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Effects of natural additives on the performance of Diesel engine

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Abstract
There is a limited reserve of the fossil fuels and the world has already faced the energy crisis and uncertainties in their supply. Fossil fuels are currently the dominant global source of emissions and their combustion is posing stronger threat to clean environment . Alternative fuels, also known as non-conventional fuels, are any materials or substances that can be used as a fuel, other than conventional fuels of coal petroleum products etc. The term "alternative fuels" usually refers to a source of which energy is renewable. Some well known alternative fuels include biodiesel, ethanol, butanol, chemically stored electricity (batteries and fuel cells), hydrogen, methane, natural gas, wood, vegetable oil and biomass.
Alternative fuels developed from renewable feedstock's are gaining market share recently. Biodiesel which is recognized as 'green fuel' is one of such alternative fuel produced from vegetable oils. Biodiesel has lately emerged as an alternative fuel of wide acceptance because of some comparative advantages over petroleum derived diesel: it has a lower environmental impact, a higher lubricity, a higher cetane number, and a lower flash point.
Remarkable reduction in emissions other than nitrogen oxides and an increase in lubricity have been reported. Biodiesel does not contain harmful aromatic hydrocarbons, and it does not produce sulfur oxides (SOx). Particulate emissions are also decreased.
Biodiesel has become more attractive recently because of its environmental benefits and the fact that it is made from renewable resources like plant and animals triglycerides and it is biodegradable. The cost of biodiesel, however, is the main hurdle to commercialization of the product. The used cooking oils are used as a raw material, adaptation of continuous transesterification process and recovery of high quality glycerol from biodiesel by-product (glycerol) are primary options to be considered to lower the cost of biodiesel.

I. Literature Survey

1.1 Biodiesel

A major concern of the modern society is the sustainable energy management. The automotive industry uses a large amount of global energy, making the implementation of sustainable fuels a crucial issue worldwide. Biodiesel is a renewable fuel that can be manufactured from vegetable oils, animal fats or even recycled greases from food industry. Remarkably, it is the only alternative fuel currently available that has an overall positive life cycle energy balance. In spite of not containing any petroleum products, biodiesel can be blended with regular diesel to provide a ready-to-use bio-fuel. Blends of 80 % petroleum diesel and 20 % biodiesel (known as B20) can be used in unmodified diesel engines. Unblended biodiesel (B100) can be also used, but may require minor engine adjustments to avoid maintenance problems.

One hundred years ago, Rudolf Diesel tested vegetable oil as fuel for his engine. With the advent of cheap petroleum, appropriate crude oil fractions were refined to serve as fuel and diesel fuels and diesel engines evolved together. In the 1930s and 1940s vegetable oils were used as diesel fuels from time to time, but usually only in emergency situations. Recently, because of increases in crude oil prices, limited resources of fossil fuel and environmental concerns there has been a renewed focus on vegetable oils and animal fats to make biodiesel. Continued and increasing use of petroleum will intensify local air pollution and magnify the global warming problems caused by CO2. In a particular case, such as the emission of pollutants in the closed environments of underground mines, biodiesel has the potential to reduce the level of pollutants and the level of potential or probable carcinogens.

Biodiesel is defined as fatty acid methyl or ethyl esters from vegetable oils or animal fats when they are used as fuel in diesel engines and heating systems. In this context, biodiesel shows the following general advantages:
(1) An alternative to petroleum-based fuel, which implies lower dependence on crude oil foreign imports,
(2) Renewable fuel,
(3) A favorable energy balance,
(4) A reduction in greenhouse gas emissions in line with the Kyoto Protocol agreement

(5) Lower harmful emissions, which is very advantageous in environmentally sensitive areas such as large cities and mines.
(6) Biodegradable and non-toxic fuel, being beneficial for reservoirs, lakes, marine life and other environmentally sensitive places
(7) The use of agricultural surplus, as agreed in the European Agricultural Policy regulations, which can also help to improve rural economies. Taking the above advantages into consideration, there is a growing interest in expanding the biodiesel industry. In this context, the research is focused on improving biodiesel quality and yield and increasing the number of raw materials available. Biodiesel is a green fuel that has many advantages over conventional diesel fuel it is safe, renewable, non-toxic and biodegradable, it contains insignificant amounts of sulfur and its increased lubricity extends the life of diesel engines. In addition, it has a high cetane number (above 60 compared to only 40 for regular diesel), a high flash point (>130 °C) and it emits 70 % fewer hydrocarbons, 80 % less carbon dioxide, and 50 % less particles. As a result of recent legislation changes that require a decrease of vehicle emissions, as much as less than 10 ppm sulfur content, the interest in biodiesel as an alternative fuel has accelerated tremendously. Biodiesel is the fuel which is substantially produced from non-petroleum renewable resources that meets registration requirements for fuels and fuel additives established by the Environmental Protection Agency under section 211(b) of the Clean Air Act and it is the only alternative fuel approved under the 1992 Energy Policy Act (EP act) that federal agencies can use without having to buy Alternative Fuel Vehicles (AFVs). Biodiesel is the only alternative fuel to have fully completed and passed the Tier I and Tier II health effects testing for the Clean Air Act, it is classified as a non-inflammable liquid by the Occupational Safety and Health Administration (OSHA). Biodiesel can help with Executive Order 13149 compliance-Executive Order (EO) 13149 "Greening the Government through Federal Fleet and Transportation Efficiency" directs federal agencies to exercise "leadership in the reduction of petroleum consumption through improvements in fleet fuel efficiency and the use of alternative fuel vehicles (AFVs) and alternative fuels.

II. Objectives

The objectives of the proposed project work are as follows:-

1. Production of bio diesel.
2. Determination of properties of bio diesel.
3. Determination of properties of biodiesel and Anti-Oxidants.
4. Determination of properties of blends of Anti-Oxidants and bio diesel.
5. Combustion Characteristics of blends of Anti-Oxidants and bio diesel.
6. Engine test

III. Materials And Methodology

3.1 Materials and methods for biodiesel Production

The conventional Transesterification method was used for the production of Biodiesel. Table 4.1 shows the raw materials used for the biodiesel production.

Table No: 3.1 Raw materials used for Biodiesel Production

Raw material	Specification	Manufacturer	Grade
Alcohol	Methanol	E.Merck(India) Ltd, Mumbai	Laboratory Reagent
Catalyst	Potassium Hydroxide	E.Merck(India) Ltd, Mumbai	Laboratory Reagent
Oil	Neem Oil	Local Market	Double refined

IV. Biodiesel Blends Using Additives

4.1 Basil used as Anti-Oxidants

4.1.1 Origin of Basil plant

Basil, Thai basil, or sweet basil, is a common name for the culinary
Herb ocimum basilicum

Figure: 4.1 Basil plant (Tulsi plant)

Kingdom: Plantae
Family: Lamiaceae
Genus: Ocimum
Species: O. basilicum
Binomial name :Ocimum basilicum

Figure: 4.2 Basil Oil

4.1.2 Basil Oil acting as Anti-Oxidants

The antioxidant activity from basil ethanol extract, the effect on oxidative stability, total polar compounds, tocopherols levels and fatty acid profile in soybean oil under thermoxidation were evaluated. The basil leaves were dried in lyophilizer, ground and subjected to extraction with ethanol. The soybean oil (SO), soybean oil with 50 mg/kg of tert-butylhydroquinone (TBHQ), soybean oil with 3,000 mg/kg of extract (BE) and soybean oil with 3,000 mg/kg of extract and 50 mg/kg of TBHQ (mixture) treatments were subjected to 180 ± 5C for 20 h. Oil samples were taken at 0, 10 and 20 h and subjected to analysis. The addition of the basil extract increased oxidative stability and resulted in lower formation of total polar compounds. Although the content of tocopherols and polyunsaturated fatty acids decreased over the course of heating, their values remained higher than the SO treatments. Synergistic effect was not observed in the mixture treatment.

4.1.3 Basil Oil Practical Applications

Antioxidants are important ingredients in food processing because they have the capacity to protect foods containing oils and fats, from damage caused by free radicals and reactive oxygen species. Synthetic antioxidants are widely used in the food industry; however, their utilization has been questioned due to toxicity. Therefore, there is a growing interest in the use of natural antioxidants to reduce or replace the synthetic antioxidants. Several species of the Lamiaceae family are used in cooking, medicine and by the pharmaceutical industry, standing out is basil. Being rich in compounds with high antioxidant activity, basil extract can be used to replace synthetic antioxidants used in vegetable oil.

4.2 Clove oil used as Anti-Oxidants

4.2.1 Origin of clove plant

A native of Indonesia and the Malacca Islands, it is an evergreen tree that grows to about 10 meters (30 feet) tall and has bright green leaves and nail-shaped rose-peach flower buds which turn, upon drying, a deep red brown. These are beaten from the tree and dried.

The Latin word 'Clavus' means nail shaped, referring to the bud.

It was often used by the Greeks, Roman and the Chinese, to ease toothache and as a breath sweetener, especially when talking to the Emperor. It has antiseptic properties and was used in the prevention of contagious diseases, such as the Plaque.

It was an important commodity in the spice trade and is still used in perfumes, mulled wines and liqueurs, love potions, dental products and, stuck in an orange as pomade, an insect repellant.

Cloves are one of the spices indigenous to Asian countries like Indonesia, India, Pakistan, and even areas of East Africa. It is native to the Maluku islands in Indonesia. They are a popular flavouring agents used in a variety of ways across the world, particularly in Asia.

Figure: 4.3 clove plant

Kingdom : Plant
Family : Myrtaceae
Genus : Syzygium
Species : Syzygium

Figure: 4.4 Clove Oil

4.2.2 Clove oil acting as Anti-Oxidants

As a search for natural system from plant materials, strong antioxidative activity was observed in leaf waxes extracted from Eucalyptus species. A novel type of antioxidant was isolated from the leaf wax of Eucalyptus globulus and identified as n-tritriacontan-16, 18-dione. Antioxidative activities were determined by different methods; a thiocyanate method, a thiobarbituric acid method, a total carbonyl value method and a weighing test. The antioxidant showed remarkable antioxidative activity in a water/alcohol system and was more effective than α-tocopherol and BHA; however, it has no antioxidative activity in an oil system.

V. Results And Discussion

5.1 Fuel Properties

The important fule properties of diesel, Neem oil, biodiesel are shown in Table 6.1. From the table, it is observed that the properties of biodiesel are better than Neem oil and close to diesel.
The measured properties are presented in the below table:

Table No: 5.1 Measured Fuel Properties

Sample	Flash point (^oC)	Fire point (^oC)	Calorific Value (kJ/kg)	Density (kg/m^3)
A	250	258	40365	931
B	236	244	40344	961
C	239	249	40351	927
D	249	250	40348	934
E	236	246	40365	942
F	238	244	40358	934
G	244	250	40348	932
H	238	244	40355	943

A-Bio-diesel sample 1
B-Bio-diesel sample 2
C-Bio-diesel sample 3
D-Bio-diesel sample 4
E-Bio-diesel sample 5
F-Bio-diesel sample 6
G-Bio-diesel sample 7
H-Bio-diesel sample 8

VI. Conclusion

6.1 CONCLUSION

Based on the results and discussion, the following conclusions were made.

1. For the present work, Biodiesel was prepared by transesterification.
2. The mass burning rate of the biodiesel blends are lower than diesel. Hence Neem oil Biodiesel blends can be used as a substitute for diesel.
3. The performance of Neem oil biodiesel blends in lamp is better than diesel and hence they may be used as a substitute for diesel.

6.2 Scope for Future Work

1. To study the effect of compression ratio on the performance and emission of diesel engine.
2. To study the effect of injection time on the performance and emission of diesel engine.
3. To study the effect of piston crown geometry on the performance and emission of diesel engine.
4. To study the optimization technique involved in bio-diesel preparation.

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