Thermodynamic Functions at Isobaric Process of van der Waals Gases

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The thermodynamic functions for the van der Waals equation are investigated at isobaric process. The Gibbs free energy is expressed as the sum of the Helmholtz free energy and PV, and the volume in this case is described as the implicit function of the cubic equation for V in the van der Waals equation. Furthermore, the Gibbs free energy is given as a function of the reduced temperature, pressure and volume, introducing a reduced equation of state. Volume, enthalpy, entropy, heat capacity, thermal expansivity, and isothermal compressibility are given as functions of the reduced temperature, pressure and volume, respectively. Some thermodynamic quantities are calculated numerically and drawn graphically. The heat capacity, thermal expansivity, and isothermal compressibility diverge to infinity at the critical point. This suggests that a second-order phase transition may occur at the critical point.

Key words: Van der Waals Gases; Isobaric Process; Second-order Phase Transition.