

Van der Waals Theory is Correct: Selections of Cubic Equations-of-State Are Problematic

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Van der Waals theory of cubic equations-of-state and its power deduction-the corresponding states principle are used to predict thermodynamic and transport properties of fluid and fluid mixtures at the macroscopic scale where engineering calculations are performed. A thorough check of the van der Waals dissertation of 1873 that was translated into English language in 1890 in the Physical memoir by Alder shows that van der Waals is essentially satisfactory for quantitatively predicting critical point of mixtures of asymmetric systems and the theory is capable to yielding accurate prediction of transport properties (viscosity and thermal conductivity) over the entire PVT states. However, the choice of the cubic equation-of-state used by van der Waals and other familiar cubic equations-of-state (Clausius, Redlich-Kwong, Peng-Robinson, Patel-Teja, Schmidt-Wenzel and Trebble-Bishnoi) are totally in disagreement with the theory of cubic equations-of-state. This paper provides an analysis for the reason for the oversight of the van der Waals equation-of-state and demonstrates the ways of using a generic equation-of-state to capture all the published cubic equations and developed analytical expressions for fluid and fluid mixtures critical point, corresponding states principle and transport property equations-of-state. The paper is useful for stopping proliferation of cubic equations-of-state while providing a single, unified equation-of-state for testing the performance of the various known cubic equations-of-state.