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Use of Combined Drilling Techniques and Hydraulic Fracturing to Inject into a Low Permeability Zone

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Low permeability groundwater zones often present a difficult obstacle to the safe and efficient injection of chemical regents using direct push technology. At a gas station site in Los Angeles County, CA, the target geologic formation for injection was comprised of a dense siltstone and claystone formation (fractured mudstone of the Monterey Formation) with low to moderate fracturing. Many of the fractures were infilled with caliche and gypsum making the formation extremely hard and dense. Advancing direct push rods to 50 to 60 feet in this formation often resulted in refusal (and broken downhole tools), so in order to complete direct push injections at this depth, a hollow stem auger rig was used to drill through the upper 45 feet and then direct push rods were then used from a depth of 46 ft to 62 feet for injection. Upon reaching the target depth for injection, a high pressure (100 to 120 psi) hydraulic fracturing tool was initially used for only a few minutes to fracture the surrounding formation and open up pore space for injection purposes.

This initial fracturing procedure allowed for subsequent injection of the chemical reagents using much lower pressures of 30 to 50 psi and also improved the injection flow rates by three-fold or more. The ISCO reagents used at this site were stabilized hydrogen peroxide and sodium persulfate. Keeping low pressures and low flow rates was instrumental at this site to control chemical daylighting.

Overall, a total of 12 direct push injection points and three injection wells were used to complete a Full Scale treatment of the gas station site. The analytical results showed that the TPH gas and BTEX compounds were reduced significantly by ISCO treatment, with contaminant reductions in the range of 75% to 95% across the site.