Correlation of the critical parameters of the gas-liquid phase transition and the density of the crystal at zero absolute temperature

© Ikhtier H. Umirzakov
The Laboratory of Modeling, Kutateladze Institute of Thermophysics of SB of RAS. Prospect Lavrenteva, 1. Novosibirsk, 630090. Russia. Phone: +7 (383) 354-20-17. E-mail: tepliza@academ.org

Keywords: critical temperature, critical volume, critical pressure, critical parameters, equation of state, liquid-gas phase transition.

Abstract
The empirical Timmermann’s formula connecting the density of the crystal at zero absolute temperature with the parameters of the critical point of the gas-liquid phase transition is derived theoretically from the Van der Waals equation of state using the conditions of phase equilibrium.

The equations of state \( p(T, v) = kT / (v - b) - a / v^\alpha \) and \( p(T, v) = kT / v + B / v^{\beta+1} - \bar{N} / v^{\beta} \) with three parameters describing the critical point of any pure substance are considered. The Timmermann’s formula is derived approximately from the first equation and exactly from the second one.