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Evaluation of the Lubricating Properties of Palm Oil

John Jiya MUSA

Department of Agriculture & Bio-Resource Engineering, Federal University of Technology, P M B 65, Minna, Nigeria
Email: jogric2000@yahoo.com

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Abstract

There has been an increase in effort to reduce the reliance on petroleum fuels for energy generation and transportation throughout the world. Among the proposed alternative fuels is biodiesel. Over the years, a little attention was paid to the industrial use of palm oil. Laboratory tests such as viscosity, fire point, flash point, pour point and densities were conducted on raw palm oil and bleached palm oil using standard procedures. The flash points of palm oil and the bleached sample are 250 and 301°C while their fire points are 260 and 308°C while the flash and fire points of the SAE 40 and SAE 30 are 260/300(°C) and 243/290(°C) respectively. It was discovered that palm oil has a better prospect as lubricating oil if necessary improvements are made.

Keywords

Additives; Bleaching; Density; Fire point; Flash point; Pour point; Viscosity

Introduction

Over the past decades, there has been an increase in effort to reduce the reliance on petroleum fuels for energy generation and transportation throughout the world. Among the proposed alternative fuels, biodiesel and diesohol have received much attention in recent

years for diesel engines due to their advantages as the renewable and domestically produced energy resources. Moreover, the studies have shown that they are environmentally friendly because there is substantial reduction of unburned hydrocarbons, CO and particulate matter emission when it is used in conventional diesel engine [3]. One of the interesting recent developments is a growing realization that bioresources present practical alternatives to fuels and lubricants derived from liquid fossil fuels. About 30 years ago in Tanzania, locally pressed castor oil, strained through an old sock was used as gearbox engine oil [4]. This was no eccentricity was shown by the many tests carried out on its uses as lubricating oil and its eventual acceptance as a jet engine lubricant [4]. Biodiesel can be produced from vegetable oils via transesterification process. Nevertheless, biodiesel has been employed not only as an alternative to the fossil derived fuels, but also as an additive for diesohol - a blending of ethanol with regular diesel.

The globe includes Nigeria is presently facing two major problems. Firstly, global warming must be reduced by preventing the release of large amounts of carbon dioxide which is created due to environmental pollution into the atmosphere by searching for alternatives to existing commercial petroleum based conventional fossil fuels and secondly, the availability of existing fossil fuels can be extended by adopting some scientific methodologies including blending of conventional fossil fuels with economically feasible, abundantly available, having renewable resources, environmental friendly, and non conventional fuels. Time has come to switch over from using non-renewable resources to using renewable resources and switching will be imminent as the present scenario of energy use is unsustainable. With foreseen switchover, one will also be switching to the sustainable energy base with no adverse impact on the environment.

Over the years, a little attention was paid to the industrial use of palm oil. Nevertheless, recent studies have indicated that apart from their domestic uses that they can be used as engine lubricants, as replacement for biodiesel if their properties are enhanced. Palm oil is gotten from the palm fruit’s pulp. It is red in color due to the presence of beta carotene in it. Previously it was the second most widely produced edible oil after Soya bean oil, 28 million metric tons were produced worldwide in 2004 [1]. Palm oil is also used in biodiesel production, as either a simply processed palm oil mixed with petrol diesel or processed through transesterification to create a palm oil methyl ester blend which meets the international EN 14214 specification with glycerin as a by product.

The objectives of this study were to evaluate the lubricating properties of palm oil and to compare these characteristics to those of the normal engine oil.

Materials and Methods

The materials and equipment used in carrying out this research work include Palm oil and palm kernel oil samples, water, open viscometer cup, stopwatch, graduated beakers, retort stand, ohous weighing equipment, gallam camp magnetic stirrer regulator hot plate, cleave land open cup Apparatus, thermometer, gas burner, viscometer bath, holding cylinder, heater, flask (flat bottom) and torch nozzle. The physical and chemical properties of the oil, which includes the density, viscosity, specific gravity and flash/fire point were determined. The method described by [2] was used in the viscosity determination except that it was conducted at normal average room temperature in Minna, Nigeria, which is 40°C. Bleaching of the sample was to remove the gumming properties and improve its color. A mixture of about 30g of the bleaching agent and 500ml of the sample were placed in a beaker which was placed inside the magnetic stirrer regulator tot plate equipment (gallen kamp) and a drop of the bleaching agent was added and stirred. A gradual heat was applied with a regulated speed of stirring the content. The bleaching stage is attained when traces of soap stock are formed on the bleached oil. The stock soap traces were packed and decants of the bleached oil into a beaker and then filtered. Conventional lubricant were collected and tested for the above-mentioned properties, and the compared with those of palm and bleached palm oil.

Results

The open cup method was adopted for the flash and fire points test due to its simplicity. The high carotene content of palm oil limited its use as engine lubricant but the action of the bleaching agent helped to improve the property as indicated in the Table 1.
From the results obtained, it is seen that the flash points of palm oil and the bleached sample are 250 and 301°C while their fire points are 260 are 308°C respectively. This property of lubricant shows their response to heat and flame under controlled conditions and when

compared with the standards of SAE, the values of bleached palm oil were higher while palm oil was lower. Conversely the flash and fire points of the SAE 40 and SAE 30 are 260/300(°C) and 243/290(°C) respectively. It is quite clear from the results obtained that palm oil and the bleached palm oil have very good flash and fire points as they fall within the range of specification for the conventional lubricants.

Table 1. Properties of samples and their values

Properties Samples	Flash point(°C)	Fire point(°C)	Pour point(°C)	Specific density(mg/ml)	Viscosity at 40° (cst)	Viscosity at 100°C (cst)
Palm oil	250	260	20	0.882	81.30	5.70
Bleached palm oil	301	308	25	0.899	127.1	10.30
SAE 40	260	300	9	0.868	159.20	15.87
SAE 30	243	290	21	0.895	104.00	12.00

The pour points for palm and bleached palm oil are 20 and 25°C respectively and the corresponding pour points of the lubricants are 9 and 21°C for the SAE 40 and SAE 30 oil respectively showing that the pour point is almost close to that of the SAE 30. Thus, implying that the samples under consideration could be used both in humid and temperate regions of the world. Since the pour point is the minimum temperature of a liquid, particularly a lubricant after which on decreasing the temperature the samples cease to flow. It is therefore important to note that the samples under consideration have pour points that satisfy their use as engine lubricating oils.

The densities of the samples determined was to ascertain the compatibility of the samples that is the ability of the samples to mix with other liquids. The results above show that palm oil, bleached palm oil, SAE 40 and SAE 30 have specific gravity of 0.882, 0.899, 0.868, and 0.895mg/ml respectively which indicates that palm oil and bleached palm oil have good values of specific gravities and will help in case of contamination with water as it will settle below the oil which allow easy draining.

The viscosity of the samples was determined at operating temperatures of 40°C and 100°C for the engine. It is seen from the results in Table 1 that the palm oil and the bleached palm oil at 40°C had viscosities of 81.30 and 127.10 (centistokes) and 5.70 and 10.30(centistokes) at 100°C respectively. This indicates a decrease of about 93% and 91.89% for the samples respectively. Comparing this percentage decrease with that of the conventional lubricants it showed a decrease of about 90% and 88% for the SAE 40 and SAE

30. This percentage decrease in viscosity shows that as the temperature is increased from 40°C to 100°C the viscosity of the SAE 30 reduces by 88%, while that of the SAE 40 by 90%. Since viscosity is the most important parameter in terms of lubricating oil, their individual strength is reflected in their various percentage decrease in their viscosities on increasing their temperatures from 40°C to 100°C. Although the percentage decrease is high in palm oil and bleached palm oil which can be enhanced by adding certain additives such as Thiadiazole dimmer (DMS2) and Polyglycol (DMS2-GL) by synthesizing them as ashless grease additives or bleaching the samples to help improve on their lubricating qualities. Bleaching removes the gummy elements and destroys the carotene (red color) of palm oil thereby reducing the staining characteristics.

Conclusions

From the results obtained, it can be concluded that

- The flash/fire points of the palm oil and the bleached palm oil meet the required SAE specifications as the values obtained were 250°C and 301°C for palm oil, and the bleached sample respectively with palm oil having a better prospect considering its property.
- The pour points of 20°C and 25°C for palm oil and the bleached sample competed favorably with that of SAE 30 which has a pour point of 21°C. The reason for this may be due to the fact that it has a higher viscosity compared to the other samples. In essence, the higher the viscosity of a sample the lower its pour point and vice versa.
- The specific density of 0.882mg/ml and 0.899 mg/ml for palm oil and the bleached palm oil conforms to those of SAE 40 and SAE 30 with values of 0.868mg/ml and 0.895mg/ml. It is obvious that palm oil and the bleached palm oil have good values of density. Hence they will help in case of contamination with water which will settle below the oil and can subsequently be drained off.
- It was also observed that the viscosity of the samples decreased with increase in temperature. But among the three specimens examined, the bleached palm oil exhibited the best lubricating features. This implies that the caroteneous content of palm oil has a negative effect on its lubricating properties. On increasing the operating temperatures

from 40°C to 100°C, all the samples analyzed showed various percentage decrease in their viscosities.

- Finally, it was observed that the shear strength of the various samples varies depending on their various carotene contents. On increasing the temperature from 40^{o}C to 100^{o}C, each showed various percentage decrease in their shear strength which is indicated in their viscosities. It is obvious that the bleached sample exhibited the best lubricating features when compared to palm oil.

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