

Biodiesel – Future Need to Substitute Diesel Fuel For CI Engine A Review

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ABSTRACT

The continuous rise in global prices of crude oil, increasing threat to environment due to exhaust emissions, the problem of global warming and the threat of supply fuel oil instabilities have adversely impacted the developing countries, more so to the petroleum importing countries like India. From the point of view of long term energy security, it is necessary to develop substitute fuels especially for CI engine with properties comparable to petroleum based fuels.

Keywords : Biodiesel, Pollution Problem, Alternative Sources, Biodiesel Production Methods.

I. INTRODUCTION

Energy is a critical input for economic growth and sustainable development in both developed and developing countries. The world's energy requirement for transportation is met from nonrenewable fossil fuels. The rise in crude oil prices has forced nations to seriously consider alternative energy sources that are renewable and non-polluting. In the face of shrinking supplies and rising demand, oil prices are expected to continue to rise. In addition, growing concerns about human-induced climate change, as evidenced by rising temperatures and environmental pollution, are further driving the impetus for non-polluting energy sources. One such source is ethanol from plant biomass/grain and biodiesel from processing edible and nonedible vegetable oils.

The highest demand for energy comes from industry, followed by the transportation sector which consumed about 16.9%. Within the transportation sector, the consumption of motor spirit (gasoline) grew by 6.64% and that of high speed diesel (HSD) by 4.1%. This growth will only escalate over the next several years since India's vehicular population is expected to grow by 10-12% per annum. Hence securing a long-term supply of energy sources and prioritizing development

are critical to ensuring the country's future energy requirements are met.

Currently, the country is looking for alternative energy options from biofuels to meet the transportation sector's demand. A mandatory 5-10% blending of biofuels with petrol and diesel stipulated by some countries in the last 15-20 years triggered a rapid growth in the biofuel sector in the last decade.

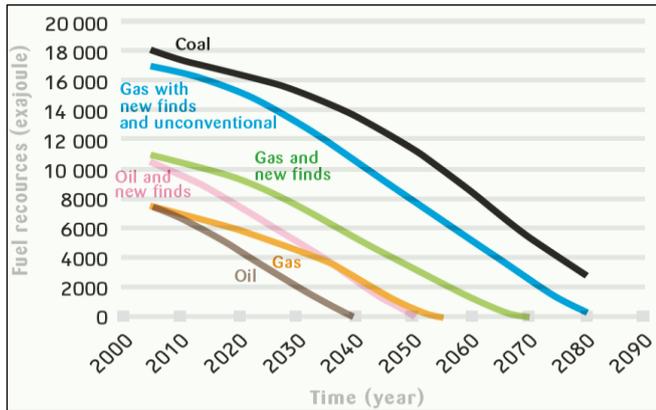
Problem Statement

India's energy demand is primarily met through non-renewable sources such as coal, natural gas and oil. These will continue to play a dominant role in its energy scenario in the next few decades. Therefore the country is looking for alternative energy options from biofuels to meet the transportation sector's demand.

Objectives

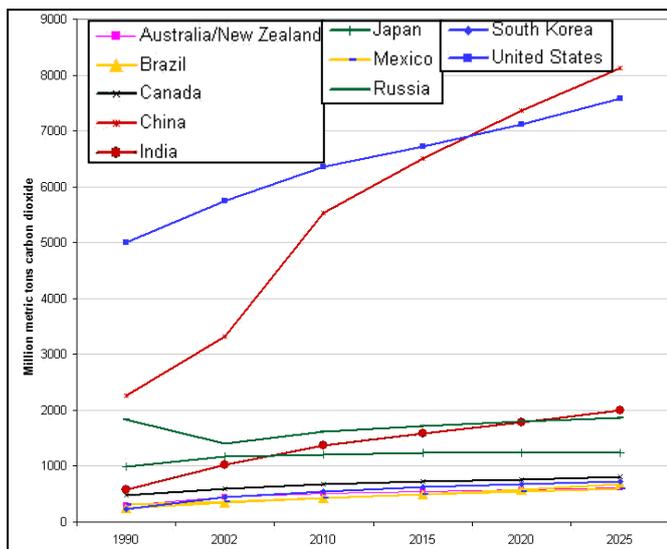
This paper highlights the current scenario of pollution, availability of fissile fuel sources, salient features of India's biofuel policy. The paper also addresses the long-term sustainability of biodiesel production using an alternative feedstock.

Current Known Sources Life Cycle

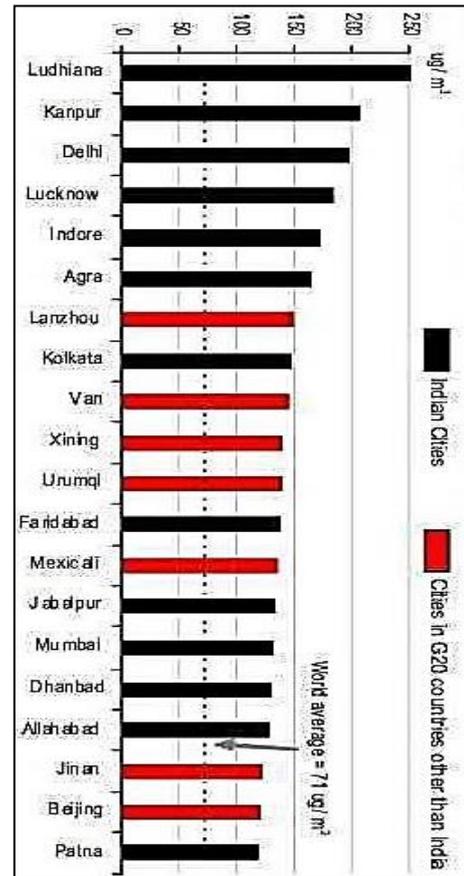


From the source, reneweconomy.com.au/2014/Indias-dirty-coal-problem, we found that currently known sources of fossil fuels coal is going to exhausted completely upto the year 2080. Other sources like gas will exhausted upto 2055 and oil upto 2040. Thus there is a need of finding new sources of all these fossil fuel or finding some sustainable substitute fuel.

With secrecy of fossil fuel the big issue is with the environment pollution, considering only for CO₂ emission which is one of the main source of greenhouse gases and global warming. The study carried away by monbagay.com, EIA 2005, it is clear that india going to be third highest CO₂ emitting county by 2020, followed to China and United State.



As per the survey of world health organization, out of G20 counties, among top twenty highly polluting cities, 13 cities are from India; this is a very serious issue to be resolve.



Alternative Sources of Energy for Transportation Vehicles

Some alternative energy sources are used in engine to reduce the dependency and to control the emission of vehicular pollutions.

1. Air Engine

The air engine is an emission-free piston engine that uses compressed air as a source of energy. The expansion of compressed air may be used to drive the pistons in a modified piston engine. Efficiency of operation is gained through the use of environmental heat at normal temperature to warm the otherwise cold expanded air from the storage tank. This non-adiabatic expansion has the potential to greatly increase the efficiency of the machine. The only exhaust is cold air (-15 °C), which could also be used to air condition the car.

The principal disadvantages are the additional steps of energy conversion and transmission, because each inherently has loss. For compressed-air cars, the power

plant's electricity is transmitted to a compressor, which mechanically compresses the air into the car's tank. The car's engine then converts the compressed air to mechanical energy.

2. Battery-Electric Engine

Battery electric vehicles (BEVs), also known as all-electric vehicles (AEVs), are electric vehicles whose main energy storage is in the chemical energy of batteries. BEVs are the most common form of what is defined by the California Air Resources Board (CARB) as zero emission vehicles (ZEV) because they produce no tailpipe emissions at the point of operation. The electrical energy carried on board a BEV to power the motors is obtained from a variety of battery chemistries arranged into battery packs. For additional range genset trailers or pusher trailers are sometimes used, forming a type of hybrid vehicle. Batteries used in electric vehicles include "flooded" lead-acid, absorbed glass mat, NiCd, nickel metal hydride, Li-ion, Li-poly and zinc-air batteries.

Battery powered cars had primarily used lead-acid batteries and NiMH batteries. Batteries recharge capacity is considerably reduced if they are discharged beyond 75% on a regular basis, making them a less-than-ideal solution.

3. Solar Engine

A solar car is an electric vehicle powered by solar energy obtained from solar panels on the car. Solar panels cannot currently be used to directly supply a car with a suitable amount of power at this time, but they can be used to extend the range of electric vehicles. These are the development of alternative energy technology such as solar cells and electric vehicles.

4. Biodiesel Engine

Biodiesel (Fatty acid methyl ester), is commercially available in most oilseed-producing, it is somewhat more expensive than fossil diesel, though it is still commonly produced in relatively small quantities (in comparison to petroleum products and ethanol).

Biodiesel has lower Energy Density than fossil diesel fuel, so biodiesel vehicles are not quite able to keep up

with the fuel economy of a fossil fuelled diesel vehicle, if the diesel injection system is not reset for the new fuel. If the injection timing is changed to take account of the higher Cetane value of biodiesel, the difference in economy is negligible.

Because biodiesel contains more oxygen than diesel or vegetable oil fuel, it produces the lowest emissions from diesel engines, and is lower in most emissions than gasoline engines. Biodiesel has a higher lubricity than mineral diesel and is an additive in diesel for lubricity and emissions reduction.

National Policy on Biofuels

An indicative target of 20% blending of biofuels both for biodiesel and bioethanol by 2017.

- Biodiesel production from non-edible oilseeds on waste, degraded and marginal lands to be encouraged
- A Minimum Support Price (MSP) to be announced for farmers producing non-edible oilseeds used to produce biodiesel
- Financial incentives for new and second generation biofuels, including a National Biofuel Fund
- Biodiesel and bioethanol are likely to be brought under the ambit of "declared goods" by the Government to ensure the unrestricted movement of biofuels within and outside the states Setting up a National Biofuel Coordination Committee under the Prime Minister for a broader policy perspective
- Setting up a Biofuel Steering Committee under the Cabinet Secretary to oversee policy implementation.

Several ministries are currently involved in the promotion, development and policy making for the biofuel sector.

- The Ministry of New and Renewable Energy is the overall policymaker, promoting the development of biofuels and research and technology development for its production.
- The Ministry of Petroleum and Natural Gas is responsible for marketing biofuels and developing and implementing a pricing and procurement policy.

- The Ministry of Agriculture's role is that of promoting research and development for the production of biofuel feedstock crops.
- The Ministry of Rural Development is specially tasked to promote *Jatropha* plantations on wastelands.
- The Ministry of Science & Technology supports research in biofuel crops, specifically in the area of biotechnology.
- In view of the multiple departments and agencies involved, a National Biofuel Coordination Committee (NBCC) headed by the Prime Minister was set up to provide high-level coordination and policy guidance/review on different aspects of biofuel development, promotion and utilization.

Bio-Diesel Production

Many standardized procedures are available for the production of bio-diesel fuel oil. The commonly used methods for bio-fuel production are elaborated below.

- **Blending**

Vegetable oil can be directly mixed with diesel fuel and may be used for running an engine. The blending of vegetable oil with diesel fuel in different proportion were experimented successfully by various researchers. Blend of 20% oil and 80% diesel have shown same results as diesel and also properties of the blend is almost close to diesel. The blend with more than 40% has shown appreciable reduction in flash point due to increase in viscosity. Some researchers suggested for heating of the fuel lines to reduce the viscosity. Although short term tests using neat vegetable oil showed promising results, longer tests led to injector coking, more engine deposits, ring sticking and thickening of the engine lubricant.

- **Transesterification**

Transesterification is the process of using an alcohol (e.g. methanol, ethanol or butanol), in the presence of a catalyst, such as sodium hydroxide or potassium hydroxide, to break the molecule of the raw renewable oil chemically into methyl or ethyl esters of the renewable oil, with glycerol as a by-product. Biodiesel, defined as the mono-alkyl esters of fatty acids derived

from vegetable oil or animal fat, in application as an extender for combustion in diesel engines, has demonstrated a number of promising characteristics, including reduction of exhaust emissions.

Trans esterified, renewable oils have proven to be a viable alternative Diesel engine fuel with characteristics similar to those of Diesel fuel. The transesterification reaction proceeds with catalyst or without catalyst by using primary or secondary monohydric aliphatic alcohols having 1–8 carbon atoms as follows :

$$\text{Triglycerides} + \text{Monohydric alcohol} = \text{Glycerine} + \text{Mono-alkyl esters}.$$

- **Micro Emulsification**

To solve the problem of high viscosity of vegetable oil, micro emulsions with solvents such as methanol, ethanol and butanol have been used. A micro emulsion is defined as the colloidal equilibrium dispersion of optically isotropic fluid microstructures with dimensions generally in the range of 1–150 nm formed spontaneously from two normally immiscible liquids and one or more ionic or non-ionic amphiphiles. These can improve spray characteristics by explosive vaporization of the low boiling constituents in the micelles.

All micro emulsions with butanol, hexanol and octanol will meet the maximum viscosity limitation for diesel engines.

- **Cracking**

Cracking is the process of conversion of one substance into another by means of heat or with the aid of catalyst. It involves heating in the absence of air or oxygen and cleavage of chemical bonds to yield small molecules. The pyrolyzed material can be vegetable oils, animal fats, natural fatty acids and methyl esters of fatty acids.

The pyrolysis of fats has been investigated for more than 100 years, especially in those areas of the world that lack deposits of petroleum. Since World War I, many investigators have studied the pyrolysis of vegetable oil to obtain products suitable for engine fuel application. Tung oil was saponified with lime and then thermally cracked to yield crude oil, which was refined to produce diesel fuel and small amounts of gasoline and kerosene.

Different Oil used for Biodiesel	Density at 15 °C (kg/m ³)	Kinematic viscosity at 40°C (cSt)	Lower heating value (kJ/kg)
ND	830	3.12	43000
Honne Oil	910	32.47	39100
Cotton Seed Oil	910	34	36800
Soybean Oil	925	33	37000
Corn Oil	915	35	36300
Olive Oil	925	32	37000
Honge Oil	924	45.23	30440
Rice Bran Oil	901	42.55	38952

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Advantages and Disadvantages

The advantages of vegetable oils as Diesel fuel are :

- Liquid nature-portability,
- Ready availability,
- Renewability,
- Higher heat content (about 88% of D2 fuel),
- Lower SC,
- Lower aromatic content,
- Biodegradability.

The disadvantages of vegetable oils as Diesel fuel are :

- Higher viscosity,
- Lower volatility,
- The reactivity of unsaturated hydrocarbon chains.

II. CONCLUSION

In this Paper it is concluded that

- Compared to diesel fuel, a little amount of power loss happened with vegetable oil fuel operations.
- Vegetable oil methyl esters gave performance and emission characteristics closer to the diesel fuel. So, they seem to be more acceptable substitutes for diesel fuel.
- Raw vegetable oils can be used as fuel in diesel engines with some modifications.
- Before starting wide application, there are some improvements that should be done, such as Fuel systems should be optimized for vegetable oil operation.

BIOGRAPHIES



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