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INVESTIGATION OF THE INFLUENCE OF OPERATIONAL PROPERTIES ENGINE OILS FOR WEAR OF ENGINE PARTS

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Abstract: *This article examines the changes in oil quality during engine operation. The main reason leading to the formation of high-temperature deposits in engines are oxidative processes occurring in the oil volume and on the metal surface. These deposits negatively affect the reliability, efficiency and durability of the engine. The greatest danger of varnish deposition is for piston rings. By filling the gaps formed by the piston rings and the grooves drilled in the pistons, it reduces the mobility of the rings. Therefore, we suggest introducing detergent additives into the engine oil.*

As detergent additives, we used the detergent additive alkylphenol with phosphorus pentasulfide and calcium salts (calcium alkylarylsulfonate). The effect of such additives gives the ability to loosen, wash off deposits from the surface of parts and transfer insoluble substances into suspension. Having determined the dissolution of the additive in the engine oil, we determined the physico-chemical parameters of the engine oil for different concentrations of additives.

Keywords: *oil quality, contamination, viscosity, alkaline number, varnish deposits, piston rings, experimental data, cleaning additives*

INTRODUCTION

The effectiveness and reliability of the operation of equipment for various purposes depends not only on its design and technological features, but also largely on how correctly selected lubricants and their quality.

Studies of the contamination of lubricating oils under operating conditions of equipment show that in hot climates and high dusty air motor oils are intensively contaminated by mechanical impurities, water, fuel and organic products, which leads to premature aging of the oil.

As you know, in a car engine a large number of moving and rubbing together parts. During the operation of internal combustion engines, their components and parts are contaminated with various deposits.The process of deposit formation is associated with thermo-oxidative transformations of products of incomplete combustion of fuel and oil components. These transformations occur both in the volume of oil and in its thin layer on a heated metal surface. The main reason leading to the formation of high-temperature deposits in engines are oxidative processes occurring in the volume of oil and on a metal surface. These deposits adversely affect the reliability, efficiency and durability of the engine.

MATERIALS AND METHODS

It is known that oils for internal combustion engines are operated in conditions conducive to their deep oxidation and thermal decomposition, which ultimately leads to deposits of various kinds of sediments, deposits and the formation of lacquer films on engine parts.

The oxidation of oil in a thin layer on heated engine parts occurs under two fundamentally different conditions - dynamic and static (in flow and at rest). The oxidation of oil in the flow occurs during engine operation, when there is a continuous circulation of lubricating oil and engine parts are constantly lubricated with new portions of it. The oxidation of the oil at rest occurs only when the engine stops, when the oil circulation stops, and the parts retain a sufficiently high temperature for a certain time after the engine stops. And although the oil on the heated parts is at rest for much less time than in the flow, the oxidation of oil under static conditions in some cases has a significant effect on the varnish formation in the engine.

The aim of this work is to study changes in the quality of oil during engine operation, and methods for improving the properties of motor oils are proposed. To achieve this goal, we took samples of engine oils SAE 15W-40 of buses and were analyzed by the main quality indicators.

The test results are shown in table 1.

Table 1

Test results of motor oils SAE 15W-40

Indicators	SAE 15W-40	1500 (km)	3000 (km)	4000 (km)	5000 (km)	6000 (km)	7000 (km)	8000 (km)
Viscosity at: t=100^{0}C	14,65	14,04	13,91	13,01	12,51	11,97	10,92	9,97
Viscosity index	129	126	125	124	123	122	121	120
Flash pointin an open crucible ^{0}C	220	216	210	205	195	190	180	175
Alkaline number	8,0	7,70	7,02	6,80	6,72	6,42	5,74	4,88

As follows from the table, viscosity deviations became noticeable when the bus ran 5000 km or more. The coefficient of friction depends on the viscosity, and consequently, the reliability and efficiency of the machine, aggregates and friction units. 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 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).

According to the experimental data, the alkaline number decreased from 8.0 to 4.88. Such a reduction has acceptable limits, upon reaching which the oil is considered to have lost working capacity. All this can lead to contamination of parts of internal combustion engines with various varnish deposits.

Lacquer deposits pose the greatest danger to piston rings. Filling the gaps formed by the piston rings and grooves grooved in the pistons, it reduces the mobility of the rings. It is here that high-carbon compounds form, which are deposited in the grooves in the form of films.

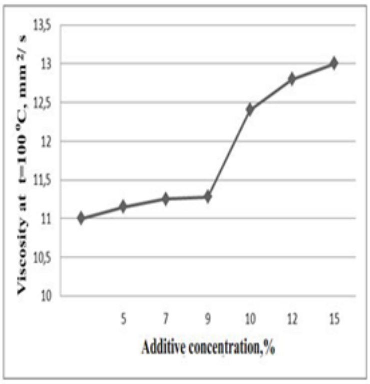
Considering the experimental data obtained by us on changes in viscosity and alkaline number, we recommend introducing detergents into engine oil. One of their main functions of these additives is the “dispersing” ability, which consists in the fact that they retain the carbonaceous particles formed in the oil in a finely dispersed state. The enlargement of carbon particles is prevented by the adsorption of additive molecules on their surface.

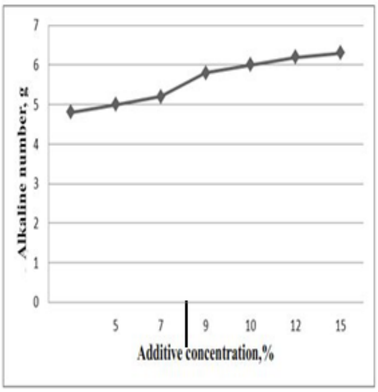
As detergent additives, we used a detergent additive containing phosphorus, sulfur and alkaline earth metal.

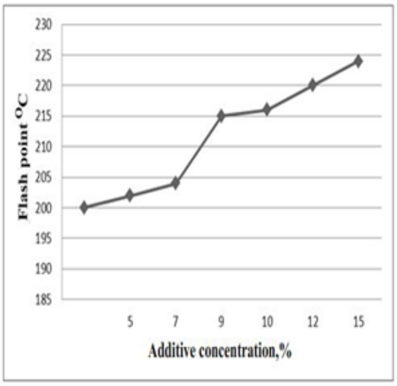
These additives are obtained by the reaction of alkylphenol with phosphorus pentasulfide and calcium salts.

These additives have the ability to improve the quality of oils. The action of such additives is based on their ability to loosen, wash away deposits from the surface of parts and transfer insoluble substances into suspension and keep these particles in this state without enlargement.

Based on this, we analyzed the motor oils SAE 15W-40 and alkylphenol with phosphorus pentasulfide and calcium salts. Having determined the dissolution of the alkylphenol with phosphorus pentasulfide and calcium salts in engine oil, we determined the physicochemical parameters of the engine oil for various concentrations of additives.







CONCLUSION

According to the results of laboratory studies of tests with the introduction of additives in the SAE 15W-40 engine oil, physico-chemical parameters gave a positive result compared to SAE 15W-40 oils. This means that using this additive will increase the life of the engine oil. From the results of the analysis, we selected the content of alkylphenol with phosphorus pentasulfide and calcium salts 9%, which shows the optimal value of viscosity and alkaline number. With a further increase in concentration, the viscosity increases significantly, which can lead to increased friction losses. With increasing viscosity, the thickness and resistance to mechanical stresses of the oil layer between the rubbing surfaces increase.

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