Method and Device for Measuring Liquid Thermophysical Properties

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A method and device for measuring liquid thermophysical properties is described. The physical model is in the form of four-layers that serves as the basis of this method. On the outer boundaries, a constant temperature is maintained. The heater is placed between the first and second layers of the system. The mathematical model is formulated as a boundary value problem for the differential equation of heat conduction. Initial and boundary conditions are taken to be preset, except a boundary condition of the 4th type is considered. Corresponding to the latter, there is an inner flat heat source with specific power q.

According to superposition principle, the solution of the boundary problem is given as the sum of solutions of stationary and non-stationary problems. From the expressions for the stationary problem, the formula for calculation of thermal conductivity is obtained. The solution of the non-stationary problem is found as a Fouier series, obtained by separation variables. From the solution of the non-stationary problem, the expression for determining thermal diffusivity is obtained.

On the basis of the accepted physical model the construction of the measuring device is specified, which allows investigation of the thermophysical properties of the flat layer of liquid, with layer thickness 2-4 mm.

The measuring device was used as a component of an automated system for the study of liquid thermophysical properties. It also includes a PC with analogue-digital and digital-analogue converters, matching device, power supply block, and liquid thermostat.

On the basis of preliminary assessment of error of indirect measurement of liquid thermophysical properties, the model of experiment, for which the mentioned error will be minimal, is determined. The program for maintaining the experiment, recording of measured physical properties, of analysis of experimental data is completed. Using the experimental data, obtained by measuring liquids of known properties (distilled water, water solutions of ethyl alcohol with concentrations of 20%, 40% and 96%, toluene, and isopropyl alcohol), the algorithm for correction of the measurement results is verified.

The total uncertainities in measuring thermal diffusivity and thermal conductivity, taking into account the corrections, does not exceed 7% to 10%. The time of the active part of the experiment is 5-7 minutes.