Measurements of Phase Equilibria and Phase Densities in Methane-Dominant Binary Mixtures at Cryogenic Temperatures and High Pressures for Improved Process Design and Simulation

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Liquefied natural gas (LNG) is the leading technology for bringing remote natural gas resources to market, and is Australia's only option for participating in the international trade of its significant natural gas reserves. The simulation of LNG processes is crucial because it is the only cost-effective method by which design improvements can be tested. However, the difference between the actual plant operating conditions and those predicted by the simulator are often substantial. The current practice is to over-engineer the plant to compensate for these discrepancies. Unfortunately, this leads to increases in the costs of constructing and running the plant, which may contribute to the development being abandoned. One reason for the inaccurate process simulations is that the equations of state used by the simulator are not tuned to thermodynamic data representative of plant conditions. In this presentation new experimental *pTxy* data are reported for methane-dominant binary systems where the minor component is one of ethane, propane, iso-butane or n-hexane. The data were measured at pressures to 6 MPa over the temperature range 130 to 300 K using a custom-built vapour-liquid equilibria apparatus. Rapid On-Line Sampling Injectors and a gas chromatograph were used to capture and measure the composition of representative micro-litre samples from the liquid and gas phases in the cell. Another apparatus has also been developed to measure *pVTxy* data for similar mixtures over the same range of conditions. This second apparatus uses the same sampling technique but incorporates circulation pumps to mix the phases and allow the densities of the saturated phases to be measured with vibrating tube densimeters. The experimental data reported are compared with modern reference equations of state of natural gas, and the experimental techniques are discussed in detail.