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Numerical study of dispersion through displacing phase in unsaturated porous media

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Dispersion through unsaturated porous media plays an important role in several industrial and natural processes including those relevant to environmental and hydrogeological applications and chemical and petroleum engineering processes. During recent years, several direct numerical simulations at the pore scale explored dispersion and solute transport in immiscible two-phase flow in porous media. Displacement patterns differ significantly depending on capillary number and viscosity ratios. Different invasion conditions impose important changes on the dispersion of the displacing fluid. Most of studies have not considered the effect of displacement patterns on dispersion through the displacing phase.
This study aims to understand and quantify dispersion in three distinct regimes of displacement including frontal displacement, capillary fingering, and viscous fingering. Hydrodynamic dispersion in all these regimes is modelled in the displacing phase using a volume of fluid (VOF) method in OpenFOAM and compared to a base case to categorize dispersion under different two phase flow regimes. Structure of velocity field and solute transport within the displacing fluid were investigated to compare dispersion phenomena for each domain. The shape of displacement in each regime causes changes and deviations in dispersion related parameters.
Hydrodynamic dispersion is separated and studied in two parts in our work: with and without diffusion. In the first part the effect of diffusion is investigated, and in the second part statistical parameters of the whole domain and Lagrangian parameters through the domain are explored. Results demonstrate that dispersion of a solute in frontal displacement behaves similar to the base case (i.e., a saturated media) with the same arrangement. Dispersion in the fingering regime is considerably different compared to the base case which can have a significant impact on dispersive behavior of solutes in porous media.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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