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CAUSES OF CHANGES IN THE VISCOSITY PARAMETERS OF MOTOR OILS DURING OPERATION

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Annotation
The purpose of this work is to study the causes of changes in the viscosity parameters of lubricants and their effect on engine operation. The less the viscosity changes with temperature changes, the better the starting qualities of the engine. The coefficient of friction depends on the viscosity, and consequently, the reliability and efficiency of the machine, aggregates and friction units. The oil viscosity may increase and decrease during engine operation. To improve the viscosity-temperature characteristics, viscous additives are used. They increase the fluidity of oils at low temperatures and stabilize the viscosity at high temperatures.

Keywords: engine oils, viscosity, temperature, wear of parts, starting qualities, engine, hydrocarbons.

The purpose of this work is to study the causes of changes in the viscosity parameters of lubricants and their effect on engine operation. The less the viscosity changes with temperature changes, the better the starting qualities of the engine. The wrong choice of oil viscosity significantly affects the wear rate.

Viscosity is the most important performance characteristic of oils. It is directly related to the boiling point of a given oil fraction, its average molecular weight, and the group chemical composition and structure of hydrocarbons.

The coefficient of friction depends on the viscosity, and consequently, the reliability and efficiency of the machine, aggregates and friction units. The oil viscosity may increase and decrease during engine operation. The viscosity increases as a result of evaporation of light fractions and accumulation of incomplete combustion products in the oil in the form of soot and oxidation of hydrocarbons. Also, an increase in the viscosity of ordinary, non-condensed mineral oil occurs during normal operation of the engine, when products of oxidation, polymerization, wear and combustion accumulate in it.

The viscosity of high-melting paraffin hydrocarbons with 20-25 carbon atoms in the molecule is extremely low (10-12 cst at 38^{o}C), so their addition to the oil significantly reduces its viscosity. When paraffin hydrocarbons are removed from the oil, its viscosity increases accordingly. The difference in the structure of normal and isoparaffin hydrocarbons has relatively little effect on the viscosity. When the chain branches, the viscosity of paraffin hydrocarbons increases slightly at moderate temperatures (38-50^{o}C) and decreases at a higher temperature (100^{o}C).

The oxidation products of hydrocarbons (resins, organic acids) present in the oil in the dissolved state contribute to an increase in viscosity and acid number, and asphaltene compounds, which are the basis for the formation of lacquers and particularly dangerous sticky sediments, contribute to the occurrence and burning of piston rings. The products of deep oxidative polymerization, which differ in high temperature zones and flow back into the crankcase, as well as other precipitated deposits, continue to have a negative effect on the oil.

At the same time, the intensity of the viscosity increase depends on the temperature in the oxidation zones, the quality of the fuel, the perfection of the fuel combustion process, the efficiency of oil filtration and the ingress of coolant into it. A significant increase in the viscosity of the oil is not desirable, since at the same time its flow to the friction pairs decreases, filtration efficiency decreases and the starting properties of the engine deteriorate.

In case of incomplete combustion of fuel or due to its leaks from the power system, it can get into the oil. As a result, the viscosity of the oil will noticeably decrease, its oxidation will occur faster, the lubricity will deteriorate, deposits will increase and the mode of liquid friction will be disrupted. With a low oil viscosity and an increase in the load in the friction unit, the oil film may collapse, which will lead to an increase in wear of parts. The viscosity of the oil decreases as a result of the ingress of fuel into it, which destroys the polymer additive. The use of low viscosity oil leads to increased friction (the oil film is squeezed out of the friction zone), heating and increased wear of parts (there is direct contact between the rubbing surfaces).

As the temperature changes, the viscosity of the oil changes significantly. So, when the temperature changes by 100°C, the viscosity of the oil can change 250 times. Also, with increasing pressure, the viscosity of the oil increases. The pressure values in the oil film enclosed between the rubbing surfaces can be significantly higher than the loads themselves on these surfaces. So, in the oil film of the main bearing of the engine crankshaft, the pressure value reaches up to 500 MPa. With increasing pressure, the viscosity of more liquid oils increases to a lesser extent than more viscous oils. At a pressure of (1,5-2,0)× 103MPa, the mineral oil will harden.

The dependence of oil viscosity on pressure is determined by the equation:

$$\mathbf{v_p = v_o\,(1+kP),}$$

$\mathbf{v_p}$, $\mathbf{v_o}$– accordingly, the viscosity at a pressure of 0,4 MPa and P, mm^2/s;

k– coefficient for mineral oils, **k** = 0,025.

To improve the viscosity-temperature characteristics, viscous additives are used. These additives are also called viscosity modifiers. They increase the fluidity of oils at low temperatures and stabilize the viscosity at high temperatures. Viscous, or thickening, additives increase the viscosity and improve the viscosity-temperature properties of lubricants. Various polymers with high viscosity are used as such additives. Thickening polymers are produced in the form of solutions in standard base oil and are marketed as concentrates in accordance with their thickening effect. Viscosity modifiers increase oil fluidity at low temperature and stabilize viscosity at high temperature. Polyisobutylene, polymethacrylates, copolymers of ethylene, propylene, butylene polyvinyl butyl ether, etc. are used as viscosity modifiers.

Table 1. Characteristics of domestic viscous polymer additives

Indicators	Polyisobutylene			Polymethacry-late
	КП-20	КП-10	КП-5	
Molecular weight	16000-22000	9000-12000	4000-6000	9000-15000
Viscosity, cSt at: 100°C 40°C	 350-500 -	 280-400 -	 700 -	 - 600-1700
Flash point in an open crucible ,°C	165	165	150	165
The content of mechanical impurities , %	0,08	0,08	0,3	0,1
Ash content , %	0,08	0,08	0,3	-
Polyisobutylene content %	25	40	50	-

The concentration of additives is in the range of 1-20%. Their action is based on the suppression of gelation at low temperature as a result of crystallization of paraffin. At low temperature, when the oil is viscous, the paraffin molecules are in a "twisted" form and have little effect on viscosity. With an increase in temperature, they "unwind" and increase the viscosity of the liquid (Fig. 1).

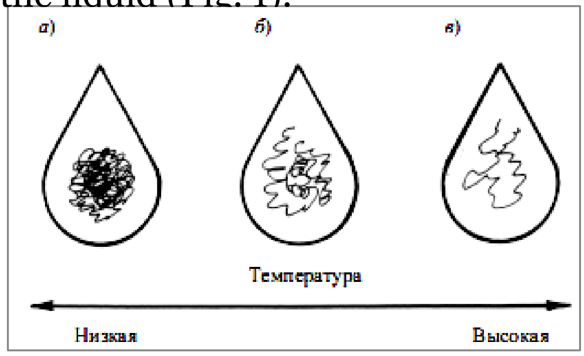

Fig. 1. Polymer molecules of the viscosity modifier in cold (a), intermediate (b) and heated (c) oil

The wrong choice of oil viscosity significantly affects the wear rate.Thus, the dependence of oil viscosity on temperature is suppressed and the viscosity index increases. Thermal effects on the oil lead to the formation of oxidation products, such as organic acids and resins in a dissolved state. They cause an increase in the viscosity and acid number of oils, thereby increasing its corrosion activity.

References

1. Dzherikhov V. B. Automotive operational materials: textbook. St. Petersburg: SPGASU, 2009.
2. Magerramov A.M., Akhmedova R.A., Akhmedova N.F. Petrochemistry and Oil Refining: A Textbook for Higher Educational Institutions. - Baku: Baki Universiteti, 2009.
3. Ostrikov V.V. O. A. Kleimenov, V. M. Bautin. Lubricants and their quality control in the agro-industrial complex - M.: Rosinformatekh, 2008, 172 p.
4. Alimova Z. Research of change of quality of motor oils when operating the engine and improving their. Industrial Technology and Engineering. 2020, 3 (36): p.11-17.
5. Alimova Z. and oth. Improvement of properties of oils used in hydraulic systems of road-construction equipment/ IOP Conference Series: Materials Science and Engineering №3 (2020) 883-012167.
7. Alimova Z. Ways to improve the properties of lubricants used in vehicles - T.: “VNESHINVESTROM”, – 2020.

8. Alimova Z. The Influence of the Process Off Oxidation of Engine Oils on Engine Performance and Improving Antioxidant Properties //Acta of Turin Polytechnic University in Tashkent. – 2018. – Т. 8. – №. 1. – С. 17.
9. Alimova, Z., Kholikova N., & Xolova S. (2020). Ways to improve the performance of hydraulic oils for agricultural machinery Research Archive (30).
10. Khamidullaevna, A. Z., & Parpiyevna, N. G. (2022). Ways to Improve the Operational Properties of Hydraulic Oils for Agricultural Machinery. Texas Journal of Engineering and Technology, 8, 20-22.
11. Khamidullaevna, A. Z. (2022). Studies of anticorrosive properties motor oils and ways to improve. European International Journal of Multidisciplinary Research and Management Studies, 2(06), 6-12.
12. Xamidullayevna, A. Z., & Parpiyevna, N. G. (2022). Research of the mechanism of action of the protective properties of inhibited compositions. The American Journal of Engineering and Technology, 4(02), 19-22.
13. Xamidullayevna, A. Z., & Ahmatjanovich, M. M. I. (2021). Study of Anti-Corrosion Properties of Lubricants and Ways to Improve them. Design Engineering, 3811-3819.
14. Khamidullayeva, A. Z., & Narinbaevna, I. M. (2021). Improving the Lubricating Properties of Gear Oils Used in Agricultural Machinery by Adding Additives. Design Engineering, 4197-4204.
15. Khamidullaevna, A. Z., & Akhmatjanovich, M. M. I. (2021). Environmental Safety in use Flammable Lubricants. Middle European Scientific Bulletin, 19, 83-85.
16. Alimova, Z. K., Makhamajanov, M., Akhmatjanovich, I., & Magdiev, K. I. (2021). Research Of Anti-Corrosion Properties Of Engine Oils When The Engine Is Running. The American Journal of Agriculture and Biomedical Engineering, 3(11), 28-33.