Fundamental Equation of State of Octafluoropropane

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In this paper, an octafluoropropane fundamental equation of state (EOS) developed on the basis of the Helmholtz free energy. The expression for this EOS is obtained on the basis of the phenomenological theory of critical phenomena [1] and the hypothesis of the same nature of the behavior of the isochoric heat capacity, isothermal compressibility and isobaric heat capacity for critical and near-critical isochores [2]. Non-analytic EOS describes the neighborhood of the critical point in accordance with the scaling theory of critical phenomena. Based on the proposed EOS calculated table of octafluoropropane thermodynamic properties on the phase equilibrium in the temperature range from the triple point to the critical point. In the single-phase region table are calculated in the temperature range from 125.45 K to 460 K and pressures from 0.001 to 70 MPa including a wide neighborhood of the critical point. It has been shown that the deviation calculated by the EOS of this work and the experimental density values in the temperature range from 130K to 210 K in the liquid region in the wide neighborhood of the critical points lie between 0.05% and 4%, respectively. Calculations using the EOS [3] showed that these variations are within 1.5% and 35%, respectively. Standard deviation calculated by the EOS of this work and the experimental data were: density in the single-phase region 0.32%; isochoric heat capacity including a wide neighborhood of the critical point 0.6%; density on the liquid branch of the saturation line 0.14%; the density of the vapor branch line saturation 0.7%; “apparent” heat of vaporization including the near critical region 0.38%; the heat capacity of saturated liquid 1.1%, isobaric heat capacity 2.4%.

References

[1] Rykov, S.V. Nauchno-Tekhnicheskiy Vestnik Povolzh'ya. 2014, 1, 33-36.
[2] Benedek, G.B. Polarisation, matiere et rayonnement. Presses Universitaires de France, Paris. 1969, 49.
[3] Lemmon, E.W., Span, R. J. Chem. Eng. Data. 2006, 51, 785-850.