

Biodiesel: A promising alternative fuel

Rohan N, Prashant Muchakhandi, Nithin Kumar N G, Veerendra S

Alva's Institute of Engineering & Technology

Abstract

Due to the finite stock of fossil fuels and its negative impact on the setting, several countries across the world are currently leaning toward renewable sources energies like alternative energy, wind energy, biofuel, hydropower, geothermal and ocean energy to make sure energy for the countries development security. Biodiesel is one reasonably biofuel that's renewable, perishable and has similar properties of fossil fuel. The aim of this paper isto provide the substantial data on biodiesel to the researchers, engineers and policy manufacturers. To achieve the goal, this paper summarizes the knowledge on biofuel development, feedstocks round the world, oil extraction technic, biodiesel production processes. what is more, this paper also will discuss the benefits of biodiesel compared to fuel. Finally, the combustion behavior of biodiesel in an enclosed combustion engine is mentioned and it'll facilitate the researchers and influential person and manufacturer. to see the longer term and goal of technology the study found that, feed stock choice for biodiesel production is incredibly important because it associates seventy five cost. Moreover, the take a look at of fuel properties is incredibly vital before using within the engine that depends on the kind of feed stocks, origin country, and production method. Most of the researchers reported that the utilization of biodiesel in diesel reduces engine power slightly however reduces the harmful emission considerably.

Keywords: *Biodiesel, Production, Effects of different Parameters, Advantages & Disadvantages*

1.INTRODUCTION

Biodiesel may be a biofuel derived from vegetable oils and animal fats. It is non-toxic, perishable and produces less sulfur and hydrocarbons, and can be utilized in diesel engines with nominal modifications. Biodiesel consists of a combination of monoalkyl esters and long chains of fatty acids derived from differing types of oils and fats, obtained mostly via transesterification with a lower alcohol within the presence of a catalyst.

Edible vegetable oils, like soybean, sunflower and palm oils, are the most feedstock utilized in the assembly of biodiesel. However, the high price of those oils, that accounts for concerning 70% of the whole worth of biodiesel production, similarly because the competition with food and soil degradation thanks to giant planting scales, are disadvantages for production and commercialisation of biodiesel. Palm biofuel contains a higher flash purpose than diesel, therefore it's safer. But because the "kinematic consistence and density are on top of diesel fuel it should have an effect on spray characteristics". Biodiesel provides decrease in carbonic acid gas CO₂", and hydrocarbons HCemissions, with little increase in chemical element oxides NO_x". The results of experiments of a ICE performance victimization different palm biodiesel mixtures show "73% reduction in unburned HC emissions and forty six reduction in CO₂ emission". Palm biodiesel mix (B20) causes reduction in "exhaust emissions compared to diesel fuel" increased "percentage of biodiesel within the blends will increase Roman deity emissions and decreased CO and "HC emissions".

The transesterification reaction to get biodiesel on Associate in Nursing industrial scale is typically distributed employing a homogenised chemical process with a powerful catalytic base. This reaction has blessings such as: lower reaction time, higher conversion, and a comparatively bit of catalyst used, when compared to alternative chemical action ways. However, this homogenised, basic chemical process is affected principally by the presence of FFA and water, that ends up in the formation of soap and consequently reducing the yield reaction. Acid-catalyzed reactions (sulfuric acid, hydrochloric acid), on the other hand, are not influenced by the presence of FFA. However, they are sensitive to the presence of water, and as such, their reactions are slower and require higher temperatures.

2. Preparation of Biodiesel

2.1 Methods of producing Biodiesel

There are four procedures are available for the production of Biodiesel are elaborated below.

2.1.1 Blending (Dilution)

Viscosity of vegetable oil is more than the viscosity of diesel fuel. But, when the high viscosity liquid is mixed with low viscosity liquid in small quantity it will not affect the overall liquid property. Some oils have viscosity almost 25-30 times higher than the viscosity of diesel can be blend with diesel up to 5%. But most of the oils with low viscosity can be easily blended with diesel up to 20%. With most of the researches, ratio 20:80 oil to diesel blend has given results approximately to the same as the result of diesel fuel alone. When the blend percentage is increased to above 20% of oil then viscosity of blend increases, affecting the atomization of fuel which results in improper combustion and may cause to increase to UBHC emission. Increase in oil percentage also increases flash and fire points of the blend solution which will restrict starting condition of an engine. But before blending we must keep tracking to the oil about its purity and is completely filtered with no impurities in the oil.

2.1.2 Micro emulsification

A micro emulsion is defined as the colloidal equilibrium dispersion of optically isotropic fluid microstructures with dimensions generally in the range of 1–150 nm formed spontaneously from two normally immiscible liquids and one or more ionic or non-ionic amphiphiles. As the cost of this process is costlier compare to the other processes hence it is rarely used method in the field of biodiesel production. In this method, diesel & oil are mixed to each other in the form of very fine particle so that they can proper mix and form a uniform solution. In this method, solvents like alcohols are used which have good combustible properties while mixing oil and diesel for improving the combustion of fuel.

2.1.3 Cracking (Pyrolysis)

The chemical method in which heat is used to convert one substance into another is called as Cracking or Pyrolysis process. Fuel production from plastic is one of the examples for this process. Heating is done in the presence of inert gases like xenon, krypton etc or in the absence of oxygen. This method is used to purify raw oil & to reduce the oil viscosity to very low value. Refining of Petroleum products are done by this method itself.

2.1.4 Esterification/Transesterification

Transesterification is most commonly used process for the production of biodiesel from any oil. In this, alcohol is used to breakdown the raw oil molecule into ester molecules. For this kind of process, it is required to supply heat energy. Catalyst is used a source of energy. Alcohols like methanol, ethanol or butanol are used for Esterification/Transesterification process. Initially oil is mixed with the alcohol in presence of acid or base catalyst. Alcohol mixed with oil is either methanol or ethanol, but mainly methanol is used for mixing because its lower boiling temperature compare to ethanol. This mixing process is done under constant temperature & is continuously stirred with the help of the stirrer for 1.5 hour. Then it is kept for 4-5 hours to get settle down which forms two layer of liquid. Upper layer is the required oil for making biodiesel and lower layer is glycerine which can be used for other industrial purpose. Then the next step is methanol recovery in which methanol which was mixed is extracted from the oil. Then washing of the oil is done by passing hot water through oil which gives the by-product phenyl. We can use this phenyl for cleaning purpose. At last the drying process is done to remove the water which got dissolved in the oil while washing.

Trans-esterification is either done by one stage or two stages. It is identified by conducting the FFA test of the raw oil or refined oil. This whole process takes as much as 10 hours for single stage and 16 hours for 2 double stages to convert it from vegetable oil to biodiesel. Transesterification can be classified into seven types as follows,

- Microwaves Assisted Synthesis Transesterification
- Alkaline/Base catalyzed Transesterification
- Acid-Alkaline catalyzed Transesterification (Two Stages)
- Acid catalyzed Transesterification
- Heterogeneous catalyzed Transesterification
- Non Catalyzed Supercritical Transesterification

3. Effect of different parameters on biodiesel production

Looking at the theory for the production of the biodiesel, anybody would feel it is easy to produce biodiesel referring to theory. But in actual there are many factors which affects the biodiesel composition. Below are the factors experienced during the procedure of producing RB and H biodiesel.

- **Effect of Moisture or Water content**

Moisture content is one of important factors for the change in composition of the oil. Small amount water content makes the huge effect on biodiesel production. The main reason of decrease in yield is presence of moisture. Moisture also leads to difficulty in mixing of oil with esters. Because of moisture separation also becomes very complex and complicated. But in case of esterification the effect of moisture is zero. There is almost no effect moisture to the yield or production of biodiesel in esterification method. If we use supercritical methanol for the reaction between alcohol and oil, then there is totally no effect of moisture on production biodiesel.

- **Effect of Time & Temperature**

As we use methanol, as the alcohol, most of the time for reaction, it is important know about the property of methanol for the biodiesel production. As the temperature at which methanol starts boiling is 65°C it is important to let the reaction take place at below 65°C . Usually the reaction temperature is 60°C for most of the oils. Again time and temperature both are interrelated to each other. In Esterification and Transesterification, time is inversely proportional to temperature. If take more time for reaction then temperature is needed to be decrease & if we increase the reaction temperature then reaction time must be reduced to maintain the quality & quantity of biodiesel production. Also if the viscosity of the oil it high the temperature range can be increase to maintain the reaction.

- **Effect of Specific Gravity**

Specific gravity plays a vital role in making the blends of biodiesel with diesel. It is important for the biodiesel to have the specific gravity very near to that of diesel. If there is wide difference in viscosity between biodiesel & diesel, then there is chance of not proper blending of biodiesel and diesel. This type of fuel is not acceptable for running the engine.

- **Effect of Molar Ratio**

One of the main reasons for the use of methanol or methyl alcohol is its cost cheaper compare to other alcohol. Methanol is used for breaking the triglycerides chain structure to get esters. Here the molar ratio is the ratio of oil molecular weight to methanol molecular weight. Optimum molar ratio is 6:1. In case we increase molar ratio value, then it will take more time for the separation process & recovery of methanol becomes complicated which will lead to the increase in the processing cost increase in optimum molar ratio will lead to strong bond of ester with moisture & reducing the molar ratio will lead to less yield of biodiesel.

- **Effect of Fatty Acid**

Esterification & Transesterification is done to reduce the amount of fatty acid present in the oil. It is usually reduced to about less than 2% so that we can get better properties of oil. Properties like flash point, fire point, viscosity & density are the crucial property that is to be study properly. Acid catalyst helps in separating FFA from the oil & base catalyst produce soap from FFA which can be separated from the oil by washing process.

- **Effect of stirring**

Stirring is done during the reaction because it avoids the separation of methanol from the oil which can lead to incomplete reaction process between oil and methanol. Hence stirring is important for the reaction process. Mostly magnetic stirrer is used during Transesterification. If the speed of the rotating stirrer is less then yield will be less and if the stirrer is fast then pellet will bounce out of the flask. For most of the oil stirrer speed is kept around 600 to 800 RPM.

4. Advantages and disadvantages of biodiesel:

4.1 Advantages

The biodiesel has numerous benefits as well as some shortcoming which have been listed below. The major benefits of using biodiesel as a fuel is:

- Biodiesel emits fewer emissions like CO₂, CO, SO₂, PM and HC compared to diesel.
- Manufacturing biodiesel is less complicated than diesel and is a smaller amount time overhelling.
- Biodiesel will build the vehicle perform higher because it has higher etane variety.
- Biodiesel prolongs engine life and reduces the requirement for maintenance.
- It is used while not adding further lubricator, not like diesel engine.
- Biodiesel holds an excellent potential for exciting property rural development and answer for energy security issue.
- Biodiesel is a lot of price economical than diesel as a result of it's created locally.
- Biodiesel is best than diesel oil relating to sulfur content, flash point, aromatic content, and biodegradability.
- Biodiesel doesn't have to be trained, transported, or refined like diesel.
- It's safer to handle, being less cvanogenetic, a lot of perishable, and having a better flash purpose.
- Non-flammable and non-toxic, reduces pipe emissions, visible smoke and unwholesome fumes and odors.
- No needed engine modification up to B20.
- Higher combustion potency, movability, accessibility, and renewability of biodiesel.

4.2 Disadvantages

- It emits higher Nox emission than diesel.
- Higher pour and cloud purpose fuel phase change in weather inflicting a cold weather beginning.
- Biodiesel contains a corrosive nature against copper and brass.
- the upper consistence thanks to the big molecular mass and chemical structure of vegetable oils results in an issue in pumping, combustion, and atomization within the appliance system of a diesel engine.
- Biodiesel lower engine speed and power. The biodiesels on the average decrease power by fifth compared to it of diesel at rated load .
- Coking of injectors on the piston and head of the engine.
- Biodiesel degradation beneath storage for prolonged periods.
- The high consistence, in long-run operation, introduces the formation of appliance deposits, plugging of filters, lines and injectors, ring sticking and incompatibility with typical
- Lubricating oils. Carbon deposits on piston and head of the engine.
- Biodiesel causes excessive engine wear.

Conclusions:

Biodiesel is associate environment-friendly fuel and offers several social and economic edges. This paper provides the excellent info on biofuel development, feedstocks round the world, oil extraction technic, biodiesel production processes, and blessings of biodiesel. Finally, the combustion behavior of biodiesel in internal combustion engine has been mentioned which can facilitate to the researchers and influential person and manufacturer. outline of this study may be discussed as follows:

- Feedstock choice is extremely vital to provide biodiesel as its associated two-third of total cost.
- Among the biodiesel production technic, transesterification method is most convenient method thanks to less value and ease.
- The characteristics of made biodiesel rely on the carboxylic acid compositions of extracted oil.
- Totally different biodiesel has different characteristics that additionally depends on the country of origin. As a consequence, performance and emission behavior of biodiesel in internal-combustion engine conjointly varies. The main factors that have an effect on the combustion behavior of biodiesel within the engine are properties, injection temporal order, biodiesel feedstocks, styles of engine and in operation conditions.
- The employment of biodiesel and their blends within the engine slightly reduces the engine power and will increase fuel consumption however considerably reduces the harmful emission like PM, HC, CO, PAHs emission. However, generally will increase Roman deity emission which might be reduced using EGR or another additives.

- The greenhouse emission from biodiesel are often neglected as will be absorbed by the crops itself. Finally, biodiesel will play a very important role to cut back the world energy demand thanks to its handiness, environment-friendly and renewable properties.

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