NOMENCLATURE

Latin symbols:

- in figures:

A	- liquid being investigated;
B, C	- liquid heat transfer agents;
ADC	- analog-to-digital converter;
ASSR TPP	- an automated system for the scientific research of the thermophysical properties of liquids;
CD	- control device;
DAC	- digital-to-analog converter;
DRD	- the digital readout device;
FM	- flow rate meter;
MCS	- measuring-computing system;
MP	- microprocessor;
MT	- the measuring tube;
SW	- stopwatch;
SM	- servomechanism;
TPP	- thermophysical properties;
VR	- voltage regulator;

- in equations:

A	- thermal diffusivity tensor;
$a_{r\varphi}$, $a_{\varphi r}$, $a_{x\varphi}$, $a_{\varphi x}$, a_{xr}, a_{rx}	- the extradiagonal components of the thermal diffusivity tensor, A;
$a_{\varphi\varphi}$, a_{rr}, a_{xx}	- the diagonal components of the thermal diffusivity tensor, A;
A_n	- constant coefficients;
a	- thermal diffusivity;
a_w	- the thermal diffusivity of tube wall;
B_n	- constant coefficients;
C	- constant coefficient;
c	- specific heat capacity;
d = 2R	- internal diameter of the central tube;
$F(\overline{z})$, $f(\overline{\theta})$, $f_n(\overline{R})$	- mathematical functions;
f	- index of the sample geometry

	(f = 0,1,2 correspondingly for flat, cylindrical and spherical systems);
$G(r, \xi, z, \eta)$, $\overline{G}(\bar{r}, \bar{\xi}, \bar{z}, \bar{\eta})$	- Green's functions in dimensional and dimensionless form;
g	- liquid volume flow rate through the tube;
g	- gravitational acceleration;
K, k, k_1, k_2, k_3, k_4	- constant coefficients;
k	- parameter of the power law /8.2/;
$L, L_1, L_2, \ell_1, \ell_2, \ell_h, \ell_{h1}, \ell_{h2}, \ell_{is}$	- lengths of the sections of the measuring tubes;
m	- heat transfer parameter;
n	- parameter of the power law /8.2/;
P	- electrical power, consumed by the electrical heater;
p	- Laplace transformation parameter;
$Pe = \frac{\overline{\omega} d}{a}$	- Peclet number;
q, q_w	- heat flux, heating the liquid flow on the heat exchange section of MT;
$\vec{q}$	- heat flux vector;
R	- internal radius of the central tube;
R1, R2, R3	- resistances;
$R_1, R_2, R_3, R_4, R_i, R_n$	- dimensional coordinates of the boundary surfaces;
r, z	- the radial and longitudinal coordinates of the heat exchange section;
$\bar{r} = \frac{r}{R}$, $\bar{z} = \frac{\pi a z}{2g}$	- dimensionless radial and longitudinal coordinates of the heat exchange section;
RK1, RK2, RK3, RK4	- resistant thermometers;
Re	- Reynolds number;
T	- temperature;
T_0	- the initial value of sample temperature;
T_1, T_2	- temperatures on the surfaces of the sample with coordinates $r = R_1$, $r = R_2$;
$T_b, T_e, \overline{T}_b, \overline{T}_e$	- bulk temperatures of the liquid in the beginning and end of the test section;
$(T_e - T_w), (T_b - T_w), (T_e - T_b)$	are the temperature differences,

measured on the MT of thedifferent type;

T_w - temperature of the tube wall;

$\overline{T}$, $\overline{T}_1$, $\overline{T}_2$ - deviation of the mean integral value of the wall temperature on the measuring device central tube heat exchange section from the initial temperature T_0;

U_b, U_e - output signals;

$\overline{U}$ - velocity vector;

V - liquid volume, which is gathered in the measuring vessel in time τ;

W - density of internal heat sources;

$\overline{W}$ - dimensionless density of the internal heat sources;

x - axis;

$Y_1 = \frac{\pi a L_1}{2g}$, $Y_2 = \frac{\pi a L_2}{2g}$ - values of dimensionless coordinate $\bar{z} = \frac{\pi a z}{2g}$ at $z=L_1$ and $z=L_2$;

z - dimensional longitudinal coordinate of the tube;

$\bar{z} = \frac{\pi a z}{2g}$ - dimensionless longitudinal coordinate of heat exchange section;

$\tilde{z} = \frac{z}{g}$ - ratio of current value of a longitudinal coordinate z to the volume flow rate g;

Greek symbols:

β - coefficient of volumetric expansion;

$\beta = \overline{T}_2/\overline{T}_1$ - ratio of experimentally measured average integral temperature values of tubes wall sections $[\ell_2, L_2]$ and $[\ell_1, L_1]$;

$\gamma = \frac{d\omega}{dr}$ - shear rate;

$\Delta\theta = \frac{\Delta T\lambda}{q_w d} = \left[\theta(1,\bar{z}) - \bar{\theta}(\bar{z})\right]$ - is the difference between the demensionless temperature $\theta(1,\bar{z})$ of the tube wall and the dimensionless bulk temperature $\overline{\theta}(\overline{z})$ of the liquid;

ΔP - the pressure difference;

ΔT - temperature difference

ΔT_{max} - the maximum rise of temperature at the distance x from heat source;

$\Delta T = T(R,z) - \overline{T}(z)$ - difference between dimensional temperature T(R,z) of the tube wall and dimensional bulk temperature $\overline{T}(z)$;

Δg, Δq_w, Δd, Δa, Δg, $\Delta \ell_h$, $\Delta(T_e - T_w)$, $\Delta(T_b - T_w)$ - are the absolute errors of the measurement of the flow rate g, heat flux q_w, diameter d, temperature T, thermal diffusivity a, the volume flow rate g, the length ℓ_h of the heat exchange section and temperature difference (T_e-T_w) and (T_b-T_w);

$\delta a = \frac{\Delta a}{a}$, $\delta g = \frac{\Delta g}{g}$, $\delta_{q_w} = \frac{\Delta q_w}{q_w}$, $\delta_d = \frac{\Delta d}{d}$, $\delta \ell_h = \frac{\Delta \ell_h}{\ell_h}$, $\delta(T_e - T_w) = \frac{\Delta(T_e - T_w)}{(T_e - T_w)}$, $\delta(T_b - T_w) = \frac{\Delta(T_b - T_w)}{(T_b - T_w)}$ - relative errors of a, g, q_w, d, ℓ_h, (T_e-T_w) and (T_b-T_w) measurements;

$\delta\overline{\theta}$, $\Delta\overline{\theta}$ - relative and absolute errors of the dimensionless value $\overline{\theta}$ determination;

$\delta_{\mu a}$, δ_λ - relative errors of the thermophysical values μa and λ of the liquid measurements;

δ_L - relative error of the measurement of length L of the section;

$\delta_R = \delta_d$ - relative measurement error of inner radius of the measuring tube;

$\delta_{\Delta P}$ - relative error of the pressure difference ΔP measurement;

ε - systematic errors of measurements of thermal diffusivity a and thermal

	conductivity λ;
$\varepsilon_n,\ \psi_n(\bar{r})$	- eigenvalues and eigenfunctions of the Sturm-Liouville boundary value problem;
$\theta=(T-T_b)\lambda/(q_w 2R)$	- dimensionless temperature;
$\bar{\theta}(\bar{z})=4\int_0^1 \theta(\bar{r},\bar{z})\bar{r}\left[1-(\bar{r})^2\right]d\bar{r}$	- dimensionless bulk temperature;
$\bar{\theta},\bar{\theta}_i=\frac{T_{ei}-T_w}{T_b-T_w}$	- dimensionless bulk temperature;
θ_{opt}	- the optimal dimensionless temperature value;
$\bar{\theta}_e=\frac{T_e-T_w}{T_b-T_w}$	- is the dimensionless bulk temperature of the liquid at the end of the measuring tube;
$\bar{\theta}_f$	- actual value of the dimensionless temperature;
$\bar{\theta}(\bar{z})$	- function which determine the change of the dimensionless bulk temperature;
Λ	- thermal conductivity tensor;
λ	- thermal conductivity;
$\lambda_{r\varphi},\ \lambda_{\varphi r},\ \lambda_{x\varphi},\ \lambda_{\varphi x},\lambda_{xr},\lambda_{rx}$	- extradiagonal components of the thermal conductivity tensor Λ;
$\lambda_{\varphi\varphi},\lambda_{rr},\lambda_{xx}$;	- the diagonal components of the thermal conductivity tensor Λ;
μ	- dynamic viscosity;
$\mu\cdot a$	- complex thermophysical parameter;
$\mu_{ef}=k\gamma^{n-1}$	- apparent viscosity of the Non-Newtonian liquid;
ν	- the kinematic viscosity;
$\xi_1=\frac{\ell_1}{L_1},\ \xi_2=\frac{\ell_2}{L_2}$	- ratio of the geometrical coordinates, determining the positions of resistance thermometers RK1, RK2 on the heat exchange section of the measuring tube;
$\xi,\ \eta$	- integration variables;
$\bar{\xi}=\frac{\xi}{R},\ \ \bar{\eta}=\frac{a\eta}{2\bar{\omega}R^2}=\frac{\pi a\eta}{2g}$	- dimensionless coordinates;

ξ_n, ψ_n	- characteristic values and functions of the Sturm-Liouville boundary value problem;
$\bar{\xi}(\overline{W}, \bar{\theta})$	- is the inverse function of the initial function $\bar{\theta} = \varphi(\overline{W}, \bar{z})$;
ρ	- density of the sample material;
ρg	- mass flow rate of the liquid;
σ	- stress tensor; tangential or shear stress;
τ	- time;
τ_H	- is the relaxation time;
τ_0	- time of filling the tank with capacity V;
$\Phi(\beta)$, $\Phi_1(\beta)$	- mathematical functions;
φ	- axis of cylindrical coordinate system;
$\varphi(\bar{z})$	- is the mathematical function;
$\psi_n(\bar{r}), \psi_i(\overline{R})$	- eigenfunctions of the Sturm-Liouville boundary value problem;
$\Omega=(T_w-T_e)/(T_e-T_b)$	- the dimensionless parameter;
$\bar{\omega} = \dfrac{4g}{\pi d^2}$	- average velocity of liquid flow in the tube;
$\bar{\omega} = \dfrac{n}{n+1} k \left[R \left(\dfrac{R \Delta P}{2Lk} \right)^{\frac{1}{n}} \right]^n$	- is the average flow velosity of the sugar solution through the central tube at the differential pressure ΔP, applied over the heat exchange section of length L;
ω_0	- maximum velocity of liquid flow;
$\omega_0 = \left[\dfrac{3n+1}{n+1} \right] \bar{\omega}$	- is the maximum non-Newtonian liquid flow velocity;
$\omega_z(r)$	- velocity profile;
$\omega(r)$	- profile of the velocity of flow of the liquid or gas, which, for fully developed flow in a tube, is given by Poiseuille's formula;