Cost and Performance Summary Report
Thermal Desorption at Site B, Western United States

Summary Information [1, 2, 3, 4]

Site B (actual site name and location confidential) in the western United States was used for formulation of pesticides from 1938 to 1985. Wastes from the formulation process and an on-site laboratory were discharged to a french drain/sump area. Two discharge lagoons were also used to collect and discharge liquids from the formulation area. During the mid-1970s, the lagoons were filled with surrounding soil and debris.

Operations ceased in May 1985. Site characterization activities performed in 1986 showed elevated levels of pesticides in the soil, including p,p'-DDD (DDD), p,p'-DDT (DDT), p,p'-DDE (DDE), hexachlorobenzene, toxaphene, bis(2-ethylhexyl)phthalate, lead, and zinc. DDT was determined to be the most wide-spread contaminant at the site.

From March through September of 1993, soils were excavated and screened to remove items larger than eight inches in diameter. The soil was placed in two large stockpiles on the northern and southern ends of the site, containing approximately 10,000 cubic yards (CY) and 15,000 CY of material, respectively. Thermal desorption with thermal oxidation of off gases was performed from April to August 1995, with a total of 26,000 tons of soil treated. This report covers the thermal desorption application at the site.

CERCLIS ID Number:	Confidential
Type of Action:	Removal
Lead:	Potentially Responsible Party

Timeline [1, 3]

March - September 1993	Soil excavated and stockpiled on site
February 1995	Thermal desorption treatment vendor mobilized to site
April - August 1995	Thermal desorption treatment of soil conducted
May 1995	Performance test conducted
September 1995	Site restoration

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, 3]

Parameter	Value
Soil Classification:	Glacial till
Clay Content and/or Particle Size Distribution:	Not available
Moisture Content:	15-20%
Organic Content:	0.1 %
pH:	Not available
Bulk Density:	Not available

Treatment Technology Description [1]

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 six main units - feed system, rotary dryer, baghouse, thermal oxidizer, wet quench, and acid gas scrubber. The rotary dryer (desorber) unit consisted of a direct-heated rotary kiln, feed belt, a 49 million BTU/hr propane-fired burner, and discharge screw conveyor. The stainless steel dryer was approximately 40 ft long and 8.5 ft in diameter. Treated soil was moisturized and discharged to a belt conveyer for stacking and subsequent use as backfill on site.

Contaminated soil was screened with a PowerScreen Model Mark IV to remove cobbles and rocks greater than two inches in length. Approximately 50% of the excavated material contained oversized cobbles and other debris and was stockpiled for use as backfill at the site. The screened material was stored on a pad prior to treatment.

Operating Parameters [1, 3]

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

Operating Parameter	Value
Residence Time	15 - 20 minutes
System Throughput	30 tons of soil/hr - target
Soil Exit Temperature	> 750 °F (average - 20 minutes) 725 °F (minimum)
Dryer Rotation	2.2 rpm
Dryer Slope	1.5 degrees
Thermal Desorber Exit Gas Temperature	>250 °F
Thermal Oxidizer Exit Gas Temperature	> 1,810 °F
Baghouse Differential Pressure	>0.5 inches water column

Performance Information [1, 4, 5]

The thermal desorption unit was subject to the requirements of Subpart O of the Resource Conservation and Recovery Act. Table 1 presents the cleanup goals identified for the contaminants of concern at the site. In addition, the State's maximum acceptable source impact levels (ASILs) were identified for ground level air and stack emissions. A treatability study and performance test were conducted to establish the full-scale operation conditions for the project. Performance data were available for the treatability study and performance test; no data were provided for the full-scale operation of the system.

Treatability Study

Prior to mobilizing to the site, a treatability study was conducted using a composite soil sample from the two stockpiles and from roll-off boxes which contained the most highly-contaminated materials. The samples were screened, homogenized, and treated using static tray tests conducted at temperatures of 750 °F and 900 °F, and with residence times of 30 minutes and 45 minutes. The results from the treatability test showed that cleanup goals could be met with operations conducted at 750 °F and 30 minutes residence time.

Table 1. Cleanup Goals for Contaminants of Concern - Site B [1, 3]

Contaminant	Average Feed Concentration (mg/kg)	Cleanup Goal (mg/kg)
Aldrin	1.94	0.0588
alpha-BHC	1.50	0.159
beta-BHC	3.00	0.556
gamma-BHC	1.87	0.769
Chlordane	4.48	0.769
DDD	23.22	4.17
DDE	10.98	2.94
DDT	5.98	2.94
Dieldrin	7.80	0.0625
Endrin	2.99	24
Heptachlor	1.49	0.222
Heptachlor Epoxide	4.92	0.11
Hexachlorobenzene	16.06	0.625
Methoxychlor	57.05	400
Toxaphene	673.25	0.909
Arsenic	9.25	20
Lead	42.80	250
Mercury	0.16	1

Performance Test

In mid-May 1995, a performance test of the LTTD system was conducted. The results of the performance test were used to establish the operating parameters for the LTTD system, and to verify performance with regard to the cleanup goals and emission limits for the system. The test consisted of three full test runs (Runs 1 - 3) and one additional run (Run 4) where only a stack gas sample for particulates was collected. While the system had several operational problems (see discussion below), the overall test results demonstrated that the system could meet the objectives established by the performance test plan.

Runs 3 and 4 were initiated from cold-start conditions to simulate startup conditions and identify products of incomplete combustion (PICs). Runs 1 and 2 were initiated from steady-state operating conditions. Additionally, Runs 1 and 2 were split

into morning and afternoon test periods (A and B) to accommodate stack sampling procedures. Both tests were conducted under the same operating conditions.

Results from the performance test are summarized below.

- As shown in Table 2, the treated soil met the cleanup criteria for organochlorine (OCL) pesticides and PCDD/PCDF.
- The modeled ground level concentrations of OCL pesticides resulting from stack gas emissions met the State maximum ASILs.
- The modeled ground level concentrations of indicator metals (As, Hg, and Pb) resulting from stack gas emissions were below the State maximum ASILs. In addition, the modeled maximum ground level concentrations of all other metals of concern were below the appropriate risk specific dose (RSD) (for carcinogens) or reference air concentrations (RAC) (for non-carcinogens).
- A 99.99% destruction and removal efficiency (DRE) was achieved for the principal organic hazardous constituent (POHC), hexachlorobenzene.

Table 2. Summary of Treated Soil Analyses - Performance Test [1]

Contaminant	Soil Cleanup Goal (mg/kg)	Test Run 1A (mg/kg)	Test Run 1B (mg/kg)	Test Run 2A (mg/kg)	Test Run 2B (mg/kg)	Test Run 3 (mg/kg)	Average (mg/kg)
Aldrin	0.0588	0.0085 ND	0.008 ND	0.0085 ND	0.0085 ND	0.008 ND	< 0.0083
alpha-BHC	0.159	0.0085 ND	0.008 ND	0.0085 ND	0.0085 ND	0.008 ND	< 0.0083
beta-BHC	0.556	0.0085 ND	0.008 ND	0.0085 ND	0.0085 ND	0.008 ND	< 0.0083
gamma-BHC	0.769	0.052	0.0066	0.015	0.078	0.008	0.032
Chlordane	0.769	0.4 ND	0.08 ND	0.4 ND	0.4 ND	0.08 ND	< 0.27
DDD	4.17	0.004	0.019	0.016 ND	0.056	0.016 ND	< 0.029
DDE	2.94	0.62	0.064	0.27	1.1	0.074	0.43
DDT	2.94	0.34	0.24	0.025	0.25	0.031	0.18
Dieldrin	0.0625	0.016 ND	0.016 ND	0.016 ND	0.016 ND	0.016 ND	< 0.016
Endrin	24	0.016 ND	0.016 ND	0.016 ND	0.016 ND	0.016 ND	< 0.016
Heptachlor	0.222	0.0085 ND	0.008 ND	0.0085 ND	0.0085 ND	0.008 ND	< 0.0083
Heptachlor Epoxide	0.11	0.0085 ND	0.008 ND	0.0085 ND	0.0085 ND	0.008 ND	< 0.0083
Hexachlorobenzene	0.625	0.34	0.48	0.26	0.38	0.35	0.36
Methoxychlor	400	0.085 ND	0.08 ND	0.085 ND	0.085 ND	0.08 ND	< 0.083
Toxaphene	0.909	0.85 ND	0.16 ND	0.85 ND	0.85 ND	0.16 ND	< 0.57
Arsenic	20	10.0 ND	15.0 ND	10.0 ND	10.0 ND	10.0 ND	< 11.0
Lead	250	41.0	29.0	32.0	44.0	28.0	35.0
Mercury	1	0.13	0.10 ND	0.13	0.15	0.10 ND	< 0.12
2,3,7,8-TCDD TEQ	0.001	5.6E-05	NA	6.2E-05	NA	6.4E-05	6.0E-05

ND - Not detected at stated detection limit
NA - Not available

Table 2. Summary of Treated Soil Analyses - Performance Test [1] (continued)

- The emission rates of hydrogen chloride (HCl) and chlorine (Cl_2) in the stack gas met the ambient air impact guidelines described in the Boilers and Industrial Furnaces (BIF) guidelines.

- The concentration of carbon monoxide (CO) in the stack exhaust gas was less than 100 ppm_v (corrected to 7% O_2), based on a 60-minute rolling average.

The performance test showed that the LTTD system did not meet the objective for stack gas particulate concentration, with the average particulate concentration of 0.04 gr/dscf greater than the required 0.03 gr/dscf (corrected to 7% O_2) during the initial 3 runs. According to the vendor, during testing, a fine mist emanated from the stack gas, indicating possible failure of the scrubber demisters. In addition, as the water droplets evaporated from various surfaces, a solid residue was observed, indicating the presence of entrained salts in the stack gas.

The demisters were inspected for visible damage that may have allowed entrained water to bypass the demisters and exit the stack directly. Several portions of the demisters appeared to have separated from their anchors and were reattached; however, mist discharging from the stack was observed after the unit was restarted.

To address concerns with particulate emissions, several modifications to the system were made, and a fourth test run was conducted. This test run demonstrated a particulate emission of 0.0127 gr/dscf, below the requirement. The modifications included replacing the fabric mesh demisters installed in the scrubber with stainless steel chevron demisters, and increasing the critical velocity capacity of the demisters by 150 feet per minute. The blow down rate from the scrubber was increased to reduce the amount of salts being recycled in the scrubber water. Salt concentrations had been elevated during the performance test due to the increased chlorine concentration of the most highly contaminated soils.

Additional problems encountered during full-scale operation were associated with equipment sizing, selection, and application, including:

- There were unexplained burner flame-outs for both the desorber and thermal oxidizer that caused automatic waste feed shut off (AWFSO). These were remedied by changing the hard wiring in the mother boards and adding a relay to each board.

- The continuous emission monitors (CEMs) failed twice, causing the stack gas oxygen level to fall to <3%. One failure was caused by a crack in the tubing that allowed air to enter. Processing was allowed to continue provided that the instruments were continuously monitored and corrected to 7% oxygen. The second failure was a result of a heater failure in a sample dryer, and was remedied by installing an indicator light high on the stack to verify that the heater was operable.

- The induced draft fan failed as a result of a failed bearing, causing instantaneous AWFSO. The failure resulted in the release of dust from the rotary dryer because the combustion air blowers continued to operate. The bearings were replaced, and the fan was balanced and returned to service.

Cost Information [1]

Cost information was provided by Williams, and reflect actual costs for the project, as shown in Table 3.

Observations and Lessons Learned [1]

The LTTD treated approximately 26,000 tons of soil contaminated with OCL pesticides to below cleanup goals in about four months at a unit cost of $125 per ton. In addition, the LTTD system met DRE requirements, and ground level contaminant concentrations.

Table 3. Actual Project Costs [1]

Cost Category/Element	Cost (1995 $ Basis)
1. Capital Cost for Technology	
Technology mobilization, setup, and demobilization	429,561
Planning and preparation	
Site work - preparation/restoration	
Equipment and appurtenances	
Startup and testing	
Other	
TOTAL CAPITAL COSTS	429,561
2. O&M for Technology	
Labor	2,587,250
Materials	Included in labor
Utilities and fuel	Included in labor
Equipment ownership, rental, or lease	Included in labor
Performance testing and analysis	243,706
Other (includes nonprocess equipment overhead and health and safety)	
TOTAL OPERATION AND MAINTENANCE COSTS	2,830,956
3. Other Technology-Specific Costs	
Compliance testing and analysis	285,000
Soil, sludge, and debris excavation, collection, and control	55,860
Disposal of residues	
4. Other Project Costs	
Total cost	3,601,377
Total cost for calculating unit cost	3,260,517
Quantity treated	26,000 Tons
Calculated unit cost	$125/Ton
Basis for quantity treated	Soil treated

Initially, the system did not meet the objective set for particulate emissions. This was attributed to operational problems with the demisters and scrubber. These problems were corrected and the system met all of its performance objectives.

Contact Information

For more information about this application, please contact:

EPA Contact:
Lynda Priddy
U.S. EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
Telephone: (206) 553-1987
Fax: (206) 553-0149
E-mail: priddy.lynda@epa.gov

Vendor:
Mark A. Fleri, P.E.
Vice President
Williams Environmental Services, Inc.
2075 West Park Place
Stone Mountain, GA 30087
Telephone: (800) 247-4030/(770) 879-4075
Fax: (770) 879-4831
E-mail: mfleri@wsg1.usa.com

References

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

1. Williams Environmental Services, Inc. Site B Case Study - Low Temperature Thermal Desorption of Pesticide-Contaminated Soils. February 1, 2001.
2. EPA. Basic Site Query Search Results. February 26, 2001.
3. Mark Fleri, Williams Environmental Services. Comments on draft cost and performance summary report. April 1, 2002.
4. Lynda Priddy, EPA Region 10. Comments on Draft Case Study Report. June 14, 2002.
5. URS Consultants. Final Compliance Monitoring Report, submitted to EPA Region 10. April 24, 1996.

Acknowledgments

This report was prepared for the U.S. Environmental Protection Agency's Office of Solid Waste and Emergency Response, Technology Innovation Office. Assistance was provided by Tetra Tech EM Inc. under EPA Contract No. 68-W-02-034.