Performance of a Large-Scale Reductant Amended Backfill for Remediation of Hexavalent Chromium-Impacted Groundwater

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Background/Objectives. Over an area of approximately 15 acres and 20 feet deep, soils containing chromium ore processing residue (COPR) have been excavated and the excavations have been backfilled with fill amended (mixed) with FerroBlack-H reductant (a reductant mixture of insoluble ferrous sulfide and soluble hydrogen sulfide) at a former COPR facility located in New Jersey. The soluble hydrogen sulfide reacts rapidly with residual hexavalent chromium (Cr^{6+}) present in the groundwater, reducing it to trivalent chromium, which forms an immobile and relatively insoluble hydroxide precipitate. The reductant also immobilizes other metals present in groundwater. The insoluble ferrous sulfide provides a longer term source of reductants that will continue to reduce Cr^{6+} over many years.
The application of the amended backfill is also remediating shallow groundwater, as well as serving as a safeguard against recontamination from contaminated groundwater entering the site from deeper impacted groundwater and adjacent residual sources. The longevity of the reductant in the amended backfill is a function of the dosing of the reductant, amount of chromium in the subsurface, site geochemistry, and rate of exposure of the reductant to rainfall-induced infiltration and groundwater flow.

Approach/Activities. The dosage and placement of the amended backfill was selected depending on the concentration of Cr^{6+} in groundwater and the results of bench- and field-scale testing. The performance assessment of the amended backfill included quarterly groundwater sampling of chromium species, metals, and geochemical parameters. The data were evaluated and geochemical/concentration trends were analyzed; reductive capacity calculations of the amended backfill were performed.

Results/Lessons Learned. Evaluation of groundwater data indicates that negative oxidation-reduction potential conditions have been sustained following placement of the amended backfill. Groundwater pH has also moderated in areas where amended backfill was placed. Concentrations of Cr^{6+} and total chromium have reduced and continue to reduce over time. Reductions in metals concentrations have also been observed. FerroBlack-H activity and longevity is a function of the dosing of the reductant, and site-specific geochemical and contaminant/geochemical loading conditions. A quantitative assessment of the longevity and reducing capacity of the reductant amended backfill will be presented. Lessons learned related to the application of the amended backfill, including sampling and analysis procedures will be discussed.