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Production of methylester (biodiesel) using melon seed oil as a raw material

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The production of the methyl ester was carried out using raw melon seed oil as a raw material through the process of transesterification. The most important variable which influences the transesterification reaction time and conversion were put into consideration.

Key words: Biodisel, transeterification, methyl ester.

INTRODUCTION

Biodiesel has been defined as the mono alkyl esters of long chain fatty acids derived from renewable feedstocks, such as vegetable oils or animal fats, for use in compression ignition (diesel) engines. The biodiesel is commonly composed of fatty acid methyl esters that are prepared from the triglycerides in vegetable oils by transesterification with methanol. The resulting biodiesel is quite similar to conventional diesel fuel in its main characteristics. Biodiesel production consists of the reaction of triglycerides with methanol in the presence of a catalyst usually NaOH or KOH. In this reaction, glycerol is obtained as by-product. Glycerol is also a useful starting material for other chemicals and when purified, it is a valuable supplement for pharmaceutical products (Vincent et al., 1998).

MATERIALS AND METHODS

Melon seeds was purchased from Obollo Afor market, Nsukka of Enugu State on the 20th Feburary. 2006. The raw material was prepared by shelling and removing the seeds manually (hands). The raw shelled melon seeds was sun-dried. The sun-dried melon seeds were put inside an air-tight polyethylene container, neatly labeled and kept in the refrigerator pending analysis.

Analytical procedures

The melon seeds was grinded using an electric grinder. The powdered sample was stored in an air-tight plastic container. The oil was extracted with petroleum ether (40-60°C) for 12 h using a soxhlet apparatus. After drying the solution with anhydrous sodium sulphate, the solvent was removed by vacuum distillation at 30°C

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Table 1. Chemical characteristics of the extracted oil.

Parameter	Raw melon seed oil	Methyl ester
Refractive index at 30°C	1.480	1.448
Specific gravity	0.911	0.875
Viscosity (Cst)	33.0	6.40
Flash point (°C)	186	162
pH	5.80	7.23
Iodine value (mg/g)	128.80	119.29
Acid value (mg/g)	4.61	0.92

and the oil was analysed for specific gravity, acid value, saponification value, iodine value and pH by standard methods as described by Winton (1945). The refractive index was obtained using an Abbe refractometer at 40°C, while viscosity measurement was performed using a universal torsion viscometer in a temperature controlled circulatory bath.

Preparation of the methyl ester (biodiesel)

The reaction was carried out in a closed vessel reactor, equipped with a stirrer and a thermometer. To shift the reaction to the right and to obtain a maximum ester yield, the molar ratio was increased to 6:1 of alcohol to oil. Thus the required molar volume of the methanol and the quantity of the NaOH was obtained to be 243 cm^3mol^{-1} of methanol and 3.4 g of NaOH. The molar mass of the oil (884 $gmol^{-1}$) was obtained from the fatty acid composition of the melon seed oil and with the density measured to be 0.911 gcm^{-1}, the molar volume of the oil was obtained to be 970.36 cm^3mol^{-1}.

Based on the standard methods described by Lang et al. (2001) whereby 1000 cm^3 of the oil requires 200 cm^3 of methanol and 3.5 g of NaOH. 970.36 cm^3 of the oil requires 243 cm^3 of methanol and 3.4 g of NaOH. In the same vein, 100 cm^3 of the oil was transesterified using 25.04 cm^3 of methanol and 0.350 g of NaOH. The reaction was timed as soon as the reactants were mixed. The reactor was made slightly air-tight to avoid the evaporation of the methanol. The stirring was carried out at a temperature of 30°C for 30 mins and stopped. The reactor was allowed to stand for 24 h. The two layers of methyl ester (upper layer) and glycerol (lower layer) were separated. The methyl ester was washed with 10ml of hot/warm water for 3 times to remove unreacted methanol, alkali, small glycerol and soap. This was done by pouring the water into the separating funnel, shaking vigorously and releasing pressure from time to time and allowed to stand until a clear separation of ester at the upper layer and water at the lower layer was obtained. The layers were then separated. The methyl ester was dried for 24 h in a desiccator over anhydrous sodium carbonate. The fuel properties of the raw oil and its methyl ester product was determined according to the methods of the Institute of Petroleum, London (1993).

RESULTS AND DISCUSSION

The results are presented in Table 1.

DISCUSSION

The chemical characteristics of the extracted oil are shown in the Table 1. The iodine value of the melon seed oil classifies the oil as semi-drying oil with high degree of unsaturation. Thus judging from the iodine value of the oil, the seed appears to be a viable source of oil for paint formulation and resin (Eromosele et al., 1998). The iodine value of biodiesel is within the hydrocarbon –based diesel oil range. The specific gravity of the raw oil is above the diesel oil range while the specific gravity of the biodiesel is within the diesel oil range. The flash point of the oil and its methyl ester were very much higher than the limits for diesel fuel grades which is from 100-130°C. The viscosity of the biodiesel is very low which implies that its combustion will not cause cold engine start up, misfire and ignition delay. Therefore, the fuel parameters of melon seed methyl ester has a great industrial potential as substitute for diesel fuel.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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