Three-parameter Corresponding States Models for Non-polar Systems based on Reference Equations of State

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This work presents an overview of the results obtained with three-parameter corresponding states models coupled with state-of-the-art reference equations of state. The application to non-polar systems confirmed that this device offers an alternative to the “technical equations” that are currently in use within the scope of technical applications. The model was a three-parameter three-fluid model. For mixtures of natural gas components, the reference fluids were methane, ethane and carbon dioxide. For air and mixtures of its components, nitrogen, oxygen and argon were used. The reference equations of state were: Setzmann-Wagner for methane, Bücker-Wagner for ethane, Span-Wagner for carbon dioxide, Span et al. for nitrogen, Stewart et al. for oxygen and Tegeler et al. for argon. For systems of natural gas components the overall AADs were: for *p*-rho-*T* data: 0.19 for primary binary systems, 0.40 for secondary binary systems, 0.13 for ternary systems and 0.09 for quaternary systems; 1.70 in isobaric heat capacities, 0.17 in speeds of sound and 1.32 in bubble-point vapour pressures. For air the overall AADs were: 0.080 in *p*-rho-*T* data, 0.56 in isochoric heat capacities, 0.27 in speeds of sound, 0.20 and 0.32 in bubble- and dew-point saturation pressures, respectively, and 2.89 and 2.50 in bubble- and dew-point saturation densities, respectively. For binary mixtures of the air components, the overall AADs were 0.17 in *p*-rho-*T* data and 0.44 in bubble-point vapour pressures. These results compared favourably with those obtained with state-of-the-art Helmholtz energy mixture models for natural gas components and air [1,2] and improved by an order of magnitude those obtained with the widely used Lee- Kesler model and the Peng-Robinson cubic equation with volume translation.

[1] E.W. Lemmon, R.T. Jacobsen, S.G. Penoncello, D.G. Friend, J. Phys. Chem. Ref. Data 29 (2000) 331-385.
[2] E.W. Lemmon, R.T. Jacobsen, Int. J. Thermophys. 20 (1999) 825-835.