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Studies on Biodeisel Synthesised By Using Fish Oil and Its Blends with Normal Diesel

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Abstract: *Biodiesel is often considered to improve energy security and reduce the effect of fuel on the climate change. However, there are concerns about the impact of biodiesel when its life cycle is considered. Worldwide initiatives for cleaner production make it possible to increase the efficiency of the resources and controlling the release of pollutants to the air, water and land. In this work, attempt has been made to extract oil from waste fishes available in local market. Various locally available fishes were tried out by heating them in water and finally Sardine fish was found suitable. These fishes 8 kg yielded of 400 gms of fish oil. Biodiesel obtained from fish wastes are used as alternative fuel to diesel in stationary diesel engines. Oil extraction was carried out using 4kg of sardine fishes which was incubated with 12 litres of water in a metal container at a temperature of 97^oC. After this treatment the mixture was filtered using a muslin cloth. The crude oil obtained was yellowish brown and the filtered oil was slightly yellowish in colour. The oil obtained was 100ml (86g). Performance and emission tests of Fish Oil Methyl Ester (FOME) and their blends (80%, 60%, 40%, 20%) with diesel were carried out on a compression ignition engine at variable load conditions. The experimental results show that the carbon monoxide (CO), unburnt hydrocarbon (UBHC) and smoke emissions are less at all loads for the blends compared to diesel fuel while oxides of nitrogen (NOx) emission alone is slightly higher. Trade-off between oxides of nitrogen and soot emissions for various percentage of FOME in blends show that 22% of FOME blend are observed to be optimum considering both NOx and soot emissions. The biodiesel is produced as per to meet the ASTM D 6751-02 specifications. This specification covers low sulphur biodiesel or use as blend component with diesel fuel. This specification standard specifies various test methods to be used in determination to certain properties for the biodiesel. Some test includes flash point and kinematic viscosity.*

I. Introduction

Conventional sources of energy such as coal, petroleum, natural gas, etc. Are get exhausted day by day with their usage. Also conventional sources of energy generate toxic gases that are harmful to the environment and also lead to polluting the environment and causes global warming on a large scale. Biodiesel is the alternative fuel for normal diesel. Biodiesel is non-conventional and also it produces less toxic gases on combustion except for NOx which increases. Biodiesel can be produced from different sources such as Soya bean, Sunflower seeds, Palm, Canola, Cotton, Jatropha, Pongamia and also animal fat. But for this project, we have selected Fish as our raw material to produce biodiesel. Fishoil was obtained from sardines which have high free fatty acids (mackerels, king fish can also be used) were used for biodiesel production.The fish was bought from local fish market and was used to extract oil, the filtered oil then was generated accordingly to meet the ASTM D 6751-02 specification. The fish oil was then trans-esterifiedto convert it into biodiesel. In these process Sodium Hydroxide (NaOH) was used as catalyst. Using the biodiesel different blends were prepared with normal diesel.B100 blend is pure biodiesel. Different tests of such as fire point, flashpoint, density, kinematic viscosity were carried out for the obtainedfish oil biodiesel. Also the biodiesel produced was tested for four stoke diesel engine. The experiment result showed that the level of CO and UHC emissions were less as compared to normal diesel. However there was slight increase in NOx emissions.

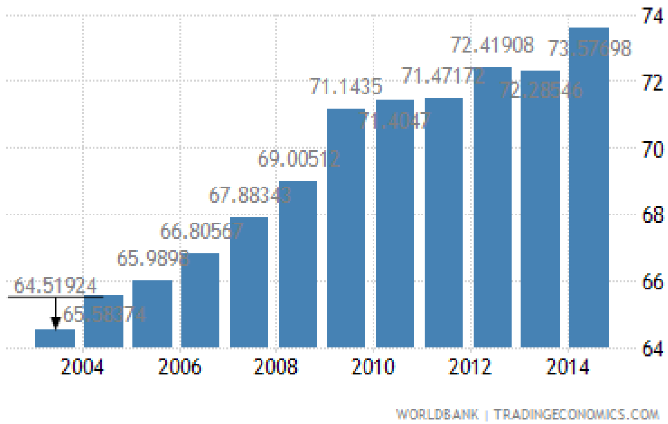

FIG.1 Fossil Fuel consumption from 2004-14

II. Methodology

Steaming is the primary method for extraction of fish oil. Although the wet pressing method yields a larger amount of fish oil, water and solid material released during steaming is also strained to separate liquid from solid matter. If press liquor is stored in a tank, the sludge settles at the bottom and the oil rises to the top. This process is time-consuming, however, and yields a higher percentage of impurities in the oil. Centrifugation speeds up the process and creates a purer fish oil product.

2.1 WET PRESSING METHOD

Before oil can be extracted, the fish are cleaned thoroughly to remove any san particles and other impurities and then heated to a temperature of about 95-degree Celsius to separate water and oil from protein. The liquid extraction, referred to as press liquor, contains water, oil, dissolved protein, vitamins and minerals. The oil is separated from other liquids by centrifuge, which separates matter of varying densities. The oil is stored in tanks and the concentrated leftover liquid matter gets mixed with the solid fish matter to produce fish oil.

2.2 FILTERATION

The oil is then kept to cool down for a while and then filtered byusing muslin cloth by doing so, most of the impurities get separated and further the water and oil mixture is kept in a settling tank for 1 to 2 days for the residue to be settled down. By doing so the oil will float on the top surface of the water and then oil can be separated from the mixture.

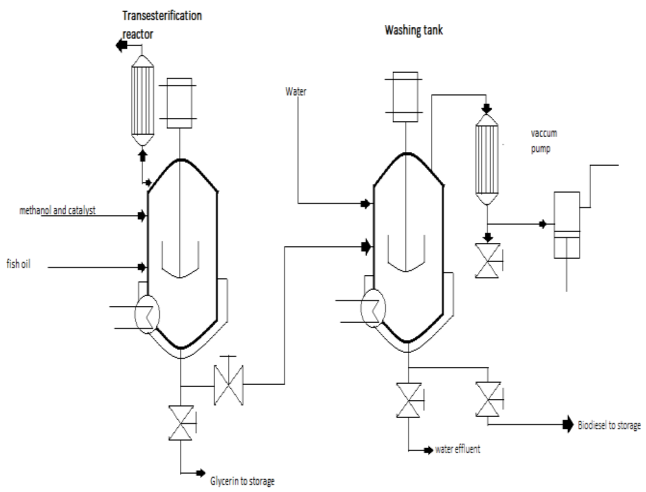

Fig.2.1 Line diagram of biodiesel plant

Fig.2.2 RAW MATERIAL (SARDINES)

2.3 TRANSESTERIFICATION

Transesterification is the most widely used process for biodiesel production. The raw fish was transestirified with methanol to produce biodiesel. An electromagnetic stirrer is used to stir methanol with base catalyst sodium hydroxide. The by-product obtained in this reaction is Glycerol.

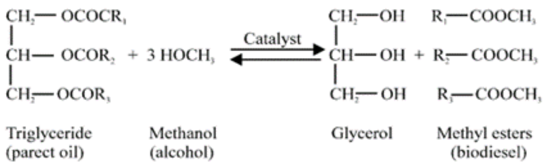

Fig.2.3 Transesterification reaction

2.4Mixing of catalyst and methanol

The purpose of mixing methanol and the catalyst (NaOH) is to react the two substances to form methoxide. The amount of Methanol used should be 20% of the volume of the oil. Methanol and NaOH are dangerous chemicals by themselves with methoixde even more so. None of these substances should ever touch skin.

NaOH does not actually dissolve methanol. It is best to turn on the mixer to begin the agitating the Methane land slowly pour the NaOH in. When particles of NaOHcannot be seen the methoixde is ready to be added to the oil.

Fig.2.4 Biodiesel Plant

2.4 Cleaning of Fuel

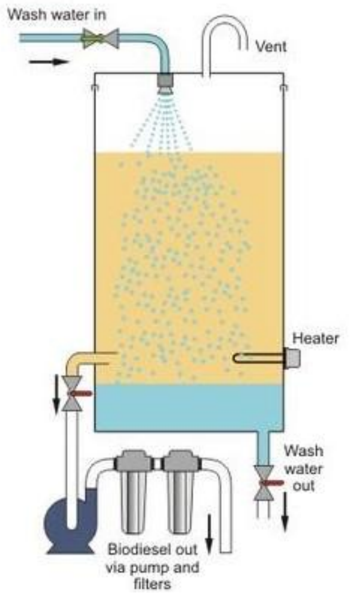

Fig.2.5 Washing tank

The washing of raw biodiesel fuel is one of the most discussed subjects. The purpose is to wash out the remnants of the catalyst and other impurities. There are three main methods.
Water wash only (a misting of water over the fuel, draining water off the bottom)-Air bubble wash (slow bubbling of air through the fuel)-Air/water bubble wash (with water in the bottom of the tank, bubbling air through water and then the fuel).

2.5 BLENDING

The cleaned biodiesel obtained is then mixed with normal diesel. Different blends of biodiesel were prepared with normal diesel (10%, 20%, 40%, 80%) and were tested for emission.

Table 2.1 Properties of diesel and biodiesel [1]

Properties	DIESEL	FISH OIL BIODIESEL
Density (kg/m^3)	850	880
Specific gravity	0.85	0.88
Kinematic viscosity at 40°c	3.05	4.0
Calorific value (kJ/kg)	42,800	42
Flash point °c	56	176
Fire point °c	63	187
Oxygen content	nil	10.9%

RESULTS AND DISCUSSION

3.1 Fuel properties

The colour of the biodiesel obtained was transparent, light yellowish. Various properties of the fish oil biodiesel were determined. The characteristics of the biodiesel obtained was observed and came to a conclusion that the characteristics were close to mineral diesel. Therefore the biodiesel can be considered as replaceable candidate for mineral diesel in the times of such global warming crises. The table below shows the properties of the biodiesel and diesel.**[3]**

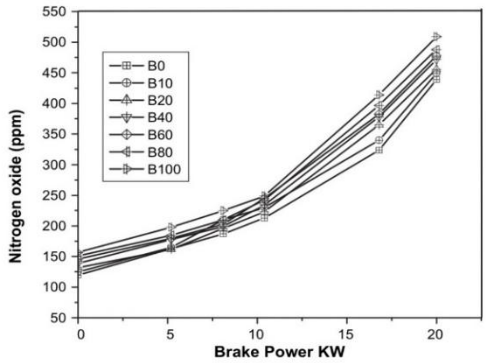

Fig.3.1 [2]

3.2 Engine performance

The fish oil biodiesel was evaluated on diesel engine in terms of brake specific fuel consumption, brake specific energy consumption, and more at various loading conditions of the engine.**[4]**

3.3Brake specific fuel consumption

The BSFC of the engine obtained for different fuels are shown in the fig. below. The BSFC in general was found to increase with the proportion of B100 in the fuel blends with diesel. The BSFC was calculated on weight, basis higher densities resulted in higher values of BSFC. The fig. below shows the decrease BSFC as the blends are reduced.**[5]**

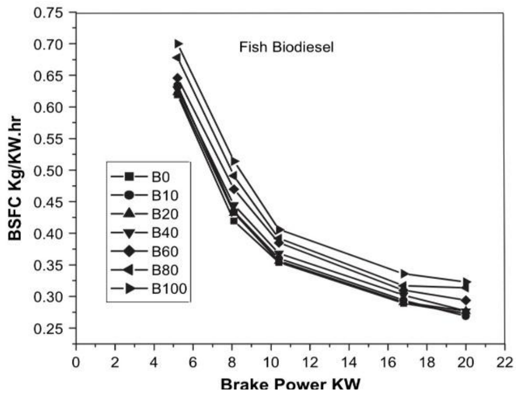

Fig. 3.2 [6]

3.4 Brake specific energy consumption

Brake specific fuel consumption is more reliable as compared to BSFC for comparing the fuels with different densities and calorific value. BSEC for B20 was observed lower than the diesel. Different trends of BSEC increasing load in different biodiesel blends was also observed while testing the biodiesel. **[7]**

3.5Hydrocarbon

There has been a significant decrease in HC emissions with blends of methyl esters of fish oil as compared to normal diesel. This reduction indicates that there has been complete combustion of the fuel.**[8]**

3.6 Nitrogen oxides

The NOx emissions were showed to slightly increase as parts per million (ppm) for various blends for biodiesel but for pure bio diesel that is B100 it showed no increase in NOx emissions.**[9]**

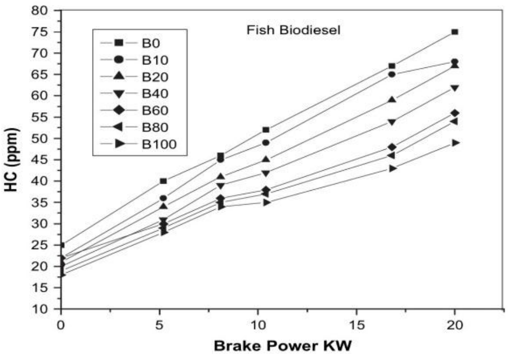

Fig.5.5 [10]

III. Conclusion

OIL from FISH waste cab be used as raw material for biodiesel, the process of which is carried out in two stages. The first stage is esterification process with an acid catalyst to lower the acid value OIL and the second one is transesterification process with alkaline catalyst to change the oil to biodiesel. The FISH OIL was generated accordingly to meet ASTM-6751-02 specification, and was analysed in a four stroke diesel engine and it’s flash and fire point was also noted. FISH oil biodiesel as alternative fuel instead of diesel, showed huge potential to reduce the CO and UHC emissions . Using biodiesel reduced the CO 5.2-27% for various blends , and also it’s NOX emissions higher than diesel.

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