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COMPUTATION OF FLUID CONFIGURATIONS AND CAPILLARY PRESSURES IN MIXED-WET 2D PORE SPACES FROM ROCK IMAGES

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Summary. We present a model for capillary entry pressure and capillary pressure curve computations in mixed-wet 2D pore spaces from rock images. The model determines two curves defined by the loci of centre positions of two circles moving around the pore boundary in opposite directions. All relevant arc menisci are associated with intersections of these curves. At lines separating pore surfaces with different wettability, the circles rotate to permit pinned contact lines with associated hinging interfaces. Arc menisci and adjoining pore boundary segments are tracked to form boundaries of bulk and layer regions. All possible combinations of these regions are generated and their associated entry pressure radii for invasion is computed by the Mayer & Stowe - Princen method, including thermodynamically consistent treatment of partial and complete displacement of oil layers forming at negative capillary pressure. Entry radius curvatures and curvature – saturation curves are computed in strongly non-convex pore spaces extracted from a 2D SEM image of Bentheimer sandstone, which demonstrates that the model captures well-known features of capillary behaviour at mixed-wet conditions. In particular, entry pressure radius, oil layer existence, fluid configurations and capillary pressure curves are strongly affected by the reversal point after drainage. The computations also demonstrate the importance of selecting the fluid displacement with minimum change in free energy. In some cases, a merged region formed by a combination of different bulk and layer regions in the pore space corresponds to the favourable entry configuration of the invading fluid.

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