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RAPESEED – AN ALTERNATIVE BIODIESEL

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ABSTRACT

Use of conventional diesel fuel causes serious problem of air pollution and effects on the environment leading to effect like green house, some factors in diesel fuel results in high emission in diesel engine. The stringent emission norms have been an important driving force to develop the CI engines more environment friendly. This recommends the intensive studies on the use of alternative fuels especially renewable ones like vegetable oils and alcohols. The use of vegetable oils as an alternative fuel for diesel engine is not a new concept. In fact early engines were demonstrated with vegetable oil. In a developing country like India where mass transportation plays an important role, the suitability of alternate fuels for a diesel fuel engine application has to be thoroughly investigated. Vegetable oils plays a prominent role in substituting diesel, since they are renewable and are easily produced in rural areas. Biodiesels such as Jatropha, Karanja, Sunflower and Rapeseed are some of the popular biodiesels currently considered as substitute for diesel.

KEY WORDS: IC Engine, Conventional Diesel, Biodiesel, Rapeseeds

INTRODUCTION

The Use of efficient diesel engines needs encouragement in the future since they consume less fuel and significantly reduce potent green house gases like carbon dioxide. Ever increasing diesel consumption, large outflow of foreign exchange and concern for environment have prompted developing countries like India to search for a suitable environmental friendly alternative to diesel fuel. The country has to simultaneously address the issues of energy insecurity, increasing oil prices and large-scale unemployment. Environmental degradation and depleting oil reserves are matters of great concern round the Globe. Developing countries like India depend heavily on oil import.

Diesel being the main transport fuel in India, finding a suitable alternative to diesel is an urgent need. Bio-diesel is a non-edible, renewable fuel suitable for diesel engines and is receiving increasing attention in India because of its potential to generate large-scale employment and relatively low environmental degradation. Biodiesel is a non-toxic, biodegradable, and renewable diesel fuel and can be used neat or blends with petroleum diesel fuels. Biodiesel has many advantages compared to diesel fuels.

When biodiesel is used as a substitute for diesel, it is highly essential to understand the parameters that affect the combustion phenomenon which will in turn have direct impact on thermal efficiency and emission. In the present energy scenario lot of efforts is being focused on improving the thermal efficiency of IC engines with reduction in emissions. The problem of increasing demand for high brake power and the fast depletion of the fuels demand severe controls on power and a high level of fuel economy. Many innovative technologies are developed to tackle these problems.

OBJECTIVE

In this paper we are deals with investigations of gaps in the current knowledge related to the optimization of C.I. engine performance parameters for biodiesel blending fuel in C.I. engines. The point of view to relate the data of biodiesel with C.I. engine will be examined critically and clarified.

Also to study different performance parameters of C.I. engine and suitable biodiesel fuel for diesel engine with their production process and properties of selected biodiesel fuel

BIODIESEL

Vegetable oils are among the various sources of energy fuels being considered as alternatives to fossil fuels. Soybean, sunflower,

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coconut and palm oils have been the main raw materials for biodiesel production. However, these oils are required in refined forms to obtain quality biodiesel and, in addition, they are foodstuffs. This makes production of biodiesel from these sources uneconomical. Non-edible plant oils such as found in rapeseeds may provide better alternatives.

Biodiesel derived from neutralized rapeseeds oil is suited for use in diesel engines given that its kinematic viscosity, flash point, cloud point, and calorific value conform to the recommended international standards. This means that neutralisation alone is sufficient to purify rapeseeds oil for biodiesel production. Savings could be made from the expensive refining processes when rapeseeds oil is just neutralized and made into biodiesel. On the other hand, biodiesel from castor oil is not suitable for use in diesel engines due to the high viscosity value. So that the rapeseeds biodiesel is most suitable biodiesel fuel for CI engine as comparative to the other alternative fuel without any modification in the engine.

Production Process

Almost all bio-diesel is produced by using base catalyzed trans-esterification process, as it is the simple process and requiring only low temperature. The trans-esterification process is the reaction of a tri-glyceride (fat/oil) with an alcohol to form esters and glycerol. The alcohol reacts with the fatty acids to form the mono-alkyl ester or bio-diesel and crude glycerol. In bio-diesel production process, the main reaction is transesterification of vegetable oil. The important factor that affects the tranesterification reaction is the amount of methanol and sodium or potassium hydroxide, reaction temperature and reaction time. A molar ratio of 6:1 is normally used in industrial processes to obtain methyl ester yields higher than 98% by weight, because lower molar ratio required more reaction time. With higher molar ratios conversion increased but recovery decreased due to poor separation of glycerol.

The glycerin phase is much denser than bio-diesel phase. The bio-diesel and glycerine can be gravity separated with glycerin simply drawn off from the bottom of the settling vessel. The bio-diesel is then purified by washing gently with warm water to remove residual catalyst or soap, dried, and sent to storage. This is normally the end of the production process resulting in clear liquid with viscosity near to petro-diesel.

The potassium methoxide was added to the pre-heated oil rapeseeds. The mixture was stirred at 550 rpm for one hour. The temperature of reaction was maintained at 55^0C. The batch wise mixture of rapeseeds methyl esters were allowed to settle for 8 hours in the setting flask. Glycerin was heavier as compared to oil so it settles down while oil floats up. The methyl ester conversion rate increases with the reaction time. Different researchers have reported different reaction times for the transesterification process. The reaction mixture was stirred for 90 min during trans esterification process.

Rapeseeds seeds were collected from the local area. The oil was extracted using screw expeller in local market. Oil was pre-heated to remove water contents at about 100^0C for 10 min. in cylindrical stainless steel tank. Potassium methoxide was prepared by mixing methanol and potassium hydroxide. The methanol was 99.6% and sodium hydroxide was 86% pure. For preparation of 1 liter of bio-diesel, 200ml methanol and 10gm of potassium hydroxide used. Methanol and potassium hydroxide were mixed to form potassium methoxide. After 8 hours glycerin settles down while methyl ester floats at top. The Crude bio-diesel obtained from rapeseeds had some impurities which were then separated by using bubble washing method. The bio-diesel was again heated to remove moisture at about 100-110^0C temperature.

COMPARISONS OF BIO-DIESEL FUEL AND DIESEL FUEL

Calorific value

Calorific value of a fuel is the thermal energy released per unit quantity of fuel when the fuel is burned completely and the products of combustion are cooled back to the initial temperature of the combustible mixture. It measures the energy content in a fuel. This is an important property of the bio-diesel that determines the suitability of the material as alternative to diesel fuels. TheCalorific value of vegetable oils and their methyl esters were measured in a bomb calorimeter according to ASTMD240 standard method.

Cetane number

A measure of the ignition quality of diesel fuel based on ignition delay in an CI engine. The ignition delay is the time interval between the start of the injection and start of the ignition. The higher cetane numbers of fuel then shorter ignition delay and the better the ignition quality and provides smoother engine operation.

The importance of higher cetane number is attached to the performance benefits provided in terms of improved cold starting, reduced smoke emission during warm up conditions. Biodiesel has a

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higher CN than petro diesel because of its higher oxygen content.

Relative density

Density is an important property of biofuel. Density is the mass per unit volume of any liquid at a given temperature. Density of the fuel can provide useful indication about its composition and related to performance characteristics, such as ignition quality, power, economy, low temperature properties and smoking tendency.

Viscosity

It indicates the resistance to flow, it is an important property of diesel fuels because its influence on the performance of the fuel injection. Especially at low temperature when increases in viscosity affects the fluidity of the fuel.

Increasing the viscosity reduces the injector spray cone angle, fuel distribution and penetration while increasing the droplet size for a given injector nozzle configuration and fuel pressure, the viscosity will certainty influence the quantity of fuel injected.

Flash point and fire point

The flash point temperature of biodiesel fuel is the minimum temperature at which the fuel will ignite (flash) on application of an ignition source. Flash point varies inversely with the fuel's volatility. Minimum flash point temperatures are required for proper safety and handling of diesel fuel.

Fire point is the lowest temperature at which fuel will sustain burning for 5 seconds. a flammable mixture with air that continuously supports the combustion establishing a flame instead of just flashing. These two parameters have great importance while determining the fire hazard (temperature at which fuel will give off inflammable vapor).

Specific gravity

Which is defined by, it is the ratio of mass density of fuel to the mass density standard fuel (water).

$$\text{Specific gravity} = \frac{density\ of\ fuel}{density\ of\ water}$$

Volatility

The volatility characteristics of diesel fuel is most important properties fuel it can be expressed in terms of the temperature at which successive portions are distilled from a sample of the fuel (the volatility means the distillation or boiling range of the fuel)

The volatility influences many other properties including density, flash point, and cetane number. High volatility could cause vapour lock and lower the flash point. Vapour lock can cause misfiring the engine. also the high volatility fuel improve the cold starting and warm up , while low volatility fuel to increase deposits, smoke and wear.

Sulphur content

One method for reducing the total emission levels of particulate matter from diesel engine low sulphur (0.05% by weight) diesel fuel. During the combustion process the majority of the sulphur in the fuel may cause exothermic reaction leads to formation of sulphuric acid aerosols. That cause wear in the piston ring and cylinder liners .

The contribution of sulphur is due to two mechanisms;

1. Corrosive mechanism
2. Deposit mechanism

These two mechanisms are directly dependant on fuel sulphur level and engine operating conditions. Another advantage or benefit of decreasing the sulphor level in diesel fuel is the wear reduction. Total sulphur is expressed as a percentage of the weight of the fuel sample.

Stability of diesel fuel

The ability of a diesel fuel to remain unchanged during the period between its manufacture and eventual use in an engine. it is very important properties of diesel fuel. The ability of fuel to maintain satisfactory storage stability is dependent upon a series of parameters which controls it rate of autoxidation.

Sediment and Water

These are obviously undesirable contaminants and should be as low as possible. The higher the specific gravity and viscosity of a fuel, the grater the quantities of water and sediment it can hold in suspension. Large quantities of sediment can affect the combustion of the fuel, and if abrasive, my cause excessive wear of closely fitting parts of fuel pumps and injectors. It may also clog filers and build up deposits in tanks and piping.

Properties measuring of diesel fuel using different type of devices and test methods for measuring fuel properties are as shown in table below.

Properties	Measurement apparatus	Standard test method
Density	Hydrometer	ASTM D941
Flash and fire point	Penksy martins apparatus	ASTM D93
Calorific value	Bomb calorimeter	ASTM D240
Viscosity	Red wood viscometer	ASTM D445
Cetane number	Ignition quality tester	ASTM D613

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Properties Measuring devices and test methods for fuel.

Effects of Diesel Fuel Properties on C.I. Engine

Properties	Effects/ importance
Cetane Number	Measure of ignitability (ignition quality), reduce knock and smoke.
Volatility	Deposits, wear, exhaust smoke
Viscosity	Injector wear & spray pattern, pump wear, filter damage
Sulfur Content	To protect emissions control equipment
Water & Sediment Content	Filter plugging, injector wear, increased corrosion
Flash Point	Safety during fuel handling & storage
Carbon Residue	Fuel system deposits, combustion chamber deposits

Effects of Diesel Fuel Properties on C.I. Engine.

CONCLUSIONS

1. It is less expensive to cultivate biodiesel and most of the seed varieties are available of less cost.
2. CV of biodiesel is higher than the other diesel fuel. Calorific value is almost 90-95 percent of the diesel fuel.
3 Biodiesel provides higher rate of output than any other type of biodiesel fuel.
4. Biodiesel can generate additional income for the rural area.
6. Biodiesel will Grow in marginal soils and tolerate drought or low rainfall of 500 mm per year.
7. Biodiesel plant can grow in waste lands and consumes less water.

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