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Biodiesel From Seabuckthorn Oil

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***Abstract*—The world is confronted with the twin crisis of fossil fuel depletion and environmental degradation. 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, their high viscosities, low volatilities and poor cold flow properties have led to the investigation of their 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 days. The main advantages of using Biodiesel are its renewability, better quality exhaust gas emission, its biodegradability and the organic carbon 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. Here we use sea-buckthorns (Hippophae L). Oils from sea-buckthorn seeds and pulp differ considerably in fatty acid composition. While linoleic acid and α-linolenic acid are the major fatty acids in seed oil, sea buckthorn pulp oil contains approximately 65% combination of the monounsaturated fatty acid, palmitoleic acid, saturated fatty acid and palmitic acid. It has low viscosity among vegetable oils. Due to low acidic value we use base catalyst, activated calcium oxide.**

***Index Terms*—seabuckthorn, hippophae L, low viscosity, activated calcium oxide.**

I. INTRODUCTION

Biodiesel is an alternative fuel formulated exclusively for diesel engines; it's made from vegetable oil or animal fats. Biodiesel burns clean, which results in a significant reduction of the types of pollutants that contribute to smog and global warming and emits up to 85% fewer cancer-causing agents. It is the only alternate fuel approved by the Environmental Protection Agency (EPA). **Biodiesel** refers to a vegetable oil or animal fat based diesel fuel consisting of long-chain alkyl (methyl, propyl or ethyl) esters. Biodiesel is typically made by chemically reacting lipids (e.g., vegetable oil, animal fat (tallow) with an alcohol. Biodiesel is meant to be used in standard diesel engines and is thus distinct from the vegetable and waste oils used to fuel converted diesel engines. Biodiesel can be used alone, or blended with petrol or diesel.

A. Seabuckthorn Oil

Seabuckthorn oil is an good option for the manufacture of biodiesel. Seabuckthorn can grow on all soils. Soils with less fertility, it requires only phosphorous as fertilizer. It requires annual rainfall nearly 400cm. it grows in Himalayan regions.it can not with stand temperature above 40degree celsius. Seabuckthorn oil has low viscosity. The plant as an whole is of high utility the oil from the seed can be used in food industry, biodisel. The fruit is edible and has high herbal and medicinal value. The bark of the tree has very high calorific value around 4785 kcal/kg, and so it can be used as a substitute for coal in various applications for burning.

B. Oil Extraction Methods

The oil extraction are mainly done by two methods namely

- solvent extraction
- super critical fluid extraction

1) Solvent extraction

Solvent extraction using petroleum-ether (boiling range 35-60ºC) laboratory oil extraction following a standard method (AACC 2000). Prior to extraction, seeds were prepared by grinding them in two 15-s cycles in a rotary mill. During petroleum ether extraction, the oil temperature was maintained at 45 ±1ºC.

2) Super critical fluid extraction

Supercritical fluid extraction was conducted using a supercritical fluid extraction screening system The major component of the SCFE system included a carbon dioxide source (compressed cylinder of liquefied CO2 gas, 99% pure), a continuous compressor, a cylindrical stainless steel extraction vessel),a temperature controlled heating pad external to the extraction vessel, a stainless steel cylindrical oil collection vessel. Seeds were prepared by grinding following the method used in petroleum-ether extraction.. All samples (ground seeds or pulpflakes) were gently compacted inside the extraction vessel to 0.6 kPa. Oil extraction from seeds and pulp-flakes was conducted at 45ºC and 35 MPa. Flow rate of CO2 through the sample in the extraction vessel was maintained at approximately 4.5 L/min.

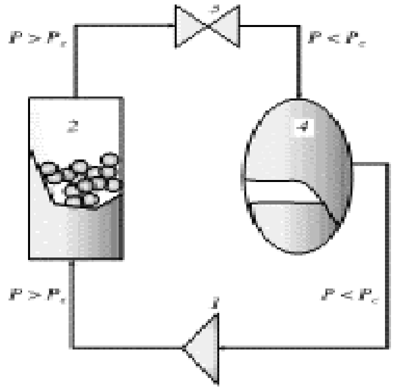

Fig 1.1 Biodiesel Extraction Unit

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C. Oil Properties

Fatty acid composition differs between the seed oil and soft parts of the fruit. The seed oil contains linoleic, α-linoleic, oleic, palmitic, stearic, and vaccenic acids. The fruit contains palmitoleic, palmitic, and oleic acids. Sterols are found in 1% to 2% of the seed oil and 1% to 3% in the soft parts of the fruit as sitosterol, isofucosterol, campsterol, stigmastanol, citrostadienol, avenasterol, cycloartenol, 24-methylenecycloartanol, and obtusifoliol.

viscocity 44(mpas.s)	
saponification number	190
cloud point	-15 centigrade
calorific value as wood	4785kcal/kg

II. Biodiesel Preparation

The three basic methods of ester production from oils/fats are 1) base catalyzed transesterification, 2) acid catalyzed esterification, and 3)enzymatic catalysis. Each reaction has associated optimal operating parameters (T & P) and conversion, although much of the available literature emphasizes the base catalyzed route because it is claimed to be the most economical.

The overall base catalyzed reaction, for example is as follows:

OO CR1
|
OO CR2 + 3CH3OH lanthanum activated R1COOME +
| ----------------
> R2COOME+
OO CR3 CaO
R3COOME+

C3H5(OH)3

The reaction progresses in three reversible steps:

1) the triglyceride reacts with the alcohol to form a diglyceride and a fatty acid ester,
2) the diglyceride reacts with the alcohol to form a monoglyceride and a fatty acid ester, and
3) the monoglyceride reacts with the alcohol to form glycerin and a fatty acid ester.

For example, if palm oil, with at least 9 different fatty acid groups, is used, there could potentially be 729 different triglycerides, 81 different diglycerides, and 9 different monoglycerides present.

III. Lanthanum Activated CAO

The catalyst can be reused for several runs without significant deactivation. Activated CaO catalyst have a high activity and an improved tolerance to water (2 %) and FFA (3 %). However, effects of water and FFA on catalyst structure and the catalytic performance in unrefined and waste oils were not fully elucidated. Seabuckthorn oil without any pretreatment was converted to FAME directly using Ca3La1 catalyst The average yield of this oil is about 96 % at 3 hours. Ca3La1 has a stronger base strength and a higher amount of basicity. Moreover, Ca3La1 has the highest specific BET surface area and FAME yield.

TABLE I. Factors For Choosing Heteregenous Catalyst

Property	Homogenous	Hetrogenous
reaction rate	fast and high conversion	moderate conversion
after treatment	catalyst cannot be recovered, must be neutralized leading to waste chemical production	can be recovered
prrocessing methodolgy	limited use of continuous methodology.	continuous fix bed operation possible
presence of water/ free fatty acids	sensitive	not sensitive
catalyst reuse	not possible	possible

IV. Performance Study

The performance of engine and emission parameters of the engine with diesel oil and blends of SEABUCKTHORN OIL ester with diesel are presented and discussed below:

A. Brake Specific Fuel Consumption

The variation of brake specific fuel consumption with load is shown in the figure. The specific fuel consumption of ester was generally higher than diesel mainly due to low volatility slightly higher viscosity, lower calorific value and high density of SEABUCKTHORN OIL ester which affects mixture formation and thus leads to slow combustion.

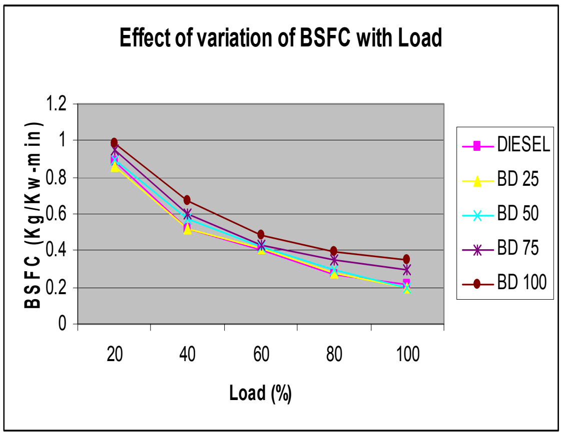

Fig 1.2(BSFC Vs LOAD)

B. Brake Thermal Efficiency

The variation of Brake thermal efficiency with load is shown in the figure. The brake thermal efficiency of blends of SEABUCKTHORN OIL with diesel is less when compared to that of HSD. This is because of high viscosity, low volatility and high density of ester which affects atomization of the fuel and thus leads to poor combustion.

The brake thermal efficiency of ester was found to be slightly lower than that of the engine run with neat diesel.

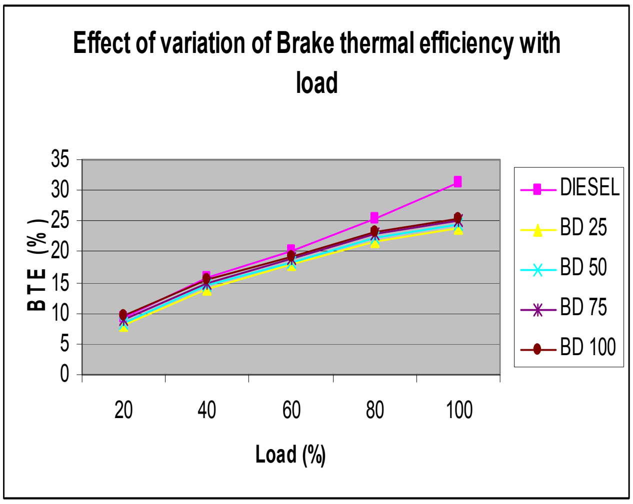

Fig 1.3(BTE Vs LOAD)

C. Induced Thermal Efficiency

The variation of Induced thermal efficiency with load is shown in the figure. The induced thermal efficiency of blends of SEABUCKTHORN OIL with diesel is less when compared to that of HSD. This is because of high viscosity, low volatility and high density of ester which affects atomization of the fuel and thus leads to poor combustion. The induced thermal efficiency of ester was found to be slightly lower than that of the engine run with neat diesel.

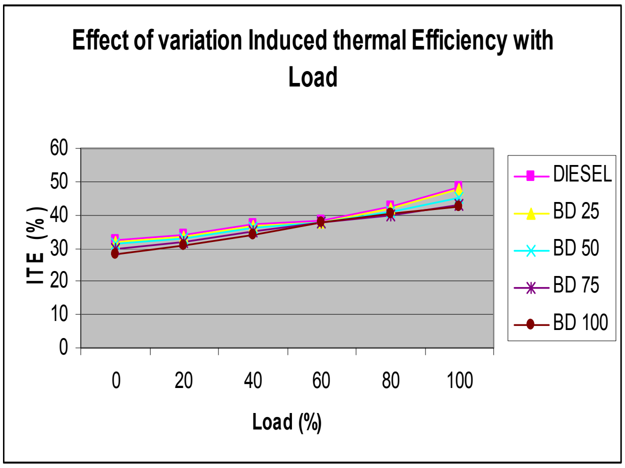

Fig 1.4(ITE Vs LOAD)

D. Mechanical Efficiency

The variation of Mechanical efficiency with load is shown in the figure. The Mechanical efficiency of blends of SEABUCKTHORN OIL with diesel is less when compared to that of HSD. This is because of high viscosity, low volatility and high density of ester which affects atomization of the fuel and thus leads to poor combustion. The mechanical efficiency of ester was found to be slightly lower than that of the engine run with neat diesel

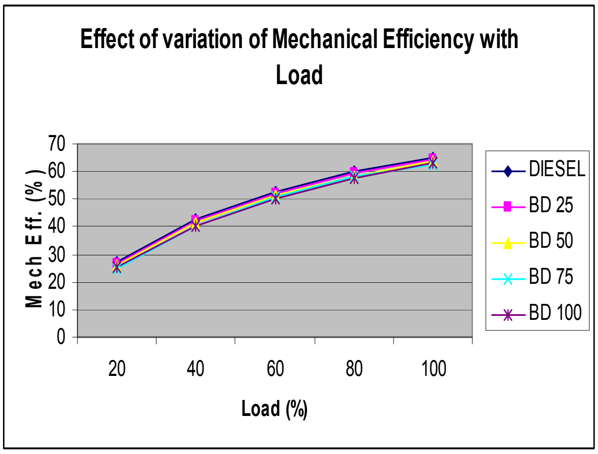

Fig 1.5(MECH EFF. Vs LOAD)

E. CO_2 Emission

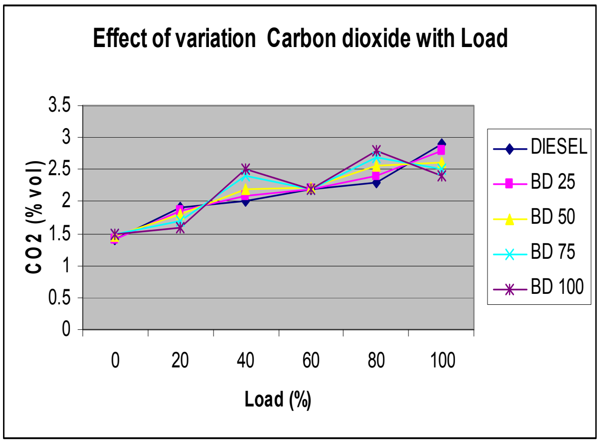

Fig 1.6(CO_2 Vs LOAD)

F. O_2 Emission

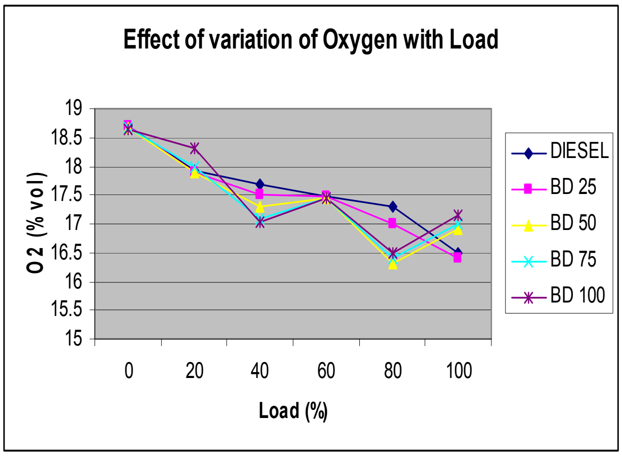

Fig 1.7(O_2 Vs LOAD)

G. NO_x Concentration

The variation of NO_x concentration with load is shown in the figure. NOx emissions were reduced due to lower heat release rate which lowers the combustion temperature

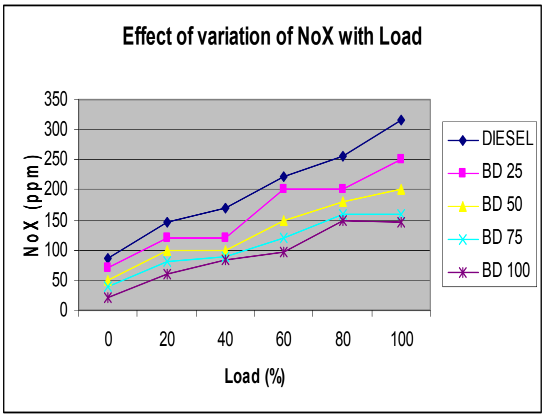

Fig 1.8(NOX Vs LOAD)

V. Results

1) Methyl ester of bio-diesel (B100) can be directly used in diesel engines without any modifications for short term with slightly interior performance than that of diesel.
2) Brake thermal efficiency for bio-diesel is slightly increased in B20.
3) Brake-specific energy consumption for B20 is reduced slightly.
4) The CO, CO2, HC PAH emissions are reduced.
5) NOx emissions are slightly increased it should be reduced by EGR or dual fuel mode.
6) A blend of 20% by volume of bio-diesel fuel in diesel does not affect any of the measured performance or emission characteristics.
7) Addition of small quantities of bio-diesel to mineral diesel is a suitable strategy for increasing alternative fuel consumption, atleast in agricultural engines.

VI. Future Plans

Plantation of seabuckthorn on southern regions namely kerala and also in northern regions like Himalayan region, Assam ,etc would produce oil as cheap biodiesel. Plantation of seabuckthorn helps in increasing the welfare of our country, reduction in global warming, soil erosion. The plant also has high herbal and medical value. It Can be used in all blends in existing engines without need for modification. Lower quality of land can be used for seabuckthorn feedstocks – so more fuel can be produced. The blending of vegetable oil esters with diesel fuel in more proportion can reduce the NOx emission and lower the peak combustion temperature. The use of 100% esters in diesel engines and addition of catalytic converter system to the exhaust may be more eco- friendly. The prospect of this green fuel as a viable alternative fuel for diesel fuel will be even more attractive if we can make ease of the 50 million hectares of degraded waste lands and 34 million hectares of protected forest cover for cultivation of the oil bearing plants.The use of 100% ester in diesel engines, with the addition of a catalytic converter system to the exhaust may be more eco friendly.

VII. Conclusion

So we can conclude that the usage of seabuckthorn oil is an effective biodiesel over other bio diesels formed from other vegetable oils. It is found to have low viscosity which is an important property of biodiesels. The plantation of seabuckthorn is very simple on a large scale. It can be easily done in India. Places like kerala and the foot steps of Himalayas are suitable places for its cultivation. So it can be produced as a cheap biodiesel with an economical cost.

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