SCALE DEPENDENCY OF DYNAMIC RELATIVE PERMEABILITY CURVES IN RELATION WITH FLUID VISCOSITY AND DYNAMIC CAPILLARY PRESSURE EFFECT

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ABSTRACT

Capillary pressure-saturation-relative permeability relationships (P_c-S_w-K_r) are commonly applied in the modeling and simulations of two-phase flow in porous media. While the dependence of P_c-S_w-K_r on fluid and porous media properties is well reported, inconsistencies and impacts of other factors like domain size and rate of saturation change are not fully clarified in literature. For example, reported trend in fluid viscosity and boundary conditions effects have been found to be contrary to each other in different studies. In this work, we determine the dependency of dynamic K_r-S_w relationships on domain scale in addition to investigating effect of fluid viscosity and boundary pressure using silicone oil (i.e. 200 and 1000 cSt) and water as the respective non-wetting and wetting fluids with a view to eliminate some of the uncertainties reported in the literature. Results show that water relative permeability, K_{rw}, increases as wetting phase saturation increases but decreases with the increase in viscosity ratio. On the other hand, the oil relative permeability, K_{rnw}, increases with the increasing non-wetting phase saturation and also increases with the viscosity ratio. As the imposed boundary pressure increases K_{rw} was found to decrease while K_{rnw} increases. The influence of scale on relative permeability was slightly indicated in the non-wetting phase with K_{rnw} decreases as domain size increases. Effect of measurement location on dynamic relative permeability was also determined which are rarely found in the literature. Finally, comparison between K_r-S_w relationships obtained under static and dynamic conditions were shown and their relationships with mobility ratio (m) and dynamic coefficient (τ) were discussed.