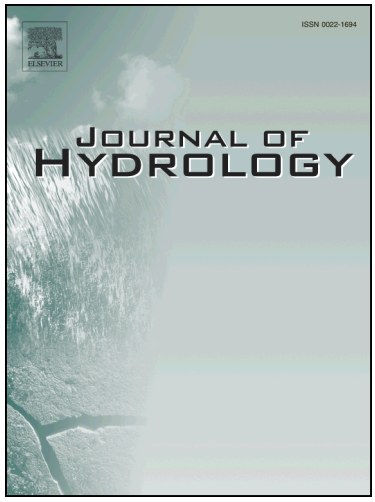

Research papers

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Entry Pressure for the Rough Capillary:

Semi-analytical Model and Lattice Boltzmann Simulation

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ABSTRACT

We develop a semi-analytical model to calculate the entry pressure in rough capillaries based on an energy balance principle and wetting theory on rough surfaces. During the drainage process, we assume fluids form arc menisci at corners of capillary cross-sections depending on the apparent angle, and that there is a wetting phase film adsorbed on the rough surface depending on the wetting condition. A Logistic model is proposed to explain the contact angle dependence on the structure of rough surfaces. Then the capillary entry pressure is calculated by extended MS-P (Mayer, Stowe and Princen) method. We verify the model using the pseudopotential Lattice Boltzmann model and obtain good agreement between the analytical and simulated pressures. Taking capillaries with triangular sections with pillar pillar-type rough surfaces as example, we discuss how rough structures and contact angles influence capillary behaviors. The results reveal that both the wetting phase saturation and entry pressure of rough capillaries are larger than those in smooth capillaries under the same conditions. Moreover, the entry pressure is not sensitive to the