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Short Communication

Effect of Temperature on the transesterification of Cod Liver oil

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Abstract

There is increasing effort in biodiesel production (fatty acid methyl ester) because of the depleting fossil fuel resources as well as similarity in properties when compared to those of diesel fuels. Diesel engines operated on biodiesel have lower emissions of carbon monoxide, unburned hydrocarbons and air toxics than operated on petroleum-based diesel fuel. Herein we report the effect of temperature in the transesterification protocol of cod liver oil. The optimum yield temperature and reaction time were found to be 75%, 40°C, and 35 minutes respectively. Two fuel properties (viscosity and calorific values) as measured according to standard methods, also found to conform to international standard

Key Words: temperature, transesterification, cod liver oil.

Introduction

Biodiesel was the first alternative fuel to have a complete evaluation of emission results and potential health effects submitted to the U.S. Environmental Protection Agency (EPA) under the Clean Air Act Section. Because of these reasons, several campaigns have been planned in many countries to introduce and promote the use of biodiesel[1-4]. In the world today, there has been an increase in the demand for petroleum certainly but the availability is limited. This has become necessity to find an alternative fuel to substitute petroleum to reduce both the demand and also the environmental pollution of petroleum combustion. Biofuels have become a matter of global importance because of the need for an alternative energy at a cheaper price and with less pollution[5].

Biodiesel is practically a domestic, renewable fuel for diesel engine, which comprised of mono-alkyl esters of long chain fatty acids derived from natural oils/ vegetable oils/animal fats designated as B100 and which meets the specification of ASTM D 6751 or BIS IS15607:05. It is obtained by the transesterification of renewable materials composed of C14 – C20 fatty acids triglycerides with alcohol such as methanol or ethanol under the presence of base catalyst, such as, NaOH or KOH. It could also be catalysed with alkoxides such as CH_3ONa or CH_3OK to reduce the tendency to from water. Biodiesel was often referred to as fatty acid methyl esters (FAME) when methanol was used. Glycerol is usually produced as a by-product which has commercial value[6].

Biodiesel is a cleaner burning fuel than diesel and a suitable replacement. It is made from non-toxic, biodegradable, renewable sources (vegetable oils and fats)[7]. The process of making biodiesel is simply known as transesterification, it's a process that involves the reaction of an ester with an alcohol in the presence of an acid or base catalyst and to produce another ester[8]. As a cleaner burning fuel, biodiesel is better for a car's engine than conventional diesel, providing greater lubrication and leaving fewer deposits behind. Biodiesels high ignition point makes it a safer fuel as well and it's also biodegradable and considered nontoxic[9].

Material and Methods

Supplies : The following equipment, supplies, and reagents ware employed: hot/stir plate, stir bars, graduated cylinder, 250-mL Erlenmeyer flask, 250-mL separatory funnel, Buchner funnel, filter flask (side-arm Erlenmeyer flask), qualitative filter paper, methanol (reagent grade), sodium hydroxide, and Cod Liver oil. Methanol and Cod Liver oil were as free from water contamination, and all glass wares were dry before used in the experiment.

Procedure: 4.0 mL of methanol (CH_3OH) was poured into a 250-mL Erlenmeyer flask and was allowed to stir.1.3 g of sodium hydroxide was added to the stirred solution of the methanol until all the NaOH pellets had dissolved, a period of about 5 min. At this point it was envisaged that the addition of the strong-base catalyst (NaOH) to the methanol (CH_3OH) to had resulted in the formation of sodium methoxide according to the reaction below.

$$NaOH + 3CH_3OH \rightarrow NaOCH_3 + H_2O$$

To a graduated cylinder 20.0 mL of Cod Liver oil was added to the stirred methanol solution in the Erlenmeyer flask. Using a hot plate, the solution was gently heated to a temperature of 10°C. This process was repeated explored via a sequence of ten experiments (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 °C). In each experiment the warm reaction mixtures was poured into a 250-mL separatory funnel and allow the solution to cool and partition into two product layers.

Purification of Crude Bio Diesel: It was envisaged that to neutralize, distill and wash the biodiesel with the aim that these protocols could further purify the crude biodiesel. 1 ml of 0.1M H_2SO_4 was added to the crude biodiesel. The black suspensions formed are left to settle down and decanted gently into a clean beaker. The product was then distilled twice and washed with warm distilled water for about three times to remove all soluble salts and suspensions. The product was dried using Na_2SO_4 were used to remove any trace of water present. The biodiesel was then collected separately in well labeled test tubes for quality tests.

Viscosity Measurement: Four Uppelhode viscometers of sized 3C were used for the viscosity measurement. About 12ml of each the sample to be analyzed was added through the open end. The viscometer was maintained on its stand and then immersed in a viscometer bath that has already been thermostated at 40 ^{0}C. Each viscometer is allowed to stay inside for at least 2 hours. By this time, the oil would have assumed the temperature of its environment. A pipette filler is then placed at on open end and by closing the other one, oil is sucked up above the upper boundary line. Oil is allowed to fall under gravity to the upper mark where the stop watch starts its counting. The watch is stopped when the liquid reaches the lower boundary. The time it takes the liquid to travel from one boundary to the other is multiplied against the calibration constant of the viscometer to obtain the viscosity in mm^2/s.

Calorific Value Determination: The Bomb calorimeter requires the burning a certain mass of oil sample in the presence of oxygen at a certain temperature and time and determination of the heat involved. This heat value is also called the Gross Calorific Value (GCV). Oil sample (0.4 g) was placed in the cup after it had been properly cleaned. A thread was fixed at the suspender just a little above the cup holder making sure the ends of the thread are immersed in the oil. About 3000 kpa of oxygen was pumped inside the tightly fixed vessel and then wait on the calorimeter to display 'insert'. The vessel was inserted, lid was closed and after about 15 minutes, the energy content was seen displayed on the screen in mega joules.

Results and Discussion

Table-1
Results of the Transesterification Protocol

Temperature	0	10	20	30	40	50	60	70	80	90
% Yield of Biodiesel	25	25	35.42	41.67	75	67.5	63.17	54.5	45.8	0

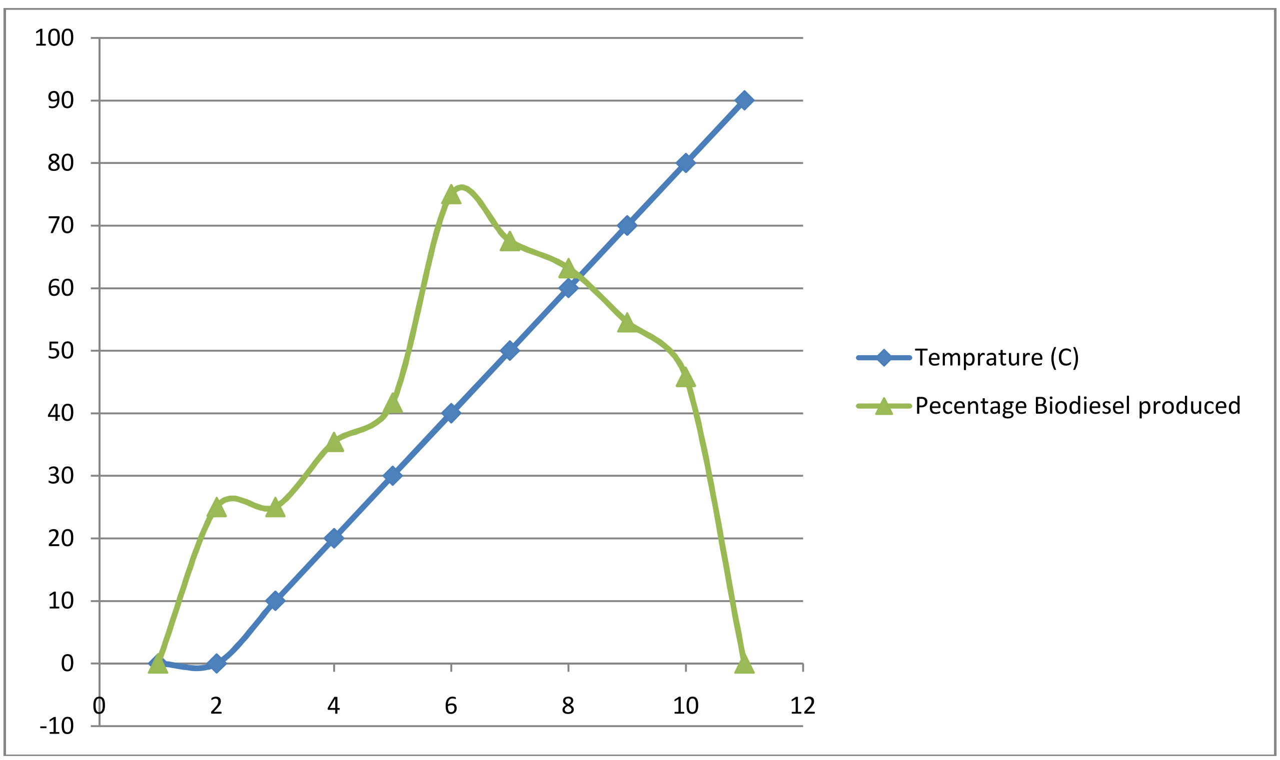

Figure-1
Effect of Temperature on the yield of the transesterification protocol

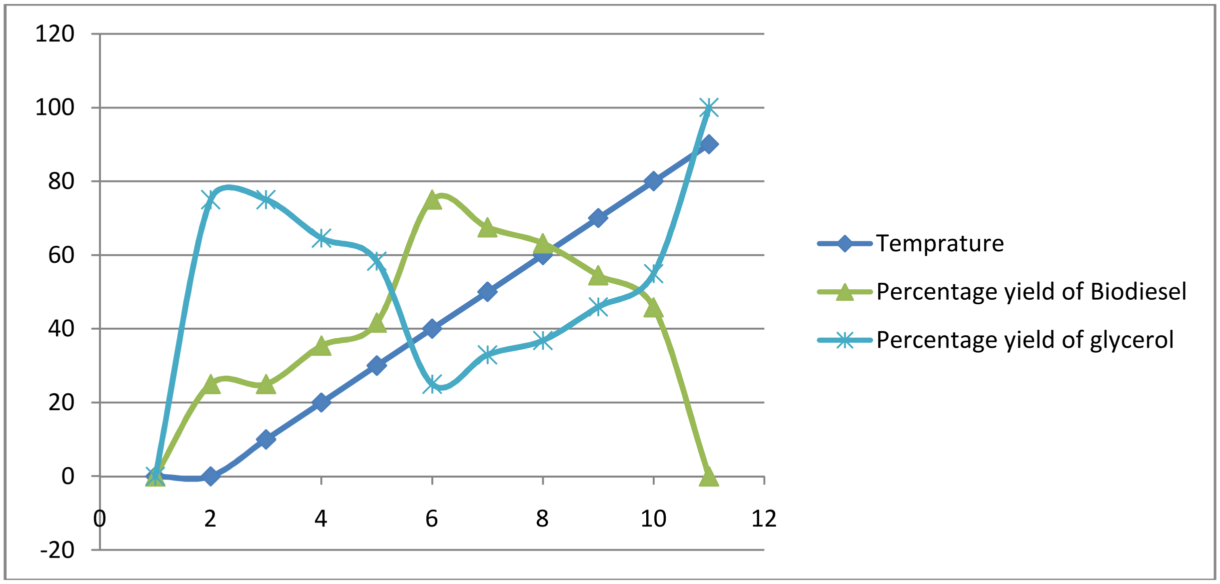

Figure-2
Comparative result of the effect of Temperature with Percentage yield of Biodiesel and Glycerol

Table-2
Results of Calorific and viscosity

Calorific Value (MJ/kg)	Viscosity @ 40^{0}C (mm^2/s)
33.20	5.77
33.51	6.33
35.41	8.31
36.31	8.87

Conclusion

Herein we have demonstrated the effect of temperature on the yield of base catalyzed transesterification of Cod Liver oil via a sequence of ten experiments (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 ^{o}C). It was found that the synthesis of bio-diesel from Cod liver oil does not either require high temperatures or very low temperature. The highest yield was at 40^{o}C

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