Etec LLC
Environmental Technologies
www.etecllc.com

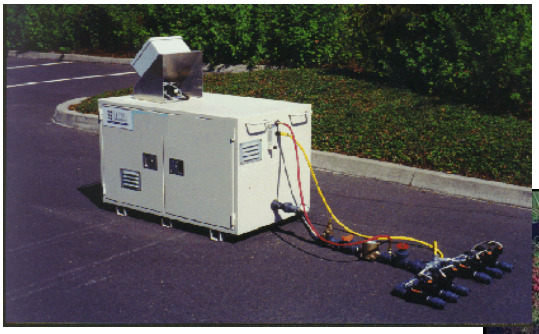
ISD™ In Situ Delivery Systems

One of the primary limitations of in-situ remediation processes (i.e. chemical oxidation, bioremediation) is a lack of contact between delivered amendments and the contaminants. Unfortunately, many pilot- and full-scale in situ processes are implemented via slug injections, which are often ineffective because they fail to maintain appropriate subsurface conditions, and also fail to deliver the required mass of amendments. In order to overcome these limitations, ETEC has developed a series of automated delivery systems that can deliver liquid and slurry-phase substrates, nutrients, or chemical oxidants to the subsurface on a consistent, scheduled basis. The In Situ Delivery (ISD™) systems are fully automated and programmable, allowing you to optimize the consistent delivery of subsurface amendments based on your site-specific remediation needs.

Use these turnkey systems to deliver...

- *Aerobic Substrates:*
  Propane
  Butane
- *Anaerobic Substrates:*
  Lactate
  Benzoate
  Dextrose
  Molasses
  Soybean Oil
- *Nutrients:*
  Nitrogen
  Phosphorus
  Potassium
- *Oxidants:*
  Hydrogen Peroxide
  Permanganate
  Persulfate
  Ozone

...for site-wide contact between the contaminants and your amendments.



Customized for site-specific applications

Mobile and portable

Ideal for delivery into silt, clay, and bedrock

Programmable logic control (PLC) integration

ISD™ Equipment Line Summary

Capabilities	ISD-Mobile	ISD-10	ISD-20
Max Flow Rate, gpm	10	10	20
Number of Injection Stations	1	1 to 12	variable
Product Injection	Automated	Automated	Automated
Mobility	Mobile Trailer	Portable	Fixed
Insulation/Heating	No	Yes	Yes
Length	12 ft.	4 ft.	6 ft.
Width	6 ft.	3 ft.	5 ft.
Height	5 ft.	3 ft.	7 ft.
Customization Available	Yes	Yes	Yes

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ISD™ Applications

Aerobic Degradation of TCE, DCE, and VC

Aerobic co-metabolism and direct oxidation are effective ways to biologically-remove chlorinated aliphatic compounds from soil and groundwater. Not only do aerobic processes have faster degradation rates than reductive dechlorination, they also do not produce toxic intermediates like VC. Propane and butane are excellent primary substrates for co-metabolic degradation of TCE, DCE, and VC but their low solubility often makes it difficult to maintain dissolved concentrations for in situ microbial growth. To overcome this, the ISD™ systems utilize a ***gaseous mixing system*** that saturates these gases in water, amends the solution with nutrients and dissolved oxygen, and injects into the subsurface to maximize microbial activity. The pulsed delivery of these co-metabolites and amendments by the ISD™ system also improves migration and mixing within the plume zone (as opposed to localized "doughnut" remediation).

Reductive Dechlorination of PCE and TCE

Reductive dechlorination remains a popular method for degrading PCE and TCE. One reason is that anaerobic conditions are usually easier to maintain in the subsurface due to low natural dissolved oxygen concentrations in groundwater aquifers and DNAPL zones. In addition, anaerobic processes generally require only the addition of a substrate like lactate, and possibly the injection of dehalogenating bacteria. The ISD™ systems are ideal to deliver lactate solutions and microbial additives to large impacted plume zones. The ISD™ systems can be used as stand-alone units, or can be incorporated as part of a ***groundwater recirculation system*** (extraction, amendment, and re-injection) to optimize dissolved and DNAPL treatment.

Chemical Oxidation

Chemical oxidation processes (Fenton's, permanganate, persulfate) are used to oxidize a broad range of organic compounds. Since chemical oxidation relies on contact between the oxidant and the target contaminant, in situ delivery is critical. Specifically, oxidant loading rates and soil oxidant demand significantly affects the oxidant mass required to complete remediation. Because oxidant cost is very high (and often cost-prohibitive), ***minimizing these costs via efficient subsurface injection*** is imperative. Recent studies show that slug injections of high-concentration oxidant solution are ineffective, unsafe, and can waste a significant mass of oxidant (thus increasing costs). Smaller injection volumes on a consistent basis using lower oxidant concentrations are more cost-effective and successful. The ISD™ systems can inject lower volumes and concentrations of oxidants, which saves money, increases contaminant destruction, and protects field personnel from dangerous chemical reactions. The ISD™ units can also deliver oxidant catalysts (i.e. iron) on demand.