2. D. P. Volkov, G. N. Dul'nev, B. L. Muratova, and A. B. Utkin, *Inzh.-Fiz. Zh.*, **50**, No. 6, 939-946 (1986).
3. G. N. Dul'nev, D. P. Volkov, and V. I. Malarev, *Inzh.-Fiz. Zh.*, **56**, No. 2, 281-291 (1989).
4. A. F. Begunkova, G. N. Dul'nev, Yu. P. Zarichnyak, and B. L. Muratova, *Inzh.-Fiz. Zh.*, **31**, No. 6, 973-980 (1976).

THE P-ρ-T DEPENDENCE OF DIETHYL SUCCINATE

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We have derived experimental results with respect to the P-ρ-T dependence of diethyl succinate. Based on these results we have compiled an equation of state which allows us to calculate the thermal properties of the material.

Diethyl ethers of succinic acid are used extensively in the chemical industry for the production of dyestuffs, alkyd resins, succinates, light-sensitive materials, etc. However, the literature contains inadequate information with respect to the thermophysical properties of these materials. With this in mind, we undertook an investigation into the P-ρ-T dependences of diethyl succinate at pressures of 0.1-49.1 MPa and temperatures ranging from room temperature to 500 K. The substance tested to a total chemical purity of 98.6%.

The measurements were carried out by means of a hydrostatic suspension method with a maximum error of 0.1% over the entire investigated range of parameters of state. A new experimental setup was designed and constructed for the purposes of this study, and it made use of elements from other experimental units designed by the authors [1, 2]. This unit differs from the ones with which we are familiar in that the sensor coil is positioned outside of the medium being studied, thus making it possible to simplify its operation and to raise operational reliability.

The elements of the suspension system were calibrated by a method of hydrostatic suspension in water (bidistillate) with the aid of VLA-200G-M-type analytical balances, using the method familiar from [3-5]. The parameters of the elements of this suspension system (the volumes) were as follows: a silver steel core 0.4210 cm^3, the filament 0.0047 cm^3, and a solid quartz float 2.8173 cm^3. In a vacuum the system weighed 9.5253 g.

The density was measured from the isotherms. Nine isotherms yielded 58 experimental density values, each of which is the result from the averaging 3-4 multiple measurements. These quantities have been tabulated in Table 1. The literature provides information with respect to density at 20°C for diethyl succinate [6], and these are in agreement with our data with an error of 0.1%.

The temperature of this material was measured during the experiments by means of a platinum resistance-type PTS-10 thermometer of the first category, in conjunction with a U-309 potentiometer unit.

Pressure was generated and measured by means of an MP-600 type piston manometer of the 0.05 class. In order to separate the oil of the piston manometer from the material being tested in the compression vessel, we made use of a thin-walled Capron (polycaprolactam resin) tube out of BF-6 cement whose sensitivity was 0.0001 MPa. The material of the divider was inert with respect to the substance being tested. This was verified by suspension of the tube prior to and subsequent to the measurement.

Analysis of the experimental material demonstrated that for the given substance the following equation of state is most appropriate [7, 8]:

$$P = A(T/T_{boi})\rho^2 + B(T/T_{boi})\rho^8, \tag{1}$$

where P is the external pressure, MPa; T is temperature, K; ρ is density of the liquid, g/cm^3; T_{boi} is the normal boiling point; $A(T/T_{boi})$ and $B(T/T_{boi})$ have been calculated by the method of least squares for each of the isotherms and described analytically in the form of the T/T_{boi} polynomial:

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TABLE 1. Experimental Values of the Density ρ, g/cm^3 of Diethyl Succinate

T, K	P, MPa						
	0,1	5,0	9,9	19,7	29,5	39,3	49,1
295,65	1039,4	1042,6	1045,8	1052,4	1058,2	1064,0	1068,6
319,15	1014,8	1018,8	1022,3	1029,5	1036,0	1042,0	1048,0
347,15	986,0	991,8	996,2	1006,2	1012,8	1020,6	1026,1
377,65	—	959,4	965,5	977,8	988,2	996,9	1004,1
406,85	—	930,7	938,6	952,0	963,4	973,0	982,9
433,65	—	903,9	915,5	927,8	940,2	950,8	962,2
446,55	—	889,8	903,2	915,5	928,2	940,0	952,9
472,35	—	857,9	873,9	887,5	902,0	916,1	929,4
498,15	—	815,8	829,0	850,8	869,6	885,6	889,6

$$A(T/T_{boi}) = \sum_{i=0}^{5} a_i (T/T_{boi})^i \; ; \; B(T/T_{boi}) = \sum_{i=}^{5} b_i (T/T_{boi})^i \; . \qquad (2)$$

The functions $A(T/T_{boi})$ and $B(T/T_{boi})$ have been described with a mean arithmetic error of 0.3%. The coefficients of polynomials (2) are as follows:

$$a_0 = 37329{,}194, \qquad b_0 = -20018{,}610;$$
$$a_1 = -236533{,}959, \qquad b_1 = 117179{,}698;$$
$$a_2 = 585663{,}100, \qquad b_2 = -265392{,}988;$$
$$a_3 = -714228{,}824, \qquad b_3 = 292896{,}580;$$
$$a_4 = 430335{,}431, \qquad b_4 = -157256{,}879;$$
$$a_5 = -102627{,}444, \qquad b_5 = 328163{,}461.$$

The equation of state (1) describes the experimental data on density with a maximum error of 0.1% for the entire region investigated here.

LITERATURE CITED

1. I. F. Golubev, *Nauch. tr. GIAP* [in Russian], Vol. 7, Moscow (1957), pp. 47-61.
2. K. D. Guseinov and N. M. Bairamov, *Izv. Vuzov. Neft' i gaz*, No. 3, 39-44 (1985).
3. I. V. Iverenova (ed.), *Physics Handbook. Molecular Physics* [in Russian], Moscow (1955).
4. S. I. Gauzner, S. S. Kivlis, and O. P. Osokina, *Measurement of Mass, Volume, and Density* [in Russian], Moscow (1972).
5. V. A. Kirillin and A. E. Sheindlin, *Studying the Thermodynamic Properties of Materials* [in Russian], Moscow-Leningrad (1963).
6. B. P. Nikol'skii, O. N. Grigor'ev, M. E. Pozan, et al. (eds.), *Chemistry Handbook*, 3rd ed., revised [in Russian], Vol. 2, Leningrad (1971).
7. A. M. Mamedov, *Teplofiz. Viz. Temp.*, No. 1, 198-204 (1975).
8. T. S. Akhundov, "An investigation into the thermophysical properties of the hydrocarbons of the aromatic series," Doctoral Dissertation, Technical Sciences, Baku (1974).