

Comparative Study of the Saturation Pressure and Its Derivatives for Some Liquids

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Some models of the saturation pressure P_s are considered in the report among them there are equations suggested by Wagner (1973), Rabinovich and Sheludiak (1995), Abdulagatov, et al. (2007), Park [1], Ustyuzhanin et al [2,3] and Xiang (2006). These equations are used to compare with reliable experimental data of some substances including H_2O , CH_4 and methanol. A modified Park model has the form

$$\ln P_r = a \frac{(-T_r)^{-1}}{T_r} + \frac{(-T_r)^{-2}}{T_r} \left[c - b \ln \left(\frac{1}{T_r} - 1 \right) \right] + e \frac{(-T_r)^{-3}}{T_r}, \quad (1)$$

where $P_r = P_s/P_c$, $T_r = T/T_c$ - relative pressure and temperature, a , b , c and e - coefficients determined by fitting model (1) to input $(P, T)_{exp}$ - data sets.

A combined model is written as

$$\ln P_r = B_{p0} \tau^{2-\alpha} + B_{p1} \tau^{2-\alpha+\Delta} + B_{p2} \tau^{2-\alpha+2\Delta} + B_{p3} \tau + B_{p4} \tau^5 + B_{p5} \tau^7 + B_{p6} \tau^9, \quad (2)$$

where $\tau = (T_c - T)/T_c$ - a relative distance in the temperature, (B_{pi}) - amplitudes.

The degree laws of the scaling theory of critical phenomena (ST) were taken into account. A scaling part or $(\ln P_r)_{scale}$ includes the first four terms of (2). Adjustable coefficients, (B_{pi}) , and characteristics $D = (P_c, T_c, \alpha)$ are determined by fitting the MPEI model to the input data sets.

Linear and non-linear algorithms of an approximation have been used to determine fitting coefficients of models (1,2). These input data sets were placed in wide temperature intervals including reliable experimental results near the critical temperature T_c . Criteria of an optimization S1 and S2 are taken into account in the routines: S1 represents RMS deviation of $(P, T)_{exp}$ values from $(\ln P_r)_{scale}$ in the critical region, $\tau = (0 \dots 0.1)$, S2 represents RMS deviation of $(P, T)_{exp}$ data in the whole temperature interval.

Some functions were investigated among them: derivatives dP_s/dT and d^2P_s/dT^2 and a relative derivative α_w . The functions are determined for some models and compared in wide temperature intervals.

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