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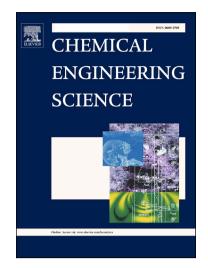
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Modeling of CO₂ Diffusion into Water-Shielded Oil at Pore Scale Using

Moving Mesh Technique

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Abstract

During processes such as solvent-steam co-injection and tertiary CO₂ 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 CO₂ 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-CO₂ 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; CO₂ flooding

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