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Sequencing ISCO and Bioamendments for Successful Cleanup

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Background/Objectives. In situ chemical oxidation (ISCO) using a strong oxidant, contaminant desorption/oxidation using an infrastructure-safe oxidant, and a traditional aerobic bioremediation amendment were implemented for cleanup of an on-site/off-site plume emanating from a gasoline service station affected by high concentrations of petroleum hydrocarbons. The site, located in the state of Washington, had a potential lawsuit looming, so effective remediation was critical. Through a strong partnership with a remedial solutions provider, thorough data evaluation, and a comprehensive monitoring program, a successful cleanup was achieved.

Approach/Activities. The subject site was assessed through groundwater monitoring events at baseline (pre-application) and at regular intervals (post-amendment applications). The monitoring program focused on reductions in contaminant concentration (especially TPH-gasoline), and changes in geochemistry/field parameters. These data were used in injection design as well as assisting the project team in understanding the conditions produced in the treatment area and to guide future injection modifications. Without a sufficient monitoring program, optimization of succeeding rounds of injection would have been difficult.

Results/Lessons Learned. An initial amendment injection event using the moderate oxidant, (sodium percarbonate) for desorption/oxidation and the bio-amendment (a slow release oxygen compound) resulted in considerable desorption followed by changes in field parameters and geochemistry at on-site and off-site monitoring locations. Following two rounds of injection of those amendments, and a period of time to allow maximum effects from the amendments, significant rebound occurred in the off-site area to the extent that TPH-gasoline concentrations rebounded to baseline levels, though on-site wells demonstrated effective treatment. The measured field parameters and geochemical responses at the off-site monitoring wells indicated that complete response to the treatment was not occurring throughout the treatment area. Lesser changes in field parameters and geochemistry suggested potential preferential pathways, deviation in groundwater flow, and questions surrounding the target injection intervals.

A third injection event was completed with a different oxidant, an all-in-one activated sodium persulfate product, which allowed for application at a higher solution concentration. Changes to the injection layout were made based on a new understanding of groundwater flow. Injection target intervals were also reduced and the amendment provider was able to self-perform the injection of their technology, to ensure application success. The net result was a stronger signature response at the off-site monitoring wells and TPH-gasoline decreased in concentration by two orders of magnitude. Through three quarters of post-injection monitoring, TPH-gasoline concentrations have achieved the remediation standard of 700 µg/L. The overall conclusion of this project is that sequencing amendments, coupled with good partnering and a robust monitoring program, can lead to an effective site cleanup.