Method and Device of Express Thermal Control over Volatile Impurities in Oils, Fuels, and Process Liquids

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An analysis of the quality of oil products, newly synthesized compounds on their basis, and practically significant process liquids calls for the use of modern means of control. The monitoring of liquids for correspondence to specifications is realized over several tens of parameters, which is accompanied by financial and time charges. We will formulate the main requirements for the methods and devices of control:

- sensitivity to the presence of limiting concentrations of impurities;
- a high operation speed;
- simplicity and safety in application;
- autonomy;
- a low cost of the device and a single measurement.

This paper discusses a method of heat pulse monitoring and a device for analyzing oil products. The device makes it possible to evaluate in real time the presence and the dynamics of variations in concentrations of volatile impurities (mainly moisture) in energy oils, fuels and process liquids. The essence of measurements consists in determining the threshold temperature of characteristic changes in the heat-change process in a liquid with a step-by-step increase in the amplitude of the heating pulse. Changes in the content of the impurity in a sample lead to changes in the value of the characteristic temperature. A wire probe 20 mm in diameter serves as heat source and as a sensor. The heating of the probe to the temperature chosen is realized in 0.1 ms. The subsequent control over the heat-exchange process is carried out in 1-10 ms. The peculiarity of our approach consists in the fact that the comparison is made for not fully stable state of a substance superheated not only with respect to the temperature of the liquid-vapor equilibrium of a volatile impurity, but also with respect to the temperature of its spontaneous boiling-up. The use of highly superheated states of substance provides a high sensitivity of the method to the content of volatile impurities in the substance (~ 10^{-4} – 10^{-5}). The short time of action and the diminutiveness of the probe contribute to the decrease of the scale of a perturbation methodically introduced into the system. The device has been approbated on samples of diesel fuel, aviation kerosene, transformer and turbine oil, and also on samples of hydraulic liquids with moisture-content levels from 0 to 500 ppm.

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