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Exploring the Influence of Porous Media Morphology and Capillary Number on Immiscible Oil Recovery

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Pore-scale simulation and analysis of oil displacement in digital rocks has shown great promise in tracking oil recovery in porous media. This paper examines three digital rocks with varying pore and throat radii but the same porosities, studying their behavior under immiscible oil recovery through waterflooding. Computational fluid dynamics was used to conduct numerical simulations to observe the impact of rock morphology on breakthrough times, residual oil saturations, and oil displacement patterns. The validity of the simulation mechanism is confirmed in both imbibition and drainage conditions through the pore doublet Chatzis' experiment. This study consisted of 33 separate simulations which varied in mobility ratios, interfacial tensions, and injection velocities. The findings suggest that smaller pore and throat radii result in higher oil recovery and water percolation and faster breakthrough times that facilitates the effects of viscous fingering. An increase in capillary number was found to have a significant impact on oil recovery in larger pores and throats.

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