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The Mechanism of Lubricants Protective Layers Formation in Friction Sliding

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Abstract

The article presents the results of a study of the temperature degradation of motor oils of various basic framework and lubricity when the load changes, which have established a process flow thermal degradation of engine oils, comprising the sequential formation of primary and secondary degradation products, different optical density, and the impact of these products on the processes forming a boundary lubricant layer. The dependences of the wear parameters of temperature and temperature control loads on the basis of which identified education adsorption, chemisorption and modified layers. There are three characteristic temperature range of the parameter-dependent wear degradation products thermostatically controlled oil and load.

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Keywords: motor oil; thermal degradation; the absorption coefficient of the light flux; wea; lubricant boundary layer.

Impact of oil on the durability and reliability of the machine parts is determined by their ability to protect the friction surfaces against wear, to provide the necessary friction characteristics. Therefore, consider the impact of oil on the durability and reliability of machine parts - it means to discuss issues of their lubricating effect and influence on friction and wear in the lubricated surfaces of concrete machinery parts. The friction in the boundary lubrication conditions always leads to wear of the rubbing bodies, and the wear mechanism is determined by the nature of the boundary layer, and the latter is determined by the nature of the lubricant and the material contacting bodies and the conditions of the formation of boundary layers [1]. The theory of boundary lubrication was developed by U.B. Hardy, V.G. Deryagin, A.S. Akhmatova, F.F. Bowden, D. Tabor, G.V. Vinogradov, R.M. Matveevski et al. [2-6].

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Conventional theory of friction are adhesively-deformation theory Bowden-Tabor [6] and the kinetic theory of friction, proposed I.V. Kragelsky [7]. At the heart of these theories is the concept of convergence of two rough surfaces upon contact. Even at very low load, due to the discrete nature of contact, pressure is very high roughness. As a result of deformation of the contacting materials begin to approach the contact surface, resulting in an increasing number of contact asperities. This process continues until the area of contact will not be enough to carry the load.

The aim of this work is to establish the connection between the processes of thermal degradation occurring in the volume of motor oils of various core framework when thermostating and wear processes.

The test is subjected to: commodity motor oil based on mineral M-8G2k, but partial-synthetic TNK Super 5W-40 SL/CF and synthetic ESSO Ultron 5W-40 SL/CF. These oils thermostatted in a special apparatus for 8 h in a temperature range from 140 to 300 °C with increasing temperature at 10 °C at atmospheric pressure. Each temperare-tested a new oil sample. After every 8 hours of testing with thermostat-foot oil sample photometrically at thicknesses photo-metric layer 8 and 2 mm in order to determine the absorption coefficient of the light flux K_a [8] and tested on three ball friction machine with friction scheme "ball-cylinder" with the following parameters: the load 13, 23 and 33 H, the sliding speed of 0.68 m/s, the oil temperature of 80 °C, 2 h testing time. Antiwear properties were appreciating-on arithmetic mean wear scar diameter on the three balls.

In contrast to the methods for determining the thermal stability of the developed R.M. Matveevski [9] in this study when tested engine oils are preincubated in the temperature range from 140 to 300 °C and then held tribological tests.

In the study of optical properties depending on temperature thermostat motor oils of various core framework (Fig. 1) are installed the temperature field of education of primary and secondary degradation products. For the mineral oil temperature range of formation of primary thermal decomposition products ranges from 160 to 240 °C, but partial-synthetic from 160 to 210 °C, and synthetic from 170 to 220 °C. The transition from primary education to secondary degradation products is characterized by a critical temperature T_{cr} and is mineral oil of 240 °C, partly synthetic - 210 °C, synthetic - 220 °C.

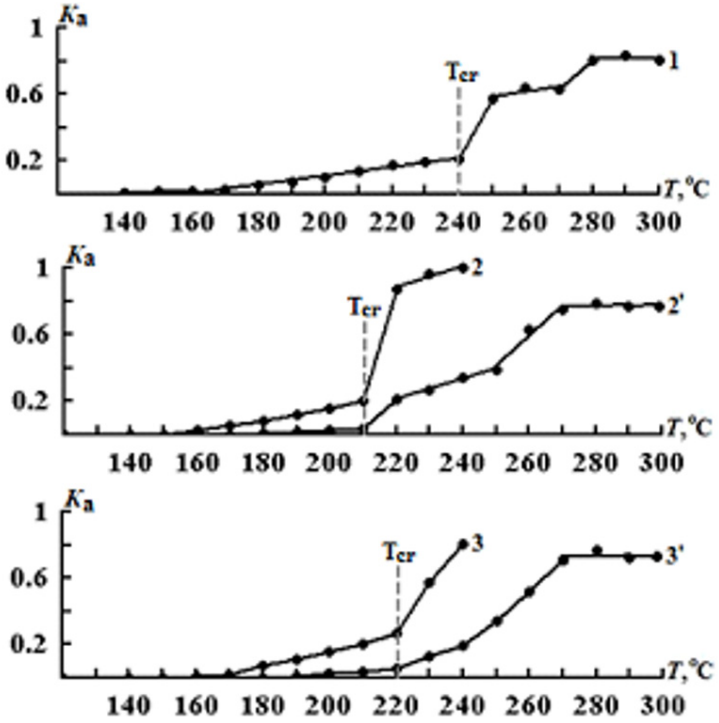

Fig. 1 - Dependence of the absorption coefficient of the light flux on the temperature thermostatic motor oils: a - M-8G2k; b - TNK Super 5W-40 SL/CF; c - ESSO Ultron 5W-40 SL/CF (1, 2, 3 - layer thickness of the photometric 8mm, 2 'and 3' - 2 mm)