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EPA

Groundwater Remediation For UST Sites

In Situ Bioremediation

In situ bioremediation *is a technique for removing biodegradable contaminants from groundwater. The technique relies on microorganisms and supplemental oxygen and nutrients to break down petroleum products in the groundwater.*

In situ bioremediation offers the advantage of being able to treat contamination in place, without the need for pumping or the subsequent treatment of pumped groundwater. The technique is most effective in permeable aquifers.

Petroleum Types And Constituents

- Fresh or weathered gasoline, diesel, jet fuel, kerosene, motor oil, heavy fuel oil, lubricating oils, and crude oils
- Volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene, and xylene (BTEX); residual semivolatile organic compounds (SVOCs) such as polynuclear aromatic hydrocarbons; and nonvolatile constituents

In Situ Bioremediation	
Advantages	• Degrades contaminants in place • Achieves lower concentration levels than pump and treat
Limitations	• Effectiveness is limited in low permeability or heterogeneous media • Ability to transport nutrients and oxygen might be limited by soil and groundwater mineral content or pH • Targets only biodegradable constituents
System Components	• Groundwater containment system • Oxygen delivery equipment • Nutrient delivery equipment • Injection trenches • Recovery walls or trenches • Pumps • Monitoring points

Wastestream Treatment	• Recirculated groundwater treatment options:
	  • *Air stripping*
	  • *Granulated activated carbon*
	  • *Bioreactors*

Parameters to Monitor[1]	• Constituent concentrations in groundwater • Microbial population in aquifer • pH and total organic carbon • Dissolved oxygen • Nutrient concentration • Flow rates
Cleanup Levels and Timing[2]	• Generally, can achieve maximum contaminant levels (MCLs) • Achieves ≥ 90% reduction of biodegradable constituents • For an ideal site[3], ~90% in 6 months to 1 year • For an average site[4], ~90% in 6 months to 4 years • Longer time required to degrade heavier hydrocarbons
Costs[5]	• For an ideal site[3], $150,000 to $250,000 • For an average site[4], $200,000 to $500,000

[1]"Parameters to monitor" are for performance purposes only; compliance monitoring parameters vary by state.
[2]Cleanup standards are determined by the state.
[3]An "ideal site" assumes no delays in corrective action and a relatively homogeneous, permeable subsurface.
[4]An "average site" assumes minimal delays in corrective action and a moderately heterogeneous and permeable surface.
[5]Costs include equipment, and operation and maintenance.