Air Sparging at Four Sites

Site Name: Multiple Locations (site names confidential)

Site Location: See locations under site history

Contaminants: MTBE, BTEX, TPH

Media: Groundwater

Technology: Air Sparging

Technology Scale: Full

Type of Cleanup: Not Provided

Period of Operation: 1993 to 1995

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Site History [3, 4]:

Air sparging was used to treat groundwater contaminated with gasoline from leaking storage tanks at the following four sites:

1. Service station, Pensacola, Florida, 3/94 – 7/94
2. Fuel station, Albuquerque, New Mexico, 6/93 – 1/95
3. Service station, Sebato, Maine, 4/94 – 10/95
4. Service station, Massachusetts (city and date not provided)

Contaminants found in the groundwater included MTBE and benzene, toluene, ethylbenzene, and xylenes (BTEX) at two sites, MTBE, BTEX, and gasoline at one site, and MTBE and benzene at one site.

Technology Description [1]:

Table 1 presents information about the air sparging systems used at the four sites, including the number of wells, spacing of the wells, air flow rates, frequency of sparging, duration of operation, and type of contaminant. As shown in Table 1, the number of air sparging wells at the four sites ranged from 4 to 9, with well spacings ranging from 25 - 50 feet (ft) and flow rates of wells ranging from 5 - 10 scfm. One of the systems was pulsed on a daily cycle and the others sparged on a continuous basis. The length of each project ranged from 4 - 21 months.

For the sites 1, 2, and 3, the air sparging wells were located over the source area. For the fourth site, the air sparging wells were arrayed at points located downgradient to treat dissolved-phase MTBE and to prevent downgradient migration.

Technology Performance [4]:

Information on specific cleanup goals for each site was not provided.

Table 1 summarizes performance information on the air sparging systems at each of the four sites, including data on contaminant concentrations at the start of air sparging system, at system shutdown, and at post-closure. Percent reduction by contaminant is presented for system shutdown and post-closure, along with the calculated rebound.

For the four sites, the reduction in MTBE concentrations at shutdown ranged from greater than 99% (Site 3- Maine) to 46.5% (Site 4 -Massachusetts). Post-closure reductions in MTBE concentrations, measured for Sites 1,2, and 3, ranged from greater than 97.8% to 99.97% ug/L.

Air sparging reduced the concentration of MTBE in the groundwater to <5 ug/L, with no rebound after 6 months of post-closure monitoring at Site 1 (Florida). MTBE concentrations were reduced to 27 ug/L at Site 2 (New Mexico), with the concentration further reduced to 8 ug/L after 13 months of post-closure monitoring. At Site 3 (Maine), MTBE concentrations were reduced to between 16 and 980 ug/L, and the concentration was further reduced to ND - 115 ug/L after 6.5 months of post-closure monitoring. For the fourth site (Massachusetts), MTBE was reduced to 115 ug/L (a 46.5% reduction). No rebound was reported for this site.

Technology Cost [5]:

No cost data for the air sparging systems at these sites was available.

Observations and Lessons Learned:

The vendor provided the following conclusions about the air sparging applications at the four sites:

1. Source removal remains the best strategy, and aeration technologies are good options for mass removal from source zones, when they are applied properly.

2. In the past, most petroleum remediation systems, including the systems at these four sites, have been designed using benzene as the limiting constituent. MTBE will likely play a more important role in future designs.

3. With MTBE, the assessment, design, and optimization of remediation technologies needs to be better – inadequate remediation activities will no longer be hidden by post-remediation natural biodegradation.

Table 1. Air Sparging Site Performance [4]

Site Name, Location	Technology Description	Duration (months)		Contaminant	Dissolved Concentrations at Most Contaminated Wells (ug/L)			Rebound[c]	Comments
		Sparge (start to shut-down)	Post- Closure (after shut-down)		At start	At shutdown (% reduction)[a]	Post-Closure (% reduction)[b]		
1. Service station, Pensacola, Florida	5 sparge wells 35 ft spacing 8 scfm/well pulsed (daily cycle)	4 (3/94 – 7/94)	6	MTBE BTEX	230 3,413	<5 (>97.8%) <2 (>99.94%)	<5 (>97.8%) <2 (>99.94%)	0 0	Sandy soil; sand aquifer
2. Fuel station, Albuquerque, New Mexico	9 sparge wells 40 – 50 ft spacing 6 – 10 scfm/well continuous flow	19 (6/93 – 1/95)	13	MTBE BTEX	1,600 64	27 (98.3%) ND	8 (99.5%) ND	-0.3 0	Well is 100 ft down-gradient of sparge system; soil is gravelly sand; gravel/sand aquifer; depth to water about 40 ft
3. Service station, Sebato, Maine	7 sparge wells 25 – 35 ft spacing 5 – 10 scfm/well continuous flow	14.5 (4/94 – 10/95)	6.5	MTBE BTEX Gasoline 	7,200 62,000 8,700 18,000 22,600 97,300 50,600 198,000 92,000 49,000 71,000 210,000	860 (88%) 16 (99.97%) 980 (89%) 48 (99.7%) 550 (97.6%) 172 (99.8%) 6 (99.99%) <20 (>99.99%) 3,500 (96.1%) 301 (99.4%) 103 (99.9%) 80 (99.96%)	ND 29 (99.95%) 115 (98.7%) 38 (99.8%) 604 (97.3%) 20 (99.98%) 2 (99.99%) 30 (99.98%) 3,590 (96.1%) 301 (99.4%) 103 (99.9%) 80 (99.96%)	NR 0.072 -0.98 -0.039 0.025 -0.034 -0.12 NR 0.007 -0.28 -0.22 0.12	All wells are within 10 ft of the nearest sparge well; soil is fine sand and silt; fine sand aquifer
4. Service station, Massachusetts	6 sparge wells 30 – 40 ft spacing 5 scfm/well continuous flow	21 (Dates not provided)		MTBE Benzene	215 1,230	115 (46.5%) 7 (99.4%)	NR NR	NR NR	Well is 70 ft down-gradient of the sparge barrier; system operation continues; soil is fine to medium sand

Notes:
a - 100 (1-Cf/Co), where Co is concentration at start of sparging and Cf is concentration at termination of sparging
b - 100 (1-Cr/Co), where Co is concentration at start of sparging and Cr is concentration at end of post-shutdown monitoring period
c - relative indication of change in concentration from end of sparging to end of post-closure monitoring and start of sparging, calculated as [log(Cr/Cf]/[log(Co/Cf]
NR - not reported

4. In situ air sparging also can be applied in combination with bioaugmentation for rapid initial mass removal by volatilization followed by removal via aerobic biodegradation (where air sparging becomes the oxygen delivery vehicle).

5. In situ processes do not appear to be limited by partitioning to the same degree as for above-ground treatment processes.

6. Groundwater should be treated in the ground whenever possible.

References:

1. Tom Peargin, Chevron Research and Technology Company, and Cristin Bruce and Paul C. Johnson, Department of Civil and Environmental Engineering, Arizona State University. "Application of Aeration-Based Technologies to MTBE-Impacted Sites". Presentation at In Situ Remediation Alternatives for MTBE Impacted Aquifers, Oxnard, California. August 10, 1999.

2. Record of Telephone Conversation, Steve Michener, Tetra Tech EM Inc., and Tom Peargin, Chevron. Obtain Information on 8 Small Groundwater Sites. September 9, 1999.

3. Record of Telephone Conversation, Steve Michener, Tetra Tech EM Inc., and Nick Hastings, IT Corporation. Obtain Information on Air Sparging Case Studies. September 29, 1999.

4. Nick Hastings, IT Corporation. Table 2. Air Sparging Case Histories at Sites with Petroleum Contamination. Not Dated.

5. Nick Hastings, IT Corporation. E-mail to Linda Fiedler, EPA/TIO. Comments on Case Study of Four Sites: Air Sparging of Groundwater. April 21, 2000.