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The Developed Method for Evaluation of the Oil Spot of Engine Oil of Motor Vehicles by Comprehensive Criteria for Diagnostics of the Technical Condition of Engine Oil

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Annotation: A technique has been developed for correcting the frequency of maintenance of an internal combustion engine of motor vehicles according to a complex criterion for diagnosing the technical condition of engine oil. The dependence of the frequency of oil change of motor vehicle engines on the developed complex criterion was determined.

Keywords: Technical means, maintenance, technical condition diagnostics, maintenance of motor vehicles, labor intensity of technical impacts, motor vehicles, maintenance and repairs, internal combustion engine.

The use of methods and technical means for diagnosing the technical condition during operation and maintenance of vehicles can reduce the complexity of technical impacts, the duration of vehicle downtime for maintenance and repairs, and operating costs. Methods for diagnosing the technical condition are aimed at obtaining information about the actual condition of vehicles and its individual elements. Thus, the ultimate goal of diagnosing a technical condition is the maintenance of vehicles according to the actual condition. This requires an adjustment to the existing frequency of maintenance of vehicles. The internal combustion engine of modern vehicles is one of the most basic and expensive units that requires constant monitoring and maintenance. In turn, the most important and costly maintenance operation is the replacement of engine oil for an internal combustion engine of vehicles. Thus, in order to correct the frequency of maintenance of an internal combustion engine of vehicles, it is necessary to objectively and accurately diagnose the technical condition of engine oil.

In the practice of technical diagnostics of operating materials of motor vehicle engines, express methods for assessing the control parameters of the "engine–motor oil" system by the method of a drop test by appearance make it possible to determine the dispersing properties of motor oil by the ratio of the diameters of its core and diffusion zone.

The developed method for assessing the oil stain according to the complex criterion for diagnosing the technical condition of motor oils is based on the technologies for evaluating the criteria of the "engine-motor oil" system using a drop test method [1]. In contrast to the known method, where the stain assessment technique is reduced to the organoleptic method, a technique has been developed for digital processing of an oil stain using computer tools and application software, which allows for a formalized and objective assessment

One of the important tasks in oil analysis is sampling. The whole result of the analysis depends on the quality and frequency of sampling. For the correct application of oil analysis, initial data on the operation of vehicles is necessary. The sample taken for analysis must be representative of the oil used in the engine. When taking samples, the following rules must be followed:

- before starting sampling, the engine must warm up to operating temperature. This ensures that the samples taken will have a representative level of oil contamination;
- subsequent samples should be taken in the same place, proceeding in a similar way;
- before filling in new oil, it is necessary to obtain a sample of the used oil;
- Use a clean and dry container to collect oil samples.

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To diagnose the technical condition of Cummins engine oil, oil sampling is carried out in three ways [2]:

1. Sampling through the sampling cock: the cock is installed on the inside of the filter. Before sampling, the faucet is wiped, the engine warms up to operating temperature, after which the faucet opens. After the stagnant oil flows out, an oil sample is taken from the jet supplied by the engine idling.

2. Sampling from the Compuchek® fitting: The hose with the Compuchek® adapter must be connected to the Compuchek® filter head fitting. The Compuchek® fitting is thoroughly wiped before sampling. After the engine has warmed up to operating temperature, an oil sample is taken from the Compuchek® fitting; while the engine should run at low idle.

3. Taking a sample from the vacuum pump: the length of the tube is longer than the dipstick, which allows it to be lowered 25 - 50 mm below the oil level in the tank attached to the vacuum hand pump. Oil sampling is carried out immediately after the engine is stopped, warmed up to operating temperature and placed in a clean, dry container. Do not take an oil sample from the bottom of the oil pan, as excess sediment will enter the sample and the analysis results will be incorrect. The tubing is changed after each sampling to avoid secondary contamination of the oil samples.

The drip test method consists in taking an oil sample from the crankcase of an engine warmed up to operating temperature, similar to the Cummins method 3 described above. Then a drop of oil is applied to the filter paper - the "blue ribbon" ashless filter, made in accordance with GOST 12026–76 [3,4]. The dispersing properties of motor oils are evaluated after drying a spreading oil drop for a certain time by the size of the core and diffusion zone of the oil spot obtained on filter paper and their ratio [5, 6]. It is believed that the larger the diffusion zone, the higher the dispersing properties of the oil [7,8,9].

In contrast to the drop test method, when determining the parameter of an internal combustion engine, in the improved method, the oil slick is assessed using a developed methodology (an assessment is used using computer tools and application software).

Initially, a sample of engine oil is taken from the engine crankcase of motor vehicles, heated to operating temperature. Depending on the distance of vehicles from the laboratory, sampling is carried out by the operator of vehicles or laboratory assistant. For sampling, a tube is used, the length of which is greater than the length of the dipstick. The tube is inserted into the hole for the oil dipstick and lowered 25 - 50 mm below the oil level in the crankcase of the internal combustion engine. At the other end of the tube, the operator (laboratory assistant) fixes a vacuum hand pump, to the drain hole of which a sample collection container is fixed. Sampling is carried out immediately after stopping the internal combustion engine. The operator (laboratory assistant) using a hand pump fills the container at the rate of filling the container with engine oil with a volume of 0.1-0.2 liters. After that, the tube is removed and disposed of. The container with the sample is closed with a lid and transferred to a mobile or stationary laboratory. At the same time, the date of sampling, the operating time of engine oil from the moment of replacement, the name and service number of vehicles are applied to the container.

In the laboratory, the laboratory assistant opens a container with a sample of motor oil (the oil has a room temperature of 20-25 ° C), and takes a sample of motor oil using an ophthalmic pipette to the middle of the glass part of the pipette. Next, a drop of oil is applied with a pipette to filter paper, an ashless filter "blue ribbon", made in accordance with GOST 12026–76 [10, 11]. After applying the drop, the filter paper with the oil stain is dried at room temperature (20-25°C) for 3-4 hours.

After drying the filter paper, the laboratory assistant, using a scanning device with a resolution of the obtained image of 300 dpi, receives a positive digital image of the filter paper with an oil stain. A positive digital image is converted into a negative one using a graphics editor. The negative image is cropped with a 490x490 pixel square centered in the middle of the oil image using a spot graphical editor. The resulting image of 490x490 pixels in size is rotated 3 times by 90° clockwise by the laboratory assistant and each time the resulting image is saved in a new graphic file. As a result, the laboratory assistant receives 4 graphic files with a negative image of an oil spot sized 490x490 pixels.

Further, with a known value of the criterion, the curve of the dependence of the criterion Uh on the operating time is used to determine the operating time of engine oil corresponding to its technical condition indicators.

To determine the residual resource of engine oil, it is necessary to plot the dependence curve of the

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control parameter dispersing properties on operating time for the same samples that were used to plot the dependence curve of the criterion Uh on operating time.

To perform work on the method of diagnosing the technical condition of engine oil, an internal combustion engine of motor vehicles according to the complex criterion for diagnosing the technical condition of engine oil, a laboratory assistant of the 3rd category is required.

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