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Full-Scale Treatment of a Large, Dissolved Lead Plume: Injection Approach, Field Operations, and Distribution Assessment

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Background/Objectives. Dissolved metals in groundwater remain a challenging remediation problem. Most remedial solutions focus on extractive options due to a paucity of proven in-situ technologies, which is a consequence, in part, of the geochemical complexities of in situ stabilization. There do exist a small number of proven, commercially available products in the remediation marketplace that provide effective stabilization through adsorption and co-precipitation of metal species. Though these products are proven on the bench, the form of these materials – generally granular solids with low solubility and high density – mean they are more commonly used for stabilization of metals in soil, where soil blending methods are utilized to achieve good distribution. Outside of reactive barriers, they are less commonly used for in-situ groundwater treatment of large dissolved plumes, as they present special challenges required by a full-scale injection project, including safe handling, efficient mixing and injection, and penetrative distribution in the target treatment zone.

Approach/Activities. We present an effective approach for delivering a granular, calcined magnesia solid for full-scale plume treatment of dissolved lead in groundwater. The project site is a former agricultural chemicals facility in the Coastal Plain physiographic province in North Carolina. The 15-acre plume is composed of dissolved lead with concentrations up to 350 mg/L in a low-pH aquifer with very slow seepage velocity (add velocity data – if desired). Product dosage was accurately determined through benchscale testing, but initial injection testing proved unsuccessful at delivering the required dose to the target zone. An alternate approach was selected to successfully deliver the required dosage, and the full-scale injection project involved injection of approximately 525,000 lbs of granular magnesia via 70 direct-push borings and 419 discrete injection intervals.

The field implementation was characterized by a rigorous health and safety program to enhance jobsite communication and critically assess potential hazards to personnel, equipment, and the environment. Field conditions that required special consideration included safely handling 1-ton super sacks of the remediation material in the flat, naturally wet, unpaved work area during cold and wet weather conditions encountered during the winter injection program. The program led to numerous process improvements and multiple equipment innovations that improved not only health and safety, but also the quality of the completed field project.

Results/Lessons Learned. A critical component of the project was distribution verification of the injected materials. Three primary methods – high-frequency pressure logging, surface deformation analysis, and soil coring – were employed to verify effective subsurface distribution. Surface deformation monitoring was employed at 10% if the injection intervals for a total of 42 unique surface deformation data sets. Select locations were cored for visual identification of injected materials and corroboration of indirect methods. A fourth indicator of effective distribution was the notable lack of surfacing of injected material, and surfacing occurred during injection in only 9 of 419 injections. Data reduction and analysis of the pressure logs and surface deformation provide, in conjunction with the direct observations provide a compelling picture of satisfactory amendment distribution.