



Electrokinetic induced solute dispersion in porous media; pore network modeling

Shuai Li, Ruud Schotting, and Amir Raouf

Environmental Hydrogeology group, Utrecht University, the Netherlands

Electrokinetic flow plays an important role in remediation process, separation technique, and chromatography. The solute dispersion is a key parameter to determine transport efficiency. In this study, we present the electrokinetic effects on solute dispersion in porous media at the pore scale, using a pore network model. The analytical solution of the electrokinetic coupling coefficient was obtained to quantify the fluid flow velocity in a cylinder capillary. The effect of electrical double layer on the electrokinetic coupling coefficient was investigated by applying different ionic concentration. By averaging the velocity over cross section within a single pore, the average flux was obtained.

Applying such single pore relationships, in the thin electrical double layer limit, to each and every pore within the pore network, potential distribution and the induced fluid flow was calculated for the whole domain. The resulting pore velocities were used to simulate solute transport within the pore network. By averaging the results, we obtained the breakthrough curve (BTC) of the average concentration at the outlet of the pore network. Optimizing the solution of continuum scale advection-dispersion equation to such a BTC, solute dispersion coefficient was estimated. We have compared the dispersion caused by electrokinetic flow and pure pressure driven flow under different Peclet number values. In addition, the effect of microstructure and topological properties of porous media on fluid flow and solute dispersion is presented, mainly based on different pore coordination numbers.