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Apparatus for Determining of the Pour Point of Crude Oil and Petroleum Products

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Abstract

This article describes the tools and techniques to determine the pour point of lubricating oils. It identifies their strengths and weaknesses on the basis of which the authors developed their own device. The scheme of the developed device for measurement of the solidification temperature of petroleum products, a brief description of the device and how it works, as well as measuring the temperature of the lubricating oil pour point are provided in the work.

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Keywords: pour point of petroleum and petroleum lubricant; a refrigerant circuit of the device; the measuring block temperature sensors.

1. Main text

Pour point is a very important indicator of the properties of the oil [1-4]. True, many operating staff mistakenly believe that it is for them, the figure given in the passport in order to know at what the lowest temperature of this oil can be used. However, pour point can not be set at exactly what temperature the oil will still be pumped, and will provide the engine from starting. Typically, the temperature at which the mobility of the oil is sufficient to start the motor and pumping cold oil is always higher than the pour point oil of about 10-20 °C [5-9]. All this is due to the fact that the laboratory method for determining the pour point is very imperfect [10-12]. The disadvantages of the known methods is the complexity of the analysis due to significant, lasting cooling and heating oil, as well as to use only in stationary conditions [13-16], so the development of devices that improve efficiency in conducting rapid analysis is an urgent task [17-19].

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An apparatus for determining the pour point of petroleum products is in the form of mechanical and measuring units (Fig.1). The mechanical unit 1 comprises a hollow body formed with a longitudinal groove 2 and secured to the front panel 3, the measuring unit. The hollow body with the possibility of reciprocating movement and fixation are three coaxial nozzle. The outer and middle 4 5 6 insulation glasses are separated, the middle glass 5 is provided with a bottom spigot 7 and the outer glass 4 is formed with a return hole 8. Between 5 and an average inner cups 9 a cavity 10 to fill with refrigerant via conduit 11 to a funnel, which mounted at the top of middle cup 5 is movable in the longitudinal groove in the hollow body 2. 4 and the average outer cups 5 are closed lid 12 provided with holes 13 for exit of the refrigerant vapor and a central aperture encompassing the inner sleeve 9 to its orientation. In the internal mixer cup 9 is located 14 coaxially mounted on a shaft 15 which is connected via a coupling 16 to a shaft 17 microelectric coaxially mounted relative to the inner sleeve 9 on a platform 18 attached to the front panel 3, the measuring unit. The mixer 14 is designed as a thin-walled aluminum plate with holes 19 arranged symmetrically relative to the rotational axis and in schahmatnom manner relative to one another, wherein the stirrer is 2/3 of the width of the inner diameter of the cup. Thus the total area of the openings 19 with these parameters stirrer reduces hydraulic resistance during its rotation to a minimum at the speed of 250 rev / min and does not form a funnel in the oil, and by lowering the temperature increases the flow resistance and the stirrer speed is reduced. The inner sleeve 9 is arranged protruding above said lid 12 a top end and sealingly mounted in fixing cup 4, 5 and 9 in the upper position by a seal 20 mounted on the platform 21 beneath the sleeve 16 microelectric and fixed on the front panel 3, the measuring unit. On the platform 21 is also attached temperature sensors 22 with the possibility of immersing them into the inner glass sleeve 9. On 16 Microelectric rigidly fixed disc 23, equipped with holes 24 on both sides of the disc are arranged board 25 fixed to the base 26 mounted on the front panel measuring 3 block. The boards aligned holes 25 in the disc 24 mounted photodiode 27 and the photodetector 28, interact with each other through the holes 24 in the disk as it rotates and recording speed agitator with a measuring unit.

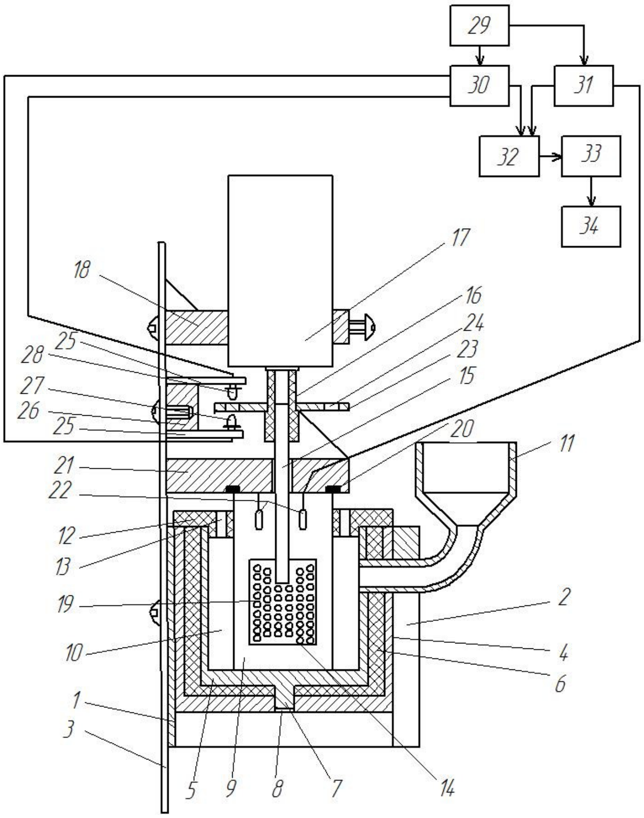

Fig. 1. Device determining pour point of oil and petroleum products

The measurement unit is enclosed in a casing, the front panel 3 is fitted and fixed elements of the mechanical unit. In this measuring unit includes a stabilized voltage source 29, a first output of which is connected to the block reference and speed registration mixer 30, which is associated with microelectric 17, a photodiode 27 and photodetector 28, and a second output connected to the block recording temperature test oil 31, which connected temperature sensors 22. The outputs of the task unit and the speed recording mixer 30 and the temperature of the recording unit 31 are connected to the voltage converter 32, whose output is connected to a computer 33, reflecting on the monitor 34 recording charts change stirrer speed and temperature of the test oil.

An apparatus for determining the pour point of crude oil and petroleum products is as follows. In preparing the device for the cavity 10 formed by an average of 5 and 9 domestic cups, filled with ethanol to the level of the pipe with a funnel 11. The outer cup 4 after unlocking lowered to the bottom position, together with the established in it an average of 5 and 9 domestic cups and removed from the hollow the cylindrical body 1 to fill the inner cup 9 petroleum product under test in a volume of 35 ml. Thereafter tumblers mounted in the hollow body 1, with the outer glass 4 is fixed to the front of the measuring unit 3, the inner sealing glass 9 with the petroleum product by its clamping to seal 20. After these preparatory operations, the device is ready to implement the method of determining pour point test oil.

To implement the method to connect the measuring device unit. With the speed setting unit 30 and register the agitator stirrer set rotational speed of 250 rev/min. Stress on the job and the speed recording mixer blocks 30 and recording the temperature of 31 through the converter 32 fed to the computer 33 and recorded on the monitor 34 in the form of diagrams with the corresponding amplitudes. Through the pipe 11 with the funnel 10 is filled into the cavity portion of the liquid nitrogen, wherein the test oil temperature decreases and the viscosity increases, which causes a decrease in speed mixer 14. Diagrams recording speed stirrer and oil temperature amplitude is reduced accordingly (Fig. 2). After the cessation of clouds of steam through the apertures 13 in the lid 12, topped the next portion of liquid nitrogen. These actions continue as long as the rotation of the agitator stops. According chart recording of the test oil is determined by the temperature at which the stop occurred mixer 14. Next, the shutter glasses with the petroleum product to start rotating the agitator whereby it changes chart oil temperature and the rotation frequency mixer determined temperature at which the rotation of the agitator started. Temperature of the test oil starts hardening is calculated as an average value between the temperature of the agitator stops when cooling oil temperature and start rotating in a heated cooling stop.

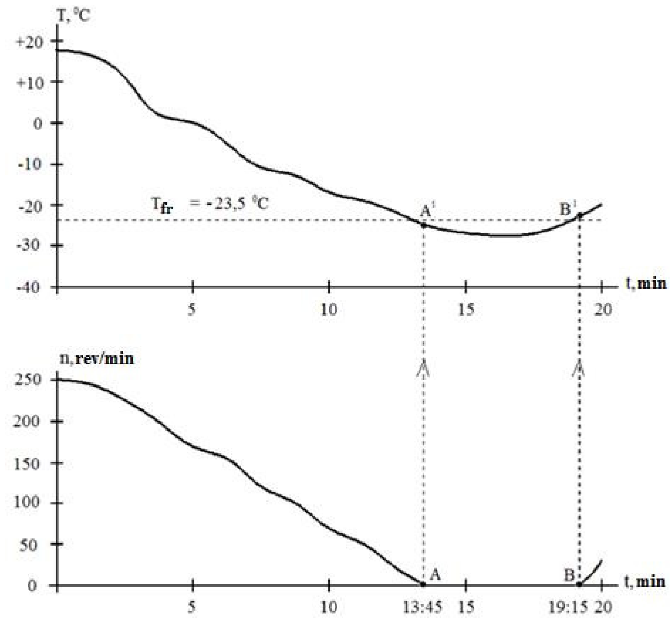

Fig. 2. speed recording charts stirrer and oil temperature

Exploration exposed to mineral motor oil Lukoil Standard 10W40 SF/CC [20]. The data presented in Fig. 2 shows that the stirrer stopped after 13 min 45 s (graph P = f (t), point A), which corresponds to a temperature of -24 ^{o}C (point A') according to diagrams T = f (t). Rotation of the agitator started after 19 min 15 sec (point B), which corresponds to a temperature of -23 ^{o}C (point B'). Average pour oil temperature Lukoil standard 10W-40 SF/CC was 23.5 ^{o}C.

2. Conclusions

The advantage of the method and apparatus is to increase the efficiency and degree of expressiveness determining pour point oil, through the use of effective liquid coolant, ensuring rapid cooling of oil, and automatic recording in the form of graphs of temperature-dependent parameters - speed mixer.

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