FAST-TEK Engineering Support Services

TECH MEMO #105: ELECTRO-KINETIC ENHANCED REMEDIATION

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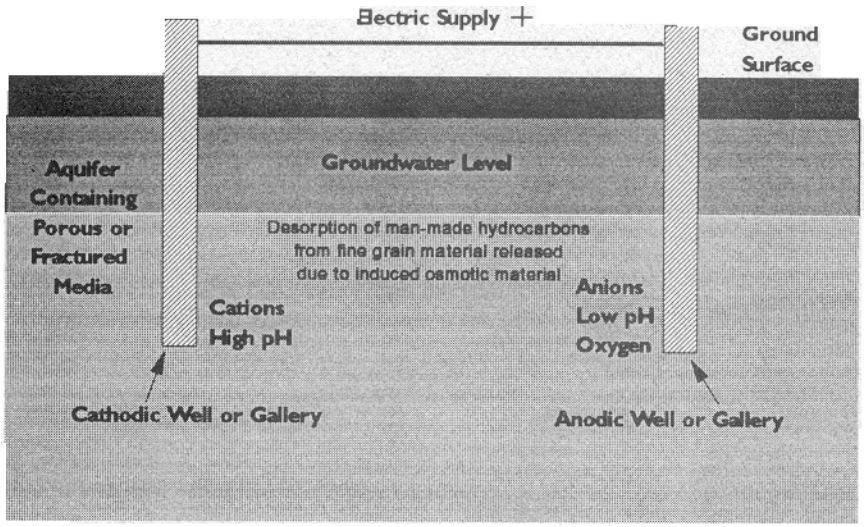
THE PROBLEM: Many in-situ projects need an enhancement to help move subsurface contaminants in low permeability soil. Electrokinetic enhancement for remediation has been a proven geotechnical process to dewater clays. In recent years, electrokinetics has proven successful in the environmental field for treatment of organic and inorganic contaminated soils in in-situ and ex-situ applications. It may also be used for destruction of explosives and is valuable when applied to produce a barrier to control contaminated aquifers. For more information, see Loo, 2000.

HISTORY: Electrokinetics was developed during WWII by the Germans to stabilize Norwegian railroad beds. Geotechnical engineers have used it extensively as a means of dewatering fine-grained soils or stabilizing embankments. In recent years, the processes, electrolysis and electro-osmosis, have been further developed as effective and inexpensive methods for the enhancement of in-situ remediation of contaminated soils.

Electrolysis, one of the principal industrial processes used in the production of aluminum, chlorine, metal plating, welding and corrosion protection, can also be sued for isolation of capture of metallic ions at and near the cathode electrode and negatively charged ion at and near the anode electrode.



Electrochemical treatment schematic diagram (Jacobs and Loo,1994),

Electrolysis will oxidize petroleum hydrocarbons and benzene-based organic chemicals such as PCBs, pesticides, and PAHs. Electrolysis can be applied in both permeable and impermeable soil. It can be used as a neutralization process for pH control. Electro-osmosis enhancement can be used in the treatment of hazardous chemicals in silty and clayey soils. The essence of the electro-osmosis process is to cause an

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imbalance of charge bonds in clayey soil which results in clay compaction and chemical desorption. The compaction and desorption processes will reduce remediation time and are particularly successful in desorbing organic chemicals and metals from clay-rich soil. This process is a way to enhance in-situ chemical oxidation, bioremediation and pump and treat projects. Electrokinetic processes can be applied both above ground or in-situ.

ELECTROCHEMICAL PROCESSES CAN TREAT OR ENHANCE THE FOLLOWING:

Chemical oxidation of petroleum hydrocarbons such as gasoline, BTEX, diesel, fuel oil, jet fuel and kerosene.

Chemical oxidation of benzene-based organic chemical such as PAHs, pesticides and PCBs.

Isolation, capture and precipitation / stabilization of metals.

Isolation and capture of common hazardous anions like nitrite and capture and disinfection of pathogenic bacteria.

Application of the process involves the installation of an anode and cathode within the zone of contamination. An electrical potential will be initiated across the two electrodes. The voltage potential across the target area can cause several processes to be initiated, depending on the soil matrix, including: (1) Movement of water through soil systems at rates much faster than expected using hydraulic heads, (2) Removal of contaminants through pore water or water films at a rate much faster than the water phase, and (3) Development of an acid front that moves through the treatment zone**.**

RECOMMENDED PLAN: FAST-TEK recommends a review of the existing physical and chemical data, including pH, permeability, lithology, and water depth, concentrations of contaminants, alkalinity, and other data and a bench test (5 to 10 working days). The electrokinetics enhanced in-situ remediation pilot test can occur within 10 to 15 working days.

REFERENCES:

Jacobs, J., and Loo, W.W., 1994, Direct Push Technology Opens New Remediation Avenues, Econ Magazine, December, p. 36-37.

Loo, W.W., 2000, Electrokinetic Treatment of Hazardous Wastes, Standard Encyclopedia of Environmental Science and Technology, McGraw Hill, New York, NY, p. 14.69 – 14.84.