Remediation Overview
Technologies and Equipment
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How do we clean it up?

• Types of Soil Clean-up

• Types of Ground Water Clean-up

• There are multiple technologies available to remediate a contaminated site.
  In-situ – in place
  Ex-situ – out of place/on site or off site
Remediation

Soil

• Stabilization
  • Encapsulation/Fixation
  • Vitrification
• Excavation
  • Conventional
  • LDA
• Vapor Extraction
• Bioremediation
  • Landfarm
  • Biopiles
  • Blending
• Chemical Oxidation
  • Direct Injection
  • Blending

Ground Water

• Air Sparge
• Pump and Treat
• Dual Phase
• Multi Phase
• Bioremediation
• Chemical Oxidation
• Thermal
Stabilization

- Encapsulation/Fixation
  - Slurry Wall
    - Trenched
    - Cast
  - Polymer/Cement
    - Blending
    - Direct Injection

- Vitrification
  - High Heat and Energy
Encapsulation
Vitrification

Cross section of a vitrified monolith from the Savannah River Site demonstration.
Excavation

• Conventional
  • With Shoring
    • Sheet Pile
      • Unbraced
      • Braced
    • LDA
  • Without Shoring
    • Side Slopes (OSHA)
      • Soil Type

• LDA
  • Overlap
  • With Chambers

• With Dewatering
  • Ingress/Egress
• Most Commonly Used Technology
• Best In Sandy Lithology

• Key Design Parameters:
  • Well Depth/Screen Interval
  • Well Spacing
  • Radius of Influence (ROI)
  • Overlap
  • Air Flow: Volume and Pressure
What's the Air Flow?

There are multiple ways to obtain flow readings:
- Anemometer
- Direct Read
- Rotameter
- Differential Pressure
Anemometer
Rotameter
Differential Pressure
Types Blowers and Compressors

- Regenerative
- Centrifugal/Multistage
- Rotary Lobe
- Rotary Claw
- Rotary Screw
Regenerative
Centrifugal Multistage
Rotary Vane
Rotary Lobe
Rotary Lobe
Rotary Claw
Rotary Claw
Rotary Screw
Reciprocating
Groundwater Remediation

- Pump and Treat
- Dual Phase
- Multi Phase
- Air Sparge
- Chemical Oxidation
- Bioremediation
Pump and Treat

• Old Technology
• Good for Hydraulic Control
• Mass Removal/Cleanup Typically Very Slow
Pump and Treat

- Submersible Pump
- Surface Pump
  - Head
  - Flow Rate
  - Well Spacing
  - Drawdown
Dual Phase/Multi Phase

- **Flow direction:**
  - Bubble
  - Slug
  - Churn
  - Annular
  - Froth

- **Graph:**
  - V vs. \( V_{fg} \)
  - Phases: Bubble, Slug, Churn, Annular

- **Flow patterns:**
  - Bubble flow
  - Plug flow
  - Stratified-wavy flow
  - Slug flow
  - Annular flow
  - Upward vertical flow
  - Horizontal flow

- **Images:**
  - Example of flow patterns with different concentrations (1000 ppm, 400 ppm)
Well Head Configurations
Rotary Lobe/Claw
Liquid Ring Pump
Direct Observation
Off Gas Treatment - Granular Activated Carbon (GAC)
Off Gas Treatment Thermal Oxidizer
Water Treatment
Air Stripping Tower
Tray Strippers
Diffused Aerators
Level Controls
Chemical Oxidation
Totalizing Flow Meters
Typical Fouling
Submersible Pump Fouling
AS/SVE Performance Issues

• Treatment Wells Screened Inappropriately:
  • AS Wells Too Far Below Contamination
  • SVE Wells Recovering Too Much Water

• Undersized Equipment Used

• Technology Used At A Site with Too Much Clay
Not The Correct Application
Details are Critical
What we are getting into
It’s a New Dawn
Shinning Bright
Questions?