Can I Use HRC in a High Sulfate Environment?

When a site is evaluated for HRC application, its fundamental hydrogeological characteristics must be evaluated to determine their impact upon the placement of HRC. Once this is complete and hydrogeological conditions are deemed appropriate, the potential for "wasteful side reactions" is assessed. These reactions consume the hydrogen produced from the breakdown of HRC-derived lactic acid so that the it is unavailable to support the microbes responsible for reductive dechlorination.

When HRC is applied to a site with contaminated groundwater, it supplies hydrogen which acts as an electron donor to the dechlorinating bacteria responsible for contaminant degradation. The contaminant acts as an electron acceptor, removing the electron from the bacterium and consequently being dechlorinated. The presence of competing electron acceptors (CEAs) such as oxygen, nitrate, iron, and sulfate complicates this seemingly simple process.

The presence of these CEAs will "waste" the electron donor hydrogen, as they themselves are reduced through various reactions. Furthermore, these same CEAs can be involved in the microbial consumption of lactic acid before it can even generate hydrogen.

Of the common CEAs, the worst is sulfate since it can be present in high concentration due to its solubility; it is not uncommon to see sulfate levels in hundreds or even thousands of parts per million. When sulfate concentration is extremely high, the impact of other CEAs is almost negligible. Sacrificial lactic acid may be recommended in the design of an HRC application to overcome high CEA concentrations and drive contaminant dechlorination.

While it is true that sulfate reducing reaction will expend HRC and its by-products, all the sulfate does not have to be reduced before reductive dechlorination may occur. Due to the ubiquitous nature of microbes in the subsurface environment, it is possible to carry out reductive dechlorination even in the presence of elevated sulfate concentrations. Different redox zones will exist in different parts of the aquifer allowing various reductive processes to occur simultaneously. Unfortunately, this multitude of ongoing processes is not observable in a well sample since everything is mixed; one stratum may have a very high sulfate concentration and, given limited vertical mixing, will not impact a zone elsewhere which is actively supporting reductive dechlorination.

If designing for a site with high sulfate concentration, simply enter the concentration into the HRC Application Software and complete the design program. If the output generated has unacceptable physical or economic requirements, REGENESIS recommends a small pilot field test to determine the feasibility of the HRC application in the presence of existing sulfate. Rapid dechlorination may yet occur with moderate HRC application, even with prevailing sulfate levels. To determine an appropriate pilot test design, please contact REGENESIS directly for technical support.

In conclusion, the presence of high concentrations of sulfate in an aquifer is not a definite indication that the use of HRC will not accelerate reductive dechlorination. Increasing the amount of HRC applied often overcomes the additional demand of the competing electron acceptor. In the initial design state, if the cost for additional HRC to overcome the demand of the sulfate is too high, REGENESIS recommends performing a pilot field test to determine if a moderate HRC application can generate adequate contaminant degradation in the presence of existing sulfate.