

A Comparison Study of CO₂-Heavy Oil Physical Properties in Bulk Oil and Oil Saturated Porous Media

Ali Kavousi¹, Farshid Torabi¹, and Christine W. Chan¹

¹University of Regina, Regina, Saskatchewan, Canada

Abstract

CO₂ mass transfer process plays a significant role in CO₂ based enhanced oil recovery techniques. Therefore, it is essential to have a deep understanding about this mechanism in reservoir condition. In this work, CO₂ solubility and diffusivity in two heavy oil samples were studied for both bulk and oil saturated porous media. First, CO₂-heavy oil was brought in contact under stationary condition at initial CO₂ pressure of 1.73, 3.10 and 4.48 MPa and system temperature of 301 K for oil with 5 and 20 Pa.s viscosities. Then, a mini bench-top reactor (PAAR 4560) was employed to create convection inside the oil phase and the system behavior was studied in a convective medium. Afterwards, an oil saturated porous media was developed with the same oil samples used in the bulk study under the same operational conditions. For all the test conditions, pressure decay method was utilized to determine CO₂ solubility in heavy crude oil samples. Mathematical models describing the experiments were derived and then numerically solved to determine CO₂ diffusion coefficient under the test conditions. It was seen that CO₂ solubility in heavy oil samples is principally controlled by pressure change rather than to the oil viscosity change. Moreover, in the convective medium, the apparent diffusion coefficient is higher than that of static condition due to the convection effect. Such an effect showed 0.5-15% increase on diffusion coefficient at different pressures.