Evaluating Enhanced Biological Dechlorination Performance Using a Mixed Substrate over a 7-Year Period

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Background/Objectives. The practice of introducing organic substrates to promote biological enhanced reductive dechlorination has become common in the environmental remediation industry. Although well accepted, the limits of the performance of this technology has been difficult to quantify due to the relatively long periods of time typically needed to demonstrate that remedial objectives have been met. Performance evaluation has also been complicated on many sites by an incomplete understanding of the site conditions and/or contaminant distribution resulting in the technology being frequently used more as an assessment tool rather than a remediation tool. This leaves few sites with sufficient data to demonstrate the maximum limits of the technology.

Approach/Activities. In 2018, data collected over a period of five years after the application of organic substrates to enhance biological reductive dechlorination became available for a site in Colorado that suggests that the process may be effective for longer than originally estimated or expected. Over this period of time annual evaluations of the performance of the process were conducted to determine if additional substrate injections were warranted to maintain the process. These evaluations ultimately revolved around the continued evaluation of geochemical and contaminant profiles including evaluating the trends in dissolved oxygen, oxidation reduction potential, dissolved organic content, alkalinity, and chlorinated ethene concentration and molar ratio comparisons.

The project of interest is PCE plume from a dry cleaner in central Colorado that had been the subject of a number of remedial approaches since 2009 including multiple chemical oxidation injections followed by three partial injections pf organic substrates to enhance reductive dechlorination. While success in the form of dramatically reducing the concentrations of chlorinated ethenes was achieved over almost the entire plume, one small upgradient area continued to see contaminant flux, presumably from a source area that was never adequately treated. This resulted in multiple episodes of “rebound” followed by contaminant degradation in several of the monitoring wells over time even after theoretical optimal geochemical conditions were seemingly reversed.

Results/Lessons Learned. The data trends suggest that the original application of a mix of readily soluble and slowly soluble substrates were able to rapidly establish anaerobic conditions that supported robust reductive dechlorination and maintain those conditions for a period of time in excess of 5 years. The data also suggest that once reductive dechlorination was established it may continue after optimal geochemical conditions have been partly reversed. This set of seemingly contrary information opens the discussion as to how long can one expect to be able to maintain robust reductive dechlorination and what information can the practitioner look for to support the premise.