

LABORATORY 9

DETERMINATION OF THE CONTAMINATION LEVEL OF OILS

1. Objective of the laboratory work

The purpose of this laboratory work is to determine the contamination level of motor and hydraulic oils, that is, to evaluate the amount of mechanical impurities, solid particles, and sediment substances present in the oil.

2. Instruments and equipment required for the laboratory work

1. Filtration apparatus (simple or vacuum type)
2. Filter paper (standard laboratory type)
3. Measuring cylinder (100–250 ml)
4. Glassware (beaker, flask)
5. Analytical or technical balance
6. Thermometer
7. Stopwatch
8. Oil samples (clean and used oil)
9. Laboratory protective equipment

Task

Examine the given oil sample, determine its grade and type, compare the obtained results with GOST requirements, and indicate under what operating conditions the tested oil sample can be used. The oil should not form deposits on engine components and should not adhere to the surfaces of heated parts. The contamination characteristics of oil can be evaluated using the following methods.

3. Determination of the contamination level of used oil using a chromatogram

In this method, a drop of used oil is placed on filter paper, and its size and chromatogram pattern are analyzed. When used oil is dropped onto filter paper, a spot consisting of a dark central core and a lighter ring around it is formed. In the core, contaminated and insoluble particles of the oil accumulate. The clean part of the oil spreads along the ring. The color of the oil ring gradually changes from dark brown to light brown (Figure 1).

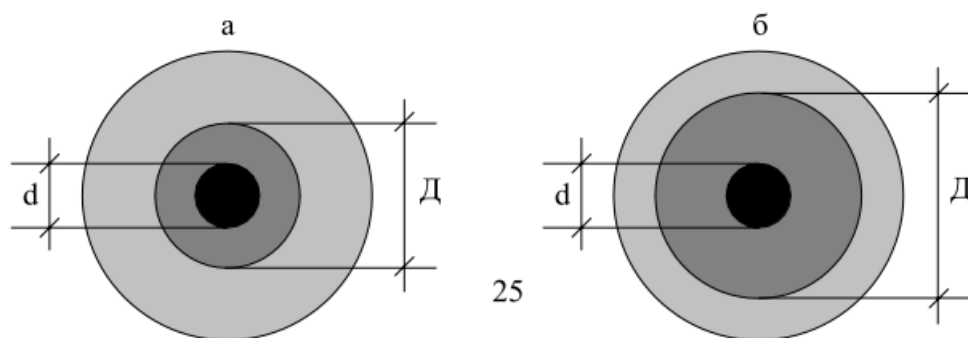


Figure 1. Chromatogram for determining the dispersion properties of oil:

a - oil with low dispersion properties;

b - oil with high dispersion properties.

From the rings of the formed oil spot, the following characteristics can be evaluated:

- the degree of oil oxidation (from the color of the oil ring);
- the level of oil contamination (from the color of the core);
- the detergent properties of the oil (from the ratio of the core and diffusion diameters).

4. Procedure

1. To prevent the tested oil from flowing in one direction, the rings are placed horizontally on the stand.
2. A filter paper is placed on the ring, and the used oil sample is thoroughly mixed. A sample of 5–6 cm³ is taken into a crucible.
3. The oil is heated to 15–40 °C, taken with a dropper, and the first two drops are returned to the crucible. The third drop is applied to the filter paper three times in a triangular pattern. After 2–4 hours, the chromatogram becomes ready for evaluating the dispersion properties, contamination level, and oxidation degree of the oil.

The serviceability of the used oil can be evaluated based on the table provided.

1.Determination of the oxidation level of oil.

Degree of oil oxidation	
Oil ring color	Accepted decision
Light yellow	Serviceable
Light brown	Serviceable

Brown Dark brown	Unserviceable Unserviceable
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2.Determination of the oil contamination level

Oil contamination level	
Core color	Accepted decision
Light brown or light gray Brown or gray Dark brown or dark gray Black	Serviceable Serviceable Unserviceable Unserviceable

3.Determination of the dispersion properties of the oil

The dispersion properties of the oil are determined using the following formula.	Accepted decision
$DC = 1 - \frac{d^2}{D^2}$	$\Delta \tilde{N} \leq 0.3$ — serviceable $DC \geq 0.3$ — unserviceable

A conclusion is drawn based on the obtained results.

5. Determination of the contamination level of used oil using a solvent

The essence of this method is to determine the volume of sediment separated under the influence of a selective solvent.

Procedure

1. The used contaminated oil is heated to 50–60 °C and stirred for 5 minutes.
2. The test tube is placed vertically in a stand until sediment forms.
A 30% volumetric solution of butyl acetate is prepared.
3. The test tube containing the used oil and solvent is closed with a stopper and mixed for 2–3 minutes. The volume and time of sediment formation are measured. The contamination level of the oil X is determined using the following formula:

$$X = \frac{U_o}{U_n} 100\%$$

here: U_0 - sediment volume (ml);
 $U_{\square}$ - volume of the oil sample (ml).

The serviceability of the oil is evaluated based on the table.

Sedimentation rate of impurities in the oil	Accepted decision
No sediment formation	Serviceable
Sediment forms after 90 minutes, with a small amount of impurities above the sediment.	Serviceable, the oil should be monitored every 1000 km.
Sediment forms after 20–30 minutes. The impurities above the sediment are not transparent.	Unserviceable.

A conclusion is drawn based on the obtained results.