Study on characteristics of Diesel Engine using Corn oil blend with diesel

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***Abstract*— *At present, about 80% of the world's demand for transportation fuels- road, rail, air and sea- are met by derivatives from the fossil fuels such as petroleum and diesel. This project aims at finding an alternative for these fossil fuels. The various parameters that have been considered for the selection of the oil are kinematic viscosity, viscosity index, calorific value, flash point, fire point, sulphur content, carbon content, pour point, and density etc. Bio diesel is produced by transesterification of triglycerides present in animal fat or vegetable oils, by displacing glycerin with a low molar mass alcohol. This resulting ester mixture has physico-chemical properties similar to those of petroleum diesel. This paper reviews the synthetic paths that lead to size-chain bio diesel by means of the catalytic transesterification of vegetable oils. Although methyl esters are at present the only ones produced at industrial scale, the use of ethanol, which can also be obtained from renewable resources, has been considered, since it would generate a cleaner and more bio compatible fuel.*

Keywords*— Alternate fuel; Biodiesel; Glycerin; Transesterification;

1. INTRODUCTION

The world petroleum situation due to rapid depletion of fossil fuels and the degradation of the environment due to the combustion of fossil fuels have caused a resurgence of interest in finding alternative fuel. Internal combustion engines for man indispensable part to the transportation as well as mechanized agricultural systems. Thermodynamic tests, based on engine performance evaluation have established the feasibility of using a variety of alternative fuels such as hydrogen , CNG, alcohols, biogas, producer gas and a host of corns such as castor oil, neem oil, palm oil, corn oil etc.

The energy crisis of 1973 and the unstable situation in the Middle East have led to a number of approaches to reduce dependence on fossil fuels. This has resulted in environmentally friendlier at proceeds with a alternatives which allow obtaining energy from non- conventional and renewable energy sources (i.e., bio fuel) with a similar efficiency output . Energy comes in a variety of renewable forms; wood, biomass, wind, sunlight. It also comes in the nonrenewable form of fossil fuels- oil and coal and their use is a major source of pollution of land, sea and above all the air we breathe. Two centuries of unprecedented industrialization, driven mainly by fossil fuels, have changed the face of this planet.

Renewable fuels like bio diesel are becoming increasingly popular alternatives to petroleum based fuels. While vegetable oil can be burned directly, it is not recommended as an engine fuel due to its high viscosity.

In the transesterification reaction, vegetable oil, that is predominately made up of triglyceride molecules, is re- acted with an alcohol (usually methanol) to produce a by-product, glycerol, and three bio diesel molecules with viscosity and other properties similar to those of petroleum diesel fuel. The recent increase in biodiesel production has also led to increasing interest in developing new uses for the low-cost glycerol by-product (Acosta etal., 2011). Reaction rate and product quality are influenced by type and amount of catalyst, type of oil feed stock, alcohol to oil ratio, water and free fatty acid content of the oil, and operating conditions such as temperature, pressure, and mixing rate (Freedman et al., 1986; Sing etal., 2006). The complex dependence of rates and yields on a variety of factors makes it of interest to monitor the transesterification reaction for research and development as well as commercial bio diesel production processes. The base-catalyzed transesterification reaction involves multiple reaction steps: (1) triglyceride is attacked by a methoxide ion CH3OÀ (present in the basic methanol solution) to produce one bio-diesel (BD) and a di-glyceride, (2) di-glyceride is converted to a second BD and a mono-glyceride, and (3) mono-glyceride is converted to a third BD and glycerol. Methanol and oil are essentially insoluble in one another, as are the glycerol and bio diesel products.

2. PROBLEM IDENTIFICATION

A. Emission

Now a day's emissions are the major problem for environmental condition. Exhaust gas of I.C engines contain harmful gas like HC, COx, NOx, SOx and solid carbon particulates. This exhaust emission into the surroundings pollutes the atmosphere and causes the following problems, Global warming, Acid rain ,Smog ,Odours ,Respiratory and Health hazards.

It is the dream of engineers and research scholar to develop engines and fuels such that very few quantity of harmful emissions are generated and those could be let into the surrounding without a major impact on the environment. C.I engines are pollutant engines.

According to that dream emission norms are reduced in vast manner by using filters like catalytic converters and chemical method like EGR system and ammonia injection system, etc. I.C engines also contain non exhaust emission that present in fuel tank, carburetor, crank case, and also in tail pipe exhaust emission. The contributions of pollutants are evaporative losses.

B. *Vibrations and Noise*

For smooth running of the engine, balancing of the engine is necessarily required. Unbalanced parts of engine create vibration and noise. By rotating parts of engine (crank shaft, fly wheel, etc) create high vibration due to unbalancing and moving parts of engine (connecting rod, fly wheel, etc) create vibrations. Noise is produced by air intake manifold, tyres, transmission system, silencer, etc.

3. Rectification of Emission Problems

In general alternate fuel contains less amount of carbon chain is very less. So, hydro carbon and carbon dioxide emitted by alternate fuel is very less when compare to diesel fuel. Fuel combination can be changed by adding some amount of blending with existing fuel. That blending fuel is called as alternative fuel. Some blending combination are given below,

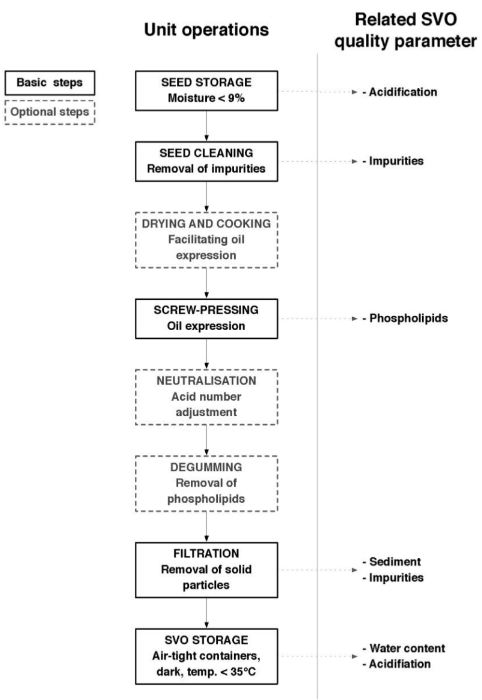
10% bio diesel & 90% diesel.

20% bio diesel & 80% diesel.

30% bio diesel & 70% diesel.

40% bio diesel & 60% diesel

4. Experimental Setup



A. *Transesterification reaction*

The transesterification of vegetable oils with alcohol simple long the preferred method for the production of biodiesel. In general, there are two methods of transesterification. One method uses a mere catalyst and the other is without a catalyst. Former method has a long history of development of bio-diesel produced by this method is now available in North America, Japan and some countries in Western Europe

$$\text{Triglyceride} + \text{ROH} \overset{\text{catalyst}}{\Longleftrightarrow} \text{Diglyceride} + \text{R}^{\text{I}}\text{COOR}$$

$$\text{Diglyceride} + \text{ROH} \overset{\text{catalyst}}{\Longleftrightarrow} \text{Monoglyceride} + \text{R}^{\text{II}}\text{COOR}$$

$$\text{Monoglyceride} + \text{ROH} \overset{\text{catalyst}}{\Longleftrightarrow} \text{Glycerol} + \text{R}^{\text{III}}\text{COOR}$$

B. *The effect of catalysts*

To make the transesterification process possible a catalyst in the form of an alkali, acid or lipase enzyme is required

1) Alkali Catalyst:

Alkali-catalysed transesterification is much faster than acid-catalysed transesterification and is less corrosive to industrial equipment and therefore is the most often used commercially (Ma and Hanna, 1999; Ranganathan et al., 2008; Agarwal, 2007; Marchetti et al., 2007). Sodium hydroxide or potassium hydroxide is used as basic catalyst with methanol or ethanol as well as the vegetable oil. Sodium hydroxide is cheaper and is the widely used in large scale-processing. The alkaline catalyst concentration in the range of 0.5 - 1% by weight yield 94 - 99% conversion of most vegetable oils into esters. There are several disadvantages in using an alkaline catalysis process although it gives high conversion levels of triglycerides to their corresponding methyl esters in short reaction times. The process is energy intensive, recovery of glycerol is difficult, the alkaline catalyst has to be removed from the product, alkaline wastewater generated requires treatment and the level of free fatty acids and water greatly interfere with the reaction. The risk of free acid or water contamination results in soap formation that makes the separation process difficult.

C. *Acid Catalyst*

The second conversional way of making the biodiesel is to use the triglycerides with alcohol and an acid. Sulphuric acid, sulfonic acids, and hydrochloric acids are the usual acid catalysts but the most commonly used is sulphuric acid. Acid catalysts are used if the triglyceride has a higher free fatty acid content and more water. Although the yields could be high, the corrosiveness of acids may cause damage to the equipment and the reaction rate can be low, sometimes taking more than day to finish (Freedman et al., 1984). According to some authors, the reactions are also slow, requiring typically temperature above 100°C and more than 3 h to complete the conversion (Meher et al., 2006). For example, Freedman et al. (1986) studied the transesterification of soybean oil in the presence of 1% sulphuric acid with alcohol/oil molar ratio 30:1 at 65°C and the conversion was completed in 20 h.

D. *Heterogenous Catalysts*

Heterogeneous catalysts such as amorphous zirconia, titanium and potassium zirconias have also been used for catalysing the transesterification of vegetable oils. Huaping et al. (2006) demonstrated the potential of preparing biodiesel from J. curcas oil catalysed by solid super base of calcium oxide and its good refining process. When treated with ammonium carbonate solution and calcinated at high temperature, calcium oxide becomes a solid super base, which shows high catalytic activity in transesterification. Under the optimum conditions, the conversion of J. curcas oil can reach

93%. The heterogeneous catalyst eliminates the additional cost associated with the homogeneous sodium hydroxide to remove the catalyst after transesterification.

5. What Types of Vehicles Can Use Biodiesel?

Limited amounts of biodiesel can be used in any diesel vehicle without modification. Applications include buses, delivery trucks, waste disposal and recycling trucks, construction equipment, heavy-duty freight-hauling trucks, boats, passenger vehicles and tractors (Fig. 3). Biodiesel can be blended at any ratio with petroleum diesel to achieve cost efficiency and improve cold weather performance. It is commonly used as B20 – a blend of 20 percent biodiesel and 80 percent petroleum diesel. You can use B100 or "neat" (100 percent biodiesel) or any other mix with diesel.

- Biodiesel has a higher flash point than fossil diesel and so is safer for storage or in the event of an accident.
- Compared with fossil diesel, biodiesel combustion emits fewer pollutants such as carbon monoxide (CO) and particulates (see Table 1). Sulfur is almost completely eliminated. Nitrous oxides may stay the same or increase but can be reduced with a catalytic converter and/or by altering the engine timing.
- Biodiesel is more lubricating than mineral diesel and so increases fuel injector pump life.
- Biodiesel can reduce waste by recycling used oil.
- Biodiesel has an energy balance of 3:1; i.e., it provides over three times the amount of energy used to produce it. toolbar.

A. *Economic Feasibility of Biodiesel*

India has rich and abundant resources of edible and non-edible oilseeds, the production of which can be stepped up manifolds if the government provides incentives to farmers for production of biodiesel. The economic feasibility of biodiesel depends on the price of crude petroleum and the cost of transporting diesel over long distances to remote areas. It is a fact that the cost of diesel will increase in future owing to the increase in its demand and limited supply. Further, the strict regulations on the aromatic and sulphur contents of diesel fuels will make diesel costlier, as the removal of aromatics from distillate fractions needs costly processing equipment and continuous high operational cost as large amounts of hydrogen are required for ring saturation. Similarly, reducing the sulphur content is also a big challenge for the industries. Currently, the production of methyl or ethyl esters from edible oils is much more expensive than that of diesel fuels due to the relatively high costs of vegetable oils. An economic analysis for the production of biodiesel using different types of edible and no edible oils has been carried out and the results are reported in Fig.1

Vegetable oil	Cost of vegetable oil per litre (Rs.)	Cost of biodiesel per litre (Rs.)
Groundnut	58	48.28
Mustard	48	38.60
Sesame	64	54.00
Coconut	28	18.61
Safflower	60	50.26
Soya bean	40	30.26
Sunflower	50	40.26
Linseed	23	13.56
Pongamia oil (non-edible oil)	18	10.50
Diesel		22.00

Conclusion

Emission and Performance parameters could be improved by the usage of this bio diesel. This substitute would face the economic cost based on fuel usage. Behalf the fuel consumption could be reduced to a considerable range. In order to meet the growing demands for energy and to cope with the craze in that region for bio fuels from oil-bearing plants. The diesel engine performed satisfactorily on biodiesel, so that the corn seed oil and diesel blend can be used as an alternative fuel in existing diesel engine without any modification in the system. This substitute would face the economic cost based on fuel usage. Behalf the fuel consumption could be reduced to a considerable range. A number of studies have shown that triglycerides (vegetable oils/animal fats) hold promise as alternative fuels for diesel engines. It was observed from the reported literature that the most of the transesterification studies have been

done on edible oils like rapeseed, soybean, sunflower, canola etc. by using methanol and sodium / potassium hydroxide as catalyst. There are very few studies reported on non-edible oils. From the literature review, it is observed that the biodiesel properties are close to the diesel and satisfies fuel standards of many countries. It was reported that the combustion characteristics of biodiesel are similar as diesel and the engine power output with biodiesel was found to be equivalent to that of diesel. Moreover, the use of biodiesel in diesel engine results in drastic reduction engine emissions. The oxidation of biodiesel during storage period may be reduced by the use of antioxidants.

Economic feasibility study shows that the biodiesel obtained from non-edible oils is cheaper than that from edible oils. From this review, we conclude that the biodiesel is a better alternative renewable fuel for the diesel.

References

[1] Roudardt L. Terres cultivables non cultivées : Des disponibilités suffisantes pour la sécurité alimentaire durable de l'humanité. Centre d'etudes et de prospective , Analyse 2010;18

[2] Klaus D, Derek B. Rising Global Interest in Farmland: Can It Yield Sustainable and Equitable Benefits. World Bank 2010.

[3] Blein R, Goura Soulé B, Faivre Dupaigre B, Yérima B. Les potentialités agricoles de l'Afrique de l'Ouest (CEDEAO). FARM; 2008.

[4] Roudart L. Terres cultivables et terres cultivées : Rapport de l'analyse croisée de trois bases de données à l'échelle mondiale. Notes et études socio-économiques. 2010 34:57-95.

[5] Azoumah Y, Blin J. R & D sur les biocarburants en Afrique de l'Ouest : état des lieux et enjeux Liaison Énergie-Francophonie. 2009;82:15-20.

[6] Blin J, Dabat M-H, Faugere G, Hanff E, Weisman N. Opportunités de développement des biocarburants au Burkina Faso. 2008. p. 134.

[7] Nonyarma E, Laude JP. Policy framework for the development of biofuels in Burkina Faso. Sud Sciences & Technologies. 2010;19-20.:9.

[8] Yamamoto H, Fujino J, Yamaji K. Evaluation of bioenergy potential with a multi-regional globalland- use-and-energy model. Biomass and Bioenergy. 2001;21:185-203

[9] Misra RD, Murthy MS. Straight vegetable oils usage in a compression ignition engine:a review.Renewable and Sustainable Energy Reviews. 2010;14:3005-13.

[10] [10] Singh SP, Singh D. Biodiesel production through the use of different sources and characterization of oils and their esters as the substitute of diesel: a review. Renewable and Sustainable Energy Reviews. 2010;14:200-16.

[11] [11] Karmakar A, Karmakar S, Mukherjee S. Properties of various plants and animals feedstocks forbiodiesel production. Bioresource Technology. 2010;101:7201-10.

[12] Noureddini H, Zhu D. Kinetics of transesterification of soybean oil. J Am Oil Chem Soc 1997;74:1457–63.

[13] Zhang Y, Dube MA, McLean DD, Kates M. Biodiesel production from waste cooking oil: 2. Economic assessment and sensitivity analysis. Bioresour Technol 2003;90:229–40.

[14] Kusdiana D, Saka S. Kinetics of transesterification in rapeseed oil to biodiesel fuels as treated in supercritical methanol. Fuel 2001;80:693–8.

[15] Komers K, Stloukal R, Machek J, Skopal F. Biodiesel from rapeseed oil, methanol and KOH: 3. Analysis of composition of actual reaction mixture. EurJ Lipid Sci Technol 2001;103:363–71.