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OPTIMIZATION OF MOTOR OIL FORMULATIONS FOR HIGH-
TEMPERATURE APPLICATIONS

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Annotation: *In high-temperature operating zones, engine oil may either undergo complete combustion or form carbonaceous residues that tend to accumulate on metal surfaces. Varnish and deposit formation pose a particular risk to piston rings, as the accumulation of carbonaceous materials within the ring grooves reduces ring mobility and impairs sealing performance. To minimize or prevent deposit formation, engine oils are formulated with surface-active compounds known as detergent–dispersant additives. These additives function by loosening and removing deposits from component surfaces, dispersing insoluble particles into stable suspensions, and preventing their agglomeration, thereby maintaining engine cleanliness and operational efficiency.*

Keywords: *engine oils, additives, oxidation, sedimentation, varnish deposits, carbonaceous particles.*

In high-temperature regions of an internal combustion engine, lubricating oil components undergo thermo-oxidative degradation, leading to the formation of low-volatility, highly viscous, and poorly oil-soluble oxidation products such as oxyacids, asphaltenes, and acidic resins. These substances accumulate on metal surfaces as thin, glossy films commonly referred to as varnish deposits.

At the initial stages of oxidation, resinous compounds and organic acids remain soluble in the oil medium. However, as the degradation process progresses, they transform into insoluble high-molecular-weight products that precipitate on engine components. Resinous deposits formed on pistons and piston rings restrict ring mobility and impair sealing performance. In addition, acidic oxidation products promote corrosive wear of cylinder walls and piston assemblies.

Varnish deposits are particularly hazardous in piston ring grooves, where their accumulation reduces ring movement, causes ring sticking, and leads to localized overheating. As a consequence, blow-by of combustion gases into the crankcase increases, cylinder compression decreases, and overall engine efficiency and durability are compromised.

Given the significant impact of thermo-oxidative degradation on engine reliability, improving the high-temperature stability and detergency of motor oils remains a critical research objective.

The aim of this study is to investigate the mechanisms of deposit formation in high-temperature zones of the engine and to evaluate the effectiveness of detergent–dispersant additives in preventing varnish formation and enhancing the thermal stability of motor oils.

The accumulation of carbonaceous deposits on the cylinder walls, pistons, rings, valves, etc., occurs not only due to oxidation products, but also as a result of purely thermal transformations of polycyclic hydrocarbons. At the same time, engine oil consumption increases significantly, wear increases, even bulging on cylinder mirrors and piston rings breakage with piston jamming are possible.

The presence of precipitation in the engine is a great danger. They can clog oil ducts, oil pipelines and filters. If the oil pump receiver and oil lines are clogged with sediments, then the normal oil supply will be disrupted. As a result, melting of bearing liners, bulging of crankshaft necks and even engine failure may occur. If the oil filter is clogged with sediments, then uncleaned contaminated oil enters the rubbing parts, as a result of which the wear of parts increases sharply, there is a danger of burning piston rings, etc.

If there is precipitation in the engine, the quality of freshly poured oil deteriorates sharply. In addition, sediments can condense and harden over time so that it is difficult to clean parts from them even by mechanical means.

A very significant factor affecting the appearance of precipitation is the mode of operation of the engine. Working on light modes is the most dangerous. Since this creates the most favorable conditions for sedimentation. The operation of the vehicle in low-speed modes, with insignificant loads, frequent and prolonged stops, prolonged engine idling leads to lower operating temperatures in the engine, more severe contamination of the crankcase oil by products of incomplete combustion of fuel, oil liquefaction by fuel.

When idling for a long time, in order to reduce precipitation, it is recommended to maintain the coolant temperature at about 70 ° C.

Sediments in the engine are sticky oily substances from gray-brown to black, deposited during operation in the engine, crankcase, valve box, oil system and filters. Basically, it is an emulsion of water in oil contaminated with various impurities. The ingress of water into the crankcase oil is the main cause of precipitation. The composition of precipitation is variable and largely depends on the conditions under which it is formed.

Oils with special additives are less prone to precipitation than pure oils, since additives make it possible to better retain insoluble impurities and better resist oxidation.

One of the measures to combat varnish formation is the introduction of antioxidant and detergent additives into the oils, which inhibit the deposition of the resulting resinous-asphaltene substances and reduce the formation of varnish deposits and carbon deposits on hot surfaces of engine parts. To reduce or prevent the formation of carbon deposits, special surfactants called detergent-dispersing additives are introduced into engine oils. The alkali contained in detergents neutralizes the acids formed during the combustion of fuel.

Currently, work is underway to create motor oils with ash-free dispersing additives. An example of such additives are succinimide products, which differ in the number of amino groups, length and branching of aliphatic chains. Succinimides not only do not form abrasive particles, but also exceed many ash additives in terms of the dispersing effect.

Alkylphenolic compounds are more common as antioxidant compounds, the most effective of which are ionic, amine-type compounds and containing sulfur, nitrogen, and phosphorus compounds. Alkylsalicylate washing compound holds solid particles in the oil in the form of a tiny suspension and prevents them from sticking to metals. Also, when such

compositions are added, the deposition of varnish and sediment on the surface of engine parts and oil pipelines decreases.

Antioxidant compounds delay the beginning of the oil oxidation process, extend the working cycle, destroy the hydroxides formed during oxidation, and, as a result, interrupt the chain reaction by acting on the oxidation products of hydrocarbons, forming new substances, these substances have antioxidant properties, stop the oxidation process.

The sulfide compound or phenol derivative prevents the oxidation of the oil film on hot metal surfaces. SB-3 compounds with detergent properties are effective. The effect of such additives is based on their ability to loosen, wash off deposits from the surface of parts and transfer insoluble substances into suspension and keep these particles in this state without enlargement.

Thus, 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. To improve the ability of motor oils to high temperatures, special surfactants are introduced. The alkali contained in detergents neutralizes the acids formed during the combustion of fuel.

LITERATURE:

1. Dzherikhov V.B. Automotive operational materials: textbook. St.Petersburg: SPGASU, 2009
2. Alimova Z. K., Makhamadjanov, M.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.
3. Alimova, Z., Makhamadjanov, 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.
4. 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.
5. Alimova Zebo Xamidullayevna, & Niyazova Gulhayo Parpiyevna. (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.
6. Alimova, Z. (2018). The influence of the process off oxidation of engine oils on engine performance and improving antioxidant properties. Acta of Turin Polytechnic University in Tashkent, 8(1), 17.
7. 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.
8. Alimova, Z., Abdukhalilov, H., Kholmirezayev, B., & Samatayev, T. (2020). Ways to improve the performance of hydraulic oils for agricultural machinery. Industrial Technology and Engineering, 3(36), 17-22.

9. Khamidullaevna, A. Z., & Faxriddin, S. (2022). The aging process of motor oils during operation. *European International Journal of Multidisciplinary Research and Management Studies*, 2(06), 166-169.

10. Khamidullaevna, A. Z. (2022). Causes of changes in the viscosity parameters of motor oils during operation. *Web of Scientist: International Scientific Research Journal*, 3(10), 156-160.

11. Alimova Zebo Hamidullayevna, & Ibrahimov Karimjon Ismailovich. (2023). Causes of changes in the properties of motor oils in the high temperature zone of the engine. *American Journal of Applied Science and Technology*, 3(01), 1-5. <https://doi.org/10.37547/ajast/Volume03Issue01-01>