

Production of Biodiesel Fuel from Waste Vegetable Oils and Animal Fat - A Review Article

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ABSTRACT

World energy demand is expected to increase due to the expanding urbanization, better living standards and increasing population. At a time when society is becoming increasingly aware of the declining reserves of fossil fuels beside the environmental concerns, it has become apparent that biodiesel is destined to make a substantial contribution to the future energy demands of the domestic and industrial economies, so objective of this model is saving of conventional fuel and find out alternate fuel better fuel to reduce polluted emission from vehicles.

Survey of the research paper for reduce the conventional fuel use in such polluted world and use biodiesel in place of that which is made up of non-edible oils plants and animal waste fats. For doing work on biodiesel fuel production and its performance in diesel engine for better emission from engine.

Keywords: Biodiesel, Diesel engine, Animal fat, Bio gas oil, Waste frying oil

I. INTRODUCTION

At present, about 35% of the world's primary energy demand is met by petroleum, and the world petroleum demand in 2009 was 84 million barrels/day. According to the estimates of the International Energy Agency, demand will reach 90 million barrels/day by 2014, an increase of 7% on 2009 levels or 5 million barrels/day, with most of the increase in demand cantered in China and Asia. With a reserve to- production ratio of about 53 years, there is a concern of depletion. Since most petroleum consumption is in internal combustion engines, development of a light liquid fuel as an alternative to petroleum for use in existing internal-combustion engines is urgent. One of the greatest challenges of the modern transportation sector is to ensure the supply for the increasing energy demand of the mobility, while bearing in mind the environmental issues, too. Because of energetic and environmental demands mankind has begun to utilise bio derived fuels to replace part of the fossil energy source of the mobility. The steady development of bio derived fuels resulted in a wide range of options, which can be divided into

multiple generations on the basis of feed stocks and of technologies.

In an internal combustion engine mixture of combustible gases an air takes place, if lighter liquid fuel in present known as petrol engine. And when heavier liquid fuel is used that is known as oil compression ignition or diesel engine. In an internal combustion engine overall efficiency is high as compare to External combustion engine. Initial cost is also lower as compare to External combustion engine, less space is required in Internal Combustion, where large space is required for External combustion engine. But in an External combustion of fuel we can use cheaper fuel as combustion, even solid fuel can be used, Due to fuel some additional equipment is used to start the engine.

Literature Review

To develop methodology for the generation of driving and duty for refuse vehicle matching the statistical metrics & distribution of generated cycle such as ethanol & biodiesel, there alternate fuel promoted with potential

to reduce dependence on fossil fuel import. Current energy policies address environmental issues including environmentally friendly technologies to increase energy supplies and encourage cleaner, more efficient energy use, and address air pollution, greenhouse effect, global warming, and climate change. The biofuel policy aims to promote the use in transport of fuels made from biomass, as well as other renewable fuels.^[2]

It has found that UCO biodiesel are some as biodiesel from fresh vegetable oil so an engine performance & combustion characteristic is probably same to oxygenated nature of biodiesel. As the environment degrades at an alarming rate, there have been steady calls by most governments following international energy policies for the use of biofuels^[4].

The quality of biodiesel fuel was found to be significant for its successful use on compression ignition engines and subsequent replacement of non-renewable fossil fuels. Conventional biodiesel separation and purification technologies were noticed to yield lower quality biodiesel fuel with resultant excessive energy and water consumptions.^[10]

The harmful effect on health of particles from diesel engines is due to the smaller particles. Smaller particles get trapped in the lungs and they can pass through the lungs into the blood stream. From this point of view, the addition of biodiesel to pure diesel is an inconvenient. Furthermore, in comparison with the pure diesel, fuel blends provide, in general, an increase of NO_x emissions.^[20] Animal fats were Trans esterified with acid catalyst and basic catalyst with and without pre-esterification. Animal fats characterized by high free fatty acids were suitable feedstock to obtain biodiesel.^[23]

II. METHODS AND MATERIAL

A. ENERGY

The analysis is based on the first law of thermodynamics which state that energy can neither be created nor destroyed, it can be converted from one from two other.

In an I. C. engine fuel is fed to the combustion chamber where it burns in the presence of air and its chemical energy is converted into heat. All this is not available for

driving the piston since a portion of this energy is lost through exhaust, coolant and radiation. The remaining energy is converted to power and is called indicated energy or indicated power (I. P). The ratio of this energy to the input fuel energy is called indicated thermal efficiency.

The energy available at the piston passes through the connection rod to the crankshaft. In this transmission of energy/power there are losses due to friction, pumping, etc. The sum of all these losses, converted to power, is termed as friction power (F. P.). The remaining energy is the useful mechanical energy and is termed as shaft energy or brake power (B. P). The ratio of energy at shaft to fuel input energy is called brake thermal efficiency. The ratio of shaft energy to the energy available at the piston is called mechanical efficiency.

Properties of Diesel Fuel

- Air fuel ratio → 18:1 Compression ratio → 12 to 24
- Operating pressure → 30 bar to 50 bar (compression pressure)
→ 60 bar to 120 bar (maximum pressure)
- Calorific value → 42 MJ/KG
- Weight per unit power → 3.3 to 13.5 kg/kw

DIESEL FUEL FOR IC ENGINES CAN BE DIVIDED TWO CATEGORIES.

- Light diesel fuel (molecular weight 170 approximately)
- Heavy diesel fuel (molecular weight 200 approximately)
 - ✓ Lighter fuel will be less viscous and easier to pump, will generally inject into smaller droplets, and will be more costly.
 - ✓ Heavy diesel fuel can generally be used in larger engines with higher injection pressures and heated intake systems.
 - ✓ Often an automobile or lighter truck can be used a less costly heavier fuel in the summer , but most change to a lighter ,less viscous fuel in cold weather because of cold starting and fuel line pumping problems.^[1]

B. FUELS

Fuel may be chemical or nuclear. Here we shall consider briefly chemical fuels only. A chemical fuel is a substance which releases heat energy on combustion. The principal combustible element of each fuel is carbon and hydrogen. Though sulphur is a combustible element too but its presence in the fuel is considered to be undesirable.

FUELS CAN BE CLASSIFIED ACCORDING TO WHETHER:

- i) They occur in nature called primary fuels or are prepared called secondary fuels.
- ii) They are in solid, liquid or gaseous state. The detailed classification of fuel can be given in a summary from as following table:

TABLE 1: DIFFERENT TYPE OF FUEL

Type	Solid	Liquid	Gaseous
Natural (Primary)	Wood Lignite Coal Peat	Petroleum	Natural gas
Prepared (Secondary)	Coke Charcoal briquettes	Gasoline Kerosene Alcohol Fuel oil Shale oil	Petroleum Producer gas coal gas coke-oven gas carbureted gas Sewer gas Blast furnace gas

C. BIODIESEL

Biodiesel is a renewable and alternative fuel used in diesel engine in little modification. Biodiesel environmentally friendly fuel, some low cost like waste oil cooking oil, animals fats are used to produce biodiesel. Due to increase in urbanization world energy demand is also increases. Our population also increases by looking all present problem biodiesel will be more demandable in future.

The continuous decreasing in petroleum resources we led to some biodiesel is best fuel we can use which is also environmental friendliness. Now a day more and more new technology is developed to purification of biodiesel and by adding some good additives we can use low pride diesel fuel in our day to day life. From all crops microalgae is very highest oil yield as composed

to other, which is 25 times higher than yield traditional biodiesel crops like palm oil. It produce of at least 70% oil by weight it requires only 0.1 m² year per KG biodiesel of land which produce 121,104 KG of biodiesel per year, this is large production value.

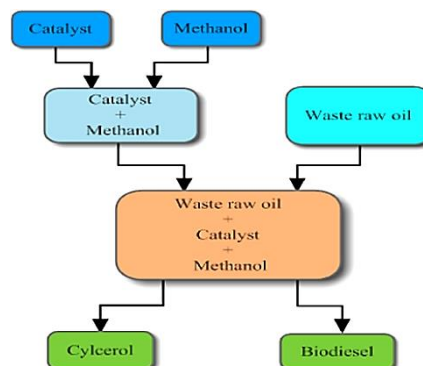


Figure 1: Biodiesel Production Stages

Oil Extraction Technique:

There are three main methods that have been identified for the extraction of the oil

- (i) Mechanical extraction,
- (ii) Solvent extraction
- (iii) Enzymatic oil extraction.

1) Mechanical Extraction

The technique of oil extraction using mechanical presses is the most conventional practice. In this type, either a manual ram press or an engine driven screw press can be used. It has been found that, engine driven screw press can extract 68–80% of the available oil while the ram presses only achieved 60–65%. This broader range is due to the fact that seeds can be subjected to a different number of extractions through the expeller.

2) Solvent extraction (chemical extraction)

Solvent extraction is the technique of removing one constituent from a solid by means of a liquid solvent. It is also called leaching. There are many factors influencing the rate of extraction such as particle size, the type of liquid chosen, temperature and agitation of the solvent. The small particle size is preferable as it allows for a greater interfacial area between the solid and liquid.

3) Enzymatic oil extraction

Enzymatic oil extraction technique has emerged as a promising technique for extraction of oil. In this process suitable enzymes are used to extract oil from crushed seeds. Its main advantages are that it is environment friendly and does not produce volatile organic compounds.^[8]

III. RESULTS AND DISCUSSION

Performance on IC Engine

It is necessary to examine and analyse performance and exhaust emission test results after using of FOB 20 and C F B 20 fuel samples in a diesel engine. Therefore, two main tests, which are engine performance and exhaust emissions tests, are conducted in the present study to see whether the fuel samples can be used efficiently in a diesel engine or not.

Performance

The change of brake torque depends on the engine speed, and the change of brake power. It is also clear that there is an average 1.9% and 2.4% decrease in the values of brake torque and power of C F B 20 in comparison to D 2, respectively. When number of revolution increases engine power of test fuels also increases and maximum power occurs at 2500 rpm using diesel fuel.

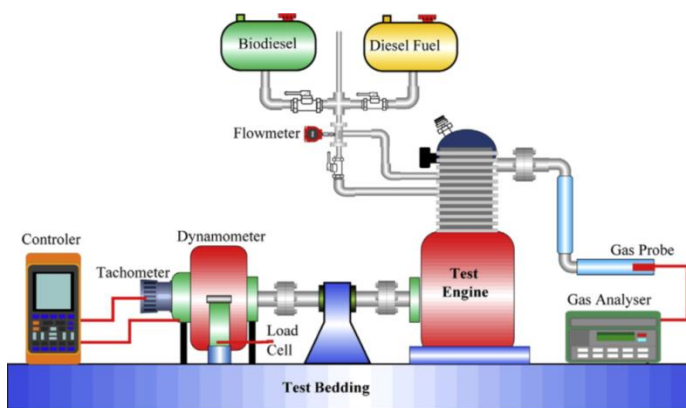


Figure 2 : Schematic view of experimental apparatus

Emission

In this section, effects of the FOB 20 and C F B 20 (blends of fuels derived from fish oil and waste chicken fat methyl ester and petroleum-based diesel fuel) fuels on the concentration in the exhaust emissions, such as carbon monoxide (CO), unburned hydrocarbon (HC), nitrogen oxide (NO_x) are given. It is appreciated that when compared to biodiesel fuels which are produced from different raw materials and used as fuel in diesel engines with petroleum-based diesel fuels, derived emissions from these fuels such as CO, HC, CO₂ and smoke intensity decrease, but NO_x emissions increase.

Carbon Monoxide (CO)

The main reason of the presence of CO in the combustion products is insufficient oxygen. Emissions from internal combustion engines affect fuel type and characteristics, rate of atomization, combustion chamber shape, engine speed, air-fuel ratio and the other engine operating parameters. CO₂ emissions of blend fuels are lower than the emissions of diesel fuel because CO emissions in blend fuels are converted into CO₂ emissions and also, blend fuels have lower CO emissions due to the biodiesel fuels oxygen content.

Carbon dioxide (CO₂) emissions

One of the main factors of global warming, and the most important environmental problem of the world is CO₂ which causes greenhouse effect in the atmosphere. One way to reduce CO₂ emissions caused by the combustion of fossil fuels is to use alternative fuels instead of fossil fuels.

Nitrogen Oxides (NO_x)

Two important parameters that influence the formation of NO_x are combustion chamber temperature and air-fuel ratio. When the combustion chamber temperature increases above 1800 K, nitrogen and oxygen are chemically combined in the air and becomes nitrogen oxides which are harmful for human health and environment. Nitrogen oxides combine with moisture in the lungs by forming nitric acid and lead to a respiratory disease. As a result, diluting the mixture with exhaust gases in the combustion chamber causes to reduce both

the combustion temperatures and the amount of NOx produced.

Smoke Capacity

The amount of smoke present in the exhaust gas gives the measurement of particulate matter present in the exhaust gas. Use of petroleum based diesel fuel in diesel engines result in the black smoke. The darkness of smoke is an important parameter for oxygen content of the molecular structure of crude vegetable oils. The main reason for this can be specified as aromatic compounds in the fuel.

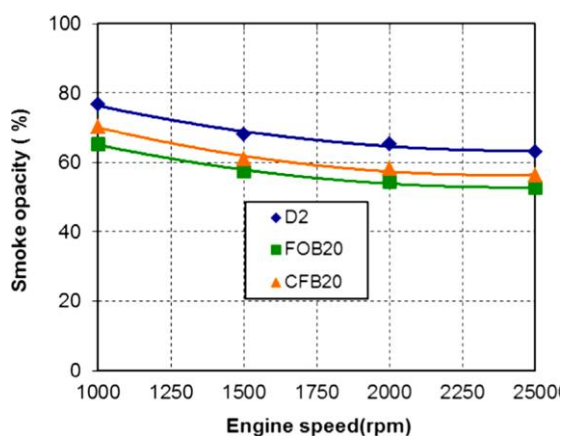


Figure 3: Variation of smoke opacity the test fuels according to engine speed

IV. 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 performance parameters of biodiesel proved to surpass that of diesel fuel and its application requires no engine modification. The purity of raw materials for the development of biodiesel fuel was found to be crucial for the success of its application and future replacement of non-renewable fossil fuels.

Energy is an indispensable factor for human to preserve economic growth and maintain standard of living. Globally, the transportation sector is the second largest energy consuming sector after the industrial sector and accounts for 30% of the world's total delivered energy. This sector has experienced a steady growth in the past 30 years. It has been estimated that the global

transportation energy use is expected to increase by an average of 1.8% per year from 2005 to 2035. Nearly all fossil fuel energy consumption in the transportation sector is from oil (97.6%). However, the expected depletion of fossil fuels and the environmental problems associated with burning them has encouraged many researchers to investigate the possibility of using alternative fuels. Among them, biodiesel seems a very promising resource.

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