Interaction between Nano-Bubbles and Colloidal Particles in Saturated Porous Media under Flowing Condition

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Nano-bubbles (NBs) have a considerable potential for the remediation of soil and groundwater contaminated by organic compounds, especially when used in conjunction with bioremediation technologies. Understanding the transport mechanisms of NBs in soils is essential to optimize NB-based remediation techniques. In natural soils, there are several types of colloids, which are particles with diameters of around 10 nm to 10 mm, in various organic and inorganic sources: silicate clays, iron and alumium oxides, or humic minerals. Deposited colloidal particles on the soil particles likely affect NBs transport. However, interaction between NBs and deposited colloidal particles in saturated porous media under flowing condition is not fully understood.

In this study, one-dimensional column transport experiments using glass beads with 0.1 mm size were conducted, where carboxyl latex (CL) with 500 nm and NBs created by oxygen gas were consecutively injected to the column at the constant flow rate. Effluents were collected at the same time interval. Bubble and particle concentrations in the effluents were measured by a resonant mass measurements. Results showed that NBs retention was enhanced at the condition where CLs were initially deposited in the porous media, suggesting deposited CLs worked as additional deposition sites for NBs. The obtained breakthrough curves of NBs were well simulated by one-dimensional advection-dispersion equation with first-order deposition kinetics.

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