Precise Measurements of Pvtx Properties for CO_2-Hydrocarbon Systems in the Temperature Range from (280 to 440) K at Pressures from (1 to 200) MPa

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A long-term objective of this study is to accumulate the precise measurement data for environmentally acceptable natural working fluids such as CO_2, isobutane, propane, and their mixtures in the wide ranges of temperatures and pressures. Recently, *pvTx* and saturation property measurements for light hydrocarbons and their mixtures had been carried out using the metal-bellows valuable volumometer developed by Kabata et al. (1) and modified by Miyamoto and Uematsu (2). In this study, we will report new measurement results of (p, v, T, x) property for CO_2-hydrocarbon systems in the compressed liquid phase in temperatures from (280 to 440) K at pressures up to 200 MPa. Before the present measurements, we did the entire calibration test again and prepared several new calibration equations, such as the equation of the inner volume of the bellows, and that of the pressure difference between the internal and external pressure of the bellows. The expanded uncertainties (k=2) of temperature, pressure, density, and composition measurements have been estimated to be 3 mK, 1.4 kPa - 0.2 % in the respective ranges of pressures, 0.09 %, and 1.3×10^{-4}, respectively. Throughout the present study, the comprehensive comparisons of the measurement results with published data are made, in order to assess the reliability of the experimental apparatus quantitatively. We also observe the reproducibility of the available equation of state to the present measurements of mixtures in the ranges over the range of validity of the model, from which the reliability of the available model can be confirmed. Moreover, the excess molar volumes are calculated based upon only the experimental data and are illustrated as a function of temperature and pressure.

[1] Y Kabata, S Yamaguchi, M Takada, M Uematsu, J. Chem.Thermodyn. 24 (1992) 1019-1026
[2] H. Miyamoto, M. Uematsu, J. Chem. Thermodyn. 39 (2007) 588-593.