Evaporative Desorption Technology (EDT) as Remedial Measure for On-site Soil Treatment during RCRA Facility Closure Process

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Agenda

- Fundamentals of Evaporative Desorption Technology (EDT)
- Case Study of a RCRA Facility Closure using EDT
  - Site background
  - Selection of EDT as Remedial Solution
  - Approach to Site Clean up
  - EDT Results
Fundamentals of EDT
Evaporative Desorption Technology (EDT) is a flameless electric, ex-situ, batch, low temperature thermal desorption, soil remediation technique performed statically in a closed chamber under light vacuum.

Convection, rather than conduction, is the primary means for delivery of heat energy to the process chamber and for removing extracted contaminants.
Evaporative Desorption Technology
EDT Process Overview

Simplified Process Schematic

Blue-shaded boxes indicate operations outside of the Reterro processing equipment.
Contaminant Types
- CVOC/VOC
- BTEX
- TPH
- SVOC
- PAH

Process Parameters
- Batch: 18 - 22 Tons
- Temp: 380°F to 650°F (500°F nom.)
- Air Flow: 2,000 to 2,400 scfm
- Time: 1.25 to 4 hrs (2 hrs nom.)
- Energy: 480V, 3 phase
Convective Soil Heat Transfer within EDT Treatment Bin
Evaporative Desorption Technology
EDT Process Overview

Direct Load Soil Treatment Bins
Weigh filled soil bins pre-EDT process
Evaporative Desorption Technology
EDT Process Overview

Load soil bins to EDT process unit
Evaporative Desorption Technology
EDT Process Overview

Approximately 20 tons soil loaded for EDT treatment
Evaporative Desorption Technology
EDT Process Overview

EDT soil treatment in Progress
Evaporative Desorption Technology
EDT Process Overview

Automated EDT Process Controls

- Sets process parameters
- Monitors and records treatment process
- Provides early warning of process variance
Evaporative Desorption Technology
EDT Process Overview

EDT System with GAC Abatement Unit
Unload and cool treated soil
<table>
<thead>
<tr>
<th>Site Characteristics</th>
<th>Soil Characteristics</th>
<th>Contaminant Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project size</td>
<td>Plasticity &amp; Density</td>
<td>Type(s)</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Particle size distribution</td>
<td>Concentration(s)</td>
</tr>
<tr>
<td>Weather</td>
<td>Moisture content</td>
<td>Vapor pressure &amp; Boiling point</td>
</tr>
<tr>
<td>Operating restrictions</td>
<td>Humic content</td>
<td>Water solubility</td>
</tr>
<tr>
<td>Electrical service</td>
<td>Metals content</td>
<td>Thermal stability</td>
</tr>
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</table>
Implementation of EDT for RCRA Facility Closure
Fullerton, CA
2014-2015
• 45-acre Former instrument manufacturing plant in Fullerton, CA

• Operated between 1954 and 2010

• Designated a large quantity generator for hazardous waste
  • *Chlorinated solvents – PCE and TCE*
Case Study
RCRA Facility
Investigation Results

• Site Geology
  • Man-placed Fill – Predominantly Clayey silt w/inorganic debris
  • Native Soil – Predominantly fine-grained clayey silty sand, silt and clay

• Hydrogeology
  • Groundwater zones between 30’ and 100’ bgs

• Contaminants of Concern
  • PCE, TCE and degradation products in soil, soil vapor and groundwater

• Identified Exposure Pathways
  • Vapor Intrusion
  • Dermal Contact
  • Leaching to Groundwater
• Soil and soil vapor impacts within fine-grained soils (0 - 15 feet bgs)

• Vapor plume delineated to:
  • Residential Screening Level (0.18 ug/l)
  • Industrial Screening level (0.53 ug/l)

• Maximum PCE Concentrations in vapor and soil:

<table>
<thead>
<tr>
<th>Development Phase</th>
<th>Vapor (ug/l)</th>
<th>Soil (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1 (mix)</td>
<td>6.59</td>
<td>0.11</td>
</tr>
<tr>
<td>Phase 1 (com)</td>
<td>15.9</td>
<td>&lt;0.002</td>
</tr>
<tr>
<td>Phase 2 (res)</td>
<td>390</td>
<td>13</td>
</tr>
<tr>
<td>Phase 3 (res)</td>
<td>243</td>
<td>16</td>
</tr>
</tbody>
</table>
Proposed Property Sale for Residential/Commercial Development

**Considerations**

- Expedited soil remediation and facilitate unrestricted property use

- In situ technologies eliminated from further consideration given low permeability soil and treatment time needed to achieve the cleanup goals
Soil Remedial Action Objectives

- Reduce contaminant mass in soil and soil vapor *(originally estimated at 60,000 tons)* to:

Consultant Retained Two Remedial Alternatives

1. Off-site Transportation and Disposal
   - Eliminated alternative due to trucking emissions

2. On-site Treatment using EDT
   - Retained for Pilot Testing
Initial EDT Pilot Test Scope of Work

- 1,100 tons in Areas 1, 2 & 3
- Determine level of VOC reduction for a range of soil types and VOC concentrations

Preliminary Soil Remediation Goals

<table>
<thead>
<tr>
<th>COC</th>
<th>Regional Screening Level (RSL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCE</td>
<td>4.4 mg/kg</td>
</tr>
<tr>
<td>TCE</td>
<td>0.182 mg/kg</td>
</tr>
</tbody>
</table>

EDT Pilot proved successful in ~1 month - Regulatory Agency approved extended test
Extended EDT Pilot Test Scope of Work

- 8,800 tons across site
- Confirm that final soil and soil vapor goals can be achieved

Soil and Soil Vapor Remediation Goals

<table>
<thead>
<tr>
<th>COC</th>
<th>RSL</th>
<th>Soil Goal SSL (gw)</th>
<th>In situ Soil Vapor Goal (res)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCE</td>
<td>4.4 mg/kg</td>
<td>0.0023 mg/kg</td>
<td>0.18 ug/l</td>
</tr>
<tr>
<td>TCE</td>
<td>0.182 mg/kg</td>
<td>0.0018 mg/kg</td>
<td>0.52 ug/l</td>
</tr>
</tbody>
</table>

Areas 1 & 2

Area 3

EDT System Location
Case Study
Extended Pilot Test Summary

Soil and Vapor Sampling of Treated Stockpiles

EDT System Location

4300 N Harbor Blvd
Mass Removal

VOCs measured in EDT effluent

Clean up Goals Met

Soil Results:
25/25 samples <0.0023 mg/kg

Carbon Loading

Soil Vapor Results
(29 samples)

VOCs in EDT effluent

PCE Soil Gas
μg/L

Vapor Treatment Goal

Approved by Regulator for Full Scale Remediation
Full Scale EDT selected for Soil Remediation

- ~97,000 tons soil for EDT processing
- Installed 2\textsuperscript{nd} EDT system in Bldg 8
- Grid power connection
- 24/7 operation
- Treat & stockpile pending Regulatory approval
Case Study
Full Scale EDT Soil Remediation

Two EDT systems within Bldg #8

Dump Tent within Bldg #8
Case Study
Full Scale EDT Soil Remediation

Excavation depths 8’ min
16’ to 24’ at source areas

Soil treatment bins delivered to excavation for direct load
Results of EDT Soil Treatment
Case Study
Full Scale EDT Results

EDT Soil Throughput and Process Time

Average Effluent Soil Vapor @ 145°F
3 significant “soil stops” in July, August & September
Post-EDT Soil Vapor Results

6.4% of vapor samples exceeded Treatment Goal (reprocessed)

Vapor Treatment Goal

Micrograms per liter

Confirmation Vapor Samples (320)
Case Study
Full Scale EDT Soil Remediation

Batch Weight (tons)
Conclusions
• ~100,000 tons of soil treated by EDT in 14 months

• 6.4% (~7,000 tons) required reprocessing to meet treatment goals

• Soil backfilled and additional round of confirmation vapor samples collected to confirm final cleanup goals for residential reuse (no rebound)

• Regulatory agency issued “Soil Corrective Action Completion” within 2 years of the start of remediation project

• Property sold for redevelopment with ongoing groundwater remediation
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Thank You!
Case Study
Full Scale EDT Results

Stockpile Management

HDPE Cover

Soil Sement Cover