THE FUNDAMENTAL EQUATION OF STATE FOR R1234yf

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On the basis of the phenomenological theory of the critical point and the Benedek hypothesis, the fundamental equation of state for R1234yf was developed in the form of the following expression for the Helmholtz free energy F:

$$F(\rho,T) = F^0(\rho,T) + RT\omega \sum_{i=0} \sum_{j=0} C_{ij}\tau_1^j (\Delta\rho)^i + F_{nreg}(\rho,T), \qquad (1)$$

where $F^0(\rho,T)$ is the ideal gas component of F; $\Delta\rho = \omega - 1$; $\omega = \rho/\rho_c$; ρ_c is the critical density; T_c is the critical temperature; R is the gas constant; C_{ij} are constant coefficients.

The function $F_{nreg}(\rho,T)$ is the irregular component of the Helmholtz free energy:

$$F_{nreg}(\rho,T) = \frac{p_c}{\rho}\phi(\omega)|\Delta\rho|^{\delta+1}a(x), \qquad (2)$$

where $a(x)$ is the scale function; $x = \tau/|\Delta\rho|^{1/\beta}$; $\tau = T/T_c - 1$; β and δ are critical indices; $\phi(\omega)$ is the regular function; p_c is the critical pressure.

To calculate the parameters of the function (2), the results of [1] are used. Two variants of the choice of the scale function $a(x)$ are considered: (i) on the basis of Migdal phenomenological theory of the critical point [2]; (ii) on the basis of a new presentation of the scale hypothesis [3]. As a result, the equation of state for R1234yf has been developed, which has the following working area: for temperature 230–400 K and for pressure up to 20 MPa. A comparison is made with the known experimental data on the equilibrium properties of R1234yf and the fundamental equation of state [4].

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1. Lysenkov V.F., Rykov V.A. // High Temp. 1991. V. 29. P. 1236.
2. Kudryavtseva I.V., Rykov S.V. // Russ. J. Phys. Chem. A. 2016. V. 90. P. 1493.
3. Rykov S.V., Rykov V.A., Kudryavtseva I.V. // XXXI International Conference on Equations of State for Matter. 2016. P. 62.
4. Richter M., McLinden M.O., Lemmon E.W. // J. Chem. Eng. Data. 2011. V. 56. P. 3254.