A Predictive Model for the Thermodynamic Properties of Mixtures

Ryo Akasaka [C, S]
Kyushu Sangyo University, Faculty of Engineering, Department of Mechanical Engineering, Fukuoka, Japan
ryo-a@ip.kyusan-u.ac.jp

Yukihiro Higashi
Iwaki Meisei University, Department of Science and Technology, Iwaki, Japan

A new mixture model is presented for the thermodynamic property formulation of mixtures based on Helmholtz energy equations of state. Experimentally-determined correlations for the critical locus of a target mixture form the basis of the mixture model. The critical temperature and density obtained from the correlation are directly used as reducing parameters to calculate reduced temperature and density that are independent variables of the model. The model is predictive and does not use any other information on thermodynamic properties of the mixture. Vapor-liquid equilibrium (VLE) calculations using the model were performed for the five binary refrigerant mixtures of R-32 with R-1234yf, R-1234ze(E), R-290 (propane), R-600a (isobutane), and R-1270 (propylene). These mixtures are considered as possible alternatives to existing refrigerants with higher global warming potential. Although critical locus correlations and some experimental VLE data are available for these mixtures, other experimental data required for the development of an accurate mixture model, such as liquid density, heat capacities, and speed of sound, are very limited. The VLE calculated from the model were compared with experimental data and with calculated values from other mixture models. It has been shown that the new model can represent the bubble-point and dew-point curves reasonably, although no empirical parameter to fit to experimental data is employed in the model.