EXPERIMENTAL STUDY OF THE DEPENDENCE OF THERMODYNAMIC PROPERTIES OF THE WATER + PROPANOL-1 BINARY SYSTEM ON ITS COMPONENT COMPOSITION OVER A WIDE RANGE OF STATE PARAMETERS

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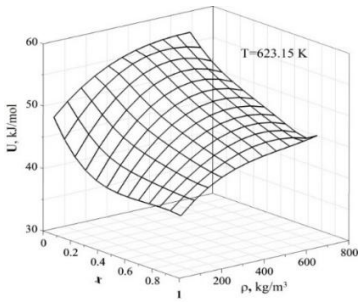
Measurements of the $(p,T\text{-}p,\rho,T)_x$ - dependences for 1-propanol aqueous solutions with compositions of 1-propanol (x = 0.1, 0.2, 0.3, 0.5, 0.8, 0.9 molar fractions), in two-phase, one-phase (liquid and vapor), and supercritical fluid states over temperatures ranging from 373.15 K to 673.15 K, densities between 1.5 kg/m³ and 850 kg/m³, and pressures up to 50 MPa have been carried out. The experimental values of $(p,T\text{-}p,\rho,T)_x$-dependencies are described by a thermal equation of state of virial form — an expansion of the compressibility factor $Z = p/(RT\rho m)$ into series of reduced density and temperature powers [1].

$$Z = p/RT\rho_m = 1 + \sum_{i=1}^{m}\sum_{j=0}^{n_i} a_{ij}\,\omega^i/\tau^j, \text{and } p = RT\rho_m\left[1 + \sum_{i=1}^{m}\sum_{j=0}^{n_i} a_{ij}\,\omega^i/\tau^j\right]$$

Herein: ρ_m is the molar density (mol/m3), $\omega=\rho/\rho_c$and $\tau=T/T_c$ are the expressions for reduced density and reduced temperature respectively, where ρc and Tc represent critical density and critical temperature; R=8.314 J/(mol·K) is a universal (molar) gas constant. The average relative deviation of calculated pressure values using this equation compared to experimental data amounts to 1.2%.

Based on Equation [1] and thermodynamic relations [2], variations of the main thermodynamic properties of the studied solutions were computed. A plot illustrating the dependence of internal energy changes (U) on solution composition (x) and density (ρ) at a temperature of 623.15 K is presented in the figure.



1. Osmanova B.K., Bazaev A.R., Bazaev E.A. Experimental research of thermodynamic properties of water+ aliphatic alcohol mixtures in the wide parameters of state // Journal of Phisics: Conf.Series 1385 (2019).

2. Shpilrain E.E., Kesselman P.M. Fundamentals of Theory of Thermophysical Properties of Substances. Moscow: Energiia Publ., 1977. 248 pp.