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FACTS ABOUT VISCIDITY OF ENGINE OIL

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ABSTRACT

Mechanical engine could be a complex machine; it consists of a many moving parts. The parts of the mechanical engine are operated under a large temperature ranges and pressure. Engine oil is employed altogether machines to scale back friction and control while working, so oil conditions and specifications controls the friction any weird actions in any engine, viscosity is one amongst the oil stating, it shows the number of forces between oil particles. A complete copy of engine oil in keeping with its viscosity is compiled during this study, through the experiment data mathematical formulas for various engine oils grades are created. Engine oils 10W-40, 5W-30, and 20W-50 are selected for testing and simulation because these types are widely utilized in the Kuwait marketplace for engines.

The SVM 3000 viscosity unit of measurement is employed to live viscosity and density of engine oils 10W-40, 5W-30, and 20W-50, optimization techniques in MATLAB software are used therefore the minimum values of viscosity are created. Oil viscidity is thought to be the key parameter for any lubrication system. One should be sure that oil viscidity in use meets original equipment manufacturer recommendations. Engine oil is of various substances that are used for the lubrication of machinery. Its main function is to scale back wear and tear on moving parts, sludge free, inhibit corrosion, etc. Engine oils are blended with different hydrocarbons and organic compounds. Engine oils are utilized in combustion engines, generators, and other machinery. This increases fuel power output, decreases fuel consumption and equipment failure. The viscidity will determine how efficiently oil is pumped to the working components, how easily it passes through the filter and the way quickly it drains back to the engine. The lower the viscidity the better this happens. For domestic use, in motorsports, etc., engine life is vital. [11]

KEYWORDS: Engine oil, Viscosity, Viscidity, Temperature, Optimization.

I. INTRODUCTION

Engine oil basic information

Motor oil or engine oil is created from petrochemicals, the origin of oil generally from animal, vegetable, or petrochemical. The basic styles of engine oil are [11]:

- Engine oil (10W-40, 4W-30, and 20W-50).
- Gear oil (80W-90, and 75W-90).
- transmission fluid.
- Special application oil.

The point of using oil in engines and rotating machineries is lubing, lubing means appending a layer of oil or film between the surfaces to intercept metal to metal contact also oil helps in cooling and heat transfer processes [2].

Multi-grades engine oil is used today for all seasons, but within the past the car owners used different engine oil in winter and different oil for summer season [2]. One sample of multi-grade engine oil is 10W-40, the letter W stands for winter, not weight or watt or the remainder and thus the opposite numbers show that the oil has maximum viscosity at low temperature, the lower W number the upper oil cold starting performance as an example 5W is best than 10W [1].

Viscidity is that the foremost vital parameter of engine oil, viscosity shows shear force or resistance to motion, and it relies on temperature and speed [3]. Engine oil should be proficient in flowing at low temperatures; oil rotates under the action mechanism around the engine in an exceedingly very fraction of a second at start-up and must guard engine components at high temperatures without evaporating or carbonizing and maintain ample oil pressure.[5] Engine oil must cover the next points:

- Lubricate engine parts and reduce wear.
- Reduce friction.
- Protect against corrosion mechanism.
- Keep engine parts immaculate and free of oxidizing.
- Minimize combustion chamber deposits.
- Cool engine parts.
- Seal combustion pressures.
- Resist foaming.
- Aid fuel economy.
- Permit easy starting.

The SAE stands for (Society of Automotive Engineers), the SAE number is measured in Centistoke (cst) at 100oC [3], Centistokes measures the fluid resistance to motion. The oil grades with viscosity ranges are SAE 20 = 5.6 to but 9.3cst, SAE 30 = 9.3 to but 12.5cst, SAE 40 = 12.5 to but 16.3cst, SAE 50 = 16.3 to less than 21.9cst, and SAE 60 = 21.9 to but 26.0cst. The factors effect on the oil operating period for various forms of engines is [4]:

- Individual engine equipment status.
- Tolerance scatters.
- Operating conditions.
- Duty profile.
- Fluids and lubricants.
- Miscellaneous assembly materials supported the wear status of the engine components.

API this standard for passenger cars, two categories. S represents Petrol and C represents Diesel, most oils carry both petrol (S) and diesel (C) specifications.

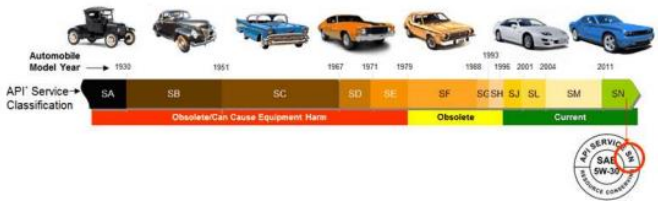

Fig1API categorization for car passenger engine oil

Table (1): Specifications of the up to date engine oil [11].

SG	Introduced 1989 - has much more active dispersant to combat black sludge.
SH	Introduced 1993 - has same engine tests as SG, but includes phosphorus limit 0.12%, together with control of foam, volatility and shear stability.
SJ	Introduced 1996 - has the same engine tests as SG/SH, but phosphorus limit 0.10% together with variation on volatility limits
SL	Introduced 2001 - all new engine tests reflective of modern engine designs meeting current emissions standards.
SM	Introduced November 2004 - improved oxidation resistance, deposit protection and wear protection, also better low temperature performance over the life of the oil compared to previous categories.

The engine oil operation temperature difference from one grade to another, the temperature range for each grade iscleared in figure (2).

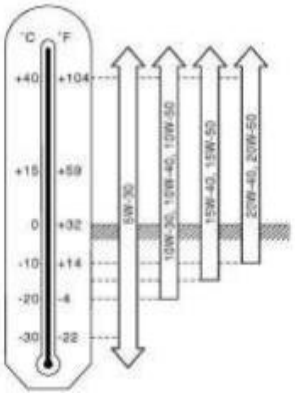

Fig 2 Engine oil grades with their temperature.

1.2 ESCALATION TECHNIQUES

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Optimization is an act, process, or methodology of constructing something as fully perfect, practical, or effective as possible, notably within the mathematical methods as finding the most or less of functionality. The polynomial equation basically consists of constants a[i] and variables x^i, the polynomial function f(x) for n terms (1<i<n):

$$f(x) = \sum_{i=0}^{n} k_i x^i \dots\dots\dots\dots (1)$$

$$f(x) = k_0 + k_1 x + k_2 x^2 + k_3 x^3 + \cdots + k_n x^n \dots\dots\dots\dots (2)$$

$$f_{min,max} = f(x_{min}, x_{max}) \dots\dots\dots\dots (3)$$

The critical points for polynomial of one variable are:

$$\frac{\partial f}{\partial x} = 0, \frac{\partial (k_0 + k_1 x + k_2 x^2 + k_3 x^3 + \cdots + k_n x^n)}{\partial x} = 0 \dots\dots\dots\dots (4)$$

II. LITERATURE REVIEW

Engine oil fundamental parameter is viscidity, there are numerous methods for measuring engine oil viscosity, and these techniques are classified into static and dynamic tests. within the static test, the viscidity is measured supported the oil conditions as an example oil temperature but in dynamic technique, the apparatus can apply load and torque on sample to simulate different operation conditions. [6] they used the dynamic testing method to live the viscidity of different types of engine oil, the tested oils are utilized in four-stroke motorcycle engine, the tested oils are 10W-40 standard type, semi-synthetic type, and artificial type, the temperature range during the experiment from -5°C to 115°C, the experiment results are accustomed create a mathematical formula for every sort of oil.

The effect of amalgamating new and old engine oils is presented [7], the study shows the repercussions of adding old oil to new oil and adding new oil to old oil, during this study blends of the new and therefore the used engine oil are created, the temperature scale of -10°C to +60 °C during the analysis, the repercussions shows engine oil viscidity with temperature for various mixing percentages In their study [8] .they focused on a comparison of 4 methods of recycling the used lubrication oils, the knowing techniques are acid/clay treatment, distillation/clay, acid treatment, and activated charcoal/clay treatment method, the tests are done on recycled oil supported the most oil parameters, the tested parameters are flashpoint, pour point, relative density, metal contents, viscidity, and Sulphur contents, the study results showed that viscidity ameliorate from 25.5 for utilized lube oil to 86.2 for distillation, 89.10 for acid/clay treatment and 80.5 is for activated/clay treatment. this is often compared with 92.8 cs for fresh lube oil.

For oil recycling of waste engine oils [9] by carboxylic acid treatment, the treatment oil engine oil process was developed for automotive engines applications, the method happen at temperature after treatment process two layers were separated from oil, the primary layer may be a transparent redness colure oil and also the second layer could be a black dark sludge at the underside of the container. The results showed the treated engine oil viscidity compared with new oil from the identical grade.

Turbo -mechanical differentia of technical systems are surveilled using special techniques [10], the various physical, chemical and tri biological methods are employed in wear monitoring and diagnosis, they used tri biological tests that are a part of the oil scrutiny and to ingress the condition of the system, the study repercussions rely upon the tribological differentia of engine oil (Mercedes O 345, PUCH 300GD and PINZGAUER 710M), also tribological differentia replace of oil for engine and equipment transmission lubrication are presented supported the experimental results.

III. ENGINE OIL PROTOTYPE

The analysis is done in former paper [11] for old and new engine oils, the alternative oils are 5W-30, 10W-40, and 20W-50. The oil samples are taken from a cars workshop in Kuwait, the test is done in the college of technological studies in COEP (College of engineering and petroleum). Old engine oils are selected after 5000km and 10000km travelling period. Table (2) shows new and old engine oil specifications.

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Table (2): The selected engine oil specifications[11].

New Engine Oil	Old Engine Oil
5W-30	5W-30 (5000km)
10W-40	10W-40 (10000km)
20W-50	20W-50 (10000km)

The old oil and new engine oil viscidity are mathematically counterfeit in sixth order polynomial using Excel software, the mathematical equation is in the form:

$$\mu = ao + a_1T + a_2T^2 + a_3T^3 + a_4T^4 + a_5T^5 + a_6T^6$$

Table (3): The sixth order polynomial coefficients [11].

Engine oil	a_0	a_1	a_2	a_3	a_4	a_5	a_6
10W-40 (New)	231.74	3.9958	-0.7215	0.0228	-0.0003	$2x10^{-6}$	$-7x10^{-9}$
10W-40 (Old)	612.13	-40.954	1.3408	-0.0252	0.0003	$-2x10^{-6}$	$4x10^{-9}$
20W-50 (New)	1740.60	-112.42	3.3932	-0.0583	0.0006	$-3x10^{-6}$	$7x10^{-9}$
20W-50 (Old)	1237.7	-74.135	2.0887	-0.0338	0.0003	$-2x10^{-5}$	$4x10^{-9}$
5W-30 (New)	366.91	-18.794	0.4541	-0.0061	$5x10^{-5}$	$-2x10^{-7}$	$2x10^{-10}$
5W-30 (Old)	293.07	-12.497	0.2078	-0.0007	$-2x10^{-5}$	$3x10^{-7}$	$-1x10^{-9}$

IV.ESCALATION RESULTS

The escalation technique shows the minimum viscidity of engine oil and minimum temperature, the technique is solicited for new and used engine oils. MATLAB software shows a detailed plot of oil viscidity with temperature also shows the less numerical values of engine oil viscidity and temperature. Less values of viscidity and temperature of new engine oil 10W-40 are 104.4215mPa.sec and 39.2736oC, figure (3) shows viscidity curve with temperature for fresh engine oil 10W-40.

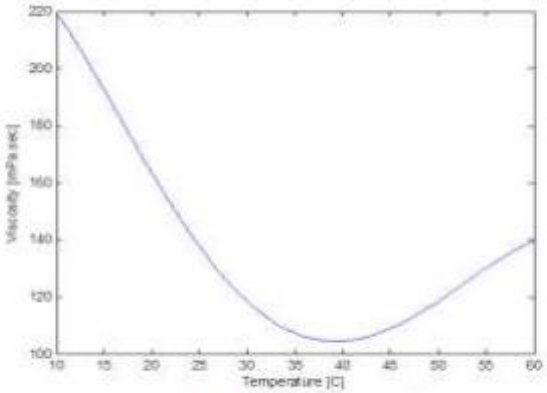

Figure (3): Viscosity of Engine oil 10W-40 vs. temperature.

For fresh engine oil 5W-30 the less values of viscidity and temperature are 66.8957 mPa.sec and40.9076oC, figure (4) shows viscidity curve with temperature for fresh engine oil 5W-30.

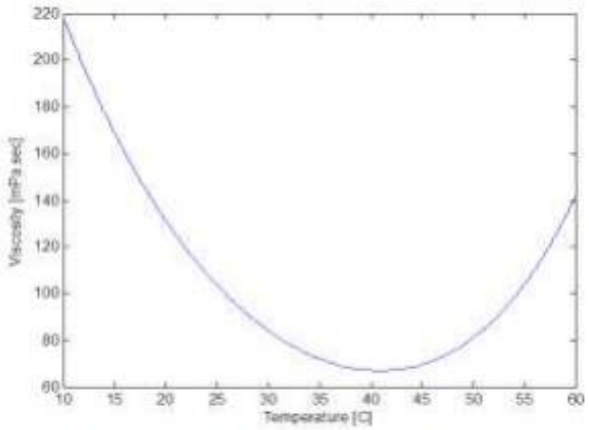

Figure (4): Viscosity of Engine oil 5W-30 vs. temperature.

For fresh engine oil 20W-50 the less values of viscidity and temperature are 198.3505 mPa.sec and 41.2930oC, figure (5) shows viscidity curve with temperature for fresh engine oil 20W-50.

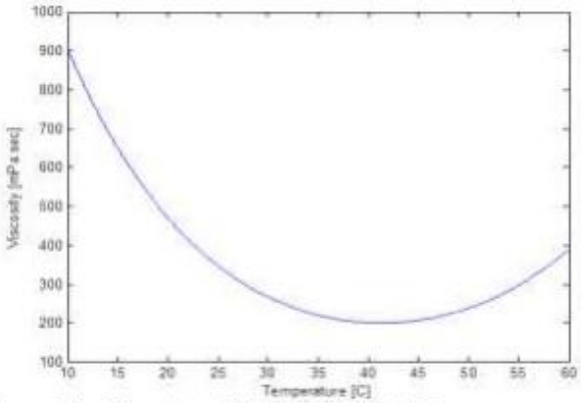

Figure (5): Viscosity of Engine oil 20W-50 vs. temperature.

CONCLUSION

Engine oil is produced from petrochemicals with distinctive variations of grades, the mass important stating of engine oil detailed list is viscidity, and mathematical models of different grades engine oil (10W-40, 5W30, and 20W-50) are used based on former paper. The escalation technique is used to show the less value of viscidity of engine oil also the temperature of less viscidity is found. As shown in the study results the temperature of less viscidity for all engine oil grades (10W-40, 5W-30, and 20W-50) is approximately around 40oC.

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