Isothermal Vapor-Liquid Equilibria for Pentafluoroethane + Propane and Pentafluoroethane + 1,1,1,2,3,3,3-Heptafluoropropane Systems

Shuxin Hou [C, S] and YuanYuan Duan
Key Laboratory for Thermal Science and Power Engineering of Ministry of Education, Tsinghua University, Beijing, China

Xiaodong Wang
Department of Thermal Engineering, University of Science and Technology Beijing, Beijing, China

Chlorofluorocarbons (CFCs) have been widely used as refrigerants, blowing agents, propellants, and cleaning agents due to their outstanding properties. However, production and usage of CFCs are prohibited under the international Montreal Protocol agreement because of global environmental concerns. Hydrofluorocarbons (HFCs) and related mixtures have been considered as promising alternatives since their low ozone depletion potentials and global warming potentials. The vapor-liquid equilibria (VLE) data are required as fundamental data for evaluating the performance of refrigeration cycles and determining the optimal compositions. Isothermal vapor-liquid equilibria data were measured for the pentafluoroethane (R125) + propane (R290) and pentafluoroethane (R125) + 1,1,1,2,3,3,3- heptafluoropropane (R227ea) binary systems using a circulation-type VLE apparatus. The estimated accuracies of the measured data are ±0.005 K for temperature, ±600 Pa for pressure, ±0.002 in mole fraction for both the liquid and vapor phases. VLE data for R125 + R290 at 293.15 K were compared with the literature data to validate our experimental setup, which show good consistent with published data sets, and for R125 + R227ea system, no data in open publications are available. The vapor-liquid equilibria data for the measured system were tested for thermodynamic consistency. Furthermore, the experimental data sets were correlated using the Peng-Robinson equation of state both with the classical mixing rules and the Wong-Sandler mixing rules. The calculated results agreed well with the experimental data in both cases, though the Peng-Robinson equation of state with the Wong-Sandler mixing rules gave much better results. The compositions of the azeotropes at each temperature were also evaluated.