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Analytical model of wetting liquid unsaturated climb in a porous medium B. MARKICEVIC, Kettering University, B. BIJELJIC, Imperial College, H.K. NAVAZ, Kettering University — The analysis of the dynamics and stability of the wetting liquid capillary climb flow in the porous medium, which is opposed by gravity force, suggests that there may be a unique analytical correlation between the capillary and Bond number given in the exponential form. Starting from this exponential expression, the analytical model for the climbing height as a function of time is obtained. The model accounts for two-step climbing dynamics, where for smaller climbing height, the height of single-phase displacement flow is identified. For larger climbing heights closer to the point in which the capillary and gravity forces equilibrate, the height of the developing multiphase flow front and interface position between partially wet and dry fraction of porous medium is defined. It turns out that the analytical solution predicts the climbing height for short and longer times. To use this approach, one needs the capillary versus Bond number correlation only, which is completely measureable from the experiments. In calculating both numbers, the average pore radius is used as the geometrical scale. There is an excellent agreement between the analytical model predictions and the set of experimental results in which the permeability varies for two orders of magnitude, and where both single-phase and multiphase climbing dynamics is observed. Finally, the generality of analytical model needs to be examined further.

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