°K; t, temperature, °C; B, B_p, B_λ, B_η, (cm³/g), E, E_p, E_λ, E_η [(cm³/g)⁴], H, H_p, H_λ, H_η, [(cm³/g)⁷], coefficients of the temperature functions; Pr, Prandtl number; η, dynamic viscosity, N · sec/m²; λ, thermal conductivity, W/(m · deg K); c_p, specific heat at constant pressure, J/(kg · deg K); Pr', η'_s, λ'_s, c'_{ps}, properties in the saturated state.

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THERMAL CONDUCTIVITY OF POLYMETHYLPHENYLSILOXANES AT HIGH PRESSURES

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Results are presented of an experimental investigation of the thermal conductivity of polymethylphenylsiloxanes in the 20-200°C temperature range and up to 200-MN/m² pressure range. An equation is proposed to compute the heat conduction in the temperature and pressure ranges investigated.

Results of an experimental investigation of the thermal conductivity (λ) of polymethylphenylsiloxanes (PFMS) and polymethylsiloxanes (PMS) at atmospheric pressure are presented in papers [1-3].

Results of an investigation of the thermal conductivity of PFMS-4 and PFMS-2/51 at pressures up to 200 MN/m² and in the 20-200°C temperature range are presented in this paper. The thermal conductivity was measured in an apparatus whose measuring cell operates according to the method of coaxial cylinders with flat

TABLE 1. Characteristics of Polymethylphenylsiloxane Fluids

Polymer	ρ_4^{20}	ρ_{20}, kg/m³	n_D^{20}	$\nu_{20} \cdot 10^6$, m²/sec	M	N	λ_{20}, W/m · deg	$\left(\frac{\partial\lambda}{\partial t}\right)_p^{\overline{av}} \cdot 10^4$ atm
PFMS-4	1,1015	1094,0	1,5320	658,7	1328	9	0,1456	5,10
PFMS-2/51	1,0196	1012,0	1,4982	16,93	570	3	0.1278	5,17

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TABLE 2. Thermal Conductivity of Polyorganosiloxane Fluids

t, °C	Pressure, MN/m^2										
	0,098	20	40	60	80	100	120	140	160	180	200
						PFMS-4					
28,9	0,1444	0,1482	0,1519	0,1554	0,1585	0,1618	0,1646	0,1673	0,1698	0,1721	0,1741
60,3	0,1405	0,1453	0,1497	0,1538	0,1574	0,1611	0,1642	0,1672	0,1699	0,1724	0,1745
95,8	0,1360	0,1418	0,1470	0,1519	0,1561	0,1602	0,1637	0,1660	0,1700	0,1728	0,1752
117,2	0,1332	0,1398	0,1455	0,1507	0,1553	0,1597	0,1634	0,1669	0,1700	0,1730	0,1755
141,3	0,1303	0,1375	0,1438	0,1495	0,1545	0,1591	0,1632	0,1668	0,1700	0,1732	0,1760
160,4	0,1279	0,1357	0,1424	0,1485	0,1538	0,1586	0,1630	0,1667	0,1701	0,1734	0,1763
180,2	0,1255	0,1338	0,1409	0,1472	0,1531	0,1582	0,1627	0,1666	0,1702	0,1736	0,1765
199,7	0,1228	0,1318	0,1395	0,1464	0,1524	0,1577	0,1625	0,1666	0,1702	0,1738	0,1771
						PFMS-2/51					
27,9	0,1267	0,1315	0,1352	0,1389	0,1425	0,1459	0,1490	0,1521	0,1548	0,1572	0,1593
59,8	0,1225	0,1279	0,1323	0,1364	0,1404	0,1441	0,1475	0,1511	0,1543	0,1570	0,1593
89,3	0,1186	0,1244	0,1295	0,1339	0,1385	0,1426	0,1462	0,1503	0,1538	0,1567	0,1594
120,3	0,1144	0,1208	0,1265	0,1314	0,1366	0,1408	0,1449	0,1495	0,1533	0,1564	0,1594
161,6	0,1090	0,1160	0,1226	0,1281	0,1339	0,1387	0,1431	0,1484	0,1528	0,1561	0,1595
188,2	0,1055	0,1130	0,1201	0,1259	0,1323	0,1373	0,1419	0,1478	0,1524	0,1559	0,1596
200,1	0,1039	0,1115	0,1189	0,1249	0,1315	0,1366	0,1414	0,1475	0,1522	0,1558	0,1596

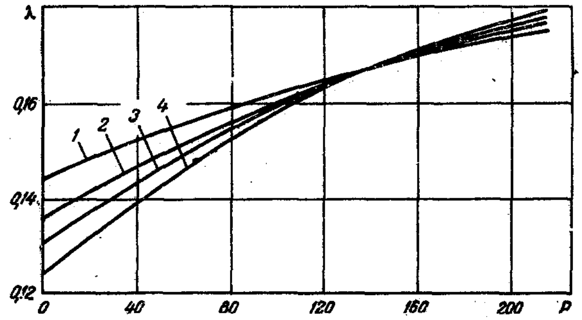

Fig. 1. Pressure dependence of the thermal conductivity of PFMS-4: 1) isotherm 28°C; 2) 95; 3) 140; 4) 200. λ, W/m·deg; P, MN/m^2.

closed end faces. The construction of the apparatus and the method of measurement are described in [4, 5]. A method elucidated in [6] was used in processing the experimental results. The maximum relative error in the measurements is estimated as ± 1.6%. Presented in Table 1 are values of the density (ρ_4^{20}), viscosity (ν_{20}), index of refraction (n_D^{20}), molecular mass (M), and also the degree of polymerization of the products investigated.

The thermal conductivity of polymethylphenylsiloxane was measured every 20 MN/m^2 on the isotherms. Presented in Table 2 are values of the effective thermal conductivity, smoothed according to the pressure, for the polymers investigated.

Analysis of the experimental results showed that the thermal conductivity of PFMS grows with the increase in pressure, and the more rapidly, the higher the temperature. Thus the thermal conductivity of PFMS-4 grows 18% at a temperature of 20°C and a pressure rise from 0.98 to 200 MN/m^2 and 44% at 200°C. The growth in the influence of the pressure with the rise in temperature results in a change in the sign of the temperature coefficient of heat conduction to the opposite.

The pressure at which the temperature coefficient of thermal conductivity changes its sign to the reverse is different for different substances and depends on their molecular structure and the intramolecular interaction force. The isobars of thermal conductivity of PFMS are practically straight lines in the temperature range investigated. The isotherms have a sufficiently high curvature, especially in the range of moderate pressures up to 80 MN/m^2. Their curvature grows with the increase in temperature (Fig. 1).

The thermal conductivity of polymethylphenylsiloxane is described in the temperature and pressure ranges investigated by the equation

$$\lambda_{p,t} = \lambda_{p,20} - \left(\frac{\partial \lambda}{\partial t}\right)_p^{\text{av}} (t - 20), \tag{1}$$

where $\lambda_{p,20}$ is the coefficient of thermal conductivity at the pressure P and the temperature 20°C;

$$\lambda_{p,20} = \lambda_{20} + C \ln\left(1 + \frac{P}{B}\right), \tag{2}$$

where λ_{20} is the coefficient of thermal conductivity at atmospheric pressure and the temperature 20°C and C and B are constants.

The values of λ_{20} for the polymers investigated are presented in Table 1. The constant B can be assumed equal to 110 MN/m^2 for the two polymers, and the constant C is C = 0.0253 and 0.0297, respectively, for PFMS-4 and PFMS-2/5l.

The dependence of $(\partial\lambda/\partial t)_p^{\text{av}}$ on the pressure is described by the equation

$$\left(\frac{\partial \lambda}{\partial t}\right)_p^{\text{av}} = \left(\frac{\partial \lambda}{\partial t}\right)_{p_{\text{atm}}}^{\text{av}} - A, \tag{3}$$

where $(\partial\lambda/\partial t)^{av}_{p_{atm}}$ is the mean value of the derivative at atmospheric pressure (see Table 1) and A is a coefficient taking account of the change in the temperature dependence of the thermal conductivity of the polymethylphenylsiloxanes on the pressure. As computations for the polymers investigated showed,

$$A = (0.4 \cdot 10^5 p^2 - 0.144 \cdot 10^{-2} p)\, 10^{-3}. \tag{4}$$

The deviations of the experimental results from those calculated by means of (1) do not exceed ± 3%.

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MEASURING THE VISCOSITY OF SUPERHEATED LIQUIDS AT HIGH PRESSURES

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An experimental apparatus for measuring the viscosity of superheated liquids at high pressures is described, together with the corresponding measuring technique; results of viscosity measurements are presented for superheated n-hexane.

The thermophysical properties of metastable liquids have been very little studied. The viscosity of superheated liquids has only been measured at or near atmospheric pressure (600-1000 mm Hg) [1]. The difficulties involved in studying the properties of a superheated liquid are due to the fact that it only remains for a short period in the metastable state. This paper is devoted to the measurement of viscosity in a superheated liquid over wide temperature (20-200°C) and pressure (1.2-25 atm) ranges. The results may be used for expanding viscosity tables into the region of metastable states.

Experimental Apparatus and Measuring Technique

The viscosities of liquids in the metastable (superheated) state may be measured in a capillary viscometer. The apparatus (Fig. 1) consists of devices for creating and releasing the pressure 12, a differential manometer 1, a glass capillary 7 (diameter ~ 0.08, length ~ 150 mm), and systems of automation and measuring instruments. During the experiments the test liquid remained at a pressure P_0 and flowed through the capillary 8 under the influence of a static pressure drop $(\rho_{Hg}-\rho)gh$ created by the mercury column h in the measuring tube 5 of the differential manometer. Here ρ_{Hg} and ρ are the densities of mercury and the test liquid at room temperature. The horizontally placed capillary was heated with a thermostated liquid (water, glycerin) pumped through the glass sleeve 9 from the thermostat 10. The remaining parts of the apparatus were at room temperature. The temperature of the liquid in the thermostat was kept constant to within ± 0.02°C even under the most difficult experimental conditions (at 200°C).

The flow of liquid through the capillary was not quite isothermal. The transitional region in which the

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