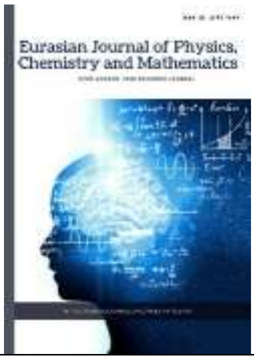


# Study of the Work of the Boundary Layers of Lubricants Materials


**Alimova Zebo Khamidullaevna (Ph.D., Professor)** — Tashkent State Transport University, Uzbekistan

**Niyazova Gulhayo Parpiena (Senior Teacher)** — Tashkent State Transport University, Uzbekistan

**Sabirova Diloram Kabulovna (Ph.D. Associate Professor)** — Tashkent State Transport University, Uzbekistan



ABSTRACT

The article analyzes and studies the work of the boundary layers of lubricants in the process of operation. The performance of the boundary layer of oil is determined by the interaction of the molecular film of the oil with the rubbing surface of the metal. In the process of work, the composition of lubricants becomes more complicated due to the oxidation of thermochemical decomposition of hydrocarbons and additives. These products enter into physical and chemical interactions with each other and with contaminants coming from outside. Lubricants containing surfactants have the ability to adsorb on the interface surfaces of two media: liquid and solid.



**Keywords:** Lubricants, viscosity, temperature, engine, hydrocarbons, strength of the boundary layer, layer thickness, molecular film, surfactants, adsorption, chemosorption


The main purpose of the lubrication system is the timely supply of clean and, if necessary, cooled engine oil to the rubbing parts to reduce friction. Under pressure, oil enters almost all of the engine's plain bearings.

The thickness and strength of the boundary layer of oil during friction of the working surfaces of engine parts depends on the chemical composition of the oil and its additives.

The performance of the boundary layer of oil depends on its viscosity and is determined by the interaction of the molecular film of the oil with the rubbing surface of the metal. The resulting molecular films of oil of physical origin are called adsorption, and films of chemical origin are called chemosorption.

Sorption phenomena play an important role in many industrial processes. Sorption (at the liquid-gas, liquid-liquid, or solid-solid boundary) is the most important factor determining the properties of systems with a large specific surface area. –

There is a relationship between the amount of adsorption and surface tension at constant temperature and pressure

$$D = -\left(\right) \frac{a}{RT} \frac{dy}{da}$$

*gde:*

*G – surface concentration;*

*a – activity of the solute;*

*dy – change in surface tension;*

*R – universal gas constant;*

*T is the absolute temperature.*

Ifthe increase in the concentration of the solute leads to a decrease in surface tension, the solute accumulates on the interface surface (positive adsorption). Conversely, if the surface tension increases with increasing solute concentration, the solute is removed from the interface surface (negative adsorption).

Chemosorbed films are stable chemical films of phosphates, chlorides or sulfides. They are created on the surface of the metal due to the presence of appropriate chemical elements in lubricants. The high rate of formation of these films ensures their rapid recovery in places of destruction of the boundary layer. Films of this type also include various soaps, which are formed from organic acids contained in the oil.

Adsorbed and chemosorbed films, possessing strength and resistance, protect friction surfaces from mechanical and thermal influences, and also prevent mutual adhesion of rubbing surfaces.

When operating a car under the influence of various factors, the oil loses its original properties. Contaminants (their share reaches 0.08-0.23%), falling into the dvigatel together with fresh oil, accumulate in the oil during its transportation, storage and directly when filling the lubrication system.

The formation of lubricating films by adsorption forces is due to the presence in lubricants of surfactants that carry an electric charge. Such substances include compounds containing carboxyl groups, alcohols, various esters, resins, sulfur compounds.

Along with the purely physical process of adsorption during the formation of a boundary film, in some cases chemical reactions also occur (the process of chemosorption). During adsorption, heat is released as a result of a decrease in the surface energy of solid molecules and adsorbed molecules. The amount of heat releasedis proportional to the thermal field stress of a solid surface.

The products of the chemical reaction provide the adsorbedlayer with increased strength. During chemical interaction, protection against wear occurs due to the formation ofa chemical film on the surface of metal la (Fig. 1).

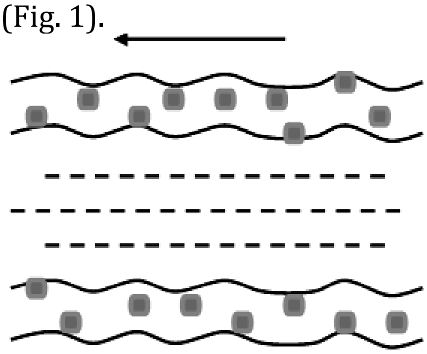

**Fig.1. Scheme of the boundary layer of lubricant**

This film has a sufficiently high mechanical strength, does not melt at a temperature lower than the melting point of the base metal.

Lubricants containing surfactants have the ability to adsorb on the interface surfaces of two media: liquid and solid. The ability of lubricants containing surfactants to form sufficiently strong layers of oriented molecules on lubricated surfaces is called oiliness or lubricity of oils.

Ifthere is a bound or adsorbed film of water on the surface of the metal, then low-polar media, which include petroleum products, will poorly wet the metal surface.

The introduction of overexpositive substances into hydrocarbon media should thus, first of all, increase the wettability of metals in the oil product management system and create conditions for inhibitors (or protective additives) to exhibit the main functional property. –

When the lubricating layer completely separates the working surfaces that move relative to each other, and this layer has a thickness at which the normal bulk properties of the oil appear, then such friction is called liquid. The coefficient of liquid friction is in the range of 0.0030.03, which is 50100 times less than with friction without lubrication. The frictional force in this type of lubricant depends only on the inner layers in the lubricant.––

The wetting ability of surfactants can be manifested by the formation of strong hydrogen bonds –andover-active substances with water and the displacement of water from the surface of the metal.

In the process of aging of oil, changes in the concentration, structure and effectiveness of additives are observed. This occurs as a result of decomposition, interaction with the products of fuel combustion and oxidation of oil, filter elements and car parts.

The elevated temperature and oxygen of the air with which the oil comes into contact cause oxidation and oxidative polymerization of its molecules. Hydrocarbon oxidation products such as resins, organic acids present in the oil in the dissolved state contribute to an increase in viscosity and acid number, and asphaltene compounds that cause the formation of varnish deposits, the occurrence and burning of piston rings.

A fine stable mechanical mixture of oxidation products leads to the formation of carbon and sludge. Products of deep oxidative polymerization, which differ in high temperature zones and enter the crankcase, as well as other fallen sediments, continue to have a negative effect on the oil.

Thus, in the crankcase of a running engine, a complex mixture of the original oil with a wide variety of products of its aging is formed, from which it is not possible to completely clean the oil by filtration.

## Literature


1. Smirnov A. V. Automotive Operational Materials: Ucheb. posobie / NovSU named after Yaroslav the Wise. – Veliky Novgorod, 2004. – 348 p.
2. Kirichenko N.B. Automobile operational materials: Uchebnoe posobie.–M.: Izdatel'skii tsentr «Akademiya» 2012.-208str.
3. Dzherikhov V.B. Automobile operational materials: ucheb. allowance. state architect.-builds. un-t. – SPb., 2009. – 256 p.
4. Alimova, Z. Kh., Sidikov, F. Sh., & Usmanov, I. I. (2021). Improving the stability of lubricants against oxidation. *Science and Education Today*, (2 (61)), 23-25.
5. Alimova, Z. Kh., Sidikov, F. Sh., & Alimov, Sh. I. (2020). Reducing wear of engine parts by improving the antioxidant properties of motor oils.
6. Alimova, Z., Holikova, N., & Kholova, S. (2020). Ways to improve the performance properties of hydraulic oils for agricultural machinery. *Archive of Scientific Research*, (30).
7. Alimova, Z. (2020). Ways to improve the properties of lubricants used in vehicles. *Monograph, Vneshinvestprom*.
8. Alimova, Z., Niyazova, G., & Sabirova, D. (2022). Investigation of the operation of engine oil additives during engine operation. *Academic Research in Modern Science*, *1*(18), 269-275.
9. Alimova, Z., Makhamajanov, M. I., & Magdiev, K. (2022). The effect of changes in the viscosity parameters of engine oils on the operation of engine parts. *Eurasian Journal of Academic Research*, *2*(10), 151-154.
10. Zebo, A., & Bakhtiyor, S. (2022). Oxidation of motor oils during operation engines in military equipment. *Web of Scientist: International Scientific Research Journal*, *3*(8), 97-103.
11. Kh, A. Z. (2022). Improving the Anticorrosive Properties of Motor Oils by Adding Additives. *Texas Journal of Engineering and Technology*, *8*,16-19.
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.