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Analysis of Non-equilibrium Capillary Pressure-Saturation Relation using Direct Numerical Simulations with Volume-Of-Fluid (VOF) Method SANTOSH KONANGI, NIKHIL K PALAKURTHI, Univ of Cincinnati, NIKOLAOS KARADIMITRIOU, Univ of Manchester, AN FU , Univ of Cincinnati, KEN COMER, The Procter and Gamble Company, URMILA GHIA, Univ of Cincinnati — In traditional two-phase flow models of porous media, capillary pressure (P_c) and saturation (S^w) are hysteretically related, i.e. different P_c-S^w curves are obtained for drainage and imbibition. Extended two-phase flow theories hypothesize that inclusion of specific interfacial area (a^{wn}) will result in a unique relation between capillary pressure, saturation and interfacial area (P_c–S^w–a^{wn}). Several studies have confirmed the reduction of hysteresis in the P_c–S^w–a^{wn} relation under quasi-static conditions. However, the uniqueness of the P_c–S^w–a^{wn} relation under transient conditions is not clear. We investigate role of specific interfacial area under dynamic conditions using pore-scale direct numerical simulations (DNS) on two micromodels with volume-of-fluid (VOF) method. From the DNS data, Pc-S^w curves are estimated for drainage and imbibition; validity of different macroscopic capillary pressure definitions is evaluated. The quasi-static and dynamic P_c–S^w–a^{wn} relations are examined for uniqueness.

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