INVESTIGATION OF THE LIQUID DENSITY, THE GAS DENSITY AND THE PRESSURE: SOME MODERN MODELS AND NUMERICAL DATA ON THE SATURATION LINE OF H_2O

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An analysis of some literary sources is made in the report. They contain tabulated data on the liquid density (ρ_l), the gas density (ρ_g) and the pressure (P) on the saturation line of H_2O. We have considered also a work of Alexandrov et. al. (1998) and a work of Anisimov et. al (1990). It is shown that the accurate calculated ρ_l, ρ_g, T data are based on scaling models of Anisimov et. al. (1990). Among them there is a form, $\rho_g(\tau, D, C)$, which is associated with ρ_g, here $\tau = (T_c - T)/T_c$ is the relative temperature, $D = (\alpha, \beta, T_c \ldots)$ are critical characteristics, (α, β) are critical indexes, C are adjustable coefficients. An Abdulagatov scaling model, $P(\tau, D, C)$, is considered too. These models meet the scale theory of critical phenomena (ST), work in the interval, $\tau = 0.002 - 0.012$, and reflects properties (ρ_l, ρ_g, P, T) data accumulated before 1990.

We have considered a model, $f_d(\tau, D, C)$, which is intended to describe the mean diameter, $f_d = (\rho_l + \rho_g)(2\rho_c)^{-1} - 1$. The model, $f_d(\tau, D, C)$, is adapted to H_2O (Anisimov, 1990) and has contained a scaling component with $(1 - \alpha)$ index and a linear component. Another type of $f_d(\tau, D, C)$ is developed in this work and referred to as a combined scaling model. Its structure contains several components, among them: (i) component with 2β index, (ii) a component with $(1 - \alpha)$ index. A similar combined scaling models have been developed for other properties (the order parameter, ρ_l, ρ_g, P).

A nonlinear methods are proposed to calculate characteristics, $D = (\alpha, \beta, T_c, \rho_c \ldots)$, and adjustable coefficients, C. For example, this statistical procedure is oriented on $f_d(\tau, D, C)$ uses input ρ_l, ρ_g, T data, which are placed in a wide temperature range including the critical region. There are got numerical estimates of parameters those are related to functions ($f_d(\tau, D, C)$, $\rho_g(\tau, D, C)$, $P(\tau, D, B)$ et. al.) and based on tabulated ρ_l, ρ_g,P, T data related to IAPWS-IF 97 of H_2O. These functions have been used to calculate (ρ_l, ρ_g, P, T) values in the interval $10^{-5} < \tau < 0.01$. We have considered an equation of state (EOS), which is included in the formulation (IF-95) and recommended by IAPWS. We have compared our (ρ_l, ρ_g, P, T) data with results those are determined on the basis of this EOS.