Practical Lesson 5

DETERMINATION OF THE CLOUD POINT AND POUR POINT OF DIESEL FUELS

Objective of the work: to study the changes that occur in diesel fuels used in diesel-engine vehicles depending on air temperature, and to evaluate the quality of diesel fuel.

Equipment and materials: instruments and reagents; a glass test tube with a length of 160 ± 10 mm and an inner diameter of 20 ± 1.0 mm; a glass test tube with a length of 130 ± 10 mm and an inner diameter of 50 ± 2.0 mm; thermometers; a water bath; a stand; sulfuric acid; ethanol; solid carbon(IV) oxide.

Depending on the season of the year**,** petroleum products may have either a low or a high pour point. At low temperatures, petroleum and petroleum products begin to solidify**,** and their viscosity increases**.** As the outside air temperature decreases, high-melting paraffins crystallize, which disrupts the normal supply of diesel fuel in the area of the high-pressure fuel pump of diesel engines.

The cloud point is the temperature at which, during the cooling of diesel fuel, the first slight cloudiness appears that is not yet clearly visible to the naked eye. The pour point is the temperature at which, when the standard test apparatus containing diesel fuel is tilted to 55°**,** no movement of the fuel is observed for 1 minute**.**The suitability of diesel fuel for service in terms of cloud point and pour point is determined by the appearance of crystals on the walls of the test tube when the fuel is cooled.

Test procedure

1. Determination of cloud point and pour point of diesel fuel

To carry out the test, a special apparatus is mounted vertically on a stand **(**Fig. 1**).** The apparatus containing the diesel fuel sample is placed into a cooling mixture and cooled to –35 to +50°C. As the cooling medium**,** ethanol with solid carbon(IV) oxide or other temperature-maintaining reagents are used.

The temperature of the cooling mixture is maintained within ±1.0°C of the proposed pour point of the diesel fuel being tested. When the sample reaches the expected pour point, the apparatus is tilted to 55° and kept in this position in the cooling mixture for 1 minute**.** Then the apparatus is removed from the cooling mixture, the test tube is quickly wiped with a clean cloth, and the reading of the thermometer immersed in the diesel fuel is recorded.Until the limiting pour point of the sample is determined with an accuracy of 5°C**,** the test is repeated by lowering or raising the test temperature by 2.0°C. The observation continues until the color of the diesel fuel changes and its movement stops; the temperature is then recorded. This temperature is taken as the pour point of the diesel fuel sample**.**

2. Standard method for determining pour point

The determination of pour point is carried out in accordance with GOST 20287-75**.**Equipment and reagents: a glass test tube with a length of 160 ± 10 mm and an inner diameter of 20 ± 1.0 mm; a glass test tube with a length of 130 ± 10 mm and an inner diameter of 50 ± 2.0 mm; thermometers; a water bath; a stand; sulfuric acid; ethanol; solid carbon(IV) oxide.

Principle of Method 2: the diesel fuel sample is first heated, and then cooled until it loses fluidity.The dehydrated diesel fuel sample is poured into a clean, dry glass test tube with a length of 160 ± 10 mm and an inner diameter of 20 ± 1.0 mm up to the marked ring level, without touching the walls of the test tube.Then a cork stopper and a thermometer corresponding to the pour point range are fitted to the test tube. The thermometer is lowered to the middle of the test tube, and its bulb is positioned at a distance of 8–10 mm from the bottom of the test tube.To prevent the thermometer from moving, a second grooved stopper is installed and fixed at the middle of the lower part of the thermometer.

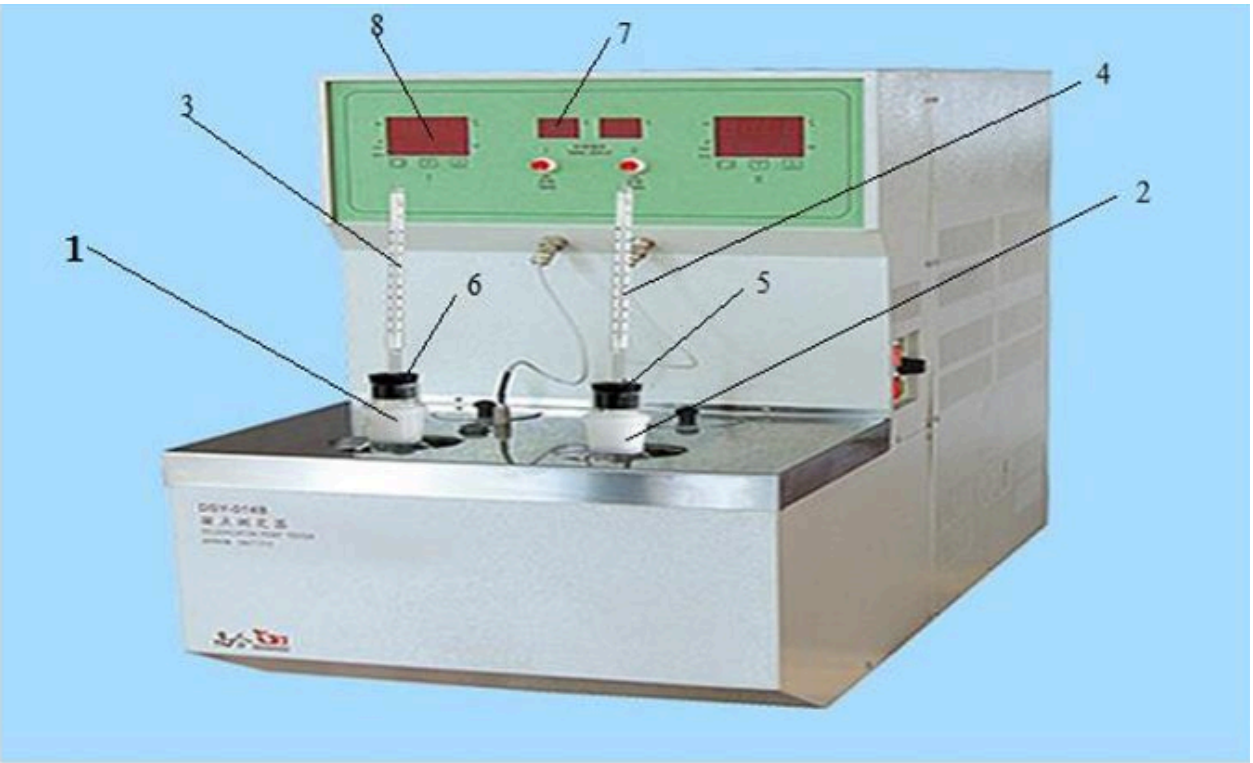


Figure 1. Determination of the cloud point and pour point of petroleum products

1, 2 - test tubes; 3, 4 thermometers**;** 5, 6 - couplings; 7 **-** time counter **(**timer**);** 8 - temperature monitoring display.

Type of Diesel Fuel	Temperature, °C
Summer grade	not higher than –10°C
Winter grade	not higher than –35°C
For cold climate zones	not higher than –45°C
Arctic grade	not higher than –55°C

Table 1. Permissible limit values of the pour point of diesel fuels according to the standard

The test tube containing the diesel fuel sample and the thermometer is placed in a water bath and heated to 50 ± 1.0°C**.** Then the test tube is removed from the water bath, wiped with a dry material, placed into a glass tube with a length of 130 ± 10 mm and an inner diameter of 50 ± 2.0 mm using a cork stopper**,** and fixed to the stand coupling.

If the pour point of the diesel fuel being tested is below 0°C**,** the outer tube is first rinsed with 0.5 ± 1.0 ml of sulfuric acid. The desiccant in the tube is necessary to absorb moisture from the air**.**The results of the conducted experiments show that any diesel fuel may be used when its cloud point is 3–5°C higher than the ambient air temperature, and its pour point is 10–15°C higher than the ambient air temperature.

Assessment questions

1. Why is the cloud point of diesel fuel determined?
2. What equipment and reagents are required to determine the cloud point?
3. Explain the cloud point of diesel fuel.
4. Explain the pour point of diesel fuel.
5. By what indicator are the cloud point and pour point of diesel fuel determined?
6. Explain the procedure for determining the cloud point of diesel fuel.
7. Explain the procedure for determining the pour point of diesel fuel.
8. What conclusion can be drawn from the cloud point and pour point of diesel fuel?