accuracy indicated. The measurements were reproduced a large number of times and may accordingly be considered quite reliable.

The liquids studied were of the analytically pure category and the solid surfaces were machined to a surface finish of $\nabla 8$, $\nabla 9$.

LITERATURE CITED

1. V. G. Stepanov, L. D. Volyak, and Yu. V. Tarlakov, Zh. Fiz. Khim., 46, 9 (1972).
2. L. D. Volyak, V. G. Stepanov, and Yu. V. Tarlakov, Zh. Fiz. Khim., 49, 11 (1975).
3. B. V. Deryagin, Dokl. Akad. Nauk SSSR, 51, 7-9 (1946).
4. V. K. Semenchenko, Surface Phenomena in Metals and Alloys [in Russian], Gostekhizdat, Moscow (1957), p. 74.
5. N. K. Adam, Physics and Chemistry of Surfaces, 3rd ed., Dover (1969).

INVESTIGATION OF THE THERMAL CONDUCTIVITY AND DENSITY OF ISOAMYLBUTYRATE IN A BROAD RANGE OF TEMPERATURES AND PRESSURES

K. D. Guseinov and O. Zhabbarov

UDC 536.22

Results of an experimental determination of the coefficient of thermal conductivity λ and density ρ of isoamylbutyrate in the 1-490 bar pressure and 295.3-578.2°K temperature ranges are presented. The interrelation between the coefficient of thermal conductivity and the density is investigated.

Taking account of the broad technical application of complex esters of butyric acid — butyrates — we determined λ and ρ experimentally for different temperatures and pressures.

The method of a cylindrical, regular-cooling bicalorimeter was used to investigate λ as a function of P and T. The λ of formates had earlier been determined on this apparatus [1]. Liquid isoamylbutyrate, whose purity was not less than 99.4% according to a chromatographic analysis (chromatograph of the brand "PAI"), was used in the investigation.

The temperature drop in the fluid layer was 0.6-1.2°. The temperature was determined by a Chromel – Alumel thermocouple with a 0.05° error, and the pressure was produced and measured by an MP-600 piston manometer of the accuracy class 0.05.

A correction for radiation of the medium [2] in the gas phase (2-3%) was taken into account in evaluating λ from the test results, and we took the liquid phase of isoamylbutyrate as being a strong absorber of the infrared radiation of the medium.

The measurements were conducted by means of isotherms. In all, 84 test values of λ, referring to the liquid and gas phases, were obtained on 12 isotherms. These values of λ are presented in Table 1.

The error in the λ data for isoamylbutyrate is estimated at 2.5% in the whole range of temperatures and pressures studied.

Isoamylbutyrate was investigated in the gas phase at atmospheric pressure for T = 472-578°K. In contrast to butyrates of normal configuration, no influence of thermal pyrolysis on λ was observed in measuring the λ of isoamylbutyrate (P = 1 bar). The values of λ obtained for the vapor phase are described well by the equation

---

V. I. Lenin Azerbaidzhan State Pedagogic Institute, Baku. Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 32, No. 6, pp. 1004-1006, June, 1977. Original article submitted July 22, 1976.

TABLE 1. Coefficient of Thermal Conductivity of Isoamylbutyrate $\lambda \cdot 10^3$ [W/(m·deg)]

T, °K	P, bar						
	0,98	49	98	196	294	392	490
295,3	126	128	130	133	136	139	149
320,4	121	124	125	128	132	136	138
343,2	117	119	121	124	128	131	134
370,0	112	114	116	119	123	126	129
396,0	106	109	111	114	118	122	125
422,6	101	103	106	110	113	117	120
443,2	97	99	102	106	110	113	117
472,3	30	94	97	100	104	108	112
497,8	33,5	88	92	96	100	104	108
521,2	36,8	84	88	92	96	100	104
548,1	40,4	79	83	88	91	96	100
578,2	44,5	73	77	82	87	91	95

TABLE 2. Density of Isoamylbutyrate ρ, (kg/m^3)

T, °K	P, bar					
	49	98	196	294	392	490
472,3	701,6	713,6	732,6	748,1	761,1	772,7
497,8	674,6	688,2	711,0	728,3	743,0	755,0
521,2	646,7	663,9	690,2	710,0	726,3	739,0
548,1	607,1	633,0	664,5	688,0	706,5	720,4
578,2	558,7	593,2	633,9	661,5	682,7	699,2

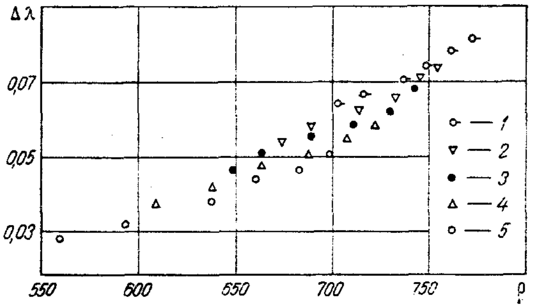

Fig. 1. Dependence of the excess thermal conductivity of isoamylbutyrate on the density: 1) 472.3°K; 2) 497.8°K; 3) 521.2°K; 4) 548.1°K; 5) 578.2°K.

$$\lambda = \lambda_{T_{\text{cr}}} \sum_{i=0}^{2} a_i \tau^i, \tag{1}$$

where $\tau = T/T_{\text{cr}}$; $\lambda_{T_{\text{cr}}}$ is the value of λ at the critical temperature and atmospheric pressure; $a_0 = 1.495404$; $a_1 = -3.595208$; and $a_2 = 3.101635$.

There are no data in the literature on the λ of isoamylbutyrate. The results obtained on $\lambda_{P,T}$ are unique.

An investigation of the relation between the coefficient of thermal conductivity of organic fluids and their density at different temperatures and pressures is of special interest. To this end, compliance with the known dependence of the excess thermal conductivity on the density

$$\lambda_{P,T} = \lambda_T + f(\rho), \tag{2}$$

where ρ is the density of the liquid phase, is often subjected to confirmation.

In order to verify compliance with (2), reliable data on ρ must be available for different P and T. Hence, we assembled an apparatus according to the known method of hydrostatic suspension [3-5] and conducted an experimental determination of the density of isoamylbutyrate in a broad range of temperatures and pressures. Part of the results obtained, which are needed to verify a functional dependence of the type (2), are presented in Table 2. We estimated the error in the data presented in Table 2 as 0.1%.

The dependence (2) for isoamylbutyrate is shown in Fig. 1. As is seen from the figure, a slight stratification in the isotherms generalizing the dependence is observed. It is insignificant at low temperatures. It should be noted that such stratification is observed quite rarely for organic fluids.

Processing was conducted for ρ = 772.7-558.2 kg/m^3 and $\Delta\lambda$ from 0.028 to 0.083 W/(m·deg).

The equation of the generalizing curve has the form

$$\Delta\lambda = b_0 + b_1\rho + b_2\rho^2, \tag{3}$$

where $b_0 = 0.277$; $b_1 = -0.00092$; $b_2 = 86\cdot10^{-8}$.

We can calculate λ_T at different temperatures and pressures by using (3) for known ρ and λ with a 3% error in the range of ρ mentioned.

LITERATURE CITED

1. K. D. Guseinov and S. G. Magerramov, Izv. Akad. Nauk AzerbSSR, Ser. Fiz.-Mat. Nauk, No. 1 (1973).
2. L. P. Filippov, Investigation of the Thermal Conductivity of Fluids [in Russian], Izd. Mosk. Gos. Univ., (1970).
3. I. F. Golubev, Tr. Gos. Nauchno-Issled. Proekt. Inst. Azot. Prom-sti Produkt. Organ. Sintez., 7, 47 (1957).
4. O. A. Dobrovol'skii, T. N. Belyaeva, and I. F. Golubev, Gaz. Prom-st'., No. 11 (1964).
5. A. K. Abas-zade, T. A. Apaev, and A. M. Kerimov, Gaz. Prom-st'., No. 8 (1970); Izv. Akad. Nauk AzerbSSR, Ser. Fiz.-Mat. Nauk, No. 5 (1970).

SOME FEATURES OF HEAT AND MOISTURE TRANSFER AND APPROXIMATE METHODS OF CALCULATING THE DRYING KINETICS OF MOIST MATERIALS

P. S. Kuts and A. I. Ol'shanskii

UDC 66.047.37

Approximate methods of calculating the drying kinetics of moist materials, derived from an analysis of experimental data, are discussed.

Drying is a complex heat- and mass-transfer process taking place within a material and close to its surface. The nature of the drying process depends on the thermophysical, physicochemical, and structural-mechanical properties of the material, the method of supplying power, and so on. The relationships between internal and external heat and mass transfer are so complex that the obtaining of analytical relationships for the drying kinetics of a specific material presents great difficulties.

Hence, the possibility of obtaining approximate, sufficiently reliable relations with a minimum number of constants to be experimentally determined is of great interest for drying calculations in engineering. The most advanced methods are those based on a study of the general laws of drying kinetics and the correlation of a large amount of experimental data [1-3].

We examine some features of the drying process and approximate methods of calculating heat-transfer kinetics on the basis of an analysis of experiments on the drying of a whole series of capillary-porous and colloidal capillary-porous materials to which heat is supplied in various ways.

Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 32, No. 6, pp. 1007-1014, June, 1977. Original article submitted October 19, 1976.