

# Environmental Bio-Systems, Inc. 1

## TECH MEMO #100: HEXAVALENT CHROMIUM IN-SITU REMEDIATION

By Jim Jacobs, CHG, 415-381-5195

**THE CHROMIUM (VI) PROBLEM:** Hexavalent chromium is highly toxic as well as highly soluble over a wide range of pH conditions. Failure to treat Cr (VI) contamination in a quick manner, results in larger future expenditures as groundwater plumes continue to spread, unless remediated.

**HISTORY:** Chromium is used in a variety of industrial processes. Highly soluble and toxic, hexavalent chromium has been used in wood treating, plating, tanning as well as in the power industry. Naturally occurring chromium occurs in the trivalent form, Cr (III), and has limited solubility (except in extremely acidic conditions).

**PAST REMEDIATION OPTIONS:** In the past, conventional soil remediation of the Cr (VI) impacted soil relied on soil excavation, which was expensive and disruptive. In addition, moving the soil only moved the problem, without treating the soil or reducing the long-term liability. For groundwater, pump and treat remediation relied on pumps to remove groundwater from the aquifer through a series of extraction wells or trenches. The extracted water was then treated above ground or disposed of off-site. Pump and treat methods fail to address the source of the contamination in the vadose zone. In addition, the lowering of the water table by pumping leaves behind residual contamination in the new vadose zone. In areas of low permeability, residual levels of chromium will be missed, creating future sources of contamination. Unfortunately, pump and treat has not been shown to be highly effective for treating chromium-impacted groundwater. Although the construction of passive permeable treatment walls containing zero valent iron filings can reduce Cr (VI) to Cr (III), the passive barriers are expensive and do not treat source areas (Thomasser and Rouse, 2001).



Installation of treatment liquids using the high-pressure Remediation Injection Process (RIP<sup>®</sup>)

**NEW REMEDIATION APPROACH:** The ENVIRONMENTAL BIO-SYSTEMS RIP<sup>®</sup> delivery system uses metals stabilization chemistry to remediate Cr (VI). Using a reductant, such as calcium polysulfide (brand name: Cascade<sup>®</sup>), the highly soluble Cr (VI) is reduced to the soluble, but non-toxic Cr (III) state. Cr (III) is then precipitated as an insoluble salt, chromium hydroxide. ENVIRONMENTAL BIO-SYSTEMS's in-situ delivery method uses close spacing

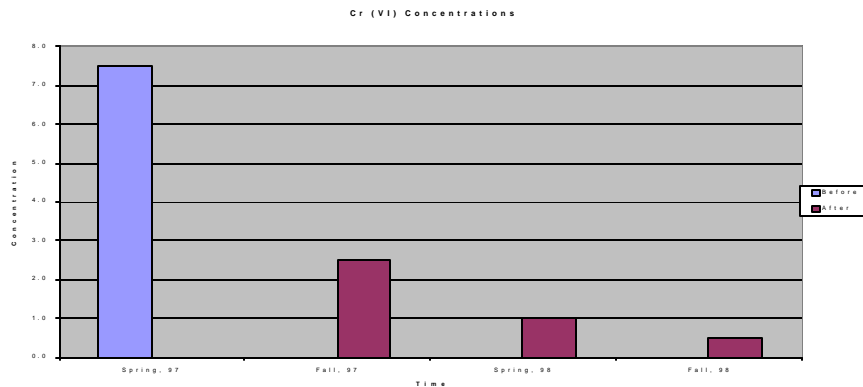
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of the RIP<sup>®</sup> high-pressure injection ports, allowing the treatment chemicals to fully contact the contaminant (Jacobs, 2001). ENVIRONMENTAL BIO-SYSTEMS uses both a direct push method as well as a specialized lance system for the delivery of treatment chemicals.

### RESEARCH AND CASE STUDY:

**UKIAH, CALIFORNIA WOOD TREATING PLANT:** Working for Groundwater Technology, Inc. in 1997, ENVIRONMENTAL BIO-SYSTEMS provided the delivery system for a Cr (VI) project in Ukiah, California. The site had hexavalent chromium contamination resulting from one specific wood-treating project in 1966. ENVIRONMENTAL BIO-SYSTEMS injected up to 300 gallons (up to 20 gallons per minute) of calcium polysulfide into the groundwater in 114 injection ports to a maximum depth of 20 feet in 1997 (Thomasser and Rouse, 2001).



**COMPANY BACKGROUND:** Since 1990, ENVIRONMENTAL BIO-SYSTEMS has been a leader in in-situ remediation. The company has developed proprietary injection remediation technologies, allowing for successful remediations of metals, hydrocarbons, and chlorinated solvents.

**RECOMMENDED PLAN:** ENVIRONMENTAL BIO-SYSTEMS recommends a review of the existing physical and chemical data, including pH, permeability, lithology, and water depth, concentrations of Cr (VI) and Cr (III), alkalinity, and other data and a simple bench test (10 working days). The in-situ remediation can occur within 10 to 15 working days after the bench test results are available.

### REFERENCES:

Jacobs, J., 2001, In-Situ Liquid Delivery Systems for Chemical Oxidation, Bioremediation and Metals Stabilization, Association for Environmental Health and Sciences, 11<sup>th</sup> Annual West Coast Conf. on Contaminated Soils, Sediments and Water, March 21, 2001, San Diego, California, Abstracts.

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Thomasser, R. and Rouse, J.V., 2001, In-Situ Remediation of Chromium Contamination of Soil and Groundwater, Montgomery-Watson.