

# Electrokinetic-Enhanced

## In Situ Biological and Chemical Remediation

### Cost Effective Remediation of Low Permeability or Heterogeneous Systems



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#### ELECTROKINETICS OVERVIEW

##### **Specific to Low Permeability Environments**

As the processes underlying electrokinetics are independent of soil permeability, the process is particularly suited to environments where hydraulic delivery approaches (such as injection or recirculation) fail.

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##### **Targets Sources of Back-diffusion**

Electrokinetic enhancement is designed to achieve rapid penetration and distribution of treatment fluids or nutrients into clays and other long term sources of contamination to aquifers. Electrokinetic approaches are currently the only proven in situ alternative to thermal remediation technologies for addressing contamination in low permeability soils and rocks.

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##### **Low-cost Enhancement of Proven Technologies**

The electrokinetic infrastructure is based on simple engineering, using commonly available materials, and requires low power inputs to achieve field-scale homogeneous distribution of treatment reagents.

# How Electrokinetics Works

Electrokinetics provides a unique delivery mechanism for the enhancement of In Situ Chemical Oxidation, In Situ Bioremediation, and other proven treatment technologies.

Electrokinetics is the application of low DC voltage gradients to the subsurface through simple electrodes, which results in the migration of ions towards their oppositely charged electrode.

The applied voltage gradient also results in the bulk movement of groundwater from one electrode to another, through a process known as electro-osmosis.

This process is highly efficient in clay-rich strata, and can result in migration of ions and dissolved compounds at the rate of several metres a month in tight clays.

For heterogeneous systems, where significant contaminant mass remains in the low permeability regions, application of electrokinetics after a hydraulic flood of amendment, donor, or oxidant results in rapid movement of the injected compound into the low permeability layers, greatly reducing the mass discharge from these sources after treatment.



## CASE STUDY:

### PCE Source Zone Treatment at a Former Industrial Facility, Denmark

The ability of electrokinetics to deliver electron donor (lactate) through a PCE source zone in a clay till was demonstrated at a former industrial site in Denmark.

The objectives of the test were to confirm the successes seen in site-specific bench scale testing of the technology, test the engineering design of the electrodes and recirculation and delivery systems, measure migration rates of electron donor in a real world system, and confirm that the applied voltage field did not have an adverse impact on KB-1® which was used to augment the indigenous organisms. The pilot test successfully demonstrated all of the objectives, with lactate appearing in all monitoring wells within days of application of the electric field, rapid increases in the concentrations of PCE degradation intermediates (cis-DCE and VC) due to the presence of lactate, and gradual increases in ethene in post-application monitoring (as KB-1® became acclimatised and spread throughout the treatment area).

## For More Information

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