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Investigation of Radial Capillary Penetration Kinetics in Virtual 3-D Porous Media Using Direct Numerical Simulations with Volume-Of-Fluid Method

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Capillary flow penetration can be categorized into two directions: Unidirectional (Linear) and Radial. The fluid invasion physics has been extensively studied for linear flow direction. Danino & Marmur study radial capillary penetration in a filter paper experimentally, and the results indicate a power-law correlation between average wicking radius and time. It shows the average spreading radius follows R ~ t^(0.425-0.44). And this wicking kinetic is slower than linear regime where L ~ t^0.5. The first goal of this research is to answer the question that why radial capillarity is slower than linear penetration. Another main purpose is to investigate the influence of pore connection and mean pore radii on the macroscopic capillary radial spreading. Direct Numerical Simulations (DNS) using Volume-Of-Fluid (VOF) method will be performed using an open source code OpenFOAM; gravity is ignored in the simulations due to its negligible influence. Important variables which include wicking radius, capillary pressure and inlet velocity will be analyzed.

References

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