Scientific Reviews
&
Chemical Communications

Sci. Revs. Chem. Commun.: 5(2), 2015, 88-92
ISSN 2277-2669

- A REVIEW

BIODIESEL AN ECOFRIENDLY FUEL PRODUCTION OF FROM VEGETABLE OIL

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(*Received : 23.06.2015; Revised : 28.06.2015; Accepted : 29.06.2015*)

ABSTRACT

The vegetable oil derived biofuel could play an important role to some extent to eradicate this worsening situation. Biodiesel is the only alternative fuel that can be used directly in any existing unmodified diesel engine. Because it has similar properties to diesel fuel, biodiesel can be blended in any ratio with diesel fuel.

Key words: Soyabean, Vegetable oil, Biodiesel.

INTRODUCTION

In the past, animal and vegetable oils were the main sources of fuel for domestic and industrial purposes. vegetable oil is a promising alternative biofuel, which can be converted into biodiesel. It is produced mostly in rural area, where there is an acute need for modern forms of energy[1]. In recent years, systematic efforts have been made by several research workers to use vegetable oil as fuel in engines[2-4]. Various oils like algal oil, sunflower oil, palm oil and olive oil have been used in different countries as raw materials for biodiesel production owing to its availability[5-8]. Biodiesel is defined as a fuel comprised of mono alkyl esters of long chain fatty acids derived from vegetable oils or animals fats[9]. In Malaysia, a considerable amount of research has been done primarily on plam oil, while coconut oil was the target of Australia scientists. The European community has been chiefly focused on rapeseed oil. In the United States, the interest is in soy oil and tallow. The vegetable oils were converted to methyl esters instead using directly. The reports available in literature indicated in various project involved with the production of vegetable oil methyl ester are underway in the unites states[10], and several European countries including U.K.[11], Italy[12], France[10,13], Finland[10] and Hungary[14]. The characteristics such as flash point, density, viscosity, octane no. cloud point, net heating value MJ/L, lower heating value of the some vegetable oil, their methyl ester and diesel fuel are reported in the literature[15].

EXPERIMENTAL

Following two industrial routes are commonly in practice for methyl ester preparation:

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(i) The classical trans-esterification method[16]

In this process, methylation of oils and fats take place in the alkaline catalyst (sodium or potassium methoxide) to produce methyl ester (methyl soyate in case of soya bean oil) and glycerin, a by –product.

(ii) Non-alkaline catalytic process (M/s DE SMET Method)

Here, trans-esterification methylation process is carried out in present of non-alkaline catalyst at ± 50 bar and ± 200^{o}C in a reaction vessel.

Soy diesel characteristics[17]

The octane number, energy content, viscosity and phase change are very similar to petroleum based fuel. Soy diesel offers a reduced emission, environmentally sound alternative to conventional petroleum based fuel.

Table 1: Vegetable oil methyl ester/bio diesel production

Country	Source of vegetable oil	Production in progress at	Project amount
USA[1]	Soybean	M/s Proctor & gamble for national soy diesel development board project	20 Million gallon/year ester to produce 100 million gallon of bio-diesel blended with 25%
U.K.[11]	Vegetable oils	M/s Cargill in collaboration with the project of cooperative united oil seeds marketing	100,000 Tones, year bio-diesel project.
Italy[7,12]	Soybean, sunflower and canola	M/s Nova mount SPA Milan	60,000 Tones/year capacity diesel fuel (Diesel-Bi) plant.
France[10,13]	Rapeseed	M/s Sofiproteol at compligne	40,000 Tones/year diester* production project.
		M/s Ferruzzi/Novamont in collaboration with ICT C&P at baleycourt verdun	40,000 Tons/year Diesel Bi project.
		French institute of petroleum (IFP)	100,000 Tones/year bio-diesel production plan by 1995.
Finland[10]	Rapeseed	M/s Finnish raiso oil	Rapeseed methyl ester diesel fuel since 1991.
Hungry[14]	Rapeseed and sunflower	In collaboration with M/s Lurgi O1. Gas.Chemie Gmbh, Frankfurt (Germany)	60 Tones/day bio-diesel since late 1993.
Australia[10,16]	Coconut	Research work in the remote pacific Islands of Vanuatu	Plans to produce improved coconut oil derived fuel for diesel engines.

* diester[13] is another diesel substitute produced from rapeseed oil

RESULTS AND DISCUSSION

Environment benefits of soy diesel[17]

(i) Soy diesel is essentially sulphur free.

(ii) Vehicles fueled by soy diesel emit significantly less carbon monoxide, hydrocarbons and particulates.

(iii) Nitrogen oxide emission is similar to those of conventional diesel.

(iv) Soy diesel does not produce explosive air/ fuel vapors.

Test trials with soy diesel/bio fuel

The fuel blend of 20% soybean oil-based diesel (methyl soyate) and 80% regular diesel fuel is being used in the United States for maintenance of vehicles[17] without modifications in the engine. That included street sweepers, dump trucks, small trucks, the maintenance vehicles at Lambert Airport[17] in st. Louis. The school buses are also running with soya diesel in the Unites State.

The studies[19] conducted at the University of Missouri, reported that the truck, a Dodge Ram powered by unmodified Cummins diesel engine has successfully completed 10,000 test miles with soy diesel. The oil samples were drawn for analysis after each 500 miles and the complete oil change was done after every 3,000 miles. The results showed that there was no sign of wear and no loss of power.

Generators[20] in St. Luke's Methodist Hospital, Iowa were supplied with modified soy diesel to try a cleaner burning diesel fuel. The report says that a 50/50 blend of petroleum based diesel fuel and methyl soyate has been successful to reduce particulate emissions by about 50%. It was also revealed that further emission can be reduced, if the level of methyl soyate is increased in blending with regular diesel.

In South America[17], there are fleets, which have put over 2,00,000 miles on them using fuel based on soybean oil methyl ester. The diesel mixture containing upto 5% diester (derived from rapeseed oil) is being marketed by Elf gas service stations in France[3]. Biodiesel fuel has also been tested in diesel-powered vehicles in U.K[10], Italy[17], Germany[21], Austria[17] and Switzerland[17], where rapeseed is the main source of vegetables oil supply.

Further studies are underway to check the fuel efficiency of a direct diesel injection internal combustion engine using soy-diesel; the wear characteristics, any change in horse-power and testing the exhaust of engine run from a esterified soy oil fuel.

Critics and the positive thoughts

While biodiesel is said to be environmentally safe, it has opposing views as well-

(i) It is argued that the biodiesel cost per gallon does not become competitive with other alternative fuels. However, it is also suggested that the larger amount of biodiesel production eventually will bring down the cost.

(ii) It is also argued that an excess production of glycerin, the by-product during trans esterification would upset the economy of this product. Since glycerin is in short supply and its over production is not an issue.

(iii) It is considered that the quantity involved in biodiesel production (from 100 million tonnes of animal and vegetable oils and fats global production per annum) will be very little by comparison to the petroleum derivatives (3.2 Billion tonnes world annual production) and hence the environmental benefits would be negligible.

(iv) Critics also point out that there would be hidden costs of bio-fuel programmers such as need for petroleum based fuels to manufacture the nitrogen fertilizers that would be used in intensive vegetables oil crops production.

(v) The cold[19], infelt is the major challenge with this break-through. The modified fuel begins gel at 35^{o}F or 1.66^{o}C. To avoid such troubles, change of fuel over to regular diesel becomes necessary before shutting down the engine. It is also advised to keep the fuel tank and fuel lines heated in cold weather.

(vi) Coconut oil-derived fuel[16], which was found to be less reactive, causing less polymerisation and the property of less chocking of injections has its own constrains such as it solidifies at 24^{o}C and below, low vaporization in the chamber, high viscosity and therefore, heating of oil becomes necessary. The microbial growth in warm coconut oil is also possible. Again the hassle of back and forth fuel change over petroleum diesel and biodiesel still remains there.

(vii) Further research[19] may focus on to develop the chemical additives that would change the physical characteristics of the oil suitable for cold weather.

Future scope

Despite the fact that the biodiesel initiatives are less attractive in terms of world's total fuel supply, the domestic biofuel projects could however make a small impact on to save valuable foreign currency for the need to import petroleum fuels. Thus, the energy dependence can be reduced to some extent by developing fuel from vegetables oils. The other advantage of such programmes can be observed by lessening the need for imported animal feed. The by-produce, which will be available locally with planting more oil-seed-crops.

In Indian context, biodiesel may occupy a special place if taken up seriously. Reason, the roads in recent years have been flooded with millions of motor vehicles, which are polluting the environment. The metropolitan cities- Delhi, Mumbai, Kolkatta, and Chennai are the worst hit from this epidemic. In the capital, where pollution revel has gone up uncontrolled than expected. Similar is the case with other cities. An international report[22] publised many years ago on the basis of survey conducted by M/s. G. E. Co. of India in June 1983 had concluded that Kolkata, the second most populated city of India, where inhaling the city's air is equivalent to smoking 20 cigarettes a day.

The literature survey however showed that not many serious efforts have been made so far in our country to gear up the biodiesel projects. The Govt. institutions like Central Road Research Institute (CRRI), New Delhi; Indian Institute of Petroleum (IIP), Dehradun; and Central Institute of Road Transport (CIRT), Pune can execute the possibility of utilizing vegetable oils as an alternative ecofriendly fuel- the biodiesel that our country needs badly.

In this regard, it becomes very necessary to include the interesting news published from Kolkata, where it has been shown that the vegetables oils can be used in the smooth running of diesel engines. The scientists working in the Institute of Engineering and Management have successfully been able to demonstrate that the purified and suitable modified vegetable oils can be the alternative fuel for the petroleum produces.

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