EXPERIMENTAL DETERMINATION OF PROPANOL-1 P, ρ, T DATA

Z. R. Zakar'yaev

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The constant volume piezometer method is used to obtain P, ρ, T data for propanol-1 at temperatures of 150-370°K and pressures of 0.1-80 MPa.

The experimental data available in the literature on the P, ρ, T properties of propanol-1 shows divergence in values by an amount greater than the sum of the experimental errors involved. Thus, although the results of [1] do agree basically with those of [2] within 0.5%, nevertheless at low pressures and temperatures above 473°K the divergence between the respective data reaches several percent. The maximum deviation of data in [3] from those of [1] comprises 0.65% at 423°K and 50 MPa.

A study was made of P, ρ, T behavior of 99.55% pure propanol-1 (density at 20°C 0.8046 g/cm^3). The constant volume piezometer technique of [4] was used, with parasitic volumes eliminated by the use of a high-pressure valve operating at the experimental temperature. Data points were taken along both isobars and isotherms. The volume of the high-pressure vessel was measured at room temperature, and comprised 40.2020 ± 0.0005 cm^3. Thermal and baric corrections for the vessel were determined by the technique of [5] to an accuracy of 1 and 1.3%, respectively. Total error in determination of vessel volume under experimental conditions was less than 0.013%. The densities determined with consideration of all corrections had an uncertainty of less than 0.02%, including reference error.

Pressure was measured by a class 0.05 piston manometer with two measurement columns at 600 and 2500 kg/cm^2, while temperature was determined with a platinum thermometer with error less than 0.01°K.

Experimental results after coarse scale graphical processing for rounded pressure and temperature values are shown in Table 1.

At the conclusion of the P, ρ, T experiments a pycnometer and type WA-33 analytical scale were used to determine the normal densities of the propanol-1 studied and nine other samples of chemically pure grade propanol-1, produced in 1974-1978. The lowest density of 0.80352 g/cm^3 corresponded to a concentration of 99.95%. This sample was diluted by distilled water to determine the dependence of density upon propanol content (Table 2).

Table 3 presents the liquid density on the saturation line for the 99.55% concentration,

TABLE 1. Density of Propanol-1 (kg/m^3), $\rho_{20} = 0.8046$ (99.55%)

T, °K	P, MPa										
	0,1	2,5	5	10	20	30	40	50	60	70	80
150	922,7	923,5	924,6	926,7	930,3	934,1	938,0	941,8	945,4	948,7	951,6
170	903,5	904,8	905,9	908,1	912,5	916,4	920,7	924,6	928,4	931,7	934,8
190	886,5	887,6	888,8	891,1	895,9	900,3	904,8	909,0	913,1	916,7	919,9
210	870,6	871,7	873,1	875,4	880,2	885,1	889,9	894,4	898,4	902,2	905,6
230	854,4	855,7	857,2	859,8	864,9	870,1	875,2	879,9	884,4	888,5	892,2
250	838,5	839,8	841,4	844,1	849,8	855,4	860,8	865,9	870,5	875,2	879,2
270	823,0	824,5	826,1	829,1	835,3	841,6	847,4	852,8	857,5	862,1	866,4
290	807,2	809,2	811,3	814,8	821,8	828,2	834,1	839,7	845,2	849,9	854,4
310	791,4	794,0	796,3	799,9	807,5	814,4	820,9	826,8	832,4	837,6	842,6
330	774,8	777,4	780,1	784,4	792,7	800,1	807,1	813,4	819,2	824,7	830,1
350	757,6	760,2	763,2	768,4	777,6	785,4	792,5	799,4	805,7	811,8	817,5
370	739,6	742,7	745,3	751,6	761,8	770,3	778,1	785,1	791,7	797,7	803,3

Physics Institute, Dagestan Branch, Academy of Sciences of the USSR, Makhachkala.
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TABLE 2. Density vs Propanol-1 Concentration at 20.0°C

K, %	70,654	80,093	89,771	96,333	99,500	99,550	99,95	100,00
ρ, kg/m^3	853,37	841,45	826,37	812,40	804,80	804,60	803,52	803,48*

*Extrapolation.

TABLE 3. Liquid Propanol-1 Density on Saturation Line (99.55%)

T, K	ρ, kg/m^3	T, K	ρ, kg/m^3
150	922,7	270	822,8
170	903,6	290	807,3
190	886,6	310	791,1
210	870,1	330	774,3
230	854,1	350	756,4
250	838,6	370	736,6

determined both from the P, ρ, T experiment, and by finding the temperature of transition from the two-phase state to a single phase with slow heating of the specimen.

The results obtained were compared with those of [1]. Table 2 was used to determine the density of the specimen used in [1], which proved equal to 0.8037 g/cm^3 at 20°C. The specimen density in the present experiments was 0.0009 g/cm^3 higher. With consideration of this difference, the agreement at the 350°K isotherm lies within the limits of experimental uncertainity of [1], i.e., 0.1%. At the same time, at the 200°K isotherm there is a divergence exceeding the net uncertainty of the experiments. The divergence decreases from 0.35 to 0.15% with increase in pressure from 2.0 to 50.0 MPa. The data of [1] are elevated compared to those of the present study. Apparently, this divergence can be explained by experimental peculiarities of the technique used in [1] and the significant increase in specimen viscosity with reduction in temperature, which makes achievement of an equilibrium position by the float difficult.

NOTATION

P, pressure, MPa; ρ, density, kg/m^3; T, temperature, °K.

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