Scale dependency of dynamic relative permeability curves in relation with fluid viscosity ratio and dynamic capillary pressure effect

This item was submitted to Loughborough University's Institutional Repository by the/an author.


Additional Information:

• This is a conference abstract accepted for the Computational Methods in Water Resources (CMWR2014) conference, University of Stuttgart, Germany on 9th -13th June, 2014. The complete abstract booklet is available at: http://www.cmwr14.de/images/bookofabstracts/CMWR14BookofAbstracts.pdf

Metadata Record: https://dspace.lboro.ac.uk/2134/15634

Version: Accepted for publication

Publisher: University of Stuttgart

Rights: This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: https://creativecommons.org/licenses/by-nc-nd/4.0/

Please cite the published version.
SCALE DEPENDENCY OF DYNAMIC RELATIVE PERMEABILITY CURVES IN RELATION WITH FLUID VISCOSITY AND DYNAMIC CAPILLARY PRESSURE EFFECT

Gaurav Goel¹, Luqman K. Abidoye², Diganta B. Das²#, Bhagu R. Chahar³, Ranvir Singh¹

¹Department of Civil Engineering, Sharda University, Greater Noida, India
²Department of Chemical Engineering, Loughborough University, Loughborough, UK
³Department of Civil Engineering, Indian Institute of Technology Delhi, New Delhi, India

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 ($\tau$) were discussed.