

Generalized Similarity Laws and Remarkable Lines in Thermodynamics of Simple Fluids

Vladimir Vorob'ev^{C, S} and Evgenii Apfelbaum

Izhorskay, Joint Institute for High Temperatures of Russian Academy of Sciences, Moscow, Russia
vrbv@mail.ru

The similarity laws play important role in thermodynamics as far as they allow one to establish the general features of behavior for very different substances. The well-known examples of these regularities are the principle of corresponding states and the law of rectilinear diameter. For the liquid-gas domain of the phase diagram the van der Waals equation (vdW) serves as the most popular test model for the similarity laws. But it also can help to find new similarities. In particular, one more similarity, known as the Zeno line law (or simply Zeno-line - ZL), firstly was discovered as a consequence of vdW. This regularity concerns the states at the temperature-density plane, where the compressibility factor is unity. The curve containing the above states is appeared to be the straight line. It was shown that ZL regularity, characterized by ρ_B and T_B parameters, has a wide area of applicability than the other analogous regularities (see [1] and references therein). Besides this fact, ZL is the tangent to the liquid branch of binodal at T tends to zero. Recently we have found that one more consequence of vdW can also be generalized fore other substance. This regularity concerns the enthalpy, saturation pressure, isobaric thermal expansion coefficient, Joule-Thomson inversion temperature. Namely for vdW the line where the enthalpy per particle coincides with the ideal gas enthalpy (H) is also the straight line (characterized by parameters ρ_H and T_H). We have confirmed these regularities for the Lennard-Jones [2] system as well as for some other models and real substances.

References

[1] Apfelbaum, E. M.; Vorob'ev V., *Chem. Phys. Lett.* **2014**, 591, 212-215.