Thermodynamic Properties of the Diethyl Ether at the Saturation: Experiments and Scaling Models

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New experimental data by Abdulagatov et al. [1] on saturated properties, F = (the saturated densities, ρ_l, ρ_g, the vapor pressure, P_s , et al.) of the diethyl ether (*DEE)* are analyzed using various scaling models. Experimental values of (ρ_l,ρ_g,T) are compared with some models which represent F = (ρ_l, ρ_g, the order parameter, f_s, the coexistence curve diameter, f_d). We have considered equations suggested by Wegner, 1980, Fisher et al, 2000, Abdulagatov et al., 2010, and other models related to F.

An analytical form to express F of *DEE* is studied. It has a combined structure [2] with scaling and regular parts

$$F(\tau,D,B) = F(\tau,D,B1)_{scale} + F(\tau,B2)_{reg} , \qquad (1)$$

here $\tau = (T_c - T)/T_c$ – reduced temperature, D = (α,β, …) - critical characteristics, B = ($B1$, $B2$) - coefficients.

Combined models of F = (f_s, f_d) have the form [2]

$$f_s = B_{s0}\tau^{\beta} + B_{s1}\tau^{\beta+\Delta} + B_{s2}\tau^{\beta+2\Delta} + B_{s3}\tau^{2} + B_{s4}\tau^{3},$$

$$f_d = B_{d0}\tau^{1-\alpha} + B_{d1}\tau^{1-\alpha+\Delta} + B_{d2}\tau^{1-\alpha+2\Delta} + B_{d3}\tau^{2} + B_{d4}\tau^{3}, \qquad (2)$$

here Δ – non-asymptotic critical exponent (a Wegner correction).

Combined models of F = (ρ_l,ρ_g) can be expressed with the Eq. (2) in the form

$$\rho_l = (f_d + f_s + 1)\,\rho_c, \qquad \rho_g = (f_d - f_s + 1)\,\rho_c . \qquad (3)$$

Adjustable coefficients, B, and characteristics D = (α,β,T_c, …) are determined by fitting combined models to (ρ_l, ρ_g T) - data sets of *DEE* with the help of a non linear method.

We have considered equations suggested by Wagner, 1973, Xiang and Tan, 1994, and Wu et al., 2005, Abdulagatov et al., 2011, and other models those can describe $F = P_s$. A combined model (1) is built [2] to represent experimental $(P_s,T)_{exp}$ – data for *DEE* in the form

$$ln(P_s/P_c) = B_{p0}\tau^{2-\alpha} + B_{p1}\tau^{2-\alpha+\Delta} + B_{p2}\tau^{2-\alpha+2\Delta} + B_{p3}\tau, + B_{p4}\tau^{5} + B_{p5}\tau^{7} + B_{p6}\tau^{9}, \qquad (4)$$

Some application results are determined and discussed. They are got with the help of the models and connected with thermodynamic properties on the coexistence curve of *DEE*. The work is supported by RFBR.

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2. Ustjuzhanin E.E., Utenkov V.F., Rykov V.A. Combined models of thermophysical properties along the coexistence curve. In the book: Soft matter under exogenic impact. NATO Science series. Part II, Vol. 242. Editor Rzoska S. Eddition - Springer, The Netherlands, 2006, 480 p.