Environmental Bio-Systems, Inc.

TECH MEMO #106: PERCHLORATE REMEDIATION OPTIONS

By Jim Jacobs, CHG, 415-381-5195

THE PERCHLORATE PROBLEM: Only recently has perchlorate been analyzed and it is becoming increasingly clear that this chemical is a major challenge for environmental restoration professionals. Perchlorate originates from solid salts of ammonium, potassium, or sodium perchlorate. The perchlorate part of the salts, the anion (ClO_4^-) is highly soluble in water and consequently exceptionally mobile in groundwater. Failure to treat perchlorate contamination in a quick manner, results in larger future expenditures as groundwater plumes continue to spread, unless remediated.

HISTORY: Ammonium perchlorate is manufactured for use as an oxygen-adding component in solid propellant for rockets, certain munitions, missiles, fireworks, and the manufacture of matches and in analytical chemistry. Due to the compound's limited shelf life, replacement with fresh stocks of the chemical and disposal of the dated material was required (EPA, 2001). This has created large disposal volumes since the 1950s in many states, including California, Nevada, Texas and Utah, among others.

PAST REMEDIATION OPTIONS: Perchlorate remediation primarily uses bioremediation. An above ground bioremediation system was used to treat perchlorate at a Department of Defense installation in Southern California. The system is identical to those that are currently removing nitrate from water. The technique of the above ground reactor is to first remove dissolved oxygen in a simple bio-ring filled reactor, followed by a second reactor that continually stirs the liquids in a vat containing small pieces of a special sponge material that hold the specialized anoxic bacteria. The bacteria are simple facultative anaerobes that are able to metabolize oxygen from a number of different contaminants (Hall, 2001). ENVIRONMENTAL BIO-SYSTEMS has constructed above ground water bioremediation systems.

Other methods for in-situ biotreatment of perchlorate include using wet cow manure and applying the liquids to the subsurface, and allowing the bacteria, moisture, and organic material from the manure or sludge to leach into the soil. An actual case study described an Aerojet General Corporation site (Borch, 2001). During the first 30 days after initial placement of the wet manure onto the soils, biodegradation destroyed over 90% of perchlorate in the high perchlorate areas (initial range of perchlorate: 600 to 1,400 mg/kg; reduced to 12 to 95 mg/kg).

Environmental Bio-Systems, Inc.

TECH MEMO #106: PERCHLORATE REMEDIATION OPTIONS

By Jim Jacobs, CHG, 415-381-5195

NEW REMEDIATION APPROACH:
ENVIRONMENTAL BIO-SYSTEMS proposes to use sludge from a waste water plant as the source of the bacteria and nutrients. Perchlorate bioremediation requires that enough bacteria, moisture, and organic material from the sludge to leach into the soil, and fully contact the contaminant (Jacobs, 2001).

Laboratory bench tests aid in perchlorate studies →.

DELIVERY SYSTEM: The ENVIRONMENTAL BIO-SYSTEMS has used closely spaced injection ports, wells, filter galleries and trenches to deliver treatment chemicals into the subsurface. The tools ENVIRONMENTAL BIO-SYSTEMS uses to construct the delivery ports include high-pressure injection lances, direct push rigs, hollow stem auger rigs, backhoes and excavators. In addition to in-situ remediation of perchlorate, soil stockpiles can be cleaned using the treatment liquids.

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 a large variety of chemicals. In addition, the firm has designed, constructed and operated numerous above ground water treatment systems, including bioreactors.

RECOMMENDED PLAN: ENVIRONMENTAL BIO-SYSTEMS recommends a planned approach to in-situ remediation, including a bench test, a pilot-scale test and then, a full-scale remediation. The first step is a review of the existing physical and chemical data, including pH, permeability, lithology, and water depth, concentrations of perchlorate, moisture content of the soils, bacteria count and identification, alkalinity, and other data. This information is used to design a simple bench test (10 to 20 working days). The results from the bench test are then used for the in-situ pilot-scale remediation. The in-situ remediation can occur within 20 to 40 working days after the bench test results are available and the designs are completed.

REFERENCES:

Borch, R., 2001, Case Study: Bioremediation of Perchlorate in Soils by the Surface Application of Wet Cow Manure, Association for Environmental Health and Sciences, 11th Annual West Coast Conf. on Contaminated Soils, Sediments and Water, March 21, 2001, San Diego, California, Abstracts.

Environmental Bio-Systems, Inc.

TECH MEMO #106: PERCHLORATE REMEDIATION OPTIONS

By Jim Jacobs, CHG, 415-381-5195

Hall, P.J., 2001, Biological Perchlorate Remediation at a DOD Installation, Association for Environmental Health and Sciences, 11th Annual West Coast Conf. on Contaminated Soils, Sediments and Water, March 21, 2001, San Diego, California, Abstracts.

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

U.S. Environmental Protection Agency (EPA), 2001, Perchlorate, web site: http://www.epa.gov/OGWDW/ccl/perchlor/perchlo.html; Office of Water, Ground Water and Drinking Water Department,