Enhanced Reductive Dechlorination in Low-pH Aquifers

Bacteria that are active in reductive dechlorination such as *Dehalococcoides* (DHC) are very sensitive to low pH. The optimal pH for DHC is between 6 and 8.5. Most microbial processes associated with the addition of electron donors tend to lower pH by the production of acidic fermentation products such as carbon dioxide and volatile fatty acids. Conversely, some microbial processes such as the reduction of sulfur stimulated by addition of an electron donor can increase pH.

While *EDS-ER* has a neutral pH when mixed with water, *EDS-ER* has no buffering as its alkalinity is below 1.0 mg CaCO3/L. We often suggest the addition of *Nutrimens*. Field and experimental data has shown that *Nutrimens* helps maintain circumneutral pH.

Sites with a ground water pH below 6.0 prior to electron donor injection are likely to produce pH values well below 6.0 after the addition of any electron donor. We often suggest performing an acidity titration on groundwater and soil slurries to evaluate the amount of alkalinity needed to reach the optimal pH range of 6.5 to 8.5. SiREM can provide this service.

Our clients have used buffers such as calcium carbonate, sodium bicarbonate, etc. with *EDS-ER*. These buffers are readily available for purchase at chemical suppliers and can work well in some applications. However, reapplication is common, as the buffering is typically not long lasting. Other options include adding a strong base like sodium hydroxide, but there is more of a concern with overshooting the pH and there are more Health and Safety issues in the field.

Many clients are looking to Gas Infusion technology. gPRO and iSOC units can infuse ammonia (NH_3) into groundwater. Treating water with ammonia is not new. The advantages of ammonia over other neutralizing agents are increasing its popularity in industries such as mining. When ammonia meets acidic groundwater, some of the ammonia will react directly with the acid, consuming acidity, raising pH and producing the ammonium ion. Ammonia will also react directly with the groundwater producing ammonium and the hydroxyl base ions ($NH_3 + H_20 \rightarrow NH_4^+ + OH^-$). Another benefit of ammonia is that it provides a source of nitrogen, which is an essential nutrient for microorganisms.

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Ph: 919.453.5577 • info@tersusenv.com