DIESEL ENGINES DEPENDENCE OF OIL CONDITION INDICATORS ON OPERATING TIME

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ДИЗЕЛЬНЫЕ ДВИГАТЕЛИ ЗАВИСИМОСТЬ ПОКАЗАТЕЛЕЙ СОСТОЯНИЯ МАСЛА ОТ НАРАБОТКИ

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ABSTRACT:

This article provides information on the dependence of oil condition indicators on diesel engines on operating time. The presence of fuel in the oil can be assessed by changes in its viscosity. For normal operation of the engine, it is possible to assess its condition by comparing the relationship between the change in viscosity and the working oil obtained during a certain period of operation. Usually, if the viscosity has decreased by more than 25%, it is necessary to change the oil. Such information is analyzed in the article.

АННОТАЦИЯ:

В данной статье приведены сведения о зависимости показателей состояния масла в дизельных двигателях от наработки. Наличие топлива в масле можно оценить по изменению его вязкости. При нормальной работе двигателя можно оценить его состояние, сравнив зависимость между изменением вязкости и рабочим маслом, полученным за определенный период эксплуатации. Обычно, если вязкость снизилась более чем на 25%, необходимо заменить масло. Такая информация анализируется в статье.

Key words: Oil viscosity, Oil composition, N-pentane, benzene, drop pattern, oil pressure

Ключевые слова: вязкость нефти, состав нефти, н-пентан, бензол, капельная картина, давление масла.

It is also undesirable to increase the viscosity of the oil during operation. Thickening of oil, as a rule, is associated with the penetration of a large amount of pollution into it. If the oil viscosity exceeds 35%, it is considered necessary to replace it [1].

The presence of fuel in the oil can also be determined by the change in the flash in the open crucible. By determining the flash point of the working oil and comparing it with the values obtained for new oil diluted with a certain amount of fuel, it is possible to estimate the amount of fuel in the oil. The accuracy of this method is low, especially for diesel engines, because diesel fuel and oil may contain the same or similar hydrocarbons. For diesel engines, more accurate results can be obtained using the ASTM D3524-86 method [2]. This method consists in gas chromatographic separation of hydrocarbons in a mixture of n-decane and oil, and then their identification. The chromatograph is calibrated using at least three mixtures containing between 0 and 12% diesel fuel, diesel fuel, and fresh engine oil.

The service life of the oil mainly depends on the increase of insoluble pollutants. One of the methods for determining the composition of insoluble particles that has been used for a long time is the "drop sample" method. A drop of working oil is dripped onto a special type of filter paper using a gauge. In the modern version, the essence of the method is to measure the opacity in several areas of the used spot with the help of a light shining through it. The concentration of insoluble products is calculated according to the calibration data of the instrument. The method allows setting the concentration of insoluble products in the range of 0.2 ... 3.5% of the mass.

Separation of insoluble particles from used oil can also be done with a centrifugal filter[4]. For this, the oil sample is dissolved with n-pentane, n-heptane or benzene, and a coagulant (n-butyldiethanolamine) is added to suppress the effect of dispersant additives. The residue separated by the centrifugal filter is weighed. The difference between residues when using n-pentane and benzene as solvents can indicate the amount of tar and oxidized products in the oil and in benzene.

One of the most objective methods of determining the content of insoluble particles in working oil is the thermogravimetric method. Using this method, approximately 50 g of oil is heated to 6500 C at a rate of 500 C per minute in a stream of nitrogen. After keeping the sample at 650 0C for 5 minutes, its weight is estimated. Then 10% air is introduced into the nitrogen stream to oxidize the carbon layers. The proportion of air is gradually increased to 100%. When the sample mass stabilizes, the analysis is completed. This method allows to determine the total mass of insoluble particles and coke products oxidized by air. [3].

To evaluate the effect of the filling procedure, the entire sample of vehicles observed (28 units) was divided into four groups based on the average volume of oil filling.

The volume of oil filled in the first group: from 1.5 to 3.5 liters of oil at one time;

in the second group - from 3.5 to 5.5 liters;

in the third group - from 5.5 to 7.5 liters;

in the fourth group - from 7.5 to 10 liters.

In each group, the average temperature of the oil in the crankcase and the pressure in the lubrication system were recorded. A thermometer was used to measure the temperature, it was installed instead of an oil dipstick. The oil pressure was determined by the pressure indicator on the car's instrument panel. Oil temperature indicates its quantity and ventilation. During the observation period (three years), the decrease in oil pressure is mainly due to the wear of the details, especially the crankshaft bearings. Oil consumption for soot was determined by the volume filled up to the upper mark on the dipstick. The aging rate of oil is directly proportional to temperature, so as the amount of oil added increases, so does it.

Thus, the proposed program and research methodology allow to evaluate the change in the condition of motor oil during operation and to determine the normative (limit) values of the oil condition indicators that are appropriate for its replacement. The experimental data collected and processed according to the methodology allow to obtain the parameters of the dependence of the oil condition indicators on the working time.

Table 1: Parameters of engine oil condition indicators depending on working time

Status Indicators*	*a*	*b*	*c*	*d*	R^2
η, sSt	15,01	-0,728	0,0695	-0,0022	0,961
C, mgKON/g	10,037	-0,616	0,048	-0,0014	0,952
t_v, ^0S	229,8	-5,591	0,69	-0,0254	0,98
Z, sm^{-1}	52,46	55,6	-3,45	0,173	0,883
ρ, kg/m^3	884,2	-1,505	0,168	-0,007	0,982

*η-kinematic viscosity, sSt; S - alkaline number, mg KON/g; tv - flash temperature, 0C; Z - pollution, cm-1; r - density, kg/m3.

Table1 shows that according to the R^2 reliability parameter b, all k indicators of a high level of relationships are consistent with analyticalgaps.

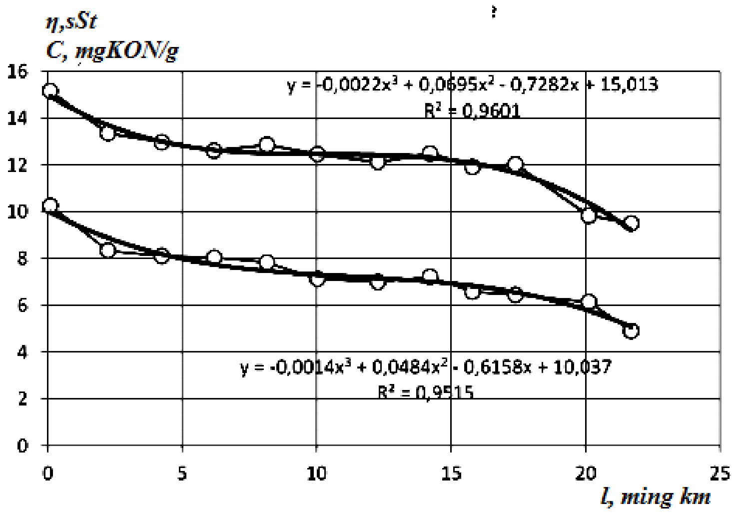

Figure 1 - Change in the number of diarrhea C and composition *η* in the process of motor oil processing for KAMAZ-EURO vehicles [6-7].

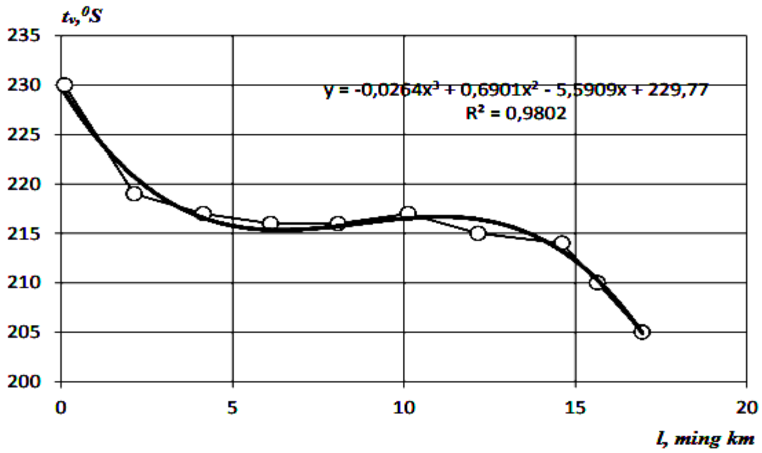

Figure 2 - T $_v$ temperature change *when running* motor oil for KAMAZ-EURO vehicles [6-7].

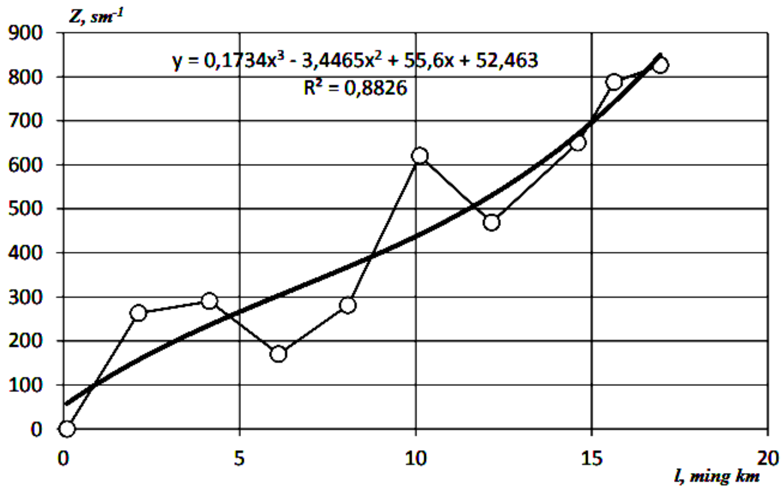

Figure 3 - Z change in the pollution when running motor oil for KAMAZ-EURO vehicles [6-7].

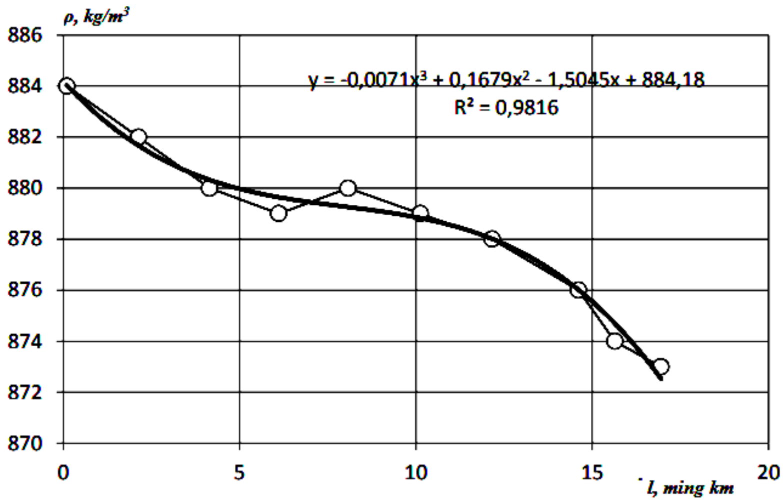

Figure 4 - *R* change in the density of motor oil for KAMAZ-EURO vehicles during operation [6-7].

Processing of oil filling data for the control cars made it possible to obtain the distribution of the filled oil volume and determine its parameters (Table 2).

Table 2. T killed oil size distribution parameters

Indicators	Average cost	Variation Coefficient
One-time filling capacity, *l*	3,6	0,292
Comparative filling, *l/thousand km*	1,78	0,289

As can be seen from Table 2, the amount and periodicity of oil filling is twice as high as the recommended indicators [6]. In addition to the periodicity of oil filling, the volume of filled oil also affects the reliability of the engine.

All indicators of the oil condition in the crankcase change during operation mainly in a third-order polynomial with a high degree of reliability. These relationships should be used to develop oil change and refill standards. In fact, the volume and frequency of oil filling are twice the recommended values, which have a large variation. In the actual procedures of oil filling, the oil temperature changes by 13-14 0C or 15-16% [5]. This causes a corresponding change in the speed of changes in the technical condition of the engine (with changes in the pressure in the lubrication system - up to 40-44%) and the speed of aging of the oil by 75-80%.

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