Sequestration of Dissolved Zinc in Groundwater Via Subsurface Injection

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A brownfield redevelopment site that has been converted to student apartments has groundwater that is impacted with dissolved zinc at concentrations over 20 mg/L. Seepage of groundwater to a local drainage path has resulted in elevated concentrations of zinc in the surface water. To address the flux of dissolved zinc from groundwater to surface water, an in-situ groundwater treatment barrier was pilot tested over a ten-month period September 2006 to June 2007. The material that was chosen as the reagent for the pilot test was a magnesium hydroxide solution that was successful in sequestering zinc in site soils and groundwater during a bench-scale treatability study conducted in early 2006. Magnesium hydroxide is typically used in waste water treatment to increase pH in wastewater impacted with metals. This pH increase allows for the formation of metal hydroxides, thus precipitating the metals out of solution and significantly decreasing mobility in water.

Approximately 7.3 tons of magnesium hydroxide, slurried in 4,205 gallons of water, was injected over a two day period through five temporary injection points. The objective was to deliver an overall 2% dose of magnesium hydroxide to a specific aquifer volume that would generate a treatment zone upgradient of the pilot test monitoring well. The treatment zone was estimated to be 30 feet long by 15 feet wide by 6 to 20 feet below ground surface. The pilot test monitoring well was then sampled monthly for a ten-month period immediately following the injections, for total and dissolved zinc, magnesium, arsenic, and cyanide. Field pH measurements were also collected during each sampling event. The monitoring of arsenic and cyanide was conducted due to concerns that the treatment might increase the solubility of these compounds and thereby change their groundwater concentrations. Analysis of the groundwater results after the injections indicated no effect on these compounds during the pilot test period. Magnesium was analyzed as an indicator of the presence of the treatment compound. Field pH collected during sampling is also an indicator of the effectiveness of the treatment.

Baseline pH of groundwater in the pilot test area was <5 at the pilot test well. Post injection pH during groundwater sampling indicated pH of 9. Temporary well samples within the injection zone had post-injection zinc concentrations of <0.020 mg/L. The pilot test monitoring well yielded 21 mg/L of zinc prior to the injection pilot test. Dissolved zinc concentrations in groundwater decreased rapidly after three months and remained low for the remaining 7 months for an overall 68% reduction during the pilot test period. Based on the elevated pH and the reduction in the zinc concentration in groundwater at the downgradient monitoring well, the injection of the magnesium hydroxide has successfully decreased the solubility of the zinc in groundwater during the pilot test period. The decrease in the solubility and ultimate mobility of zinc in groundwater should significantly reduce the flux to surface water. This treatment technology has recently been approved for full-scale application and is expected to be implemented in August 2007.