Cost and Performance Summary Report
Thermal Desorption at the Cape Fear Superfund Site, Fayetteville, North Carolina

Summary Information [1, 2, 3, 4, 5, 6]

The Cape Fear Superfund Site is located on 41 acres in Fayetteville, North Carolina. The site was operated as a wood preserving facility from 1953 to 1983, first using a creosote process and, starting in 1970, using a copper-chromated-arsenate (CCA) process. Liquid and sludge wastes generated by both of these processes were pumped into a drainage ditch and an unlined lagoon.

Two removal actions were conducted at this site in the mid-1980s. In 1984, contaminated soil and sludge were excavated and disposed off site. The lagoon water was pumped into on-site storage tanks. In response to a spill of 500 gallons of creosote from a storage tank in 1986, 10 cubic yards of soil saturated with creosote solidified and left on site. In addition, 15,000 gallons of CCA wastewater were pumped into on-site storage tanks.

Investigations at the site by EPA and the State of North Carolina showed that soil at the site was contaminated with polycyclic aromatic hydrocarbons (PAHs), benzene, and metals including arsenic and chromium. A Record of Decision (ROD), signed in June 1989, specified excavation and soil washing to address the soil contamination from the drainage ditch and unlined lagoon. Initial soil washing operations did not meet the cleanup goals for carcinogenic PAHs. According to the EPA Remedial Project Manager (RPM), EPA abandoned soil washing in 1998 and made the decision to implement the contingent remedy, low temperature thermal desorption. The local community was informed of this decision in an April 1998 fact sheet and a May 14, 1998 public meeting.

From July 1998 to April 1999, a total of 170,300 tons (113,000 cubic yards) of contaminated soil were excavated and treated at the site using thermal desorption.

CERCLIS ID Number:	NCD003188828
Type of Action:	Remedial
Lead:	Fund Lead

Timeline [1, 2]

July 1987	Cape Fear added to NPL
June 30, 1989	ROD signed
1998	Public informed (fact sheet and public meeting) that EPA was implementing the contingent remedy
June 1998	Treatment vendor mobilized to site
July 1998 – April 1999	Thermal desorption treatment performed
July 20 - 22, 1998	Demonstration test performed

Factors That Affected Cost or Performance of Treatment

Listed below are the key matrix characteristics for this technology and the values measured for each during site characterization.

Matrix Characteristics [1, 5]

Parameter	Value
Soil Classification:	Silty clays and sands
Clay Content and/or Particle Size Distribution:	10-48% silt and clay
Moisture Content:	<20% for shallow soils 20-40% for deep soils
Organic Content:	<5%
pH:	Not available
Bulk Density:	Not available

Treatment Technology Description [1, 4, 5]

The thermal treatment system used for this application was a low temperature thermal desorption (LTTD) system owned by Williams Environmental Services, Inc. The system included a direct-heated rotary kiln, feed metering unit, baghouse, thermal oxidizer, and control unit that housed the controls, data logger, and analyzers. The desorber was a countercurrent rotary dryer fired by a 49 million BTU/hour burner. The unit was approximately 40 feet long and 8.5 feet in diameter, and was fabricated from 304 stainless steel. Contaminated soil was screened to remove cobbles and rocks greater than 2 inches in diameter prior to being fed to the desorber. Treated soil was disposed on site.

Soil that was excavated from deeper locations (up to 25 ft deep) had elevated moisture contents in the range of 20 to 40 percent. Lime was added to the soil to improve its material handling and make it more amenable to thermal treatment.

After decontamination and demobilization were completed, site restoration was performed on more than 20 acres, including hydroseeding and planting of native trees, and fertilizing with compost.

Operating Parameters [1]

Listed below are the key operating parameters for this technology and the values measured for each during the demonstration test.

Operating Parameter	Value
Residence Time	20 minutes
System Throughput	43.3 tons/hr (average)
Soil Exit Temperature	851 °F (average)
Thermal Desorber Exit Gas Temperature	445 °F (average)
Thermal Oxidizer Exit Gas Temperature	1,557 °F (average)
Baghouse Differential Pressure	1.46 in w.c. (average)

Performance Information [1, 4, 5]

Table 1 shows the soil cleanup goals specified by the ROD for the contaminants of concern at the site. The carcinogenic PAHs shown in this table are the sum of benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. The total PAHs consist of total carcinogenic PAHs plus the sum of acenaphthene, acenaphthalene, anthracene, benzo(g,h,i)perylene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene.

Table 1. Soil Cleanup Goals (mg/kg) [1]

Contaminant	Cleanup Goal
Arsenic	94
Chromium	88
Benzene	0.005
PAHs (total carcinogenic)	2.5
PAHs (total)	100

For arsenic, the cleanup goal was derived in the risk assessment based on the future on-site worker scenario. For chromium, the cleanup goal represents the maximum background range as the derived cleanup concentration from the risk assessment was below background concentrations. In addition, the North Carolina Department of Environment and Natural Resources (NCDENR) approved the air permit for this project.

A demonstration test was performed July 20 - 22, 1998 during which 1,900 cubic yards of soil were treated. Full-scale thermal desorption was conducted from July 1998 to April 1999. Table 2 presents a summary of the analytical results for the 378 treated soil piles for the five contaminants of concern. With two exceptions, all soil met the cleanup goals after initial treatment in the desorber. According to the treatment vendor, approximately 1,106 tons of soil failed to meet the cleanup goal for benzene, and were retreated to meet the cleanup goal. Of the 378 piles of treated soil, only one pile had a level of chromium, 89.3 mg/kg, that exceeded the cleanup goal of 88 mg/kg. According to the RPM, EPA allowed the contractor to backfill this material without further treatment.

Table 2 - Performance Data - Minimum and Maximum Treated Soil Concentrations (mg/kg) [1]

Pile #	Sample Dates	Contaminants				
		As	Cr	Benzene	cPAHs	Total PAHs
Clean up Goal	-	94	88	0.005	2.5	100
1 - 50	7/7 - 8/15/98	9.7 - 64.8	23.8 - 65.8	0.0002 - 0.00497	0.896 - 1.0815	2.43 - 3.67
51 - 100	8/15 - 9/17/98	9.4 - 40.2	22 - 87.5	0.00072 - 0.00661	0.875 - 1.03	2.38 - 2.785
101 - 150	9/18 - 10/20/98	9.05 - 44.3	3.62 - 48.2	0.00022 - 0.00268	0.0868 - 1.05	2.35 - 2.927
151 - 200	10/20 - 11/18/98	3.9 - 21.4	15.64 - 32.7	0.00014 - 0.00094	0.74 - 1.48	1.68 - 2.96
201 - 250	11/20 - 1/6/99	1.4 - 62	5.7 - 78	0.00013 - 0.0014	0.73 - 0.91	1.68 - 6.65
251 - 300	1/6/ - 2/24/99	3.6 - 65	15 - 73	0.0001 - 0.0074	0.7 - 1.26	1.035 - 2.52
301 - 350	2/25 - 4/12/99	3.6 - 25.5	15 - 41.7	0.00009 - 0.0095	0.735 - 2.415	1.76 - 4.35
351 - 378	4/12 - 4/30/99	9.79 - 50.4	19.3 - 89.3	0.0001 - 0.00265	0.778 - 1.33	2.28 - 3.8

Prior to performing full-scale treatment, static tray treatability tests were conducted on soil samples contaminated with arsenic, chromium, and PAHs. Table 3 shows the contaminant concentration in the feed samples. Initial testing was performed on four samples using temperatures of 600, 700, and 850 °F and retention times of 20 and 30 minutes. A subsequent test was performed with a fifth sample at 600, 800, and 1000 °F at 20 minutes retention time.

Table 3. Initial Contaminant Concentrations in Samples Used in Treatability Test (mg/kg)*

Contaminant	Sample 1	Sample 2	Sample 3	Sample 5
Arsenic	10.8	<5.0	61.4	10.4
Chromium	19.1	19.9	110.0	30.3
PAHs (total carcinogenic)	10.45	35.73	45.56	76.48
PAHs (total)	25.15	652.46	318.35	488.55

* Sample 4 consisted primarily of wood chips and was not analyzed.

Results from the treatability tests showed that individual PAHs were treated to below their detection limits for tests conducted at 800 and 1,000 °F, and with a residence time of 20 minutes. Tests conducted at 600 °F, with a residence time of 20 minutes, showed treated soil had fluorene at 3.0 mg/kg, phenanthrene at 36 mg/kg, anthracene at 3.3 mg/kg, fluoranthene at 40 mg/kg, pyrene at 26 mg/kg, chrysene at 11.0 mg/kg, benze(a)anthracene at 7 mg/kg, and benzo(b and k) fluoranthene at 4.5 mg/kg. Based on these results, a nominal treatment temperature of 800 °F was selected for full-scale operation.

Performance Data Quality [1]

Analytical results were provided for each of 378 treated soil piles for this project, including sample identifier, pile number, date logged, and date results received. These results include field duplicate, matrix spike, and matrix spike duplicate samples. The only exception to established data quality measures noted in the available references was that the detection limits identified during treatability testing for some contaminants were near the method detection limits (MDLs), because of sample dilution. In cases where a constituent was reported as not-detected at an elevated detection limit, one-half of the MDL was used in calculations of total concentrations.

Cost Information [1]

Cost information was provided by the thermal treatment vendor, and reflects actual costs for the project.

Table 4 - Actual Project Costs [1]

Cost Category/Element	Cost (1999 $ Basis)
1. Capital Cost for Technology	
Technology mobilization, setup, and demobilization	1,077,215
Planning and preparation	48,399
Site work - preparation/restoration	674,915
Equipment and appurtenances	
Startup and testing	
Other	
TOTAL CAPITAL COSTS	1,800,529
2. O&M for Technology	
Labor	7,987,195
Materials	
Utilities and fuel	
Equipment ownership, rental, or lease	
Performance testing and analysis	100,851
Other (includes nonprocess equipment overhead and health and safety)	
TOTAL OPERATION AND MAINTENANCE COSTS	8,088,046
3. Other Technology-Specific Costs	
Compliance testing and analysis	358,879
Soil, sludge, and debris excavation, collection, and control	
Disposal of residues	518,733
4. Other Project Costs	
Remove and replace railroad tracks	122,128
Standby time	31,045
Miscellaneous	23,213
Total cost	10,963,573
Total cost for calculating unit cost	9,888,575
Quantity treated	170,300 Tons
Calculated unit cost	58/Ton
Basis for quantity treated	Soil treated

Observations and Lessons Learned [1]

The LTTD treated 170,300 tons of soil contaminated with PAHs and benzene to below cleanup goals in about 10 months at a unit cost of $58 per ton. Nearly all soil was treated to below the cleanup goals during initial treatment in the desorber, with only 2 batches of soil that requiring re-treatment.

According to the vendor, system operating parameters were not varied substantially during this project, except for soil that was excavated from deeper locations. This soil had elevated moisture contents and lime was added to improve its material handling and make it more amenable to thermal treatment.

This completed project involved the largest quantity of soil treated using thermal desorption the U.S. at the time the project was performed.

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References

The following references were used in the preparation of this report.

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2. EPA. Basic Site Query Search Results. February 26, 2001.

3. EPA. Annual Status Report. EPA Source Site Description. Cape Fear Wood Preserving. February 2001.

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