XVIII International Conference on Water Resources
CMWR 2010
J. Carrera (Ed)
CIMNE, Barcelona 2010

A MULTI-SCALE APPROACH TO MODEL TWO-PHASE FLOW IN HETEROGENEOUS POROUS MEDIA

Christos D. Tsakiroglou

Foundation for Research and Technology Hellas - Institute of Chemical Engineering and High Temperature Chemical Processes (FORTH/ICE-HT)
Stadiou street, Platani, 26504 Patras, Greece
e-mail: ctsakir@iceht.forth.gr, web page: http://www.iceht.forth.gr

Key words: Multi-scale models, two-phase flow, heterogeneous media, relative permeability, capillary pressure, network analysis

Abstract. The immiscible displacement of a wetting fluid by a non-wetting one in heterogeneous porous media is modeled by using a multi-scale network-type analysis: (1) The pressure-controlled immiscible displacement of water by oil in pore-and-throat networks (length scale~1mm) is controlled by capillary forces. (2) The pressure-controlled immiscible displacement in uncorrelated or spatially correlated cubic lattices (length scale~1cm) is governed by capillary and gravity forces. At this scale, each node represents a network of the previous scale. (3) The rate-controlled immiscible displacement of water by oil in cubic networks (length scale~10cm), where each node represents a lattice of the previous scale, is simulated by accounting for capillary, gravity and viscous forces. The multi-scale approach along with the pore structure properties of soils can be employed to determine the transient responses of the pressure drop and axial distribution of water saturation, and estimate the effective (up-scaled) relative permeability functions, at the soil column scale.