Continental J. Applied Sciences 8 (2): 1 - 6, 2013 ISSN: 1597 – 9928
© Wilolud Journals, 2013 http://www.wiloludjournal.com
Printed in Nigeria doi:10.5707/cjapplsci.2013.8.2.1.6

CHARACTERISTICS OF NIGERIAN ENGINE OIL, PETROL AND FUEL MIXTURE BY THE MEASUREMENT OF THEIR VISCOSITIES

[1]Musa, M., [1]Sulaiman, A. U., [1]Arzika, A. T., [1]Ahmad, M. B., [2]Itumoh, E. J., [3]Izuagie, T.
[1]Department of Chemistry, Shehu Shagari College of Education, Sokoto, [2]Department of Industrial Chemistry, Ebonyi State University Abakaliki, [3]Department of Natural Sciences, The Polytechnic of Sokoto State, Sokoto

ABSTRACT
The characteristics of some Nigerian engine oil, petrol and fuel mixture were studied. Engine oil, petrol and fuel mixture are used daily on the Nigerian roads, homes, offices etc. in various machines (engines) as lubricating oils. One important use of these lubricating oils is to reduce friction between parts of a machine in relative motion. The measurement of viscosity of the engine oil and fuel mixture was carried out to determine the characteristics of the oil and the blend with respect to their use. Using an Ostwald Viscometer method, the viscosities of the engine oil and petrol were found to be 1.192 centiPoise (cP) and 0.751 centiPoise (cP) respectively. Various blend mixtures of the petrol and engine oil also gave good results. The results indicate that the viscosity increases with increase in the proportion of engine oil. The time of flow and density also increases as the volume of engine oil increases. The changes in densities and viscosities of the blend were found to be drastic while the proportion of the petrol in the blend increases. The changes were found to be gradual while the proportion of petrol in the blend was less.

KEYWORDS: Engine oil, Petrol, Fuel mixture, Viscosity, Flow time, Sokoto

Received for Publication: 22/12/12 Accepted for Publication: 28/02/13
Corresponding Author: tomyi2012@yahoo.com

INTRODUCTION

Engine oil, petrol and fuel mixture are used daily on the Nigerian roads, homes, offices etc. in various machines (engines) as lubricating oils. Engine oil is a viscous mineral liquid used to reduce friction between parts of a machine (engine) in relative motion. Also, when lubricating oils are used, they protect rubbing surfaces and promote easier motion of connected parts. In this process, they also serve as a medium to remove high buildup of temperature on the moving surfaces (Udonne, 2011).

In Nigeria today, many commercial engine oil are available in different viscosities. It is always important to carryout analysis on engine oil used for various properties. Oil analysis involves sampling and analyzing oil for various properties and materials to monitor wear and contamination in an engine, transmission, or hydraulic system. Oil analysis not only provides a window into the mechanical condition of the component, but also determines the condition of the oil itself to help optimize drain periods (Behman*et al.* 2012).

Viscosity is the resistance to flow in a liquid. It is also defined as the resistance in which a liquid or gaseous fluid offers to the net displacement of its component molecule in a continuous and direct manner. This viscosity is normally expressed in terms of the coefficient of viscosity (Mougey, 1979). In oils it changes with temperature, increasing as temperature decreases i.e. it thickens as it cools. The units of viscosity used today are called Centistokes (cSt) and Centipoises (cP), and are usually measured in 40ºC or 100ºC (Morris Lubricants Technical Report, 2011). Viscosity is a single most important characteristic of oil as a good lubricant (Hoyt, 2009). According to Mougey (1979); viscosity is one of the important physical properties of many fluid products including engine oil. It is important to note that engine oil viscosity influences the engine friction power (Singh *et al.* 2011).

When engine oil is heated, it tends to become thinner. Using the viscosity index (VI) which is a rating of an indication of engine oil's ability to resist viscosity change, specific oil is said to have low VI if it flows out in great amount upon heating, otherwise, it is said to have high VI (Wemer and Will, 1995). The dynamic viscosities of liquid are typically several orders of magnitude than the dynamic viscosities of gases (Tilley, 1976). As a physical property, viscosity of a fluid or a blend mixture of fluids can determined using an Ostwald viscometer.

Theoretical Framework

Mathematically, the viscosity of a liquid can be directly calculated by measurement of time required for a liquid to flow through a cylindrical tube using the following equation (1).

$$n = \frac{pr^4t}{8v} \qquad (1)$$

Where n = fluid viscosity, p = pressure, r = radius of cylindrical tube, v = volume and t = time of flow.

Once the viscosity of one fluid is known, the viscosity of other fluid can be directly calculated using an Ostwald viscometer and the following relationship (2).

$$\frac{n_1}{n_2} = \frac{p_1 t_1}{p_2 t_2} \qquad (2)$$

Where n = fluid viscosity, p = fluid density and t = time of flow. The S.I physical unit of dynamic viscosity is Pascal.

Classification of Engine Oil

According to a classification by the Society of Automotive Engineers (SAE), engine oil of different viscosity have been assigned numbers from 10-50. The purpose of the viscosity range as established by this society is to standardize the nomenclature of different oils in terms of their viscosity. Table 1 summarizes the SAE number assigned to grade-one engine oil with their corresponding range of viscosity at room temperature (25^0C).

The aim and objective of this research work is to determine the characteristics of engine oil/fuel mixture (blend) by viscosity measurement.

Table 1: SAE number assigned to grade-one engine oil with their corresponding range of viscosity at room temperature (25^{0}C).

S/N	Grade-one (SAE) designation	Viscosity (in centistokes) at 25^{0}C
1	SAE 10 W	60 – 90
2	SAE 20 W	90 – 180
3	SAE 30 W	180 – 280
4	SAE 40 W	280 – 450
5	SAE 50 W	450 – 800

Source: Tobokit and Johnson (1983)

MATERIALS AND METHODS

Sample collection

Total® premium engine oil and petrol were purchased from Total Filing Station, at Bello Way Area Sokoto State, Nigeria.

Determination of Flow Time of Water

Ten centiliters (10 cm^3) of distilled water was measured and allowed to attain thermal equilibrium at 25^{0}C. The viscometer was dipped into a water bath ensuring that the upper and lower marks on viscometer were below the water level of the bath. Using a pipette filter, the water was filled into the viscometer above the upper mark and the time required for the water to flow from the upper mark to the lower mark was recorded.

Determination of Flow Time of Engine Oil

Ten centiliters (10 cm^3) of the engine oil was measured and allowed to attain thermal equilibrium at 25^{0}C. The viscometer was dipped into a water bath ensuring that the upper and lower marks on viscometer were below the water level of the bath. Using a pipette filter, the oil was filled into the viscometer above the upper mark and the time required for the oil to flow from the upper mark to the lower mark was recorded.

Determination of Flow Time of Petrol

Ten centiliters (10 cm^3) of the petrol was measured and allowed to attain thermal equilibrium at 25^{0}C. The viscometer was dipped into a water bath ensuring that the upper and lower marks on viscometer were below the water level of the bath. Using a pipette filter, the petrol was filled into the viscometer above the upper mark and the time required for the petrol to flow from the upper mark to the lower mark was recorded.

Determination of Flow Time of the Blend Mixture

Ten centiliters (10 cm^3)of the petrol was mixed with 10 cm^3 of the engine oil to obtain a blend mixture. 10cm^3 of the blend mixture was measured and allowed to attain thermal equilibrium at 25^{0}C. The viscometer was dipped into a water bath ensuring that the upper and lower marks on viscometer were below the water level of the bath. Using a pipette filter, the blend was filled into the viscometer above the upper mark and the time required for the blend to flow from the upper mark to the lower mark was recorded. Subsequently, the petrol and the engine oil were mixed respectively in various ratios. 10 cm^3 of these blends were used to obtain flow time as above.

All the results were obtained in triplicates to determine the uncertainties in measuring the flow time.

All the apparatuses and instruments used for this work including the Ostwald Viscometer were pre-cleaned properly with a cleaning solution. Distilled water was also used for the experiments.

RESULTS AND DISCUSSION

The results of the various determinations are presented in Tables 2-3. As expected the viscosity of the engine oil was higher than that of water and petrol. Fig. 1 is the graphical representation of the data.

Table 2: Properties of water, engine oil and petrol at 25^0C

Components	Volume (cm^3)	Time (sec)	Viscosity (cp)
Water	10	10.44	0.8937
Engine oil	10	14.5	1.192
Petrol	10	11.73	0.751

Table 3: Properties of blend ratio at 25^0C

Sample	Blend ratio (cm^3)	Density (g/dm^3)	Time (sec)	Viscosity (cp)
A	10:10	0.849	12.91	0.944
B	20:10	0.813	12.65	0.885
C	10:20	0.884	13.57	1.032
D	30:10	0.796	11.93	0.8179
E	40:10	0.792	11.88	0.8104
F	50:10	0.787	11.79	0.799

Key: A – F = various mixtures (blends) of Total® premium engine oil and petrol

The results indicate that the viscosity increases with increase in the proportion engine oil. The time of flow and density also increases as the volume of engine oil increases. The changes in densities and viscosities of the blend were found to be drastic while the proportion of the petrol in the blend increases. The changes were found to be gradual while the proportion of petrol in the blend was less. Hence the viscosity of the blend was favored on the part of engine oil. Consequently engine oil is more viscous and denser than petrol, the differences in viscosities as well as densities, is attributed to the fact the engine oil has greater proportion of higher molecular weight hydrocarbons like naphthenes, aromatic compounds and wax than petrol. In addition, it has lower internal energy than petrol and therefore, contains molecules that are linked together in chains or rings to one another and which are less volatile than those in petrol.

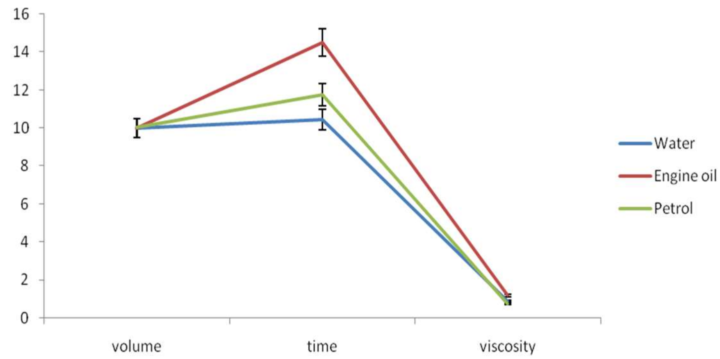

Fig. 1: Graph of Properties of Water, Engine Oil and Petrol at 25^{0}C (with 5% Error Bars).

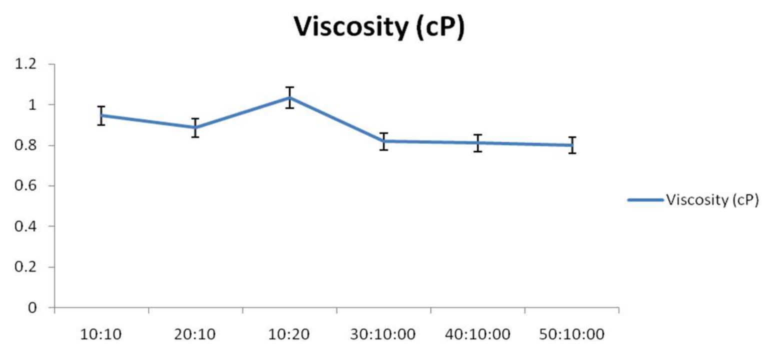

Fig. 2: The graph of Viscosities of Various Blend Mixtures of Engine Oil and Petrol at 25^{0}C (with 5% Error Bars).

CONCLUSION

Viscosity measurement is one of the most efficient techniques or methods of determining the characteristics of engine oil/fuel mixture (blend). It was found in this report that viscosity could be obtained by using the viscosity of other known solution. The results indicate that the viscosity, time of flow and density increased with increase in volume of engine oil while the changes were found to gradually decrease with high proportion of petrol in the blend mixture. It has been shown that, the time it takes a mixture (blend) to flow depends on the viscosity of the solution. Viscous mixture (blend) takes longer time flow. Further characterization of blend mixture by different techniques should be carried out to determine the characteristics of engine oil/fuel mixture.

REFERENCES

Behnam, R., Abolfazl, S., Alireza, N-E., Hamid, S. L., and Massoud, H. D. (2012). Monitoring of the Physical and Chemical Properties of a Gasoline Engine Oil during Its Usage. *Journal of Analytical Methods in Chemistry* vol. 2012, pp. 1-8.

Hoyt, H. (2009). Oil Viscosity-Tech Brief No. 13.Zplus™, LLC, 2609 Tucker St, Burlington, NC, 27215, http://www.zddplus.com/TechBrief13

Morris Lubricants Technical Report (2011). Steam Lubrication Theory. Morris Lubricants Technical Department, Morris Lubricants, Castle Foregate, Shrewbury, Shropshire, SY1 2 EL USA, pp. 1-7.

Mougey, H.C. (1979). CRC Handbook (SAE Journal), *Vol*. 10 No.104, pp. 49 – 50.

Society of Automotive Engineers (SAE). (2012). Retrieved on 17/3/2012 from http://www.standardsportal.org/usa_en/sdo/sae.aspx

Singh, D., Fieldhouse, J. D., Jain, A. K., Tyagi, M. R. and Singal, S. K. (2011).Investigating the Effect of Operating Variables and Engine Lubricant Viscosity on Engine Friction – A DOE Approach.*SAE Technical Paper*, No. 2011-28-0052.

Tilley, D. (1976). University Physics for Science and Engineering (2nd edition). Cummings Publishing Comp. Inc., London, pp. 204 – 265.

Tobokit, W. K. and Jonson, I. (1983).Automotive Encyclopedia. The Goodheart – Wilcox Company, Illinois, South Idolana, p. 101.

Udonne, J. D. (2011). A Comparative Study of Recycling of used Lubrication Oils Using Distillation, Acid and Activated Charcoal with Clay Methods. *Journal of Petroleum and Gas EngineeringVol*. 2(2), pp. 12-19.

Wermer, R. and Will, J. (1995).Viscosity of Blend mixture. University of Idaho, Moscow, p 308 – 351.