Subsurface Contaminants Award-Winning Technologies

U.S. Department of Energy
Office of Environmental Management
Office of Science and Technology

Problem:

After years of designing, manufacturing, and testing nuclear weapons, the Department of Energy (DOE) is faced with the challenge of cleaning up the hazardous waste left behind.

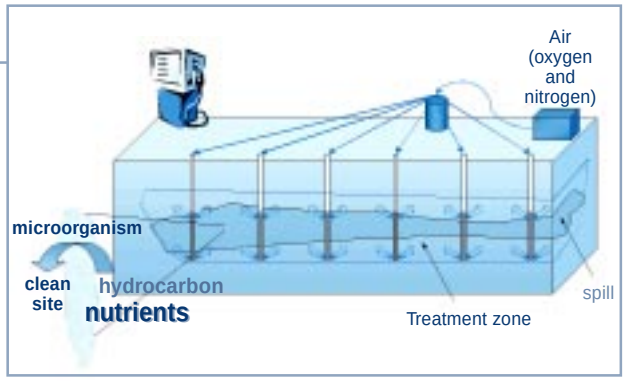
- Surface and groundwater are threatened. More than 5,700 known groundwater plumes have contaminated more than 600 billion gallons of groundwater and 200 million cubic meters of soil with DNAPLs, hazardous metals, and radionuclides.
- DOE landfills contain more than three million cubic meters of waste buried with ineffective insulation, contaminating the surrounding environment.
- Soil, groundwater, and landfills throughout the country containing hazardous and radioactive contaminants have special cleanup needs.
- Current baseline technologies are inadequate or unacceptable because of excessive costs, long remediation schedules, and generation of secondary wastes.
- Public and environment at risk.

Solution:

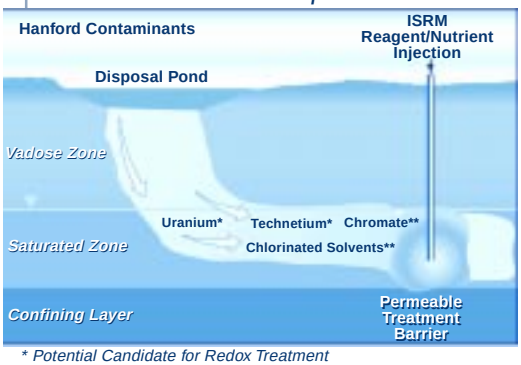
In addressing the problem, the Subsurface Contaminants Focus Area has developed four R&D 100 award winning technologies. Lasagna™ is the fourth SCFA-funded system to receive this prestigious accolade. Previous winners include SEAMIST™ (1994), PHOSter™ (1996), and In Situ Redox Manipulation (1998).

Lasagna™

PHOSter™

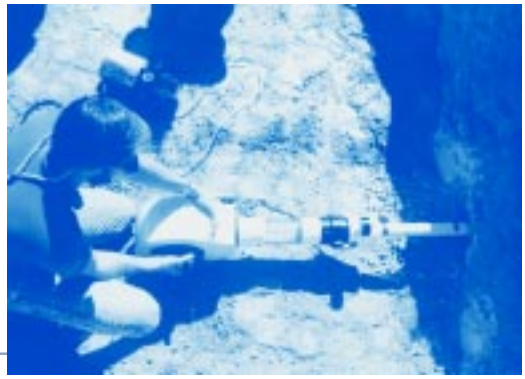


In Situ Redox Manipulation



** Potential Candidate for Redox Treatment*
*** Favorable Candidate for Redox Treatment*

SEAMIST™



Lasagna™:

OST/TMS ID 4

Cleaning contaminated soils through electrokinetics—electrically transferring water and dissolved contaminants with uniform, controlled movement—has traditionally been an expensive procedure that required off-site cleaning as a final step. Monsanto Company developed the Lasagna Process with DuPont and GE Research and Development Center in cooperation with DOE to make electrokinetics less disruptive and more affordable.

In conventional electrokinetics, water pumped in at the anode travels by electroosmosis to the cathode, causing migration of contaminants. Contaminated water is pumped to the surface and taken off-site for treatment.

The Lasagna Process pumps water from the cathode back to the anode in a closed loop. It derives its name from the different layers of its configuration. The granular electrode layers form the ends of the stack and can be oriented either vertically or horizontally to each other. A degradation zone is stacked on top of each electrode, and sandwiched in the middle is the contaminated soil.

This solves several problems. First, the Lasagna Process can move contaminants into treatment zones where they can be decontaminated *in situ*. The time and expenses of off-site processes are eliminated. Second, poles can be reversed in the Lasagna Process for multiple passes through the soil. Pole reversal combined with water recycling eliminates pH and ionic gradient build-up as well as stopping soil drying from non-uniform voltage gradients. The Lasagna Process is also unique because it performs well on both non-permeable (high in clay and silt content) and permeable soils.

The Lasagna Process is effective for organics, metals, and mixed wastes including trichloroethylene, perchloroethylene, dichloroethylene, and vinyl chloride.[1]

Benefits:

- Compared to a number of benchmarked alternative in situ treatment technologies, Lasagna™ has similar per unit costs ($40-60/ cubic yard over a three-year treatment period) but works up to 10 times faster
- Lasagna™ is attractive to regulators and stakeholders because it requires less disturbance of the substrate
- Lasagna™ has successfully remediated clay soil previously subjected to heavy traffic

[1]"Using Electrokinetics to Clean Waste Sites," *R&D Magazine* September 1999.

SEAMIST™

OST/TMS ID 53

Sandia National Laboratories with Science and Engineering Associates, Inc. developed this instrumentation and fluid sampler emplacement technique for hydrologic investigations. The Membrane Instrumentation and Sampling Technique (MIST) was developed to substantially increase the quantity and quality of hydrologic and contaminant data derived from drilled or punched wells.

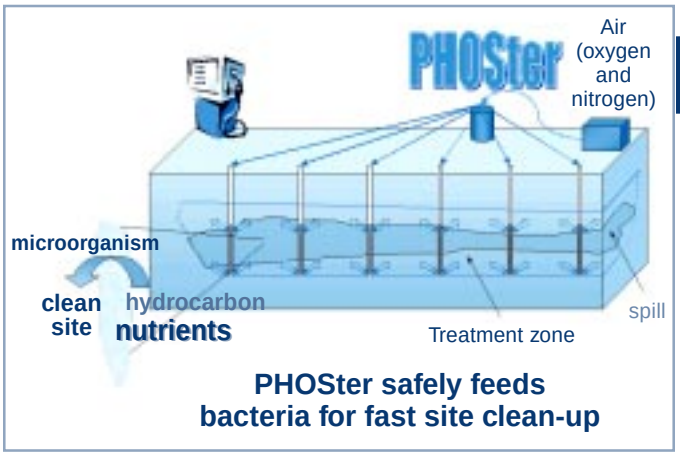
The key feature of the SEAMIST™ system is an impermeable membrane, such as coated nylon or synthetic film. The membrane is forced into the hole by the pressure in the canister. The polyester fabric membrane descends, everts, and presses against the hole wall as it is inserted, providing wall support and the effect of a continuous packer. Reversing the rotation of the reel retrieves the membrane like a rubber glove finger inversion. Monitoring instruments and pore fluid sampling devices are placed on the outer surface of the membrane, which is in contact with the hole wall when emplaced. The membrane acts as an emplacement vehicle and isolates each measurement location.

The SEAMIST™ technology is commercially available through FLUTe, Ltd.

Benefits:

- More than three times more cost-effective than conventional lysimeters when attempting to collect pore fluid samples
- Saves time and money in drilling cost, tool rehabilitation, and waste stream disposal because it is customizable, reusable, and leaves the borehole clean

SEAMIST™ being emplaced in an angled borehole



PHOSter™

OST/TMS ID 2971

PHOSter™ provides controlled addition of phosphate, a critical nutrient, into sites contaminated with organic compounds. The added phosphate balances nutrients needed by beneficial bacteria. This stimulates their growth and speeds up the natural process of contaminant degradation. PHOSter™ is a premier example of a “green”, environmentally-friendly, technology that works with nature and uses minimum energy.

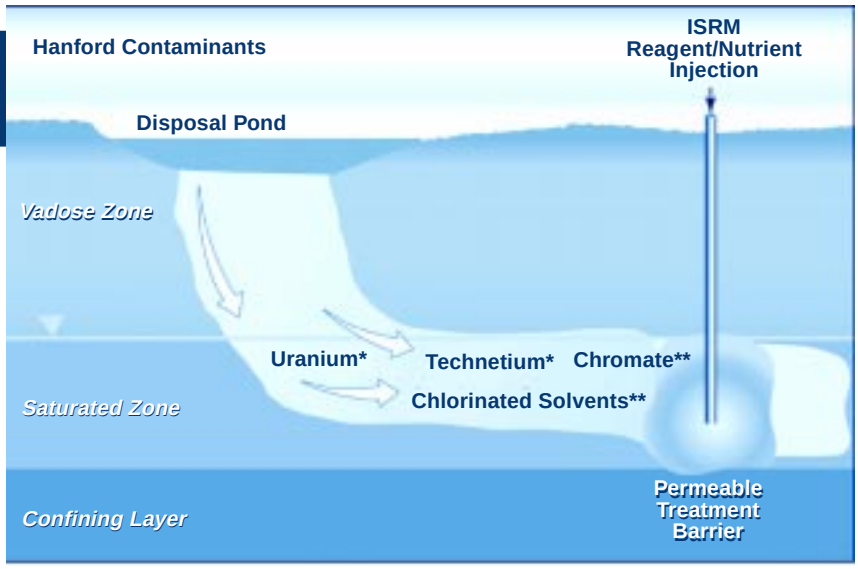
Benefits:

- Permits cleanup of contaminated sites quickly, simply and with minimum disturbance
- Cleanup using PHOSter™ is typically 5-10 times faster than previously possible
- Economical, cost-effective approach to bioremediation
- Broad applicability across the DOE complex and in the commercial sector

In Situ Redox Manipulation (ISRM)

OST/TMS ID 15

ISRM is a ground-water remediation technique that eliminates or immobilizes toxic and carcinogenic contaminants (metals, inorganic ions, and radionuclides) within an aquifer. It can also remove the toxin chromate, which above certain concentrations threatens humans and fish. ISRM operates by injecting a nontoxic chemical into the aquifer through a ground-water well, creating an in situ treatment zone within the contaminant plume. ISRM will be deployed in FY 2000 at the Hanford Site 100-D Area.



** Potential Candidate for Redox Treatment*
*** Favorable Candidate for Redox Treatment*

Benefits:

- Exposure to hazardous materials is greatly diminished because work is accomplished in situ
- Saves time because ISRM immobilizes and detoxifies more quickly
- Rapidly prevents offsite plume migration and quickly immobilizes/detoxifies the contaminant

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