SIMULATING NON-DILUTE TRANSPORT IN POROUS MEDIA USING A TCAT-BASED MODEL

Deena Hannoun, North Carolina State University, 919-515-0676, deenadeenaron@gmail.com

1. Casey Miller, University of North Carolina at Chapel Hill
2. William Gray, University of North Carolina at Chapel Hill
3. Tim Kelley, North Carolina State University
4. Pamela Birak, University of North Carolina at Chapel Hill
5. Deena Hannoun, North Carolina State University

Predicting the transport of non-dilute species in fluids of variable density in porous media is a challenging problem for which existing mathematical models are unable to represent accurately the experimental data collected to date. In this work, we consider the displacement of an aqueous phase with dense brine solutions containing a concentrated CaBr2 species, which in the most concentrated case had a density of 1.71 g/cm^3 and a dynamic viscosity of 0.058 cp. Displacement experiments were conducted in vertically oriented one-dimensional columns for stable displacements of one fluid by a more dense fluid. Simulation of a non-dilute system based upon the thermodynamically constrained averaging theory (TCAT) using an entity-based momentum equation was compared to the data collected. The model accounts for the effects of non-dilute, non-ideal systems and consists of a nonlinear set of equations including a flow equation, a species transport equation, and closure relations. We rewrite the TCAT entity-based model as a system of two coupled partial differential-algebraic equations with the relevant closure relations. We then use a stiff temporal integrator to create 1D simulations of the model. The model is nonlinear and nonsmooth. We will discuss both results and numerical difficulties.