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INFLUENCE OF OPERATIONAL PROPERTIES OF OILS ON THE TECHNICAL CONDITION OF THE ENGINE

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A B S T R A C T

The purpose of this work is to study the effect of the operational properties of oils on the technical condition of the engine. The performance properties of oils are understood as a set of those physico-chemical and functional properties that determine the effect of oils on the main performance indicators of the car. The estimated coefficient of quality of lubricants is determined.

K E Y W O R D S

operational properties, physico-chemical properties, reliability, engine, motor properties, evaluation indicators.

Introduction

The operational properties of oils should be understood as a set of those physico-chemical and functional properties that determine the effect of oils on the main performance indicators of the car – the reliability of the engine and the cost of transport work, determined directly by operational tests of oils on a sufficient number of cars or calculation, if the dependence of these properties on the functional or physico-chemical properties of oils is known.

For a quantitative assessment of the operational properties of oils, it is possible to take the value of the reliability of the engine at a given mileage of the car or the value of the mileage until the minimum reliability value is reached. At the same time, reliability in general should be understood as dependence

$$R = 1 - \frac{T_r}{T_t} = f(V).$$

где *R – reliability varying from 0 to 1;*

T_t – the total time of operation and downtime of the engine in repair;

T_r – engine downtime in repair or maintenance;

V – vehicle mileage,km.

Reliability well characterizes the effect of oil on the technical condition of the engine, but does not sufficiently reflect the economic effect obtained from the use of this oil. In this regard, it is necessary to introduce an indicator of the economic efficiency of the use of oil

$$E = 1 - \frac{A_c}{A},$$

где A_c - the average cost of a unit of transport work during the operation of cars on this oil,

A - the average cost of a unit of transport work during the operation of cars on reference oil, under the same conditions;

E - economic efficiency « positive » (+) and « negative» (-).

The motor properties of the oil should be understood as those of its functional properties that are directly assessed by changes in the general condition or performance of the engine. Motor properties of oils are estimated by the sum of functional indicators determined by measuring the engine after motor or operational tests of oils, or by calculation, if the dependence of these indicators on the physico-chemical properties of oils is known.

The physico-chemical properties of oils should be understood as a number of indicators determined during physico-chemical analyses of oils and tests on instruments and modeling installations.

Each of the properties of oils (operational, motor and physico-chemical) is expressed by a set of corresponding functional properties, and certain functional operational properties depend on functional motor properties, and the latter on functional physico-chemical properties.

Some idea of such a relationship can be obtained from Table 1, where an attempt is made to make an appropriate grouping of the functional operational, motor and physico-chemical properties of the oil.

Table 1 **Connection of functional operational, motor and physico-chemical properties of oil**

Operational properties	**Motor properties**	**Physico-chemical properties**
Duration and ease of starting at low temperatures	Oil pumpability. Minimum speed when scrolling. Maximum torque values when scrolling	Viscosity-temperature properties. Shear resistance. Crystallization and solidification temperature.
Engine wear rate	Cylinder wear. Wear of piston rings. Wear of liners and shaft necks. Wear of gas distribution mechanism parts	Viscosity-temperature properties. Properties of an oil film under conditions of boundary friction. Anti-wear and extreme pressure properties evaluated on friction machines. Anticorrosive properties. Neutralizing effect against aggressive media. Contamination of oils with impurities and oxidation products
Deterioration of traction qualities and fuel efficiency of the car	Engine power drop. Increase in specific fuel consumption. Wear of the piston group. Wear and corrosion of valves, seats, cams, pushrods. Increased carbon deposits, causing detonation, hot-pot ignition, interruptions in the operation of candles. Deposits on injectors, wear of injectors and fuel pumps.	Anti-wear properties. Anticorrosive properties. High temperature stability and tendency to carbon and slag formation.

	Coking and tarring of intake pipes with crankcase ventilation products. Coking of purge windows.	Low-temperature stability and tendency to slag formation
Emergency engine stops requiring repair	Emergency wear of parts. Occurrence of piston rings due to coking. Hanging of pushrods and valves. Badass pistons, cylinders, cams, pushers. Emergency corrosion of bearings. Termination of oil supply due to clogging of the lubrication system with deposits. Oil release due to clogging of the crankcase ventilation system.	Anti-wear properties. High temperature antioxidant stability. Washing and dispersing properties. Extreme pressure properties. Anticorrosive properties. Low temperature stability. Oil filterability. Oil contamination by impurities and oxidation products.
Increased maintenance costs of the lubrication system	Oil fumes. Wear of the piston group. A change in the original properties of the oils, causing the need for its replacement and flushing of the system. Clogging of filters with deposits	Viscosity-temperature properties Fractional composition. Anti-wear properties Antioxidant stability. Washing and dispersing properties Oil filterability. The operability of additives. Contamination of oil with impurities

From the table.1. it follows from the test experience that certain physico-chemical properties of oils affect various functional motor and operational properties, and this influence is not always unambiguous.

In this regard, the most important task of all types of tests is to establish a correlation between complex and elementary properties, to determine the significance of certain indicators, to establish limit (optimal and defective) values for functional properties and individual indicators. Without downplaying the importance of research methods used to study changes in certain properties (indicators) of oils under the influence of certain factors, it should be clearly indicated that only those methods whose estimated indicators are correlated with the results of operational tests can be of practical importance for assessing the operational or even motor properties of oils, and their limit values are justified by a certain change in operational properties of the oil.

To bring all oil quality indicators to comparable dimensionless values, we introduce the concepts of an estimated quality coefficient, the value of which is calculated by the actual value of the indicator and the accepted limits of their change.

The estimated quality coefficient (K) for each actual value of the indicator (A) is derived based on the conditions of a ten-point scale, and the coefficient takes the best score equal to 1 point, with an optimal value (V_o) the worst, equal to 10 points, with a limit value (V_l) according to equality

$$K = 1 + 9\frac{A - V_o}{V_l - V_o}.$$

This equality is derived from the assumption that the quality coefficient changes proportionally to the change in this indicator in the range from its optimal to the limit values.

Thus, it is possible to determine the totality of all oil quality indicators by one quality coefficient.

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