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THERMAL CONDUCTIVITY OF HEPTYL CAPROATE AT HIGH TEMPERATURES AND PRESSURES

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UDC 536.6

Measurements have been made on the thermal conductivity of heptyl caproate at 305-611 K and 0.098-98 MPa.

Caproates are widely used in making aromatic additives for the food and perfumery industries as well as in food chemistry, but no systematic measurements have been made on their thermophysical parameters, although values are required to design optimized techniques.

Very few data have been published on caproate conductivities. Measurements have been made at Kazan' Technological Institute [1] on the temperature dependence at atmospheric pressure for the first two members of the homologous series. Heptyl caproate has not been examined before at all.

We have made measurements on caproates over wide temperature and pressure ranges [2] by dynamic monotone heating. The theory, the measurement methods, and the instruments have been described in [3]. Here we report results for heptyl caproate at 305-611 K and 0.098-98 MPa.

TABLE 1. Measured Conductivities $\lambda \cdot 10^3$ W/m·K for Hetpyl Caproate at Various Temperatures and Pressures

T, K	P, MPa						T, K	P, MPa					
	0,098	19,6	39,2	58,8	78,4	98		0,098	19,6	39,2	58,8	78,4	98
305	138	145	152	157	162	166	464	101	112	121	129	135	141
317	135	143	149	155	160	164	476	98,1	110	119	127	133	140
330	132	140	146	152	157	162	489	96,4	107	118	124	132	138
342	129	137	144	149	154	160	501	94,6	105	115	123	130	135
354	126	135	142	148	152	158	514		104	114	122	127	134
366	124	132	140	146	151	156	526		102	112	120	126	133
378	121	131	139	145	150	154	538		100	111	119	125	131
390	119	128	137	143	148	153	550		98,7	110	118	123	130
402	116	125	133	140	146	150	563		97,8	108	117	122	129
414	113	123	131	138	144	149	575		95,9	107	116	122	127
427	110	120	128	136	142	147	587		95,3	106	115	121	126
440	107	117	127	133	139	146	598		94,7	105	114	120	125
452	104	115	124	131	137	143	611		94,1	104	113	119	124

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0022-0841/89/5702-0964$12.50

The thermal conductivity is measured in this way from the delay in the temperature rise at the core relative to the block temperature. The temperature difference in the liquid and the heating rate are measured with an Elektronika-4 timer and class 0.001 R-345 potentiometer. The pressure was produced and measured by means of a loaded-piston gauge type MP-2500, class 0.05, and a set of standard gauges. The thermal conductivity was measured with various heating rates, which produced temperature differences from 2 to 8 K in the layer, which enabled us to check for and eliminate effects from natural convection. The reproducibility indicates that there was none. The working equation incorporates all the characteristic corrections. The relative standard deviation in the thermal conductivity was ±2.2%.

Table 1 gives the results, which show that there is a negative temperature coefficient, but a positive pressure one. The pressure effect increases with temperature, which is characteristic of all carboxylic-acid esters.

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DETERMINING METAL THERMOPHYSICAL PARAMETERS BY X-RAY DILATOMETRY WITH RAPID HEATING

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UDC 621.386(088.7)

A linear approximation has been used for the thermal-conduction equation on the basis of the difference between the surface and bulk temperatures in a new method of determining metal thermophysical characteristics. The working scheme is given along with measurements on iron-alloy specimens.

High-speed x-ray diffraction measurements are widely used with metals at heating rates over 10 K/sec [1, 2]. Recently, the informativeness has been increased by combining this with dilatometry on the same specimen, which is heated by passing a current through it [2]. The measured quantities give data on the temperature patterns, and we have proposed simple methods of determining the various thermophysical parameters without increasing the number of sensors or substantially complicating the operations [3].

Figure 1 shows the scheme. The cylindrical (planar) specimen is exposed to a monochromatic x-ray beam and the diffraction line is scanned across a fixed detector by means of a slot aperture with a period $\geq 10^{-2}$ sec. The lattice parameter is determined from the diffraction angle. At the same time, one measures the change in diameter in the working part by means of a dilatometer fitted with an electromechanical sensor [sensitivity $(\Delta \ell / \ell) \leq 10^{-6}$], and the current and potential drop across the working part are monitored. The surface temperature is monitored with a chromel-copel thermocouple 50 μm in diameter welded to the specimen.

The heating rate is chosen to produce a planar temperature distribution at the center and sharp drops in temperature at the points where the specimen is attached to the contacts

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Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 57, No. 2, pp. 300-304, August, 1989. Original article submitted February 22, 1988.

0022-0841/89/5702-0965$12.50