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Groundwater Arsenic and Metals Treatment Using a Combination Compost-ZVI PRB

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A pilot permeable reactive barrier (PRB) consisting of a mixture of leaf compost, zero-valent iron (ZVI), limestone and pea gravel was installed at a former phosphate fertilizer manufacturing facility in Charleston, S.C. in September 2002. The PRB is designed to treat arsenic and heavy metals in ground water entering a tidal marsh by promoting microbially mediated sulfate reduction and subsequent sulfide precipitation. Five rounds of performance monitoring conducted at the site over a period of 30 months since installation of the pilot PRB have thus far shown effective treatment of arsenic and heavy metals in the ground water. Arsenic is being treated from concentrations of up to 126 mg/L in up-gradient wells to average concentrations of less than 0.04 mg/L within the PRB. Lead and cadmium are being treated from concentrations of up to 3.23 mg/L and 2.10 mg/L, respectively in up-gradient wells to average concentrations of less than 0.009 mg/L and 0.003 mg/L, respectively within the PRB. Ground water is converted from a net acid producing potential to a net acid consuming potential as it passes through the PRB with alkalinities within the PRB being measured as high as 630 mg/L as $CaCO_3$.

Evaluation of the hydraulic performance of the pilot PRB has been complicated by the combined effects of a very gentle horizontal hydraulic gradient and significant upward vertical gradients at the site. In addition, vertical hydraulic conductivities varying up to two orders of magnitude exist within the fill material into which the PRB was installed. Microbiological analysis has shown the presence of sulfate reducers within the PRB indicating sulfate reduction to sulfides is almost certainly occurring. However, sulfide concentrations measured in ground water within the PRB have been low suggesting that sulfide is rapidly precipitated out within the PRB upon reaction with dissolved iron and other metals. Monitoring of the PRB will continue in order to determine whether performance can be sustained over the long term.