International Journal of Engineering Science Invention
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 6 Issue 8|| August 2017 || PP. 62-67

Quality Assessment of Lubricating Oil

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Abstract: *The quality of lubricating oil has a direct relationship with optimum performance of automotive and other types of machines. The study was aimed at ascertaining the quality of available lubricating oil in the market, weather it conforms to standard. The oil sample was measured to suitable amount and transferred to the still. A solvent-carrier liquid was added into the sample in the still and glass beads/other boiling acids added to reduce bumping. The apparatus were assembled and healed, adjusting the rate of boiling. When the evolution of water was completed, trap and its content were allowed to cool to room temperature. Data were collected through experimental work established by international standard (which is ASTM and IP). Obtained results showed that multinational lubricant producing companies produce high quality compared to the indigenous companies. It also shows that some engines oil should be avoided so as to enhance the life of automotives engine. The study recommended that the roadside engine oil should be avoided so as to enhance the life of automotive engine.*

Keywords: *Viscosity index, Additive, Quality. Kinematic viscosities, inhibitor*

Date of Submission: 17-07-2017 Date of acceptance: 31-08-2017

I. INTRODUCTION

Over the past, changes in the design and operation of automotive engines/system have called forlubrication oils of progressive higher quality and performance. This tend undoubtedly continue into this century. Before 1940, passenger cars had large low-power engines that could be adequately lubrication by a straight mineral oil without additive (Mizuno and Okamoto, 1982). Most of the cars built since then, have smaller compact and more powerful engines that run at high temperature. Moreover, the hydraulic valve with their closer tolerances between moving parts make it essential to prevent engine rusting. The outgrow has been development of large family of chemical additive and viscosity index improvers, that the permit today's lubricating oils to protect engines more effectively, to ensure extreme temperature, and lubricating over several thousand miles in use (Oseni, et. al, 2006 and Anyaawu and Cholakov, 2004).

The engines/ engineering system designers and manufactures have the prescribed a particular lubricating oil for a particular system (or engine) that suite the working condition of the system.

The metallurgical limit has played a critical role in closing a lubricant for an engine because of the temperature at which the system is designed to operate for specific period of time (Yasutomi, et. al, 1984).

The research work is purposely to access the quality of lubricating oil, in relation to performance, classification and application in automotive system. Recent innovation shows that automotive system demand higher quality lubricating oil because of power output and efficiency. The engine manufacturers recommend for long time between changes in, introduction of emission control devices on automotive systems, and the expanding use of lead-free fuels, all these account for additional protection to automotive engines (Annual Book of ASTM, 2006).

The abnormal behavior of lubricating oil at prevailing condition has led to critical study the base stock and additives. The study is focused on the contribution of additives, and base stock to the formulation of high quality lubricating oil. In automotives are shed for three different reasons which are:

To replace some properties removed during refining.

To reinforce some of the natural properties and to provide oil with new properties which it did not originally have.

Oils from some petroleum oil fields. Additive is usually classified according to the property they add to the oils. Some of the common additives are anti-oxidants, viscosity index improver pour point depressants, extreme pressure and anti-wear additives, corrosion preventatives, detergents and dispersants, metal DEACTIVATORS; water replants emulsifier, dyes, color stabilizer, odor control agents and foam inhibitors. With improper additives selection, the additives may oppose each other and lose their benefit to the oil. Therefore each manufacturer should balance the additives in their oil to provide oil with desirable properties, which meet the engine needs (Oyekunle and Ochem 2000). These include; power point depressants, oxidation inhibitor, corrosion and rust inhibitor, extreme pressure resistant, detergent and dispersants, antifoaming additives and friction modifiers (oiliness Agents), up to the present, the petroleum. And the automotive industries in collaboration with government agencies such as, API ASTM SAE and other large scale users of petroleum products have been reasonably successful in updating both their performance test and their classifications remains valid requires constant surveillance of these technologies so that future work summaries the current (Michael, 1997). Status of three major means in lubricant technology that is performance classification and application.

II. METHOD AND MATERIAL

The materials used in the test but the equipment varies according to the types to be carried out. The materials are itemized on each of the test to be done.

Quality Control Tests

Experiment1: Kinematic viscosity of lubricants (ASTM D445)

Aim: to determine the Kinematic viscosity of lubricants at 40^0

Apparatus/Material

Glass capillary tube

Viscometer holder

Thermometer

Stopwatch

Procedure

The fine is measured for a fixed volume of liquid to flow under gravity through the capillary of a calibrated viscometer under a reproducible driving head and at a closely controlled and known temperature.

Calculation

The kinematic viscosity from measured flow time, t, and the viscometer constant, c, can be calculated by the equation given below:

KV=C.t

Where KV= Kinematic viscosity in centistokes (cst)

T= measured mean time in seconds, s

C= calibration constant of the viscometer in mm^2/s^2

Table For Experiment

Experiment1: calculating viscosity index of lubricating oil from kinematic viscosity of 100^0 C

OIL SAMPLE	A	B	C	D
	15.06	15.40	15.15	6.34
	15.1	15.50	15.20	6.36
	15.30	15.30	15.10	6.32
Mean=±	15.06	15.40	15.15	6.32

The table above shows the variation of kinematic viscosity at 100^0 for SAE 40 different blending companies.

Experiment 2: viscosity index of oil sample at 100^0

OIL SAMPLE	A	B	C	D
	100	15.40	108	30
	99	101	107	28
	101	99	109	32
Mean=±	100	100	108	30

The table above shows the variation of viscosity index of oil sample [SAE 40] for different blending companies.

Experiment 3: specific gravity of oil samples at 100^oc.

OIL SAMPLE	A	B	C	D
	0.891	0.8955	0.8855	0.891
	0.891	0.8955	0.8855	0.891
	0.891	0.8955	0.8855	0.891
Mean ±	0.891	0.8955	0.8855	0.891

The table above shows the variation of the specific gravity of the oil sample at 100^oc for different companies.

Table of experiment 4

Aim: to determine the actual water content of lubricating oil.

Apparatus:

Metal still

Heater

Reflux condenser

Graduated glass trap

Reagents
Oil sample to be tested
Solvent carrier liquid, e.g glass or polytetrafluorethylene (PTFE) rod.

Experiment 4: water content of lubricating oil (ASTM)IP74/82 (88).

OIL SAMPLE	A	B	C	D
	0.02	0.02	0.02	0.05
	0.02	0.02	0.02	0.05
	0.02	0.02	0.02	0.05
Mean=±	0.02	0.02	0.02	0.05

The table above shows the variation of the specific gravity of the oil sample at 100^{o}c for different companies.
Kinematic viscosity of oil sample at 40^{o}, in Cst.

Experiment 1: calculating viscosity index of lubricating oil from kinematic viscosity of 40^{o}C

OIL SAMPLE	A	B	C	D
	150.95	150.85	142.9	50.75
	150.96	150.86	143.0	50.76
	150.94	150.84	142.8	50.74
Mean=±	150.95	150.85	142.9	50.75

The table above shows the variation of kinematic viscosity at 40^{o} for oil sample {SAE 40} of different blending companies.
AIM: to determine the variation of kinematic viscosity of lubricating oil with temperature

APPARATURE
Glass capillary
Thermometer
Stop watch
Viscometer holder

Procedure
Check the kinematic viscosity of the lubricant samples at 40^{o}c and 100oc and then use the viscosity index tables for celcius temperature to check for viscosity index (ASTM D2270).

Experiment 2: viscosity index of oil sample at 40^{o}c

OIL SAMPLE	A	B	C	D
	100	100	108	100
	100	100	101	99
	100	100	99	100
Mean=±	100	100	108	100

The table above shows the variation of viscosity index of oil sample [SAE 40] for different blending companies
Table of experiment 4

Experiment 4: water content of lubricating oil (ASTM D95) IP74/82(88)

OIL SAMPLE	A	B	C	D
	0.891	0.8955	0.8855	0.891
	0.891	0.8955	0.8855	0.891
	0.891	0.8955	0.8855	0.891
Mean=±	0.891	0.8955	0.8855	0.891

The table above shows the variation of specific gravity at 150^{o}c for SAE 40 of different blending companies.

Table of experiment 4

Experiment 4: water content of lubricating oil (ASTM D95) IP74/82 (88)

OIL SAMPLE	A	B	C	D
	0.02	0.02	0.02	0.05
	0.02	0.02	0.02	0.05
	0.02	0.02	0.02	0.05
Mean= ±	0.02	0.02	0.02	0.05

Aim: to determine the actual water content of lubricating oil

Apparatus:
Metal still
Heater
Reagents
Reflux condenser
Graduated glass trap
Reagent
Oil sample to be tested
Solvent-carrier liquid, e.g. glass or polytetrafluorethylene (PTFE)rod.

Summary of Tested Method

The oil sample is measured to suitable amount and transferred to the still. A solvent-carrier liquid is added into the sample in the still and glass beads or other boiling acids may be added to reduce bumping. The apparatus is assembled and healed, adjusting the rate of boiling. When the evolution of water is complete, allows the trap and content to cool to room temperature. Dislodge any drops of water adhering to the sides of the trap with glass or polytetrafluorethylene rod. Read the volume of the eater in the trap to the nearest scale division.

Calculation:

Calculate the water in the sample, as weight or volume percent, in accordance with the basis on which the sample was taken, as follows:

Water, %(v/v)= $\frac{V_{wt}- W_{sb}}{M_{ts}}$ x 100%

Where: V_{wt} is Volume of water in trap in (ml).
W_{sb} is water ij solvent blank (ml).
M_{ts} is mass of test sample in gram

Analysis

The analysis of result obtained was done through computation and calculation of the practical test result. These calculation of were based on the available result of kinematic viscosities at 100^0 c specific gravity.

In the quality control test aimed determining among other the sulphated ash, viscosity and the index, standard test were carried out to provide the statistical approach in the analysis. Statistical procedure provides the best basis for determining form such result the quality and result in the most useful form. The average result of all test including the standard deviation and co-efficient of variation was obtained in order to estimate the lubricant control standards.

Experiment 1

Statistical distribution of viscosities at 100^0 c in Cst,

Sample	X	(Xi-X)	$(Xi-x)^2$
A	15.06	-0.15	0.0255
B	15.40	-0.46	0.2303
C	15.15	-0.08	0.0064
D	6.34	-	-

Mean viscosity at 100^0 c, X = $\frac{\sum x_i}{n}$

= $\frac{15.06+15.40+15.15}{3}$ = 15.20Cst

Standard deviation, $\delta = \frac{\sqrt{\sum(X_i-X)^2}}{n} = \frac{\sqrt{0.6226}}{3}$
= 0.29Cst

Coefficient of Variation, v = $\frac{\delta}{X}$x100% = $\frac{0.29}{15.20}$x100 = 1.91%

Statistical distribution of viscosities at 40^0 c, in Cst

Sample	X	(Xi-x)	$(xi-x)^2$
A	150.95	0.15	0.0255
B	150.85	0.06	0.0049
C	142.90	-7.87	60.0942
D	50.70	-	-

Mean viscosity at 40^oc X= $\frac{\sum x_i}{n}$

$= \frac{150.95+150.85+142.90}{3}$ = 148.2Cst

Standard deviation, $\delta = \frac{\sqrt{\sum(X_i - X)^2}}{n} = \frac{\sqrt{62.1246}}{3}$= 44.8Cst

Coefficient of Variation, v = $\frac{\delta}{X}$x100% =$\frac{44.8}{148.2}$x100 =
= 3.02%

Experiment 2

Statistical distribution of viscosity index of oil samples.

	X	(Xi-x)	(Xi-x)
A	100	-2.4	5.76
B	100	-2.4	5.76
C	108	4.5	20.25

Mean viscosity index X =$\frac{\sum X_i}{n}$

$= \frac{100+100+108}{3}$ = 102.66Cst

Standard deviation, $\delta = \frac{\sqrt{\sum(X_i - X)^2}}{n} = \frac{\sqrt{31.77}}{3}$= 1.88Cst

Coefficient of Variation, v = $\frac{\delta}{X}$x100% =$\frac{1.88}{102.66}$x100%
= 1.83%

Experiment 3

Statistical distribution of gravity at 15^0 c of oil samples.

Sample	X	(Xi-x)	$(Xi-x)^2$
A	0.8910	-0.00004	$6.4x10^{-7}$
B	0.8955	-0.0045	$2.116x10^{-5}$
C	0.8853	0.0061	$3.721x10^{-5}$
D	0.8910	-	-

Mean specific gravity at 15^0 X =$\frac{\sum X_i}{n}$

$= \frac{0.8910+0.8955+0.8853}{3}$ = 0.89Cst

Standard deviation,$\delta = \frac{\sqrt{\sum(X_i - X)^2}}{n} = \frac{\sqrt{1.56 \, x \, 10^{-3}}}{3}$= 1.32 x 10^{-2}Cst

Coefficient of variation, v = $\frac{\delta}{X}$x100% =$\frac{1.32 \text{ x } 10^{-2}}{0.89}$x100% = 1.48%

III. RESULT AND DISCUSSION

The result below was gotten from practical test carried out on sample of lubrication oil such as Mobile, Total, Tonmas, and road side oil.

Kinematic Viscosity of Oil at $100^{0\,C}$

In experiment I, this is to test for kinematic viscosity of oil at $100^{0c.}$ it was experimentally viscosity of oil at $100^{0c.}$ it was experimentally observed that sample A(mobile), B (Total) and C (Tonimas) has highest and best Kinematic viscosity from the four samples which was collected,

The result shows that samples A,B,C,and D has the best kinematic viscosity because of good quality of additives such as antifoaming addtitives, corrosion and rust inhibitors and oxidation inhibitors which the oil manufactures added into the oil in order to improve the quality and performance of the oil.

In order hand it was equally that sample D (Roadside) oil has a poor kinematic viscosity from additives which the manufactures added into the oil.

Viscosity Index at 100^0c

Experiment 2,testing for the viscosity index of the collected sample at 100^0**c.**the bar chart above show s that sample C (Tonimas) has the best and highest viscosity index because the manufactures maintain the good quality additives such as; detergents and dispersants and friction modified (oiliness agents which was added to the oil. However; sample A (mobile) and B (Tonimas) was the next in the bar chart that has the best viscosity index while

D (roadside) oil has the best poorest because of there was no good additive such as oxidation inhibitors that were added to the oil.

Experiment3 which is testing for the specific gravity of the entire collected samples at 100^0C, from the bar chart above the result obtained show that sample B (Total) has the best specific gravity in all the collected sample, the result shows that the total manufactures added good quality of additives into the oiliness which improves the quality of their company oil. It was shown that samples A (mobile) and sample D (Roadside)oil was the next that has good specific gravity because of the additives whichthe manufactures added to the oil. However, samples C(Tonimas) havethe lowestspecific gravity from the entire collected samples because of the low quality additives which was added to the oil.

Experiment 4, which is testing for the water content of all the entire collected samples at 100^0c, it was experiment observed and was shown in the bar chart above that sample A,B,C, has the best water content needed in the oil. And samples D have the highest water content which is good for automotive engines.

IV. **CONCLUSION**

At the outset it was stated that the objective of this work was tom access the quality of lubrication oil. And also, to show if there some blending companies that produce a grade of oil for another because of economic reasons. The performance of engines is a sole function of the quality of lubrication oil of the engines.

Lubricating of oil relates to the quality control standard established to quid in the blending of lubricant. The properties of these constituent of lubricating oil is very important during pilot blending of a particular lubricant. The quality and high of lubricating oil can be achieved through the following ways;

- Efficient application for production techniques
- Use of modern blending plant such as vessels.
- Blended products should be tested before supplying to market
- Regular testing of raw materials such as base stock and additives before usage.

Quality lubricating oil has good number of benefits and hence it facilitates automotive engines development. The use of quality lubricating oil in automotive engines cannot be overemphasizes. Therefore the study recommended that the roadside engine oil should be avoided so as to enhance the life of automotive engine.

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Engr. Dr. Uzorh. “Quality Assessment of Lubricating Oil.” International Journal of Engineering Science Invention (IJESI), vol. 6, no. 8, 2017, pp. 62–67.