Enhanced Distribution of Modified Nano-Scale Magnesia for Injection-Based In Situ Groundwater Remediation

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Background/Objectives. Efficient injection and distribution of nanoparticles in porous media is considered a formidable technical hurdle for injection-based in situ remediation. One approach to enhance the mobility of nanoparticles in an aquifer is to use surface modifiers. In this study, an innovative and effective remedial material for cadmium removal from groundwater, nano-scale magnesia (NMgO), is modified with electro-negatively charge and eco-friendly humic acid and glycerol, to enhance the mobility of nanoparticles in the aquifer.

Approach/Activities. A two-dimensional reactor (50 × 50 × 10 cm), with two injection wells and 30 monitoring wells, was designed, constructed and packed in the laboratory to simulate a saturated aquifer and was used to evaluate the mobility of NMgOs. The reactor was pre-contaminated with cadmium to represent a plume in groundwater. The distribution of both unmodified and two modified NMgOs (humic acid modified NMgO and glycerol-modified NMgO) slurry injected were evaluated in the reactor. During the simulation experiment, the Mg and Cd concentrations were monitored in all 30 monitoring wells at different time intervals to evaluate the radius of influence of injected NMgOs. Furthermore, SEM-EDX characterization of silica sand before and after injection of NMgOs was used to quantify the transport of nano-magnesia.

Results/Lessons Learned. The results showed that the concentration of Cd (200 µg/L) was reduced to below the world health organization guideline (3 µg/L) at the 15 cm downstream and 10 cm lateral monitoring wells from the injection well four days after the injection of unmodified NMgO, indicating the successful transport of unmodified NMgO up to the influence zone. In addition, the Mg data from all monitoring wells are required to be explored, to reveal the definitive mobility of injected NMgOs. Similarly, experimental activities for both humic acid modified NMgO and glycerol-modified NMgOs are crucial to demonstrate the enhanced mobility compared with the unmodified NMgO.