On-Site Incineration at the
Coal Creek Superfund Site
Chehalis, Washington

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<table>
<tr><td>Site Name:
Coal Creek Superfund Site</td><td rowspan="2">Contaminants:
Polychlorinated biphenyls and lead. Also other metals, including:
• lead
• copper
• barium
• mercury
• cadmium
• zinc</td><td>Period of Operation:
January 1994 to May 1994</td></tr>
<tr><td>Location:
Chehalis, Washington</td><td>Cleanup Type:
Remedial action</td></tr>
<tr><td>Vendor:
Matthew Beatty
Roy F. Weston, Inc.
1 Weston Way
West Chester, PA 19380-1499
610-692-3030</td><td rowspan="2">Technology:
On-Site Incineration
• Soil screened prior to being fed to incinerator
• Incineration system consisting of a rotary kiln and a secondary combustion chamber (SCC)
• SCC system temperature of 2,100 °F; gas from SCC cooled by water sprays before being sent through air pollution control system
• Process water was treated by carbon filtration system then discharged on-site</td><td>Cleanup Authority:
CERCLA
• ROD signed October 1990
• Consent Decree entered 1992
• RP-lead with EPA oversight</td></tr>
<tr><td>SIC Code:
4953 (Refuse Systems)</td><td>Point of Contact:
Bob Kievit
U.S. EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
360-753-9014</td></tr>
<tr><td>Waste Source:
Disposal areas - oil containing PCBs</td><td colspan="2" rowspan="2">Type/Quantity of Media Treated:
Soil (9,715 tons)</td></tr>
<tr><td>Purpose/Significance of Application:
Because of previous performance, and because it had a TSCA permit, the incinerator was allowed to demonstrate DRE compliance without spiking</td></tr>
</table>

Incineration at the Coal Creek Superfund Site
Chehalis, Washington

(Continued)

Regulatory Requirements/Cleanup Goals:
- Destruction and Removal Eficiency (DRE) of 99.9999% for PCBs as required by Toxic Substances Control Act (TSCA) regulations in 40 CFR part 761

Results:
- Emissions and performance data indicated that all DRE and emission standards were met

Description:
Between 1949 and 1983, the Coal Creek site was used for scrapping, salvaging, and repairing electrical equipment. During this time, oil containing PCBs was drained on to the ground.

In October 1990, a Record of Decision (ROD) was signed, specifying excavation and on-site incineration of soil with greater than 50 mg/kg PCBs. In 1992, the responsible parties (RP) entered into a Consent Decree with EPA, agreeing to implement the remedial action described by the ROD.

Remedial Action began in January 1994. The incineration system consisted of a feed system, a rotary kiln, a secondary combustion chamber (SCC), and an air pollution control system (APCS). The soil was screened before being fed to the incinerator. Over a 5-month period, the incinerator processed approximately 9,700 tons of soil. Treatment performance and emissions data collected during this application indicated that all performance standards and emissions requirements were met.

The actual cost for remediation using the incineration system was approximately $8,100,000.

EXECUTIVE SUMMARY

This report presents cost and performance data for the application of on-site incineration at the Coal Creek Superfund Site in Chehalis, Washington. A rotary kiln incinerator was operated from January 1994 to May 1994 as part of a remedial action. Contaminants of concern at the site included polychlorinated biphenyls (PCB) and lead.

The Coal Creek site was used for scrapping, salvaging, and repairing electrical equipment from 1949 to 1983. During this time, oil containing PCBs was drained on to the ground. Concentrations of PCBs were measured as high as 21,000 mg/kg at the site.

In October 1990, a Record of Decision (ROD) was signed, specifying excavation and on-site incineration of soil with greater than 50 mg/kg PCBs. The ROD also required a destruction and removal efficiency (DRE) of 99.9999% for the incineration. In 1992, the responsible parties (RP) entered into a Consent Decree with EPA, agreeing to implement the remedial action described by the ROD.

The incineration system consisted of a feed system, a rotary kiln, a secondary combustion chamber (SCC), and an air pollution control system (APCS). The soil was screened before being fed to the incinerator.

In the rotary kiln, organic compounds from the contaminated soil were volatilized and destroyed. The resulting ash was discharged from the kiln and quenched outside of the kiln, while exhaust gases were routed to the SCC. The SCC provided further combustion of PCBs in the off-gas, which was then quenched with water.

The APCS consisted of a baghouse and a scrubber, which removed particulate and acid gas, respectively.

Over a 5-month period, the incinerator processed approximately 9,700 tons of soil. Treatment performance and emissions data collected during this application indicated that all performance standards and emissions requirements were met.

The actual cost for remediation using the incineration system was approximately $8,100,000.

SITE INFORMATION

Identifying Information

Coal Creek Superfund Site
Chehalis, Washington

CERCLIS # WAD980726061

ROD Date: October 17, 1990

Treatment Application

Type of action: Remedial (on-site rotary kiln incineration)

Period of operation: January 1994 - May 1994

Quantity of material treated during application: 9,715 tons of soil

Background

Historical Activity that Generated Contamination at the Site: Scrapping, salvaging, and repairing electrical equipment

Corresponding SIC Code: 4953 (Refuse Systems)

Waste Management Practice That Contributed to Contamination: Improper storage and disposal of waste

Site History:

- The site is approximately one mile north of Chehalis and covers approximately 8 acres in the Coal Creek Valley. The site is bound by Coal Creek to the south and west. Wetlands are present on the western portion of the site.
- The first documented use of the site was in 1935 when it was occupied by a coal-fired electrical generating plant. From 1949 to 1983, the site was used for scrapping, salvaging, and repairing electrical equipment, including electrical transformers.
- One prominent feature in the northeast corner of the site was a mound of fill material, which covered one-fourth of the site. The mound was comprised of two to eight feet of fill material including soil, ash, coal, and mixed debris from transformer scrapping operations. A one-to-two-foot-thick sand and gravel cover was placed over the fill as a working surface for vehicle access during facility operation.
- A drainage ditch extended from the fill mound through the wetland area and discharged to Coal Creek.
- Oil containing polychlorinated biphenyls (PCB) from electrical transformers was drained on site during the salvage operation.
- The ROD estimated that 8,300 cubic yards of soil contains PCBs at concentrations greater than 50 mg/kg.
- Beginning in 1979, EPA and the Washington State Department of Ecology conducted various inspections and sampling and analysis of soil and groundwater at the site. In 1983 and 1984, at the request of the state, potentially responsible parties (PRP) stabilized the site by covering portions of the fill mound with plastic, damming the drainage ditch, installing ground water monitoring wells, and securing the site.
- A remedial investigation and feasibility study (RI/FS) was performed in 1988.
- Remedial action took place in two phases. Phase I, which began in February 1993, included the demolition of a two-story concrete building and foundation, asbestos abatement, demolition of the site drainage system, disposal of resulting debris, and removal and decontamination of underground storage tanks.
- Phase II began in August 1993. It included excavation and incineration of contaminated soil, construction of a containment cell, disposal of debris, and wetland restoration.

SITE INFORMATION (CONT.)

- The erection of the incinerator and excavation of soil for incineration were completed in December 1993. The performance test burn and incineration under interim standards began in January 1994.
- The incineration system processed approximately 9,700 tons of soil and debris in the four months that it operated. Incineration was completed in May 1994.

Background

- Various RPs entered into a consent decree with EPA in February 1988. EPA and the settling defendants entered into a Major Consent Decree effective February 1992 under which the settling defendants agreed to design and implement the remedial action described in the ROD.
- The ROD was signed in October 1990, specifying excavation of soil with greater than 1 mg/kg PCBs, incineration of the soil with greater than 50 mg/kg, and on-site containment of the ash with the soil containing 1 to 50 mg/kg PCBs.
- The site activities were conducted under provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (NCP) in 40 CFR part 300.
- The DREs were set in accordance with the Toxic Substance Control Act (TSCA) regulations in 40 CFR part 761.

Regulatory Context:

Remedy Selection: The remedial actions selected were the only response actions planned for the site. They were intended to address the principal threats posed by PCBs and other contaminants.

SITE INFORMATION (CONT.)

Timeline

Table 1. Timeline

Date	Activity
Early 1900s - 1983	Operations performed at the Coal Creek Site
1979	Initial site investigation
February 1988	Various RPs enter into a Consent Decree to cleanup the site
1989	Remedial Investigation/Feasibility Study
October 1990	ROD is signed
August 1993 - December 1993	Contaminated soil is excavated
January 1994	Performance test burn conducted
January 1994 - May 1994	Rotary kiln incinerator operational
October 1994	Containment cell cap seeding and wetland seeding
November 1994	Final site inspection

Site Logistics/Contacts

Site Management: RP-lead

Oversight: EPA

Remedial Project Manager:
Bob Kievit
U.S. EPA Region X
1200 Sixth Avenue
Seattle, WA 98101
(360) 753-9014

Treatment System Vendor:
Matthew Beatty
Roy F. Weston, Inc.
1 Weston Way
West Chester, PA 19380-1499
(610) 692-3030

MATRIX DESCRIPTION

Matrix Identification

Type of Matrix Processed Through the Treatment System: Contaminated soil from the mound area

Contaminant Characterization

Primary Contaminant Groups: PCBs and metals

- The contaminants of greatest concern were PCBs and lead. Other metals such as copper, barium, mercury, cadmium, and zinc were also present in soil at the site.
- The maximum concentration of PCBs in the soil was 21,000 mg/kg. Elevated concentrations of copper (31,000 mg/kg), lead (3,800 mg/kg), barium (1,200 mg/kg), mercury (20 mg/kg), cadmium (9 mg/kg), and zinc (5,300 mg/kg) also were detected in the soil.

Matrix Characteristics Affecting Treatment Costs or Performance

- Information on matrix characteristics such as soil classification, moisture content, and soil density was not available.

TREATMENT SYSTEM DESCRIPTION

Primary Treatment Technology

Incineration system including:

- Rotary kiln; and
- Secondary combustion chamber (SCC).

Supplemental Treatment Technology

Pretreatment (solids): Screened and mixed

Post-Treatment (air):
- Baghouse; and
- Scrubber.

Post-Treatment (water): Carbon adsorption.

TREATMENT SYSTEM DESCRIPTION (CONT.)

System Description and Operation

- Approximately 28,000 tons of granular fill was placed at the site to provide a working surface around the incineration equipment, and also to meet the requirement that the incinerator be located outside of the 100-year floodplain.
- The site was excavated using a CAT 235 and a CAT 966 loader. Excavated soil was divided into two stockpiles: soil with PCB concentrations between 1 and 50 mg/kg, and soil with PCB concentrations greater than 50 mg/kg. A track loader and three wide-track bulldozers were also used when soil at the site was wet.
- Debris was screened from the soil. At times the soil was too wet and cohesive to allow debris to be removed by conventional screening operations. Large debris was hand-picked out, corn cob pellets were mixed with soil to absorb moisture, and then the soil was screened. When corn cob pellets were not available, wood chips were used.
- After feed preparation, the waste was loaded into a feed hopper. Screw conveyors fed the material to the rotary kiln.
- The incineration system consisted of two chambers (the kiln itself and the SCC) and an air pollution control system, consisting of a baghouse and a scrubber.
- The rotary kiln was 25 feet long and 7.5 feet in diameter. The maximum rotational speed was 1.2 rpm with a minimum soil residence time of 30 minutes. The burner was rated at 33 million BTU per hour.
- Ash was discharged from the kiln and immersed in water for quenching. The ash and excavated soil containing 1 to 50 mg/kg PCBs were disposed of in waste cells on site.
- Exhaust gas from the kiln was discharged to the SCC and heated to a minimum temperature of 2,100°F for at least 2 seconds. The SCC was vertically oriented to avoid slag buildup. Gas from the SCC was cooled to 450°F using water sprays before being sent through the air pollution control system (APCS). Both the kiln and the SCC were supplemented with oxygen.
- Exhaust gas from the SCC was channeled to the baghouse for particulate removal.
- The baghouse was rated for a grain loading of treated exhaust gases of less than or equal to 0.02 grains per dry standard cubic foot (dscf). To prevent acid condensation in the baghouse, the unit was insulated and heat traced. Special high-temperature, acid-resistant coatings also were applied to all interior metal surfaces to prevent corrosion.
- The gas was then routed to the scrubber system where caustic solutions were used for neutralization. The gas was first quenched to its adiabatic saturation temperature before entering the fiberglass reinforced polyester scrubber. The quenched flue gases passed through the horizontal-flow packed tower, and finally, through a mist eliminator prior to discharge to the stack.
- Process water was treated by a carbon adsorption system then discharged on site.
- Combustion gases were drawn through the kiln system and baghouse by an induced draft fan (resulting in a constant negative pressure throughout the system) and were exhausted through a 50-foot stack. Typical flue gas velocity was 58 feet per second, and the typical stack exit temperature was 187°F.

TREATMENT SYSTEM DESCRIPTION (CONT.)

Operating Parameters Affecting Treatment Cost or Performance

Table 2. Summary of Operating Parameters

Parameter	Value
Retention Time	30 minutes
System Throughput	20,000 lbs/hr
Kiln Temperature	1,700°F to 2,000°F

TREATMENT SYSTEM PERFORMANCE

Cleanup Goals/Standards

Cleanup goals and standards were specified in the ROD.

- Soil with a concentration of PCBs greater than 50 mg/kg was incinerated.
- Residual ash with a concentration of PCBs greater than 50 mg/kg was re-incinerated until incineration operations were discontinued; then ash with those concentrations of PCBs was disposed of off-site at a TSCA-approved landfill. Ash with concentrations less than 50 mg/kg PCB and less than 500 mg/kg lead were backfilled into an on-site waste containment cell with no additional treatment. Ash with greater than 500 mg/kg of lead was stabilized with Portland cement prior to backfilling.
- The ROD required treatment standards that corresponded with a 1×10^{-5} excess lifetime cancer risk level
- The ROD specified a 99.9999% DRE. The incineration system at Coal Creek had a history of acceptable performance and had demonstrated a DRE of greater than 99.9999% in nine previous performance tests. In addition, the concentration of PCBs was so low a trial burn would have required spiking in order to demonstrate compliance. For these reasons, EPA did not require a trial burn. In lieu of a trial burn, DRE calculations for PCBs were performed during operation of the system. EPA agreed to take into account the limitations on data evaluation (analytical and statistical confidence levels) posed by the low concentrations of PCBs in the feed soil. A performance burn was conducted to demonstrate that the incinerator could meet the minimum requirements.

TREATMENT SYSTEM PERFORMANCE (CONT.)

Treatment Performance and Compliance

- An extensive sampling program was implemented during the performance burn which included collecting and analyzing samples from feed soil, treated soil, spray tower fly ash, fabric filter fly ash, scrubber blowdown, and stack gases. EPA determined that the unit was capable of meeting the incineration requirements and approved full-scale operation. Operating conditions were based on the operating limits developed during the performance burn.

- The AWFCOs could be triggered by incinerator monitors or the CEMs. The AWFCOs limits are shown in Table 4. Information about the frequency of AWFCOs was not available. Values for trial burn operating parameters are shown in Table 5; information about actual values for these parameters was not available. The incinerator at Coal Creek operated within the operating limits established during the performance burn, signifying that all cleanup requirements established in the ROD were met.

- The residual ash was analyzed for PCBs, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), and for metals using the Toxicity Characteristic Leaching Procedure (TCLP). Samples for TCDD equivalents were analyzed during the performance test. The results of this analysis demonstrated that the performance criteria would be met by the incinerator, and TCDD testing was not required after the performance test.

- Final disposal was determined based on analysis of PCBs and metals. Ash with greater than 50 mg/kg PCBs was reprocessed through the treatment system. Ash that was below 50 mg/kg PCBs and 500 mg/kg lead was placed in on-site waste containment cell without additional treatment. Ash that contained more than 500 mg/kg lead was stabilized by mixing with Portland cement prior to being backfilled in the waste cell.

- An ambient air monitoring program was implemented at the site to document ambient air quality before, during, and after remedial activities. The monitoring program was designed to identify the most likely airborne migration directions and to collect data using real-time particulate monitors and time-integrated ambient air sampling methods. Nine air monitoring stations were set up around the perimeter of the site. The stations collected samples to determine airborne concentrations of PCBs, inhalable particulate matter of 10 microns diameter or less (PM_{10}), and PM_{10} lead.

- Action levels were developed for airborne concentrations of PCBs (0.95 $\mu g/m^3$), PM_{10} (75 $\mu g/m^3$), and PM_{10}-lead (0.75 $\mu g/m^3$). Exceedance of the action levels required implementation of dust suppression techniques. Weekly air monitoring reports were prepared by Weston during major excavation, incineration, and backfilling operations.

- The airborne concentrations of PCBs and PM_{10} lead were below site-specific action levels during the Phase II remedial action activities. The action level for PM_{10} was exceeded on one occasion. The cause of this exceedance was thought to be backfilling operations. Additional dust control measures (e.g., use of sprayers, ceasing backfilling operations on windy days) were instituted after the elevated level was recorded. The action level was not exceeded for the remainder of the remedial action.

TREATMENT SYSTEM PERFORMANCE (CONT.)

Table 3. Average Destruction and Removal Efficiencies from Compliance Testing

Contaminant	Average Contaminant Feed Rate in Soil (lb/hr)	Average Contaminant Rate in Stack Gas Emissions (lb/hr)	Average Contaminant Rate in Residual (g/hr)	DRE (%)
PCB	4.53	2.66×10^{-6}	NA	99.99994

Table 4. Automatic Waste Feed Cutoffs

Parameter	Cutoff Limit
Maximum waste feed rate	5.1 tons/hr
Maximum kiln temperature	2,000°F
Minimum kiln temperature	1,700°F
Maximum SCC temperature	2,100°F
Maximum baghouse inlet temperature	450°F
SCC retention time	2 seconds
Burner in kiln or SCC	flameout
Maximum Baghouse pressure drop	18 inches water gauge
Minimum combustion efficiency	99.9%
Maximum carbon monoxide	100 ppm
Maximum shield pressure	-0.00
Emergency damper	open
Minimum scrubber pH	6.6
Minimum scrubber pack pressure drop	2 inches water gauge
Minimum scrubber inlet flow	158 gallons/minute
Minimum SCC excess oxygen	3 %
Maximum stack flow rate	16,500 acfm

Table 5. Operating Parameters

Parameter	Trial Burn Test Value
Kiln temperature	1,718°F
Waste feed rate	5.1 tons/hr
Baghouse inlet temperature	411°F
Baghouse differential pressure	2.73 inches w.c.
Scrubber blowdown turbidity	NA
Scrubber pH	6.67
Stack flow rate	15,074 acfm
Scrubber inlet flow	160 gpm
HCl stack emissions	<0.0227 lbs/hr
Particulate stack emissions	<0.000610 gr/dscf
CO (hourly rolling average)	nondetect

TREATMENT SYSTEM PERFORMANCE (CONT.)

Performance Data Available

- Data are available for concentrations of contaminants in the sediment before treatment.
- Data are also available for concentrations of contaminants in the incinerator residue. These data were collected periodically throughout operation of the incinerator before on-site disposal.

Performance Data Quality

- An independent quality assurance team, CH_2M Hill, was tasked to ensure that the remediation complied with the performance standards. The Quality Assurance/Quality Control program used throughout the remedial action was deemed to have met the EPA and the state of Washington requirements.

TREATMENT SYSTEM COST

Procurement Process

- Roy F. Weston, Inc., was the remedial contractor for Phase II, which included the incineration.

Cost Data

- The total cost was approximately $8,100,000. A total of 9,715 tons of soil were incinerated. This corresponds to a total unit cost of $830 per ton. A detailed breakdown of those costs was not available.
- The total cost provided here is an estimate reported in the Remedial Action Report.

OBSERVATIONS AND LESSONS LEARNED

Observations and Lessons Learned

- Before excavation began, structures on site were torn down and removed. During this process, PCB contaminated soil was disturbed and contamination was spread.

Public Involvement

- No written comments were received during the 60 day public comment period on the proposed plan, but support for a permanent and immediate solution was voiced during public meetings. The community response to the incineration was generally supportive.

REFERENCES

1) Superfund Record of Decision, Coal Creek, Chehalis, Washington, October 1990.

1) Mini-Burn #1 Test Result, Coal Creek, January 1994.

1) Memorandum from Catherine Massimino, Senior RCRA/Superfund, to Loren McPhillips, Coal Creek RPM, February 1994.

1) Addendum 4 - Risk Assessment Addendum, Coal Creek, February 1994.

1) Coal Creek Remedial Action Report, CH_2M Hill and Roy F. Weston, Inc., December 1994.