MRC®
METALS REMEDIATION COMPOUND

METALS REMEDIATION COMPOUND (MRC®)

MRC is a controlled release remediation product designed specifically for the treatment of hexavalent chromium (Cr(VI)) in groundwater. MRC removes dissolved hex-chrome via *in situ* immobilization and provides a substrate for the biodegradation of chlorinated solvents.

Background

Within a groundwater aquifer chromium can exist as either the trivalent, Cr(III), or hexavalent, Cr(VI) form. Cr(III) is considered to be essential to mammals for the maintenance of glucose, lipid, and protein metabolism. Conversely, in humans Cr(VI) is known to have an adverse affect on the lungs, liver, and kidneys. Groundwater can become contaminated with metals, including Cr(VI), through a variety of processes including: infiltration of leachate from landfills, land application of sewage sludge, seepage from industrial waste lagoons and spills/leaks from industrial plating and coating operations.

The Subsurface Environment

Within the subsurface environment, dissolved metals are affected by a number of geochemical factors including pH, electrical potential (Eh), complexation, sorption and ion exchange. The ability to manipulate and control these factors can directly influence the physical state, mobility, and presence of metals in groundwater through processes such as precipitation, oxidation/reduction, sorption, and complexation. MRC directly affects biogeochemical processes to remove Cr(VI) from groundwater quickly, effectively and at a relatively low cost.

How it Works

MRC is a controlled release metals remediation product that removes dissolved hexavalent chromium from groundwater via *in situ* immobilization (precipitation and/or sorption to soil particles). MRC consists of an organosulfur compound esterified to a carbon backbone. This organosulfur ester is embedded in a polylactate matrix, making MRC a thick, viscous liquid. Upon injection into an aquifer, the organosulfur compound, which is the active metals immobilization agent, is slowly released when the ester bonds in MRC are cleaved via hydrolysis by water and microbial enzymatic action. Similar processes also cause MRC to slowly release lactic acid, which acts as an electron donor and carbon source for naturally-occurring bacteria and creates the optimal conditions for metals immobilization by the organosulfur compound.

Immobilization Mechanisms

MRC stimulates chromium immobilization using a two-part mechanism. First, there is significant evidence that the organosulfur compound in MRC is a direct chemical reductant for soluble hexavalent chromium and produces insoluble trivalent chromium. Secondly, MRC can stimulate hexavalent chromium reduction indirectly by providing lactic acid, which is rapidly metabolized by subsurface microbes and creates reduced species, like ferrous iron and sulfide, that are known to chemically reduce hexavalent chromium to the insoluble trivalent state.

Dual-Purpose Functionality

MRC can also be used to treat sites with mixed hexavalent chromium and chlorinated hydrocarbon contamination because it provides the substrates needed to facilitate dissolved hexavalent chromium immobilization and reductive dechlorination. The dual-purpose feature allows MRC to effectively treat sites with co-mingled plumes because it eliminates the need for separate technologies to treat metals and chlorinated compounds. The organic substrate and lactate present in MRC accelerates the *in situ* biodegradation rates of chlorinated hydrocarbons (CHs) via anaerobic reductive dechlorination processes. Indigenous microorganisms ferment the lactate given off by MRC and produce hydrogen. Microorganisms capable of reductive dechlorination use this hydrogen to progressively remove chlorine atoms from chlorinated hydrocarbon contaminants. In general, reductive dechlorination of ethenes occurs by way of sequential dechlorination from perchloroethene (PCE) to trichloroethene (TCE) to dichloroethene (DCE) then to vinyl chloride (VC) and finally to ethene. Reductive dechlorination is one of the primary attenuation mechanisms by which chlorinated solvent groundwater plumes can be stabilized and/or remediated.

MRC offers a safe, simple and effective means of *in situ* Cr(VI) treatment at contaminated groundwater sites.

MRC® PERFORMANCE

IN THE LAB

MRC was tested for the immobilization of hex-chrome in a simulated aquifer experiment. Results of hex-chrome treatment:

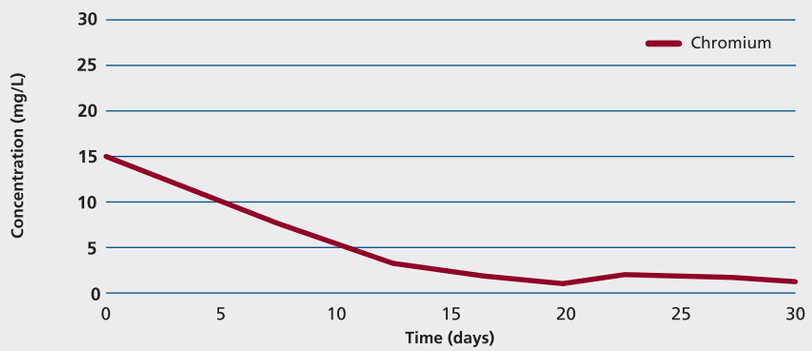
Results of Chromium Treatment

Over a 30 day period:

- Chromium was reduced from 15 mg/L to 0.4 mg/liter

After 30 days of operation, flushing was started to assess the stability of the hex-chrome. Three pore volumes of oxygenated water were flushed through the aquifer simulation vessel (ASV) for 30 days and concentrations of dissolved hex-chrome did not rebound or increase.

Figure 1: Chromium Immobilization with Regenesis Metals Remediation Compound (MRC)



IN THE FIELD

Superfund Site Replaces Pump and Treat (P&T) with MRC

A P&T system was installed at a site in Texas to treat chromium in tight soils. After 13 years of operation, the P&T system was deemed ineffective in treating the remaining chromium and the system was shutdown. MRC was chosen to further reduce concentrations of unfiltered chromium. Figure 2 shows the reduction of unfiltered chromium as a result of MRC influence. Hexavalent and total unfiltered chromium have decreased to close to or beneath target concentrations. The use of MRC resulted in a net savings of $183,000 during the first year of treatment.

Figure 2: Total Cr (unfiltered)