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# ASSESSMENT OF WEAR AND TECHNICAL CONDITION OF ENGINES

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***Statement of the problem***. During the operation of the engines, as a result of the wear of the friction pairs, metal elements accumulate in the lubricant. The concentration of wear products in crankcase oil is proportional to the intensity of wear of parts and allows for earlier detection of emergency wear when it is not yet determined by other diagnostic methodas. The concentration of metal elements in the lubricant, which characterize the technical condition of the engine as a whole and its individual parts, can be determined by spectroscopic analysis. The method allows you to obtain information about the rate of wear of parts, the quality of the filters, the tightness of the cooling system, and the timing of oil replacement. To solve these problems, it is necessary to identify indicator metals and limit values for the content of wear products in the lubricant for the parts of a certain engine.

***The main research materials***. With long-term operation of the lubricant in the engine, constant intensity of cleaning and costs, the rate of wear of parts is characterized only by the concentration of wear products in the engine oil.

Mass wear can be calculated by the elements that make up the structural materials of friction parts. The mass wear of the engine for each of the elements that are determined is taken as the total wear of all friction parts in absolute terms, falling on this element and numerically equal to the mass of wear products that contain only this element and entered the lubrication system during the period of time from the start of work engine until the time of diagnosis.

Determining the concentration of wear products in lubricant includes the following operations: preparation of standards, burning of standards and construction of calibration schedules, sampling of lubricant samples for analysis from experimental engines [1].

To control the technical condition of the engines, parts that wear out, are washed with grease and contain in their material a chemical element characteristic only for them were chosen. The following elements can be selected as characteristic when diagnosing, for example, the D-240L engine: chromium (Cr), nickel (Ni), iron (Fe), tin (Sn), lead (Pb), aluminum (Al), copper (Cu). At the same time, the same element is characteristic of several details at the simultaneously. Therefore, when assessing the technical condition of parts, it is necessary to take into account not only the concentration of one element, but also their combination [2].

Characteristic elements for sleeves, crankshaft and camshafts, piston fingers and rings, gears are Fe; piston – Al, crankshaft liners – Al and Sn, bushings of the upper connecting rod head – Cu and Sn, camshaft bearings – Cu, Sn and Pb, upper compression rings – Cr. It is known that the most closely related to the wear of the cylinder-piston group is the concentration of iron in the lubricant, the content of which is up to 85% of the total wear products.

The nature of the accumulation of wear products in motor oil mainly depends on the oxidation capacity of the oil cleaner and the engine loading mode. During the tests, the concentration of iron in the lubricant increased sharply in the first 150-200 hours, then its stabilization at the level of 26-28 g/t was observed. A high intensity of wear and an increase in the concentration of iron in the lubricant occurs until a sufficient initial layer of deposits is formed in the rotor of the centrifuge, after which it will begin intensively releasing wear products.

As a result of data processing, patterns of accumulation of wear products in the lubricant were established. The values of the coefficients of the exponential functions are closely related to the technical condition of the engine and its operating conditions (the nature of the load). In operation, the level of engine loading and the degree of its thermal effect on the lubricant can largely reflect fuel consumption. The change in the concentration of iron Fe in the oil can be described by the dependence (Figure 1)

$$Fe = (-33{,}88 + 13{,}59\delta) + (33{,}88 - 13{,}59\delta) \cdot e^{-\frac{t}{143}}, \quad (1)$$

where δ – the average hourly fuel consumption, kg/h.,

t – current oil build-up, motohours.

The spectral analysis of the lubricant can be carried out on a multifunctional photoelectric spectrophotometer of the MPS type, which works according to the rotating electrode method [1]. The operation of the installation is based on the generally accepted scheme of emission spectral analysis. Determination of the concentration of elements was carried out with the help of standards made on a base lubricant with the addition of carefully ground oxides of the elements to be determined.

The limit values of the content of wear products in the oil are selected depending on the engine brand. So, the permissible values of the content of elements in the lubricant (g/t) for the D-240L engine are as follows: Fe – 110, Si – 70, Al – 30, Cu – 10, Cr – 10. Lubricant samples were subject to triple burning. The arithmetic mean value of three determinations was taken as the result. The concentration of elements is determined using calibration graphs.

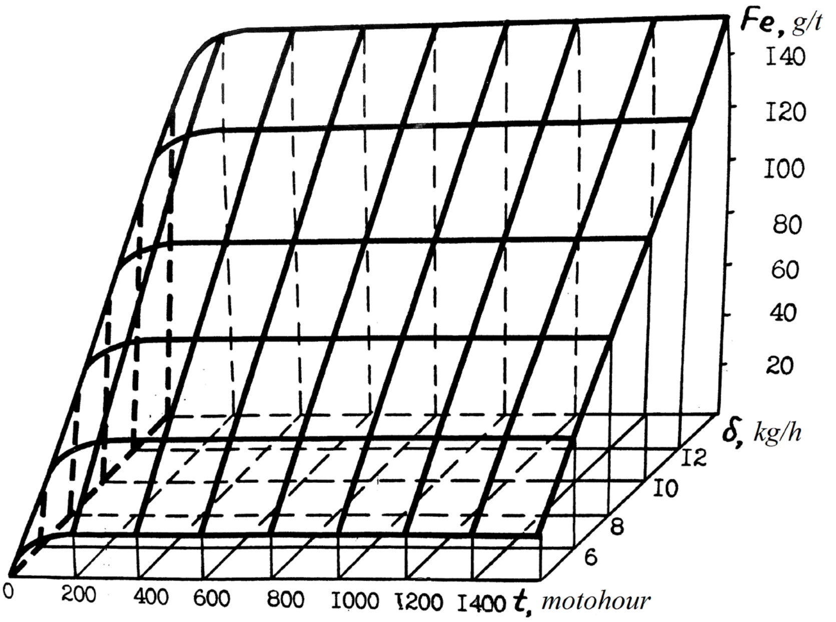


**Fig. 1 Dependence of the Fe content in engine oil on the time of its operation and average hourly fuel consumption**

***Conclusions.*** Spectral analysis is an effective method of assessing the wear and technical condition of engines. If the chemical composition of wearing parts is known, the method makes it possible to estimate the total wear of several groups of parts without disassembling the engine.

***References***

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