

**Table A-15.C. Technical implementation considerations for in situ chemical oxidation**

Data requirements	Site-specific data for technology evaluation	Site size and soil characteristics	Soil permeability, plasticity (classification), bulk density, total organic carbon and other natural oxidant sinks, site boundary.
		Groundwater characteristics	Hydraulic, gradient, geochemistry (buffering capacity).
		LNAPL characteristics	LNAPL volume, chemical properties, concentrations, co-contaminants. LNAPL type affects oxidant selection.
		LNAPL depth	Affects delivery method(s).
		LNAPL location	Open area or under building, near utilities, source area identified and removed?
		Permit consideration	Permit may be needed for oxidant injection.
	Bench-scale testing	Soil characteristics	Permeability, natural oxidant demand, classification, bulk density, acid demand.
		Destruction efficiency	Determine efficiency of oxidant selected for destruction of contaminant(s) at site, by-products, oxidant dose.
		Delivery mechanism	Use of soil properties to determine best delivery/oxidant.
	Pilot-scale testing	Injection pressure	If injecting under pressure.
		Placement/number of monitoring wells	Highly recommended ROI be determined.
		Groundwater characteristics	Reducing conditions, oxidation reduction potential (ORP), pH, alkalinity, chloride, etc.
		Number of injection points	Delivery volume, oxidant destruction rate.
		Site conditions	Ability of site to accept oxidant, ROI, heterogeneities. Aquifer metals reactions (mobilization) to high-oxidized conditions.
	Full-scale design	Injection pressure	If injecting under pressure requires care.
		Placement/number of monitoring wells	
		Groundwater characteristics	Reducing conditions, ORP, pH, alkalinity, chloride, dissolved oxygen, etc.
		Number of injection points	Delivery volume, oxidant destruction rate.
		Site conditions	Ability of site to accept oxidant, ROI, heterogeneities. Aquifer metals reactions (mobilization) to high-oxidized conditions.
	Performance metrics	Post monitoring	Reducing conditions, ORP, pH, alkalinity, chloride, injected oxidant, contaminant, daughter products, and groundwater elevations.
		Delivered amount	
		Daylighting observed	
		Oxidant distribution	
		Contaminant reduction	Long-term monitoring
		Contingency plan	Rebound effects
	Modeling tools/ applicable models	Models being developed for predictive capabilities, stoichiometries, etc.	
Further information	<a href="https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=156513">EPA. 2006. Engineering Issue: Chemical Oxidation. EPA/600/R-06/072. https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=156513</a> <a href="https://clu-in.org/download/techfocus/chemox/4_brown.pdf">Brown, R. A. 2003. "In Situ Chemical Oxidation: Performance, Practice, and Pitfalls." AFCEE Technology Transfer Workshop, Feb. 24–27, San Antonio. https://clu-in.org/download/techfocus/chemox/4_brown.pdf</a> <a href="http://www.itrcweb.org/Guidance/GetDocument?documentID=45">ITRC. 2005. Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater. 2nd ed. ISCO-2. http://www.itrcweb.org/Guidance/GetDocument?documentID=45</a> <a href="https://www.epa.gov/sites/production/files/2014-03/documents/t">EPA. 1994. How To Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan Reviewers. Chemical Oxidation (chapter 13). EPA 510-B-94-003. https://www.epa.gov/sites/production/files/2014-03/documents/t</a>		

[Ground-Water Remediation Technologies Analysis Center. 1999. In Situ Chemical Treatment Technology Evaluation Report. TE-99-01. http://clu-in.org/download/toolkit/inchem.pdf](http://clu-in.org/download/toolkit/inchem.pdf)

[ESTP. 2006. In Situ Chemical Oxidation for Groundwater Remediation—Technology Practices Manual. ESTCP ER-200623. https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Persistent-Contamination/ER-200623/ER-200623](https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Persistent-Contamination/ER-200623/ER-200623)

---