Solid-Liquid Equilibria in the Systems: $CO_2 + N_2O$, CO_2 + R32, and N_2O + R32

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Our research on properties of fluids with potential applications at low temperatures down to 200 K was focused on mixtures formed with acceptable refrigerants and, for some of them, the PVTx measurements both by the isochoric and the Burnett methods were performed. While applying the isochoric method, data for both the two-phase and superheated regions were collected. From experimental data, the VLE parameters were derived. A thermodynamic cycle analysis on the basis of the experimental data showed that some of the studied mixtures might be attractive options for low-temperature refrigeration applications, provided that the mixtures are fluid and are operating within a range of temperatures. Tentatively, the analysis was performed involving estimated mixtures considered. To cover the gap existing in the literature on solid-liquid equilibrium and, thus, to validate our predictions, the study on the solid-liquid equilibrium for some selected systems was undertaken. For this purpose, a set-up was built and measurements of the system behavior at temperatures down to 130 K were performed for three binaries: $CO_2 + N_2O$, CO_2 + R32, and N_2O + R32.

Most of the solid-liquid equilibrium measurements were performed at not very low temperatures for systems with low pressures at melting temperatures. Both factors enable visual observation of the disappearance of the last part of the solid phase and relatively easy control of the temperature. Considering the properties of the systems, ie. the expected temperature range down to about 150 K and the system pressure only a few tens above atmosphere during the whole experimental cycle, including sample charging, we decided to use a method without visual observation of the phase behavior as more technically feasible. We included the possibility of recording not only T-x but also pressure data. The results obtained were interpreted through the Schröder equation, expressing activity coefficients in terms of an equation of state thus linking our present data with VLE data measured at high pressures.