Table A-13.C. Technical implementation considerations for air sparging/soil vapor extraction

Data requirements	Site-specific data for technology evaluation	Soil permeability (to air, e.g., in unsaturated zone)	Permeability to air in the unsaturated zone directly affects the radius of treatment that can be developed around each SVE well for a given vapor extraction rate; lower-permeability soils require more SVE wells per unit area.
		Groundwater conductivity	Hydraulic conductivity is an indicator of the potential effectiveness of AS. Lower hydraulic conductivity soils(<10-4 cm/sec) are likely to restrict air flow and limit the mass removal rate of volatile LNAPL fraction. Very high hydraulic conductivity soils (10-1 cm/sec) are likely to require deeper AS wells and high air-flow rates to be effective.
		LNAPL characteristics	AS/SVE is effective on only the volatile fraction of the LNAPL. AS/SVE performed on an LNAPL with a small volatile fraction (e.g., jet fuel or a strongly weathered gasoline) does not result in significant volatile mass removal, but may contribute to aerobic biodegradation.
		Available power/utilities	The power source must be determined.
	Bench-scale testing	N/A	
	Pilot-scale testing	AS air entry pressure	To evaluate safe injection pressures.
		AS pressure vs. flow	Safety and feasibility
		AS ROI (vs. flow)	Feasibility can be measured by observing transient groundwater mounding, monitoring a tracer gas added to sparge air, or monitoring vapor concentration changes or dissolved oxygen coincident with sparge operation.
		SVE vacuum vs. flow	Feasibility
		SVE ROI (vs. flow)	Feasibility
		SVE influent concentration	Treatment system type and sizing
	Full-scale design	AS pressure and flow	Compressor sizing
		AS ROI	AS well spacing
		SVE vacuum and flow	Blower sizing
		SVE ROI	SVE well spacing
		SVE influent concentration	Treatment system type and sizing
	Performance metrics	SVE well head and blower vacuum	Basic system performance—large differences can be an indicator of system problems, e.g., water in conveyance piping.
		AS well head and compressor pressure	Basic system performance
		SVE influent concentration	Tracking mass removal rate
		O2 influent concentration	Indicator of aerobic biodegradation
		CO2 influent concentration	Indicator of aerobic biodegradation
		Cumulative mass removed or mass removal rate	Treatment effectiveness
		AS dissolved oxygen	System performance
Modeling tools/ applicable models			SOILVENT, SVAIR™GE
Further information		NAVFAC. 2001. Air Sparging Guidance Document. NFESC TR-2193-ENV. www.clu-in.org/download/contaminant focus/dnapl/Treatment_Technologies/Air_Sparg_TR-2193.pdf	
		Johnson, P. C., C. C. Stanley, M. W. Kemblowski, D. L. Byers, and J. D. Colthart. 1990. A Practical Approach to the Design, Operation, and Monitoring of In Situ Soil Venting Systems, Ground Water Monitoring Review 10(2): 159–78.	
		Johnson, P. C., M. W. Kemblowski, and J. D. Colthart. 1990. Quantitative Analysis for the Cleanup of Hydrocarbon-Contaminated Soils by In Situ Soil Venting, Ground Water Journal 3(28): 413–29.	

	Battelle. 2002. Air Sparging Design Paradigm. https://www.researchgate.net/publication/235108749_Air_Sparging_Design_Paradigm
	Air sparging guidance. https://clu-in.org/techfocus/default.focus/sec/air_sparging/cat/guidance/
	EPA. 1995. How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan Reviewers, Chapters 2 and 7. https://www.epa.gov/ust/how-evaluate-alternative-cleanup-technologies-underground-storage-tank-
	EPA. n.d. "Technology Focus: Soil Vapor Extraction." www.clu-in.org/techfocus/default.focus/sec/Soil_Vapor_Extraction/cat/Overview
	AFCEE. 2001. Guidance on Soil Vapor Extraction Optimization. https://clu-in.org/download/contaminantfocus/dnapl/Treatment_Technologies/SVE-optimization.pdf
	EPA. 1997. Analysis of Selected Enhancements for Soil Vapor Extraction. EPA-542-R-97-007. www.clu-in.org/download/remed/sveenhmt.pdf
	Ground Water Remediation Technologies Analysis Center. 1996. Air Sparging Technology Overview Report. http://clu-in.org/download/toolkit/sparge_o.pdf
	USACE. 2002. Engineering and Design: Soil Vapor Extraction and Bioventing. EM 1110-1-4001. http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-1-4001.pdf
	USACE. 2013. In Situ Air Sparging. EM 200-1-19. http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_200-1-19.pdf?ver=2014-01-06-104233-540