Measurement and Prediction of the Phase Behaviour of the System (Carbon Dioxide + N-Decane + Water) Under Reservoir Conditions

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Injection of carbon dioxide is one of the most attractive techniques used in enhanced oil recovery (EOR). An additional benefit is the potential use of active oil formations for anthropogenic carbon dioxide storage. Acquiring a comprehensive understanding of the behaviour of carbon dioxide under reservoir conditions is essential for optimizing usage and developing sequestration schemes. In this work, the system (carbon dioxide + n-decane + water) is used as an ideal carbon dioxide/oil/water mixture. To our knowledge, this system has been the subject of only one previous experimental study. Isothermal vapour-liquid equilibria (VLE) measurements were made using a new high-pressure apparatus based on the static-analytical method. The main body of the equipment consisted of a high pressure stainless steel view-cell of volume 35 cm^3. Samples from the coexisting phases were taken by two electronically actuated six-port valves and quantitative analysis was done by means of a gas chromatograph connected on-line with the cell. The calibration procedure used in this work allowed the measurement of the phase composition and estimation of the phase densities. The maximum operating temperature and pressure of the experimental setup were 423 K and 45 MPa, respectively. The apparatus was validated by comparison with published experimental data for the binary system (carbon dioxide + n-decane).

The experimental work was complemented with a theoretical effort to develop models for these molecules, using the statistical association fluid theory for potentials of variable range (SAFT-VR). In SAFT-VR the chainlike nature of the molecules and the hydrogen bonding interactions of water are treated explicitly. The phase behaviour of the three binary subsystems was calculated using this equation and, where applicable, a modification of the Hudson and McCoubrey combining rules was used to treat the systems predictively. The experimental data obtained for the ternary mixture was compared to the predictions of the theory at conditions of interest to oilfield processes.

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