Binary and Ternary HPVLE Data for Hydrocarbon + HFC Refrigerant Systems

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Up until present, the majority of supercritical applications have used either carbon dioxide or, less frequently, n-alkanes as the principle solvent. The greatest disadvantage with these solvents is their lack of polarity, and consequentially, the poor solvation power. A means to overcome the low solubilities, by improving the polarisability of the solvent, is by the addition of a polar co-solvent to the mixture. These liquid co-solvents must, however, be separated from the solute, making the process more complex. This study investigated the use of trifluoromethane (CHF_3, R-23) and hexafluoroethane (CF_6, R-116) as possible solvents for supercritical extraction, as both have critical temperatures that are close to ambient temperatures and low critical pressures. Trifluoromethane was of particular interest, as it is a highly polar species. High pressure phase equilibria of binary mixtures consisting of (refrigerant + hydrocarbon) were measured using a static analytic apparatus. The data was regressed using the (PR-MC + WS/NTRL) thermodynamic model, and the uncertainties were evaluated using the methods recommended by NIST. The critical loci of the binary mixtures were predicted by the extrapolation of the experimental data. Ternary phase equilibrium data for the mixtures of (n-hexane + n-decane) and (n-octane + n-decane) with (trifluoromethane or hexafluoroethane) were measured. The selectivity of the solvent was determined from the ternary data and compared to the apparent selectivity calculated from the binary data. These curves were then compared against published data for these liquid mixtures in carbon dioxide. The refrigerants appear to have a selectivity similar to that of carbon dioxide for the separation of these components. There is, however, a substantial increase in the solubilities of the n-alkanes in trifluoromethane when compared to those observed in non-polar solvents.