroils in Europe, palm oil in South-east Asia (mainly Malaysia, Indonesia and Thailand), coconut oil in the Philippines andcottonseed oil in Greece and Turkey are being produced.Canola is the name generally applied to rapeseed that has lowamounts of erucic acid in its oil and low levels of glucose inits meal. A lot of research work pointed out that biodiesel has received a significant attention and it is a possible alternative fuel. Biodiesel and its blends with diesel were employed as a fuel for diesel engine without any modifications in the existing engine [19].

1.1 LITERATURE REVIEW:

Amrinder Mehta (2015) concluded that without any compromise with the given standard performance and without any modification in the compression ignition engine we can use the canola biofuel in engine so it is become alternative fuel [1].

Bobade S.N. (2013) reported that the Jatropha oils can be used as a source of triglycerides in the manufacture of biodiesel by transesterification reaction. The biodiesel from refined vegetable oils meets the Indian requirements of high speed [2].

Agarwal et al. (2008) investigated that the process of transesterification is found to be an effective method of reducing viscosity of vegetable oil [3].

Lawrence et al. (2011) revealed that prickly poppy methyl ester (PPME) blended with diesel could be conveniently used as a diesel substitute in a diesel engine. The test further showed that there was an increase in break thermal efficiency, brake power and reduction of specific fuel consumption for PPME and its blends with diesel [8].

Rahimi et al. (2009) used Diesterol (combination of diesel fuel, bioethanol and sunflower methyl ester) as a fuel for diesel engines. The authors revealed that, as the percentage of bioethanol in the blends is increased, the percentage of CO concentration in the emission is reduced. This trend is due to the fact that bioethanol has less carbon than diesel [16].

Mani.M. (2009) investigated the diesel engine runs with waste plastic oil as fuel. The authors concluded that, the smoke was reduced by 40% than diesel [9].

Muralidharan and Govindarajan (2011) prepared biodiesel from non-edible pongamia pinnata oil by transesterification and used as a fuel in C.I engine. The authors reported that blend B5 exhibits lower engine emissions of unburnt hydrocarbon, carbon monoxide, oxides of nitrogen and carbon dioxide at full load [13].

Sandeep Kumar Duran (2015) conducted the experiments using pure jatropha oil, jatropha methyl ester, blends of jatropha and methanol and dual fuel operation (0–80% methanol by volume is inducted and jatropha acts as pilot fuel). The authors reported that, brake thermal efficiency for jatropha esters, dual fuel operation and diesel was 29%, 28.7% and 30.2% respectively [6].

Srivastava and Verma (2008) carried out the experiments using methyl ester of karanja oil. The authors reported that, the maximum thermal efficiency with methyl ester of karanja oil was about 24.9%, whereas that of the diesel was 30.6% at maximum power output. The authors concluded that, the methyl ester of karanja oil is a suitable substitute of diesel[18].

Ramadhas et al. (2008) studied the dual fuel mode operation using coir-pith derived producer gas and rubber seed oil as pilot fuel. The authors reported that, non-edible oils can be used as pilot fuel, which eliminates the use of petroleum diesel[17].

Nwafor (2004) studied the potential of rapeseed methyl ester and its blends with diesel fuel as alternative substitute for diesel fuel. The author described that, the fuel consumption of rapeseed methyl ester was little higher than diesel fuel operation[14].

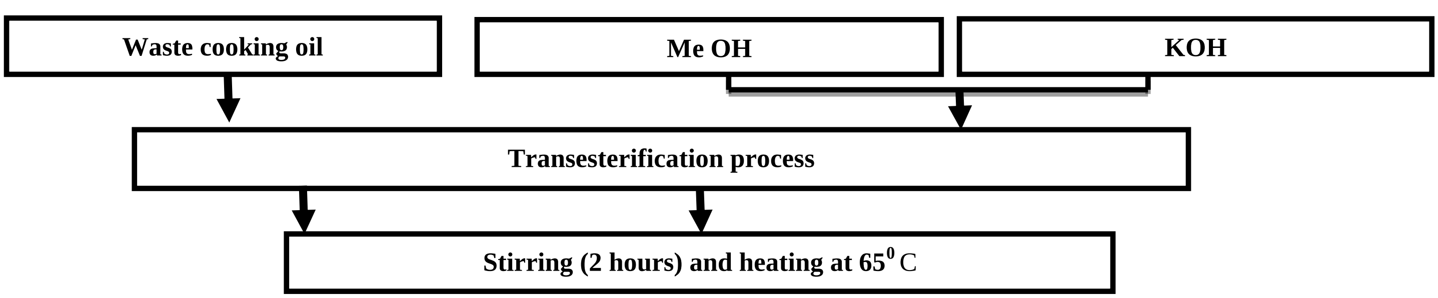
Forson et al. (2004) found that, jatropha oil could be conveniently used as a diesel substitute, in a diesel engine[5].

Wanget al. (2006) confirmed that, the vegetable oils possess almost the same heat values as that of diesel fuel. The engine power output and the fuel consumption of the vegetable oil and its blends are almost the same when the engine is fueled with diesel[20].

From the review of literatures, numerous works in the utilization of biodiesel as well as its blends in engines have been done. However, most of the literatures focused on single biodiesel and its blends. From previous studies, it is proved that single biodiesel offers acceptable engine performance and emissions for diesel engine operation.

2.0.TRANSESTERIFICATION PROCEDURE

Transesterification or alcoholysis is the displacement of alcohol from an ester by another in a process similar to hydrolysis, except an alcohol is used instead of water[10].This process has been widely used to reduce the high viscosity of triglycerides.



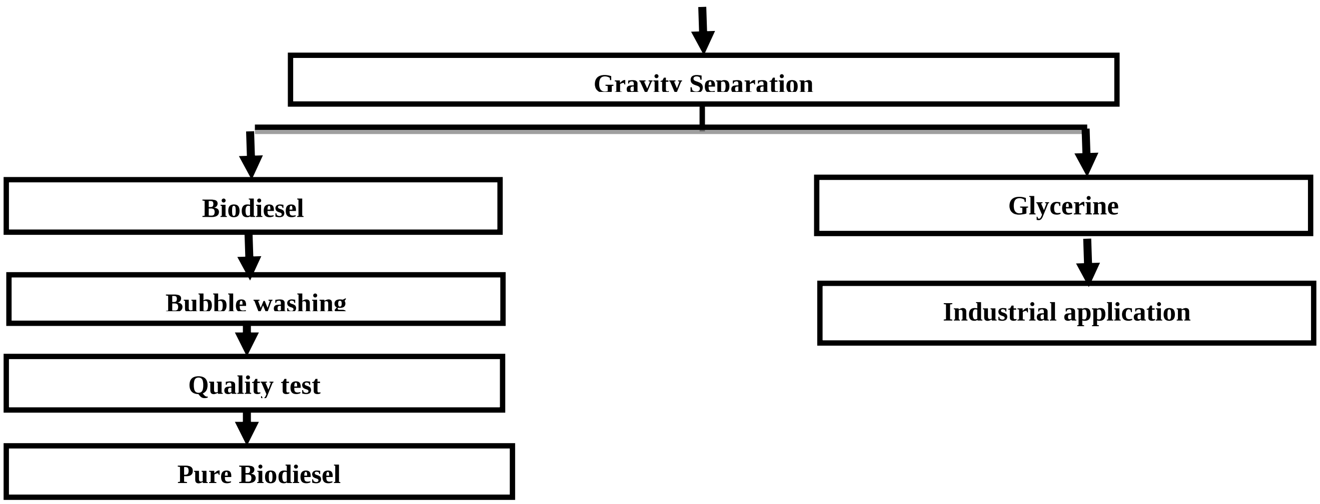


Fig -1: Basic transesterification process [1].

The transesterification reaction is represented by the general equation as below[10]

$$RCOOR' + R''OH \leftrightarrow RCOOR'' + R'OH$$

2.1.General equation of Transesterification:

Some feedstock must be pre-treated before they can go through the transesterification process. Feedstock with less than 5 % Free Fatty Acid, may not require pretreatment. When an alkali catalyst is added to the feedstock's (With FFA > 5 %), the Free Fatty Acid react with the catalyst to form soap and water as shown in the reaction below:If methane is used in this process it is called methanolysis. Methanolysis of triglyceride is represented:

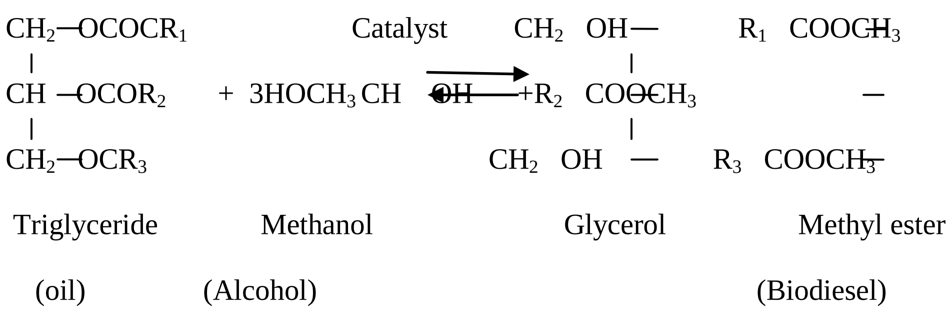


Fig2-General equation of transesterification [2]

Transesterification is one of the reversible reactions. However, the presence of a catalyst (a strong acid or base) accelerates the conversion. In the present work the reaction is conducted in the presence of base catalyst [11]. The mechanism of alkali-catalyzed transesterification is described below. The first step involves the attack of the alkoxide ion to the carbonyl carbon of the triglyceride molecule, which results in the formation of tetrahedralintermediate. The reaction of this intermediate with an alcohol produces the alkoxide ion in the second step. In the last step the rearrangement of the tetrahedral intermediate gives rise to an ester & a diglyceride. The same mechanism is applied to diglyceride and monoglyceride.

2.2.Process Requirements:

1) Revolutions of stirrer: 600-700 rpm

2) Temperature of reaction: 65-70^{0}C

3) Oil sample: 1000 ml

4) Methanol used: 250 ml/litre of vegetable oil

5) KOH: 4.5 gm/liter of vegetable oil

6) Reaction time: 2 hours

7) Sulphuric acid: 1.0 ml/liter of vegetable oil [1]

3.0.EXPERIMENTAL SET UP:

The experimental set up is shown in figure 3. A 1000 ml three necked round –bottom flask was used as a reactor. The flask was placed in heating mantle whose temperature could be controlled within +2 0C. One of the two side was equipped by necks with a condenser and the other was used as a thermo well. A thermometer was placed in the thermo well containing little glycerol for temperature measurement inside the reactorIn blade stirrer was passed through the exchange neck, which was connected to has to motor along with speed regulator for adjusting and controlling the stirrer speed. 1000ml of esterified Calophyllum oil was measured and poured into a 2000 ml three necked round bottom flask. This oil was heated upto 60^{0}C. In 250ml beaker a solution of potassium methoxide was prepared using 0.5 wt. % sodium hydroxide pellet with 1:6 molar ratio of oil to methanol [2].

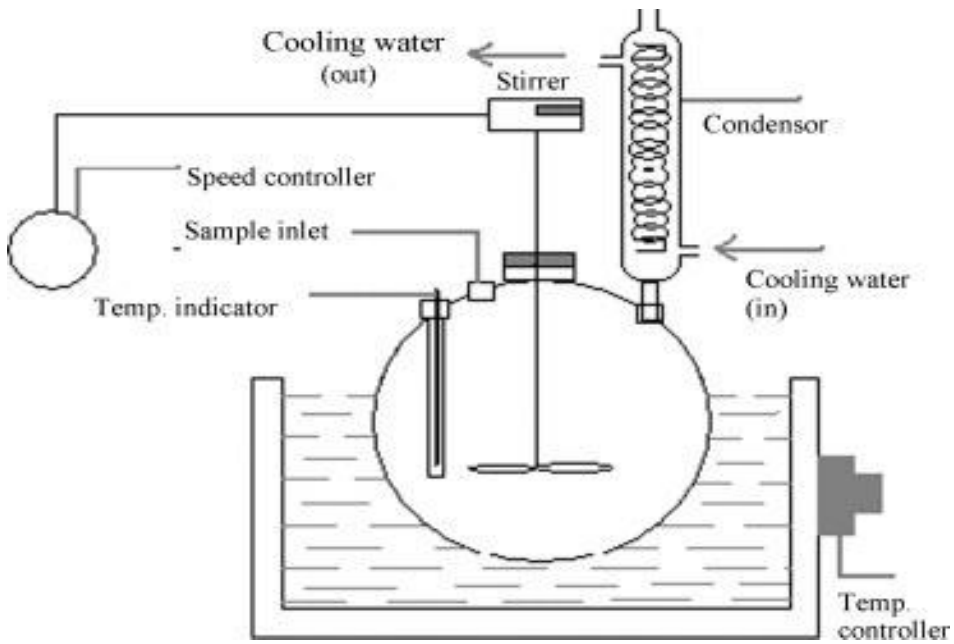


Fig-3 Experimental Set up for transesterification of crude oil[2]

The solution was properly stirred until the potassium hydroxide pellet was completely dissolved. The solution was then heated upto 60 ^{o}c and slowly poured into preheated oil. The mixture was stirred vigorously for one and half hour. Finally FFA was checked and mixture was allowed to settle for 24 hours in has separating funnel. Thereafter, upper layer biodiesel was decanted into has separate beaker while the lower layer which comprised glycerine and soap was collected from the bottom of separating funnel. To remove any excess glycerol as well as soap from the biodiesel, hot water was used to wash it and then allowed it to remain in separating funnel until clear water was seen below the biodiesel into the different funnel. The PH of biodiesel was then checked.The biodiesel was washed by a sample then dried by placing it on a hot plate and excess water still in the biodiesel removed.

Fig -4: Biodiesel Reactor before the transesterification start and after the transesterification [1].

4.0.CONCLUSION:

Biodiesel fuel has been reported to provide a lot of potentials than fossil fuel for instance better quality gas exhaust generation which can lead to reduction in global warming effects and environmental hazards. The production of biodiesel from edible oil iscurrently much more expensive than diesel fuels due torelatively high cost of edible oil.
Use of biodiesel blends in diesel reduces emission of NOx gas.The performance parameters of biodiesel proved to surpassthat of diesel fuel and its application requires no enginemodification.The biodiesel based on non-edible oil stocks has been emerging as a technically feasible, economically competitive, environmentally sustainable and socially beneficial substitute automotive fuel for diesel.Comparing the results and stating best blend that gives higher efficiency.significantly in next coming year's petroleum diesel will replace by biodiesel The lower blends of biodiesel increased the brake thermal efficiency and reduced the fuel consumption. In addition to this, biodiesel blends produce lower engine emissions than diesel.

REFERENCES:

[1] Amrinder Mehta, Sandeep Kumar Duran, 2015. "Canola Biodiesel: An Experimental Investigation for Production of Biodiesel and Performance Measurement In Diesel Engine", International Journal of Research in Engineering and Technology, Volume: 04 Issue: 04 | Apr-2015.

[2] Bobade S.N., Kumbhar R.R. and Khyade V.B, 2013,"Preperation of Methyl Ester (Biodiesel) from Jatropha Curcas Linn Oil", Research Journal of Agriculture and Forestry Sciences, Vol. 1(2), 12-19, March (2013).

[3] Agarwal, D., Kumar, L., Agarwal, A.K., 2008. Performance evaluation of a vegetable oil fuelled compression ignition engine. Renew. Energy 33, 1147–1156.

[4] Wang, Y.D., Al-Shemmeri, T., Eames, P., et al, 2006. An experimental investigation of the performance and gaseous exhaust emissions of a diesel engine using blends of a vegetable oil. Appl. Therm. Eng. 26, 1684–1691.

[5] Forson, F.K., Oduro, E.K., Hammond-Donkoh, E., 2004. Performance of jatropha oil blends in a diesel engine. Renew. Energy 29, 1135–1145.

[6] Sandeep Kumar Duran, Maninder Singh, Hardeep Singh, "Karanja and Rapseed Biodiesel: An Experimental Investigation of Performance and Combustion Measurement for Diesel Engine", International Journal of Science & Engineering Research, Volume 6, Issue 1, January-2015, pp. 295 – 299.

[7] Kumar, M.S., Ramesh, A., Nagalingam, B., 2003. An experimental comparison of methods to use methanol and jatropha oil in a compression ignition engine. Biomass Bioenergy 25, 309–318.

[8] Lawrence, P., Mathews, K., Deepanraj, B., 2011. The effect of prickly poppy methyl ester blends on CI engine performance and emission characteristics. Am. J. Environ. Sci. 7, 145–149.

[9] Mani.M, Subash.C, Nagarajan.G, 2009. Performance, emission and combustion characteristics of a CI diesel engine using waste plastic oil. Appl. Therm. Eng. 29, 2738–2744

[10] Chavan S. B., Kumbhar R. R. and Sharma Y. C.(2014),"Transesterification of Citrullus colocynthis(Thumba) oil:Optimization for biodiesel production",Advances in Applied Science Research, 2014, 5(3):10-20

[11] Keim G.I. and Newark J.N.1945, Treating the fats and fatty oils, US patents No- 2383601.

[12] P. U. Gaikwad, K L Balan, S. S. Sarawade 2017. "Biodiesel Fuel- A Review"6th National Conference RDME 2017, 17th- 18th March 2017.

[13] Muralidharan, K., Govindarajan, P., 2011. The effect of bio-fuel blends and fuel injection pressure on diesel engine emission for sustainable environment. Am. J. Environ. Sci. 7, 377–382.

[14] Nwafor, O.M.I., 2004. Emission characteristics of diesel engine operating on rapeseed methyl ester. Renew. Energy 29, 119–129.

[15] Rahimi, H., Ghobadian, B., Yusuf, T., et al, 2009. Diesterol: an environment-friendly IC engine fuel. Renew. Energy 34, 335–342.

[16] Ramadhas, A.S., Jayaraj, S., Muraleedharan, C., 2008. Dual fuel mode operation in diesel engines using renewable fuels: rubber seed oil and coir-pith producer gas. Renew. Energy 33, 2077–2083.

[17] Srivastava, P.K., Verma, Madhumita, 2008. Methyl ester of karanja oil as alternative renewable source energy. Fuel 87, 1673–1677.