2009 CSREES National Water Conference; St. Louis, MO

The effect of air and water phase configuration on colloid retention in partially saturated porous media

Yuniati Zevi, Yan Jin, Masa Prodanovic, Steven L. Bryant
University of Texas
steven_bryant@mail.utexas.edu

Abstract:

In a partially saturated system the accumulation of colloid at interfaces such as air-water (AW), solid-water (SW) and air-water-solid (AWS) interfaces depend on the area of those interfaces and its accessibility to the water phase. Accumulations of colloids near the three-phase contact line (AWS) depend on the water volume associated with that line. The area of interfaces and contact line can be varied independently by adjusting the capillary pressure (or moisture content) and/or contact angle. In the present study, we keep the contact angle constant and vary only moisture content to vary interface configurations and areas of AW and AWS interfaces. Experiments are being conducted using 3D pore-scale micromodels, made from rectangular ï□--slide (Ibidi) with inner dimension of 400 ï□-m by 3800 ï□-m, packed with glass beads which have average diameter of 180 ï□-m, and with fluorescent latex microspheres with diameter of 1 ï□-m. Both capillary tube and glass beads were treated to achieve uniform hydrophilic surface. Using a fast laser scanning microscope, volumetric (3D) images are collected in near real time during dynamic flow conditions as well as static conditions. The images will allow for investigation of the air and water phase configurations and its effect on colloid retention at the interfaces. An advanced confocal software Volocity is used for particle tracking and image analysis to quantify the number of particles retained for specified areas.

We developed a simple but robust numerical model based on the level set method for determining fluid interface position during capillarity dominated displacement. The method handles splitting and merging of menisci robustly and is independent from the pore space complexity. We calculate detailed interface and obtain volumes and interface areas. We present extension of the original method for non-zero contact angles and simulations in geometries similar to the micromodels and compare with the experiments.

Impact Statement:

Initiated in Fall 2007, this project is a new collaboration between University of Texas at Austin and University of Delaware bringing together recent advances in the areas of computational modeling of interfaces and of visualization and design of colloid transport experiments. The goal is to provide unequivocal assessment of the relative contributions of the air/water interface (AWI) and the air/water/solid contact line (AWS) to pathogen retention. Such an assessment will help resolve an ongoing debate about retention mechanisms operative in the vadose zone.

Category: Other Water Resource Topics
Type of Presentation: Poster Presentation