

CERE – SEMINAR

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Online from link in calendar invitation

“Determination of methane diffusion coefficients in live oils at high pressure

By

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Abstract

Molecular diffusion is a fundamental mechanism in oil production from shale or other tight formation through gas injection. There is a general lack of diffusion coefficients at high pressures, and the diffusion coefficients in reservoir fluids, i.e., oils with dissolved gas at reservoir pressures, are especially rare. The reported diffusion coefficients often differ in orders of magnitude, and there is no consensus on the reliability of the correlations for liquid phase diffusion coefficients.

In this study, we used the constant volume diffusion method to measure the high-pressure diffusion coefficients in a newly designed high-pressure tube. The method is relatively simple and more suitable for high-pressure reservoir fluids. For each measurement, gas and oil were loaded subsequently into a constant volume tube in a constant temperature environment. The system pressure started decaying due to diffusion, and the pressure variation was recorded for 2 weeks. The final equilibrium pressure was also measured at the end of the experiment. The experimental method was first validated by methane-hexadecane and methane-decane systems. It was then used to measure the methane diffusion coefficients in reservoir fluids at some typical gas injection conditions. The obtained pressure data were processed by compositional simulation to determine the diffusion coefficients (Ghasemi et al., 2017).

The diffusion coefficients measured for methane-hexadecane and methane-decane tests are in agreement with the existing literature data. The extended Sigmund correlation also gives reasonable estimation of the diffusion coefficients for these two systems and many other collected binary diffusion coefficients. However, the diffusion coefficients estimated by extended Sigmund correlation are much lower than the measured results for methane-live oils systems. The other correlations like Wilke-Chang and Hayduk-Minhas also give very different estimates. We compared the diffusion coefficients for the high-pressure oils reported in the literature, showing a large variation in the reported values. All these indicate the need for more accurate measurement and modeling of gas diffusion coefficients in high-pressure reservoir fluids.

References:

Ghasemi, M , Astutik, W , Alavian, S.A. , Whitson, C.H. , Sigalas, L , Olsen, D , V.S. Suicmez, 2017. Determining Diffusion Coefficients for Carbon Dioxide Injection in Oil-Saturated Chalk by Use of a Constant-Volume-Diffusion Method, SPE Journal, 22: 505-520.