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TOWARDS THE STUDY OF MINERAL INDICATION PLANTS II: PHYSICO-CHEMICAL CHARACTERISTICS OF TRANS ESTERIFIED VEGETABLE OIL (PART II)

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Abstract
This study presents the properties of the products of deposition from esterification studies of the vegetable oils derived from mineral indicating plant source. The density and viscosity after transesterification of these oils produced range between 0.84 – 0,88 and 0,15 – 2.85mM^{2}S^{-1} respectively. Diesel fuel has density in the 0.86 – 0.89 and viscosity of 0.14 – 2.64mM^{2}S^{-1} range. It is predicted that the product of some of the oils can be source of fuel among the used.

Introduction
In the first paper of this three-part series [1]; the detailed determination of the physical and chemical properties of fourteen vegetable oils derived from thirteen different minerals indicating plant source have been given. Seven of the oils have been classified as edible, the others are regarded as non-edible.
This present (Part II) relates the physical and chemical characteristics of the deposition of esterification product from these vegetable oil plant source to those of petroleum fuel.
This is a way, however, to modify the vegetable oil so that the properties are close enough to petroleum diesel fuel or kerosene for it to become interchangeable with petroleum diesel. The product is called biodiesel. Actually, fueling trucks, trailers, luxury buses, cars, and generators, with such modified vegetable oil is environmentally better than using petroleum diesel:- emissing are lower for all the pollutants of concern, unlike petro diesel, which adds fossil carbon to the green house gases in the atmosphere, biodiesel actually removes carbon from the atmosphere, since the plants grown to make it remove about 3 times as much as is present in the biodiesel itself [2]. Also in light of energy crises and skyrocketing cost of gasoline and heating oils over the years, it would be great if some of the vegetable plants oil could be converted into an inexpensive and non-polluting fuel, thereby making biodiesel from them. As we know, today, of course, most of the world's trade is moved by diesel engines fueled by petroleum-derived diesel fuel. However, the fact remains that the diesel engine can run on vegetable oil, or even lard, just as well.
In Nigeria, where long distance journey are undertaken by trailers and trucks for haulages and passengers by luxury buses and cars which run on diesel fuel, the biodesel fuels will be advantageous to our economy.
Therefore, this work is aimed at converting the oil from the ore indicating plants (Par 1) into inexpensive and non-polluting fuel in form of biodiesel. Other by-products that are expected from this work will be soap and triglycerides (glycerin)

Experiment
The samples namely TEPI-TEPI 13 (see table 1) were extracted from vegetable plant as described in Part I of this series [1]. The oil (20ml) was poured into a graduated cylinder. Ethanol (100ml) was added, covered and mixed several times. The resulting solution was poured into a 25ml Erlenmeyer flask and covered for about 6hours. A solution containing of sodium hydroxide (0.30mol) was added to the content in the flask. This procedure was repeated several times to cause the

pH to change to 9. Further addition NaOH (0.10mol) was to catalyse the reaction.
The density and the viscosity of the products were determined in the usual way using previously published methods [1], hence the specific gravity. Table 1 shows the result of the transesterification product.

Results and Discussion

Physical and chemical properties of esterification product from vegetable oil samples, namely: TEP1, TEP2, TEP3, TEP4, TEP4, TEP5, TEP6, TEP7, TEP8, TEP9, TEP10, TEP11, TEP12, TEP13 and TEP14, extracted from previously listed vegetable oil plants [1] are listed in Table 1. The values in Table 2 are the viscosity of diesel fuel oil at 100°F in mM^2S^{-1} and various areas of uses obtained from NNPC depot [7].
The result obtained from the measurements of the density of the vegetable oil extracts from the mineral plant listed in table 1 shows variation between 0.89 – 0.96. The biogenic processes whereby inorganic and organic materials may be solubilised from relatively stable mineral phases and ingested into the plants circulatory system vary with different species of plants [6]. The net effect of these combined inorganic and organic factors is an uptake of substantial quantities of the inorganic matter which is then distributed in greater or less amounts through the body of the plant. In the upper part of the plant the elements are commonly enriched in the growing cells particularly in the seed structures and growing tips.
Earlier, Brooks (1972) [6] noted that once mineral matter has entered the vascular system of a plant, its movement and storage within the plant is controlled by many factor which include free and restrained diffusion, movement of the solvent, electrical and thermal effect, exchange reaction and most important, the accumulation of mineral nutrient in metallo organic molecules. All these have effect on the molecular weight of these different plant species listed in Table 1 other factors that can affect these vegetable oil plant density variation include the pH, Eh and interferences c different element uptake in the soil.
The result (Table 1) of the density c between 0.84 – 0.88 (Part II) shows tha the procedure of formation and removal c esters from the vegetable oil extrac effectively out the molecular weigh bringing the physical properties c density, viscosity, boiling point etc. clos to the properties of petroleum diesel fue or kerosene and making them attractiv as fuels. The rise in temperature whe further heated in this present procedure and oxidation liberates enough fatty acic the free organic acids neutralize the base therefore excess base catalyses th reaction also enough to neutralize th acid. The density of the vegetable oil i Part II of between 0.84 – 0.88 and lo viscosity of some of the oils of 0.20 – 0.4 (Table 2) bring the properties close to th petroleum diesel fuel so that it ca become interchangeable with petroleu diesel. However, sample No TEP1, TEF and TEP14 have high viscosity may s find their uses in fuel for low mediu speed engine (Table 2).

Conclusion

Product of transesterification from tl various ore indicating plant source ha been shown to contribute to the formati of petroleum diesel. Oil and fat are tl most important group of orgar compounds since they are the ch source of hydrocarbons. They ha molecules from which hydrocarbons c be derived by fairly simple chemi changes which have been demonstrat in this work.
The densities of oil in this work ran between 0.84 – 0.87 viscosity is also 0. – 2.83 range. The pH range of 7 – 9 a comparable to diesel fuel for runn engine of frequent and load change do to low medium speed engines. Theref with appropriate technology these oils c

be converted to diesel fuel for heavy duty applications.

Table 1: Physical and chemical properties of the esterification product from vegetable oil plants

Sample No	pH	Density XP* at 25°C	State 30°C	Density** 25°C	Viscosity mM^2S^{-1}
TEP1	8	0.96	Liquid	0.87	2.45
TEP2	6	-	Semi-solid	-	-
TEP3	9	0.91	Liquid	0.86	0.42
TEP4	7	-	Liquid	-	-
TEP5	8	0.91	Liquid	0.88	0.42
TEP6	6	0.90	Liquid	0.85	0.29
TEP7	9	0.94	Liquid	0.84	2.83
TEP8	8	0.89	Liquid	0.85	0.19
TEP9	9	0.91	Liquid	0.85	0.29
TEP10	9	0.91	Liquid	0.84	0.29
TEP11	9	0.90	Liquid	0.84	0.29
TEP12	8	0.90	Liquid	0.86	0.63
TEP13	9	0.91	Liquid	0.85	0.23
TEP14	9	0.91	Liquid	0.88	0.89

TEP1 - TEP13 represent *Selenium modiflorum* Jacd; *Memordica balasamina*; *Cassia accidentalis* L; *Ethrina senegalensis* DC; *Khaya senegalensis*; *Melia azedarach* L.; *Ricinus communis; Teitropha curcas* L.; *Sesanum radiatum schum*; *Rann*; *Balanites aegyptiana; Arachis hypogea.; Elacis guineans* Jacq and *Elacis gineans* Jacq respectively (Detail in Part I)
* Part I; ** Part II

Table 2: The viscosity of diesel fuel oil in various uses at 100°F in mM^2S^{-1} [7]

Ranges Bracket	Use	Kinematic viscosity of Diesel fuel oil at 100°C in mM^2S^{-1}	
		Min	Max
No. 1-D	A volatile distillate fuel for engines in service requiring frequent speed and load change	0.14	0.25
No. 2-D	A distillate fuel oil at low yolatility for engines in industrial and heavy motocycle service	0.18	0.58
No. n_D	A fuel oil for low medium speed engines	0.58	2.64

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