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Study of Jatropha Oil as Bio-diesel , its characteristics, advantages and comparison with Diesel

[1]M.J. Pathak, Research Scholar, School of Technology , R. K. University Rajkot
[2]Dr. G. D. Acharya, Principal, Atmiya Institute of Technology and Sciences, Rajkot

Introduction : Biodiesel is an alternative fuel for diesel engines that is produced by chemically combining vegetable oils and animal fats with an alcohol to form alkyl esters. Extensive research and demonstration projects have shown that it can be used pure or in blends with conventional diesel fuel in unmodified diesel engines. Interest in biodiesel has been expanding recently due to government incentives and high petroleum prices. While the current availability of vegetable oil limits the extent to which biodiesel can replace petroleum to a few percent, new oil crops could allow biodiesel to make a major contribution in the future

Need For Alternate Fuels

Bio-fuels are generally considered as offering many properties, including sustainability, reduction of greenhouse gas emission regional development, social structure and agriculture, security of supply The rapid extraction and consumption of fossil fuels have led to a reduction in petroleum reserves. Petroleum based fuels are obtained from limited reserves. These finite reserves are highly concentrated in certain region of the world. Therefore, those countries not having these resources are facing a foreign exchange crisis, mainly due to the import of crude petroleum diesel. Hence it is necessary to look for alternative fuels, which can be produced from materials available within the country. Although vegetable oils can be fuel for diesel engines, but their high viscosities, low volatilities and poor cold flow properties have led to the investigation of its various derivatives. Among the different possible sources, fatty acid methyl esters, known as Biodiesel fuel derived from triglycerides (vegetable oil and animal fates) by trans-esterification with methanol, present the promising alternative substitute to diesel fuels and have received the most attention now a day. The main advantages of using Biodiesel are its re newability, better quality exhaust gas emission, its biodegradability and the organic carbon

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present in it is photosynthetic in origin. It does not contribute to a rise in the level of carbon dioxide in the atmosphere and consequently to the green house effect.

Vegetable oils are considered as most sustainable alternative fuels for CI engines as they are renewable, biodegradable, non toxic, environmental friendly, a lower emission profile compared to diesel fuel and most of the situation where conventional petroleum diesel is used. Non edible vegetable oils are the most significant to use as a fuel compared to edible vegetable oils as it has a tremendous demand for using as a food and also the high expense for production. Therefore many researchers are experimenting on non edible vegetable oils. In India the feasibility of producing bio diesel as diesel substitute can be significantly thought as there is a large junk of degraded forest land, unutilized public land, and fallow lands of farmers, even rural areas that will be beneficial for overall economic growth. . The use of vegetable oils, such as palm, soya bean, sunflower, peanut, and olive oil, Jatropha curcas etc. as

alternative fuels for diesel is being promoted in many countries . Only a very few and non-edible type such as jatropha oil, karanja oil, etc. can be considered to be eco nominally afford able to some developing countries like India in particular.

Jatropha Plant

Fig. 1 Jatropha plant and Fig.2 seed of jatropha

The Jatropha curcas Linnaeus plant J. curcas L. belongs to the family Euphorbiaceae. The genus name Jatropha derives from the Greek jatros (doctor), trophe (food), which implies medicinal uses, hence the plant is traditionally used for medicinal purposes. It is a hardy shrub that can grow on poor soils and areas of low rainfall (from 250 mm a year) hence its being promoted as the ideal plant for small farmers It is a drought-resistant, perennial plant and living up to fifty years and has capability to grow on marginal soils. It requires very little irrigation

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and grows in all types of soils (from coast line to hill slopes). It is a rapidly growing tree and easily propagated. Jatropha usually grows below 1400 meters of elevation from sea level and requires a minimum rainfall of 250mm, with an optimum rainfall between 900-1200mm . It is non-edible oil being singled out for large-scale for plantation on waste lands Jatropha plant can thrive under adverse conditions. The production of jatropha seeds is about 0.8 kg per square meter per year. The oil content of jat ropha seed ranges from 30% to 50% by weight and the kernel itself ranges from 45% to 60%. Fresh jatropha oil is slow-drying, odor less and color less oil, but it turns yellow after aging.

The Cultivation of the Jatropha plant

Jatropha curcas L. has various socio-economic benefits which makes it more economical when cultivated on commercial scale. Jatropha can be propagated from seeds as well as from cuttings. Seeds or cutting can be directly planted in the main field. Otherwise, seedlings grown in poly bags are transplanted in the main field. A hectare of jatropha plantation is reported to yield 2.5-3.5tonnes of seeds in the third year and increases sharply to 5000-12,000 tonnes per hectare from the sixth year onwards .

The Jatropha plant itself can be used in erosion control if planted across the hills and against the wind. The plant can also be used as firewood. The fact that it grows very fast means Jatropha can be used to solve the problems of deforestation in many developing countries. The toxicity of the plant deters animal browsing. The leaves are used as a medicine and could also be used to develop Silkworm. The leaves can also be used as an anti-inflammatory substance. The Jatropha plant also provides a source of employment to many rural areas, which in turn helps to reduce urban migration in developing countries

Table 1 The comparison of properties ofJatropha oil and standard specifications of diesel oil

Specification	Jatropha oil	Diesel
Specific gravity	0.9186	0.82/0.84
Flash point	240/1 10 °C	50 °C
Carbon residue	0.64	0.15 or less
Cetane value	51.0	50.0 up
Distillation point	295 °C	350 °C
Kinematics Viscosity	50.73 cs	2.7 cs up
Sulphur %	0.13%	1.2 %or less
Calorific value	9 470 kcal/kg	10170kcal/kg
Pour point	8°C	10°C
Colour	4.0	4 or less

Characterization of Jatropha oil

Non-edible oil generally contains about 3-4 % wax and gum. De-waxing and degumming of plant oils is required not only for smooth running of the CI engine but also to prevent engine failure even if plant oils are blended with diesel. It is therefore necessary to remove wax and

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gum from the fresh oil before it could be used in CI engine. Characterization of diesel and Jatropha oil is as per the [Table–1]. Crude-Jatropha oil, a non-edible vegetable oil shows a greater potential for replacing conventional diesel fuel quite effectively, as its properties are compatible to that of diesel fuel . It is however found from researches that the neat jatropha oil can be used to run the engines in mini-vans for rural transportation, haulage trucks, farm tractors and other agricultural machinery, but may require little modification . From the above table 1, Density, cloud point and pour point of Jatropha oil are found to be higher than diesel. Higher cloud and pour point reflect unsuitability of Jatropha oil as diesel fuel in cold climatic conditions but the flash and fire points of Jatropha oil is very high compared to mineral diesel. Hence, Jatropha oil is extremely safe to handle . Higher carbon residue from Jatropha oil may possibly lead to higher carbon deposits in combustion chamber of the CI engine. Low sulphur content in Jatropha oil results in lower SOX emissions. Presence of oxygen in fuel improves combustion properties and emissions but reduces the calorific value of the fuel . Jatropha oil has approximately 90% calorific value compared to diesel. Nitrogen content of the fuel also affects the NOX emissions. Higher viscosity is a major problem in using vegetable oil as fuel for diesel engines. Viscosity of Jatropha biodiesel is 4.84cSt at 40°C. It is observed that viscosity of Jatropha oil decreases remarkably with increasing temperature and it becomes close to diesel at temperature above 90°C .

Advantages of Jatropha

- Hardy shrub which grows in semi-arid conditions and poor soils
- Can be intercropped with high value crops such as sugar, coconut palm, various fruits and vegetables, providing protection from grazing livestock and phyto-protection action against pests and pathogens
- It is easy to establish and grows relatively quickly.
- Yields around 4 tons of seed per hectare in unkept hedges are achievable
- Has low nutrient requirements
- Requires low labor inputs.
- Bio-fuel almost completely eliminates life cycles CO2 emission.
- Production of 1t / ha / year of high protein seed cake that can be used as animal and
- fish feeds and organic matter that can be used as organic fertilizers.
- Various other products from the plant (leaf, bark and seed extracts) have various other industrial and pharmaceutical uses.

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- Restoration of degraded land over a period of time.
- They contain higher amount of O2 (up to 10%). That ensuresmore complete combustion of HC.

Conclusion : In this review article, it is concluded that Compared to diesel fuel, a little amount of power loss happened with vegetable oil fuel operations.

• Particulate emissions of vegetable oil fuels were higher than that of diesel fuel, but on the other hand, NO2 emissions were less.

• Raw vegetable oils can be used as fuel in diesel engines with some modifications.

• Before starting wide application, some improvements is needed as we will incorporate a device heat exchanger can be use to decrease the viscosity and thus provide smooth running of engine.

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