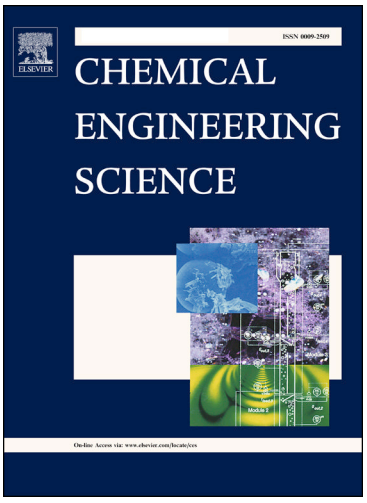

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Amir Fayazi, Apostolos Kantzas

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Modeling of CO_2 Diffusion into Water-Shielded Oil at Pore Scale Using Moving Mesh Technique

Amir Fayazi[1], Apostolos Kantzas[1,2]

1: Department of Chemical and Petroleum Engineering, University of Calgary, Calgary, AB, Canada
2: PERM Inc., Calgary, AB, Canada

Abstract

During processes such as solvent-steam co-injection and tertiary CO_2 flooding, oil may be prevented from direct contact with solvent by a water barrier which greatly affects microscopic displacement efficiency. As a result of diffusion through the water barrier, both oil and water phases swell progressively. If oil swelling displaces the blocking water completely, direct contact between solvent and oil can be achieved which results in high oil recovery. In this study, a moving mesh technique is applied to simulate swelling of a trapped oil blob by CO_2 diffusion through a blocking water at pore scale. A moving interface between oil and water is considered to track the swelling process. The modelling results were validated with micromodel experiments on the recovery process of water-shielded oil in a dead-end pore. The water film rupture time for typical oil and water thicknesses (in micro scale) was calculated using experimental data for oil-water-CO_2 system. Finally, a dimensionless rupture time was introduced and it was used to predict trapped oil recovery as a function of contact time for various pore body and throat size distributions. The results can be used to estimate the time scales necessary for having maximum trapped oil recovery.

Keywords: Diffusion; water blocking; moving mesh; swelling; CO_2 flooding