Thermodynamic Analyses of Cycles by the Volume Translated Peng-Robinson Equation of State with the G^E Mixing Rule

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The Peng-Robinson equation of state describes the VLE behavior of symmetric and asymmetric fluids reasonably by means of the volume translation and the g^E mixing rule. The volume translation, the SRK equation of state with the UNIFAC g^E model, and the volume translated Peng-Robinson equation of state with the modified UNIFAC g^E model are published by Peneloux *et al.* in 1982, by Holderbaum and Gmehling in 1991 and by Ahlers *et al.* in 2002 respectively. In this study, we used the UNIQUAC method to calculate the excess Gibbs energy, g^E, in addition to UNIFAC and modified UNIFAC with the g^E mixing rule, in order to discuss fitting methods and to extend this equation to the super heated and sub-cooled regions in order to analyze the thermodynamic cycles. There are three primary advantages in the volume translated Peng-Robinson equation of state with the g^E mixing rule (the VTPR with g^E model). First, there is an improvement in the estimation of volume in the liquid region without a more complex algorithm. Second, there is an availability of published interaction parameters of UNIFAC and modified UNIFAC. Third, there is an adaptation of specified mixtures by fitting UNIQUAC parameters. The parameter fitting procedure adapted to cycle analysis and the availability of the VTPR with g^E model in thermodynamic analyses of cycles with different working fluids are presented in this paper. We conclude that the VTPR with g^E model can predict properties of many substances not only in phase equilibria but also in super heated and sub-cooled regions reliably.