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Effect Of Temperature On Methyl Ester (Biodiesel) Yield From Groundnut And Palm Kernel Oils

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----------ABATRACT----------
Methyl ester (Biodiesel) was produced from Nigeria palm kernel and groundnut oils through direct base-atalysed trans-esterification process using methanol and sodium hydroxide as alcohol and catalyst respectively. The trans-esterification process involved 1 litre of palm kernel and groundnut oil each, 200ml of methanol, 1.0% NaOH by weight. The process was carried out at different reaction temperatures in order to examine the effect of temperature on yield. The temperature was varied from 30°C to 70°C. The results show that the methyl ester yield of 87.67% for palm kernel oil reached maximum at 65°C while that of groundnut oil attained maximum value of 82.5% at 50°C. These show that yield increased with temperature up to certain points beyond which it decreased due to increase in miscibility.

KEYWORDS: *Trans-esterification, Temperature, Yield, Methyl Ester.*

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I. INTRODUCTION

The use of fuels from bio-resources has been widely acknowledged as panacea to the global twin-problem of fuel crisis and environmental pollution informed by over dependence on fossil fuels (Barman, et al. 2010). Fossil fuels like petroleum, coal and natural gas have limited life and the fast depletion of their reserve has raised the fear of their exhaustion and possible fuel crisis in the near future. Besides, the combustion of these fossil fuels has been identified as the major source of emissions that cause air pollution and global warming. These challenges have engineered a global search for alternative fuels that are both renewable and environmental friendly. For diesel engines, raw vegetable oils were used as alternative fuels in place of the petrodiesel. This however, was found to cause some engine problems like injector cooking, high engine deposits and piston ring sticking due to high viscosity and low volatility of these oils. These problems were reduced or eliminated by chemical modification of the oils through the process of transesterification. Transesterification involves the reaction of vegetable oils or fats with an alcohol in the presence of a catalyst to produce biodiesel and glycerol. The triglyceride is converted stepwise to diglyceride, monoglyceride and finally, glycerol. Currently, there is a growing interest in the production of biodiesel from various crop oils and other bio-sources because of its attractive features. Biodiesel fuels are non-toxic, biodegradable, sulphur and aromatics free. They have high cetane number and good oxygen content which enhance combustion. They have similar engine performances and low engine emissions compared with petrodiesel (Nagarhalli, et al, 2010).
Except for the reaction temperature, other reaction parameters in transesterification have been optimised by various studies (Yusuf and Sirajo, 2009; Krishnakumar et al, 2009). There seems to be no consensus on what is optimal temperature for maximum biodiesel yield for different oils using base catalysed transesterification. While some reports favoured room temperature, other suggested higher temperatures. Consequently, the influence of temperature on yield was investigated in this work.

II. MATERIALS AND METHODS

The palm kernel and groundnut oils were purchased from local market in Owerri town in Eastern Nigeria while the methanol and sodium hydroxide pellets were bought from a standard chemical shop in Owerri. The transesterification was done with a batch reactor equipped with a stirrer, thermometer and a heater. One liter high density plastic vessel was used for catalyst/methanol mixing. 200ml of methanol was measured and poured into a high density plastic vessel and 8.12g of NaOH was added to the methanol. The mixture was shaken vigorously till the sodium hydroxide was completely dissolved in the methanol resulting to a strong base known as sodium methoxide. 1000ml of palm kernel oil was poured into the reactor and was preheated to required temperatures. The sodium methoxide was added to the oil. The reactor lid was closed and the mixture was stirred for 90 minutes and later allowed to settle over night.

The fluid separated into two layers with the biodiesel floating on top. The biodiesel was decanted carefully and washed with warm water in order to remove the impurities. The experiment was repeated for a number of times at different temperatures.The same process was repeated for groundnut oil. The temperature of the reaction was varied from 30^{o}C to 70^{o}C for both oils as shown on tables 1.1 and 1.2 while other parameters were kept constant.

III. RESULTS AND DISSCUSSION

The direct base catalysed transestarification of Groundnut oil (GNO) and Palm Kernel oil (PKO) produced in Nigeria gave maximum yields of 82.50% and 87.67% respectively. These values are comparable to the results of other works by Lalita, et al (2004); Alamu, et al (2007); Galadima, et al (2009).The maximum yield occurred at 50^{o}C for groundnut oil and 65^{o}C for palm kernel oil as shown in figure 1.1. The results show that temperature increased with the yield till 65^{o}C for palm kernel oil and 50^{o}C for groundnut oil and thereafter, the yield decresed with further increase in temperature as illustrated in figure 1.1 The decreasing yield at elevated temperature is possibly due to high miscibility, which reduces the phase separation and hence, the yield. On the average, the palm kernel oil gave more biodiesel yield than groundnut oil by direct base catalysed trans-esterification based on the results of this work.

Table 1.1EFFECT OF TEMPERATURE ON PALM KERNEL OIL BIODIESEL YIELD

Temperature (^{o}C)	Volume of Methanol (ml)	Volume of Oil (ml)	Total Volume (ml)	Volume of Biodiesel (ml)	% Biodiesel Yield
30	200	1000	1200	1004	83.67
45	200	1000	1200	1020	85.00
55	200	1000	1200	1037	86.42
65	200	1000	1200	1052	87.67
70	200	1000	1200	1040	86.70

Table 1.2 EFFECT OF TEMPERATURE ON GROUNDNUT OIL BIODIESEL YIELD

TEMP (^{O}C)	Volume of Methanol	Volume of oil	Total Volume	Volume of Biodiesel	% Biodiesel Yield
30	200	1000	1200	965	80.4
40	200	1000	1200	970	80.8
50	200	1000	1200	990	82.5
55	200	1000	1200	960	80.0
60	200	1000	1200	960	80.0
70	200	1000	1200	945	78.6

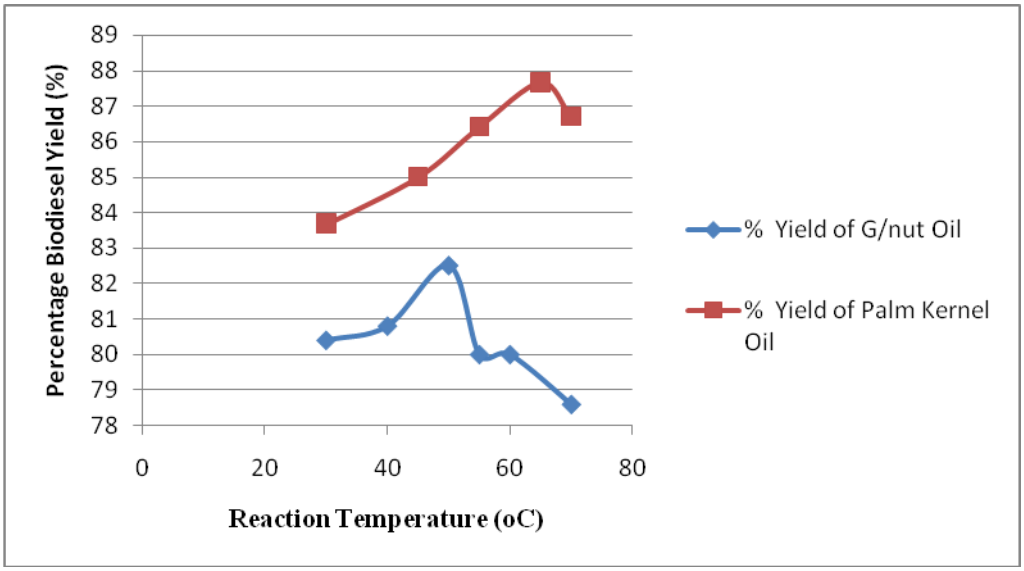

Figure 1.1 Effect of Temperature on Groundnut oil and Palm Kernel oil biodiesel yield

IV. CONCLUSION

From the result of this work, it can be concluded that

- An average biodiesel yield of 87.67% at 65^{O}C and 82.5% at 50^{O}C was achieved by direct – base catalyzed transesterification of palm kernel and groundnut oil produced in Nigeria.
- The yield was temperature dependent and increased with temperature to certain points beyond which it decreased due to increased miscibility.
- The palm kernel oil gives higher methyl ester yield than groundnut oil under the conditions covered by this study.
- Nigerian palm and groundnut oils give high methyl ester (Biodiesel) yield by base catalysed trans-esterification.
- Nigerian palm kernel and groundnut oils are potential feedstocks for the production of biodiesel in Nigeria.

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