American Journal of Engineering Research (AJER)
e-ISSN : 2320-0847 p-ISSN : 2320-0936
Volume-03, Issue-03, pp-264-266
www.ajer.org

Research Paper Open Access

Synthesis And Characterization of Biodiesel From Nigerian Palm Kernel oil.

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Abstract: - Biodiesel was produced from Nigerian Palm kernel oil through direct base- catalyzed transesterification process using methanol and sodium hydroxide as alcohol and catalyst respectively. The trans-esterification process involved 1 liter of Palm kernel oil, 200ml of methanol, 1.0% NaOH, reaction temperature of 65 degree Celsius and reaction time of 90mins and an average biodiesel yield of 87.67% was obtained. The produced biodiesel was blended with diesel fuel at a ratio of 20% biodiesel to 80% diesel fuel (by volume). The neat biodiesel and its blend were characterized using the ASTM methods. The results showed that the properties of the neat palm kernel oil biodiesel and its blend fall within the American Society for Testing and Materials (ASTM) specifications for Biodiesel fuels hence confirming their suitability as alternative fuels for modern diesel engines.

Keywords: - *Biodiesel, Characterization, Fuel Blend, Diesel fuel, Trans-esterification,*

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 reserves 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 environmentally friendly. For diesel engines, raw vegetable oils were used as alternative fuels in place of the diesel fuel. 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. (Konis,et al, 1982). These problems were reduced or eliminated by chemical modification of the oils through the process of transesterification (Perkins,et al,1991). 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. (Ulf Schuchardt, et. al 1998). Currently, there is a growing interest in the production of biodiesel from various crop oils and others bio-sources because of its attractive features. Biodiesel fuels are non-toxic, biodegradable, sulphur and aromatics free. They have high cetane numbers and 11% oxygen content which enhance combustion. They have similar engine performances and lower engine emissions compared with diesel fuel (Rodjanakid ,et,al, 2004; Canakci, et al, 2003, Sugozus, et al.,2010; Nagarhalli,et al 2010).

The properties of the PKO biodiesel and its blend were determined using the ASTM characterization methods in order to determine their compliance with international standards and hence the suitability of the fuels for modern diesel engines.

II. MATERIALS AND METHODS

The palm kernel oil used was purchased from local market in Owerri in Nigeria while the methanol and sodium hydroxide pallets 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. The characterization was carried out at the laboratory of the Petroleum Training Institute Warri, Nigeria.

2.1 EXPERIMENTAL METHODS

200mlof 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 65 degrees Celsius. The sodium methoxide was added to the oil. The reactor lid was closed and the mixture was stirred for 90minutes and later allowed to settle overnight. 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 three and an average yield 87.67% was obtained. A portion of the biodiesel was blended with diesel fuel at a volume ratio 20% biodiesel and 80% petrodiesel (B20). Both the pure biodiesel and its blend were characterized using the ASTM methods.

III. RESULTS AND DISSCUSSION

The transesterification process gave an average yield of 87.67% with catalyst concentration of 1%, reaction temperature of 65 degrees Celsius and reaction time of 90 minutes. This level of yield is considered reasonably high when compared with other similar works. The results of the characterization of pure biodiesel produced (B100) and its blend with petrodiesel (B20) are shown on Table 1. It is interesting to observe from the results that all the determined properties of biodiesel produced from Nigerian palm kernel oil and its blend fall within the ASTMD 6751 specifications for biodiesel fuels. It can also be observed that the cetane numbers and the flash points of B100 and B20 are higher than that of diesel fuel. This is in agreement with that of biodiesel fuels produced from other vegetable oils. High cetane number shortens the engine delay period and promotes smooth combustion while high flash point reduces fire risk.

TABLE 1: Physical Properties of The Produced PKO Biodiesel, Blend and Diesel Fuel

PROPERTY	TEST METHOD	ASTM SPECIFICATION FOR BIODIESEL	B100 PURE BIODIESEL	B20 BLEND	D2 DIESEL FUEL
Density@$_{15}$^{0}c kg/m ^{3}	D1298	0.8833	0.865	0.846	0.8368
Cloud point ^{0}c	D2500	-3 to 12	7.5	3.0	-15 to 5
Pour point^{0}c	D97	-15 to 10	0.0	-12	-35 to i5
Kinematic viscosity@40^{0}c	D445	1.9 to 6.0	2.99	2.04	1.3 to 4.1
Flash point^{0}c	D93	100 to 170	150	123	60 to 80
Iodine No.	DIN 53241-2	7.5 to 8.6	15.35	17.2	11.7 to16.3
Cetane No.	D613	48 to 65	54.57	51.2	40 to 53
Ash content	D482	0.02	0.02	0.02	<0.01
H.Value(MJ/Kg)	D3338	37-40.8	38.6	42.47	43.4 to 44.9.

IV. CONCLUSION

From the results of this work it can be concluded that:
An average biodiesel yield of 87.67% or more can be achieved by direct- base catalyzed transesterification of palm kernel oil produced in Nigeria.
The physical properties of Nigerian Palm kernel oil biodiesel and its blend with diesel fuel (B20) conform to the ASTMD6751 Specifications for biodiesel fuels. This makes it a potential feedstock for biodiesel production.
Biodiesel from Nigerian palm kernel oil is a suitable alternative fuel for modern diesel engines.
Fuel blend (B20) has properties that are closer to those of diesel fuel than the pure biodiesel thus suggesting a better engine performance potential.

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