Metals Remediation Compound MRC®

TECHNICAL BULLETIN 5.0

Cr(VI) Reduction: MRC vs. HRC

Metals Remediation Compound (MRC®) is an organosulfur compound embedded in a polylactate matrix designed to immobilize metals from groundwater. Hydrogen Release Compound (HRC) is a polylactate compound without the organosulfur compound originally designed for the reduction of chlorinated solvents.

Hexavalent chromium (Cr(VI)) is used in a variety of industrial processes. Highly soluble and toxic, Cr(VI) is used in wood treating, plating, tanning, as well as the power industry. Both MRC and HRC have proven to be effective in removing Cr(VI) from groundwater by reducing it to its trivalent form, Cr(III), which was limited solubility. However, the mechanisms by which MRC and HRC reduce Cr(VI) are slightly different. The organosulfur compound in MRC is an abiotic reductant and reacts with Cr(VI) directly in the initial stages, whereas HRC releases lactate to biologically reduce Cr(VI). In general, the rate of abiotic Cr(VI) reduction is faster than that of biological Cr(VI) reduction.

An investigation was conducted at Hanford, a Cr(VI)-contaminated DOE site with a plume migrating towards the Columbia River. Sediment was collected from the Hanford site and exposed to 1,000 ppb Cr(VI) and either HRC or MRC. In less than 1 week, MRC had reduced Cr(VI) to undetectable concentrations whereas it required 3 weeks for HRC to reduce Cr(VI) to undetectable concentrations (Hazen *et al*., 2004).

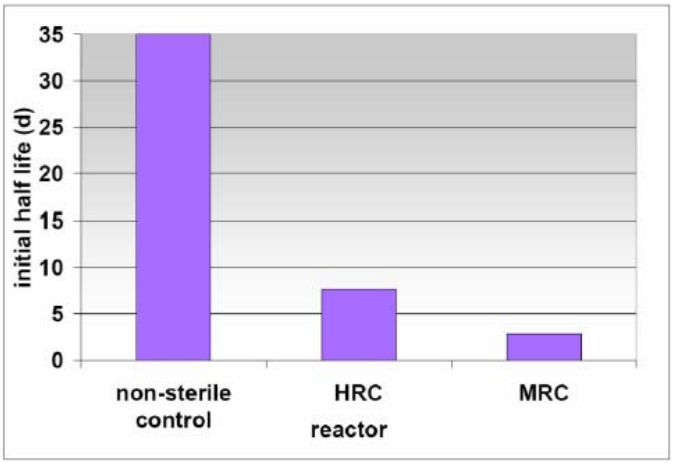

Figure 1: Half-live calculations for HRC, MRC, and non-sterile reactors

A similar investigation was carried out at a former chrome plating facility in Sacramento, California. HRC and MRC were used in soil reactor experiments to examine their potential for stimulating dissolved Cr(VI) reduction and precipitation. Contaminated water with 12,000 µg/L of Cr(VI) was placed into three 32-gallon reactors filled with soil from uncontaminated on-site borings and then treated with HRC, MRC, or no amendment (non-sterile control). The results can be seen in the Figures 1 and 2.

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The Cr(VI) half-lives for MRC for the first 12 days was 3 days for MRC, which was less than half that of HRC at 7 days. By contrast, the non-sterile control had total chromium half-lives of 35 days.

MRC and HRC reactors showed respectively, 100% and 73% reduction in Cr(VI) concentrations over the same 12 days. The non-sterile control was reduced by 25% over this time span.

These experiments demonstrate that while both HRC and MRC are effective at reducing dissolved Cr(VI) concentrations in groundwater, the abiotic reduction of Cr(VI) due to the organosulfur compound in MRC can result in much quicker results that do not rely on native microbial populations.

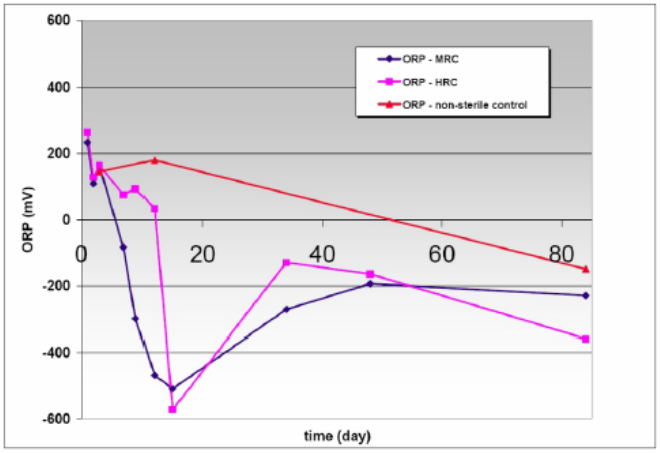

Figure 2: ORP measurements taken from MRC, HRC, and non-sterile reactors

While the difference in Cr(VI) reduction rates may not seem significant in bench-scale studies, in a full scale application the disparity could potentially be extrapolated to additional weeks or months of treatment. As well, the addition of an abiotic reductant decreases the reliance on microbiological factors increasing the overall efficiency of reduction.

References

Hazen T.C. et al. (2004) "Functional Microbial Changes During Lactate and HRC-Stimulated Bioreduction of Cr(VI) in Hanford 100H Sediments." *Fourth International Conference on the Remediation of Chlorinated and Recalcitrant Compounds*. Battelle, Columbus, OH.

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