A

Seminar report

On

# Biodiesel

Submitted in partial fulfillment of the requirement for the award of degree of CIVIL



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# Acknowledgement

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# Preface

I have made this report file on the topic **Biodiesel**; I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to …………..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

## Abstract

Biodiesel is the name of a clean burning methanol (mono-alkyl) ester- or ethanol ester based fuel made from vegetable or animal fats. Biodiesel can be blended with petro- diesel in any relation. It can be used in diesel engines without modification. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulphur and aromatics.

## Overview

The use of biodiesel in a conventional diesel engine results in substantial reduction of unburned hydrocarbons, carbon monoxide and particulate matter. The exhaust emissions of sulfur oxides and sulfates (major components of acid rain) from biodiesel are essentially smaller compared to petrodiesel. Scientific research confirms that biodiesel exhaust has a less harmful impact on human health than petroleum diesel fuel.

Biodiesel emissions have decreased levels of polycyclic aromatic hydrocarbons (PAH) and nitrited PAH compounds which have been identified as potential cancer causing compounds. In recent testing, PAH compounds were reduced by 75% to 85%, with the exception of benzoanthracene, which was reduced by roughly 50%. Targeted nPAH compounds were also reduced dramatically by using biodiesel fuel, with 2-nitrofluorene and 1-nitropyrene reduced by 90%, and the rest of the nPAH compounds reduced to only trace levels.

## Introduction

Biodiesel can be operated in any diesel engine with little or no impact to the fuel system. Biodiesel has a solvent effect which may release deposits accumulated on tank walls and pipes from previous diesel fuel storage. The release of deposits may clog filters. Biodiesel can be used as a pure fuel or blended with petroleum in any ratio.

The politics of car producers are different, e.g., all production models since production year 1996 are fully equipped and rated for biodiesel use. Mercedes Benz delivers biodiesel equipped cars upon request. For other cars, please check with the manufacturer.Biodiesel can be used instead of mineral diesel in any car or truck. Only the compatibility of fuel pumps and seals has to be ensured.

Due to high viscosity of rapeseed oil it must be heated to 75 °C in order to be compBatible with standard injection pumps.Biodiesel has a higher cetane number than diesel fuel. In over 15 million miles of in-field demonstrations, biodiesel showed similar fuel consumption, horsepower, torque and haulage rates as conventional diesel fuel.

## WHAT IS BIO-DIESEL:

Biodiesel can, in theory, be used in all diesel engines. However, due to the parts attached to the diesel engine, some manufacturers do not approve engines running on 100% biodiesel.

Biodiesel’s chemical name is "Fatty-Acid Methyl Ester". This fancy name means it is a simple molecule made from vegetable oil. This fuel has a high energy content and a proper viscosity “willingness to flow” to be used in all diesel vehicles and equipment. It’s made from a naturally grown crop making its energy from the sun.

## What is NOT Biodiesel

Look Carefully! Many companies and groups improperly use the word biodiesel to describe diesel fuel replacement products they have developed. This creates significant confusion for consumers looking to purchase and use biodiesel. Some of these alternatives have not been properly tested and could lead to damage to vehicles. Below is some information to help distinguish real biodiesel from imposters.

What biodiesel IS NOT:

- Biodiesel is not vegetable oil.
- Biodiesel is not vegetable oil diluted with solvents, i.e. diesel fuel or alcohols.
- Biodiesel is not vegetable oil with “special additives” to make it run better.
- Biodiesel is not vegetable oil refined through a conventional oil refinery process.
- Biodiesel is not vegetable oil refined through thermal depolymerization (renewable diesel).
- Biodiesel is not a fuel that requires costly modifications to your diesel engine (straight vegetable oil).
- Biodiesel is not crude methyl esters which have not been refined or minimally refined.

Unlike biodiesel, none of the fluids listed above have undergone renewable fuel certification, emissions or toxicity testing, or long-term reliability testing in engines and vehicles.

## TRANS - ESTERIFICATION PROCESS

The trans-etherification process is carried out in order to reduce the viscosity of the oil by removing the fatty acid present in it.100ml mixture of NAOH and methanol is take in a burette and added to the raw jatropha oil with a constant interval of 30min. during addition of the mixture the temperature should be maintained between 50°C - 60°C. If the temperature exceeds beyond this limit the oil could catch fire since methanol ignites at very low temperature.

Trans-Esterification Process

When all the mixture of methanol and NAOH is added to the raw jatropha oil it is allowed to settle in the container for 10hrs. After this there will clear separation on glycerol and the ester which is the required oil (Biodiesel)

The final test which proves that the oil is undergone good Trans - esterification is by its golden colour formation and the smell which should not have any occurrence of the alcohol used in process. The picture below shows the difference between raw jatropha oil and trans- esterified oil.

## FABRICATION OF EGR

External EGR, using piping to route the exhaust gas to the intake system where it is inducted into the succeeding cycles, has emerged as the preferred current approach. This methodology was followed in our project.

The engine exhaust and intake manifold was modified so as to enhance the EGR set. The constraints involved in the fabrication of EGR are as follows:

• Effective cooling has to be enforced for good performance of EGR since gas at 500-600°C can’t be let into engine.

• Effective throttling has to be maintained so as to allow required gas inside the cylinder.

The exhaust has to be modified and the following condition has to be acquired, so as to use the AVL 437C Smoke meter.

o The temperature at the position of measurement should be maintained between 200 - 250°C

o The pressure at the position of measurement should be maintained between 60-75mm of manometer.

o Exhaust gas should be taken at an angle of 135° so as to have accurate readings.

# TEST PROCEDURE:

1. The room temperature was noted down first.

2. Required quantities of blends were prepared according to their ratios by volume.

3. The fuel in the fuel tank, the supply of cooling water, level of lubricant in the sump as indicated by the dipstick and no load on the engine were checked before starting the engine.

4. The engine was started and allowed to run at no load for about 10 minutes to warm up and attain steady state. The speed of the engine was measured using a tachometer and it was adjusted to the rated speed of 1500 rpm by adjusting the governor connected to the fuel pump.

5. The fuel was then supplied from the burette by opening the metering valve. By noting the change in level of fuel in the burette, the time taken for 10cc of fuel consumption was noted using a stop watch.

6. The desired cooling water flow rate was obtained by adjusting the valve and was kept constant throughout the experiment.

7. The inlet and outlet temperatures of the cooling water are noted. The temperature of the exhaust gas was noted.

8. The full load of the engine was distributing equally so as to run at least five trials during the test from zero load (0 amps) to full load (12 amps). The set up readings were taken and tabulated.

9. The emissions are measured using the Flue gas analyzer, AVL 437C Smoke meter for all the combinations of biodiesel with HSD.

10. The manometer readings are also noted.

11. All the above readings were taken for various loads with applying and without applying EGR.

Electrical loading arrangement was used for loading the engine. All parameters relating to the engine performance were observed from the reading. Such parameter as,

1. Brake power

2. Fuel consumption rate, Specific fuel consumption

3. Fuel power

4. Brake thermal efficiency, indicated thermal efficiency

5. Brake and indicated mean effective pressure.

After, the experimental part of the project was completed, the calculations were carried out and various graphs were drawn so as to discuss and arrive at specified result. From the analysis of graphs the conclusion were made.

## APPLICATIONS OF BIODIESEL

¬ Motor fuel

Biodiesel as self-contained renewable fuel has been applied in Diesel engines for decades.

¬ Fuel additive / biocomponent

Biodiesel is used as fuel additive for several reasons. some of them are:

♣ To increase and speed-up the deployment of vehicle. Biodiesel is used as an alternative fuel .

¬ underground mining

Diesel-powered equipment is used in underground mines because it is more powerful and mobile than electric-powered equipment. However, diesel emissions in the enclosed environments of underground mines pose a significant health hazard to mine workers.

¬ oil spillage remediation

Biodiesel has excellent biodegradability in soil and ground water. It is even used to help clean up mineral oil slicks.

## What are the benefits of Biodiesel?

Biodiesel has many environmentally beneficial properties. The main benefit of biodiesel is that it can be described as 'carbon neutral'. This means that the fuel produces no net output of carbon in the form of carbon dioxide ($CO_2$). This effect occurs because when the oil crop grows it absorbs the same amount of $CO_2$ as is released when the fuel is combusted. In fact this is not completely accurate as $CO_2$ is released during the production of the fertilizer required to fertilize the fields in which the oil crops are grown. Fertilizer production is not the only source of pollution associated with the production of biodiesel, other sources include the esterification process, the solvent extraction of the oil, refining, drying and transporting. All these processes require an energy input either in the form of electricity or from a fuel, both of which will generally result in the release of green house gases. To properly assess the impact of all these sources requires use of a technique called life cycle analysis. Our section on LCA looks closer at this analysis. Biodiesel is rapidly biodegradable and completely non-toxic, meaning spillages represent far less of a risk than fossil diesel spillages. Biodiesel has a higher flash point than fossil diesel and so is safer in the event of a crash.

## Biodiesel Production

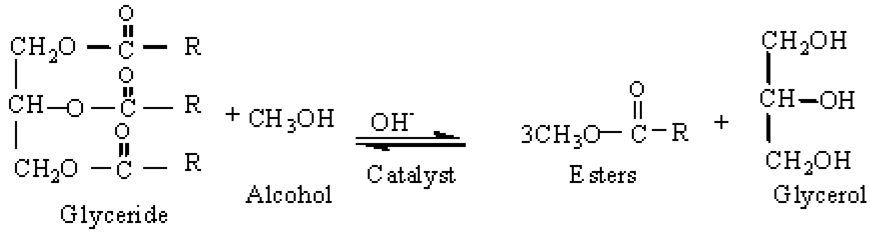
As mentioned above biodiesel can be produced from straight vegetable oil, animal oil/fats, tallow and waste oils. There are three basic routes to biodiesel production from oils and fats:

- Base catalyzed transesterification of the oil.
- Direct acid catalyzed transesterification of the oil.
- Conversion of the oil to its fatty acids and then to biodiesel.

Almost all biodiesel is produced using base catalyzed transesterification as it is the most economical process requiring only low temperatures and pressures and producing a 98% conversion yield. For this reason only this process will be described in this report.

The Transesterification process is the reaction of a triglyceride (fat/oil) with an alcohol to form esters and glycerol. A triglyceride has a glycerine molecule as its base with three long chain fatty acids attached. The characteristics of the fat are determined by the nature of the fatty acids attached to the glycerine. The nature of the fatty acids can in turn affect the characteristics of the biodiesel. During the esterification process, the triglyceride is reacted with alcohol in the presence of a catalyst, usually a strong alkaline like sodium hydroxide. The alcohol reacts with the fatty acids to form the mono-alkyl ester, or biodiesel and crude glycerol. In most production methanol or ethanol is the alcohol used (methanol produces methyl esters, ethanol produces ethyl esters) and is base catalysed by either potassium or sodium hydroxide. Potassium hydroxide has been found to be more suitable for the ethyl ester biodiesel production, either base can be used for the methyl ester. A common product of the transesterification process is Rape Methyl Ester (RME) produced from raw rapeseed oil reacted with methanol.

The figure below shows the chemical process for methyl ester biodiesel. The reaction between the fat or oil and the alcohol is a reversible reaction and so the alcohol must be added in excess to drive the reaction towards the right and ensure complete conversion.




The products of the reaction are the biodiesel itself and glycerol.

A successful transesterification reaction is signified by the separation of the ester and glycerol layers after the reaction time. The heavier, co-product, glycerol settles out and may be sold as it is or it may be purified for use in other industries, e.g. the pharmaceutical, cosmetics etc.

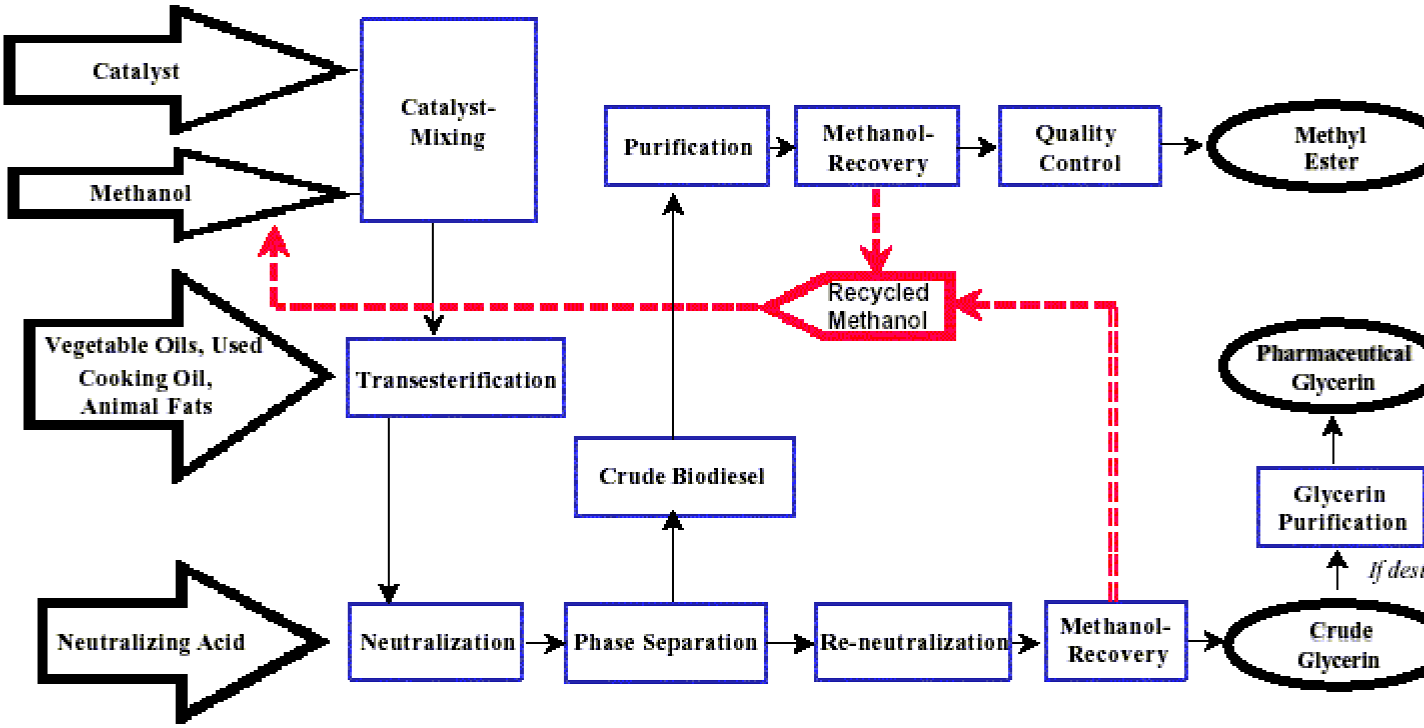
Straight vegetable oil (SVO) can be used directly as a fossil diesel substitute however using this fuel can lead to some fairly serious engine problems. Due to its relatively high viscosity SVO leads to poor atomisation of the fuel, incomplete combustion, coking of the fuel injectors, ring carbonisation, and accumulation of fuel in the lubricating oil. The best method for solving these problems is the transesterification of the oil.

The engine combustion benefits of the transesterification of the oil are:

- Lowered viscosity
- Complete removal of the glycerides
- Lowered boiling point
- Lowered flash point
- Lowered pour point

***Production Process***

An example of a simple production flow chart is proved below with a brief explanation of each step.




## Mixing of alcohol and catalyst

The catalyst is typically sodium hydroxide (caustic soda) or potassium hydroxide (potash). It is dissolved in the alcohol using a standard agitator or mixer. Reaction. The alcohol/catalyst mix is then charged into a closed reaction vessel and the oil or fat is added. The system from here on is totally closed to the atmosphere to prevent the loss of alcohol. The reaction mix is kept just above the boiling point of the alcohol (around 160 °F) to speed up the reaction and the reaction takes place. Recommended reaction time varies from 1 to 8 hours, and some systems recommend the reaction take place at room temperature. Excess alcohol is normally used to ensure total conversion of the fat or oil to its esters. Care must be taken to monitor the amount of water and free fatty acids in the incoming oil or fat. If the free fatty acid level or water level is too high it may cause problems with soap formation and the separation of the glycerin by-product downstream.

## Separation

Once the reaction is complete, two major products exist: glycerin and biodiesel. 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 more dense 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.

**Alcohol Removal**

Once the glycerin and biodiesel phases have been separated, the excess alcohol in each phase is removed with a flash evaporation process or by distillation. In others systems, the alcohol is removed and the mixture neutralized before the glycerin and esters have been separated. In either case, the alcohol is recovered using distillation equipment and is re-used. Care must be taken to ensure no water accumulates in the recovered alcohol stream.

**Glycerin Neutralization**

The glycerin by-product contains unused catalyst and soaps that are neutralized with an acid and sent to storage as crude glycerin. In some cases the salt formed during this phase is recovered for use as fertilizer. In most cases the salt is left in the glycerin. Water and alcohol are removed to produce 80-88% pure glycerin that is ready to be sold as crude glycerin. In more sophisticated operations, the glycerin is distilled to 99% or higher purity and sold into the cosmetic and pharmaceutical markets.

**Methyl Ester Wash**

Once separated from the glycerin, the biodiesel is sometimes purified by washing gently with warm water to remove residual catalyst or soaps, dried, and sent to storage. In some processes this step is unnecessary. This is normally the end of the production process resulting in a clear amber-yellow liquid with a viscosity similar to petrodiesel. In some systems the biodiesel is distilled in an additional step to remove small amounts of color bodies to produce a colorless biodiesel.

**Product Quality**

Prior to use as a commercial fuel, the finished biodiesel must be analyzed using sophisticated analytical equipment to ensure it meets any required specifications. The most important aspects of biodiesel production to ensure trouble free operation in diesel engines are:

- Complete Reaction
- Removal of Glycerin
- Removal of Catalyst
- Removal of Alcohol
- Absence of Free Fatty Acids

## Conclusion

- Biodiesel is eco-friendly.
- Biodiesel is clean burning alternative fuel.
- Biodiesel contain no petroleum, but can be blended with conventional diesel fuel.
- These fuel can be used in any diesel engine without any modification.
- Biodiesel is degradable , non toxic and free from sulphur and lead.
- Biodiesel provide superior lubricating properties and help to extend engine life.
- India's target is to achieve 20 % substitution of HSD till 2012.
- Government have to pay attention toward the cultivation of Jatropha seeds.

## REFERENCES

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