Poster SCF4

Viscosity and Density of Carbon Dioxide + n-Heptane Under High Pressures: Measurements and Molecular Simulations

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Enhanced oil recovery by carbon dioxide miscible flooding is among the most effective non-thermal improved oil recovery methods. In that method, CO_2 is injected into reservoir under high pressure, then it migrates in oil phase via convective dispersion processes and molecular diffusion causing a significant reduction in oil viscosity. In addition, CO_2 dissolution makes the oil swell which results in an easier displacement of crude oil due to gravity. Both oil swelling and viscosity reduction improve crude oil mobility and thereby provide opportunities to recover oils that would not otherwise be produced. The process is applicable to a wide range of oil types as supercritical CO_2 is mutually soluble with many hydrocarbons. To model recovery processes and to evaluate their real efficiency viscosity and density are essential thermophysical properties. Accurate viscosity as a function of CO_2 composition, temperature and pressure is needed to predict diluted oil flow properties in porous media. The knowledge of density as a function CO_2 content in reservoir conditions is also required to perform reservoir simulation during CO_2 injection. With this aim in mind, an investigation by both experimental and molecular simulation of density and viscosity of binary systems containing CO_2 and a hydrocarbon has been initiated in our laboratory. At the initial phase of this program, it was chosen to investigate the carbon dioxide + n-heptane mixture. Viscosity, using a technique recently developed by Daridon et al. [1], and density measurements have been conducted for six compositions ranging from 0 to 100 % of carbon dioxide in the temperature range from 293.15 to 313.15 K at pressures up to 70 MPa. The molecular dynamics simulations have been performed on a coarse grained representation of the CO_2 and n-C7 as in Galliero et al. [2], yielding results in very good agreement with experiments both on density and viscosity.

References

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[2] GALLIERO, G., C. NETO-DRGAHI, C., BONED, C., MACKIE, A. D., BONET-AVALOS, BONET-AVALOS, J., BAYLAUCQ, A., MONTEL, F., Ind. Eng. Chem. Res., Vol.46, **2007**, p.5238