Webinar Agenda

Company Overview

Technology Overview
  • S-ISCO Highlights
  • Chemistry behind the technology
    • Applications

Case Studies
About Us

• VeruTEK develops high performing solutions for:
  
  Environmental remediation
  
  Surface clean up – oil spills, PCB
  
  Enhanced Oil Recovery
• VeruTEK develops high performing solutions for:
  
  * Environmental remediation*
  
  * Surface clean up – oil spills, PCB*
  
  * Enhanced Oil Recovery*

• Three patents issued in 2011
  
  16+ patents pending
VeruTEK develops high performing solutions for:

- Environmental remediation
- Surface clean up – oil spills, PCB
- Enhanced Oil Recovery

- Three patents issued in 2011
  - 16+ patents pending

- VeruTEK is a chemical company specializing in plant based chemistry to enable time released oxidation
VeruTEK Remediation Proposition

Source destruction

- alternative to excavation
- around and under structures
VeruTEK Remediation Proposition

Source destruction
- alternative to excavation
- around and under structures

Short timeframe
- Fewer injections
- Weeks or months not years
VeruTEK Remediation Proposition

Source destruction
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Short timeframe
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Permanent solution
no rebound
Field Proven Technology

40+ sites remediated

• Non-Aqueous Phase Liquid (NAPL), LNAPL, DNAPL
• Manufactured Gas Plants (MGP) Wastes
• Creosote – PAHs
• Fuels – Diesel, Gasoline, # 2 & # 6 oils
• Chlorinated Solvents – TCE, PCE
• MTBE
Partnering with Leading Academic & Industry Institutions

- Electric Power Research Institute (EPRI)
- Yale Center for Green Chemistry
- University of Connecticut Department of Chemistry
- Australia CRC CARE
- EORI University of Wyoming
- Kansas University TORP
- University of Copenhagen
Partnering with Environmental Protection Agency (EPA)

- Joint Development and Patent of Green Zero Valent Iron; Dec 2010
- Surface Washing Agent listing; Dec 2010
- Addressing Superfund sites
S-ISCO uses biodegradable, low toxicity, plant based surfactants.

Co-patented a new green synthesis technique, with the US EPA, which uses polyphenol rich plant material to form nano-iron catalysts.

Our in situ treatments are a lower carbon footprint solution to Brownfield development compared to excavation.
S-ISCO

- VeruSOL, biodegradable, plant-based surfactant/co-solvent mixture
- Desorbs soil contaminants
- Prevents rebound
- Stabilizes the oxidant and improves the performance of the treatment.

Green Time Released Surfactant, Oxidant and Catalyst Technology

1. Oxidant
2. Green Surfactant
3. Catalyst
4. Source Zone NAPL
5. Soil
6. Aquifer

Surfactant Controlled Source Destruction

Degradation to Harmless By-products Within Days or Weeks

1. Clean Soil
2. Clean Groundwater
Self Assembling Design

Soil
Surfactants Allow for Destruction of Insoluble Contaminants

Source: VeruTEK R&D laboratory
Surfactant/Oxidant Combination Advantages

VeruTEK Surfactants improve the stability and efficacy of oxidants

• Controls the rate of oxidant reaction
• Extends the life of the oxidant in the subsurface

Lower oxidant dose vs. ISCO

• ISCO typically uses 12-16% peroxide
• S-ISCO uses 4-8% peroxide
• Lower oxidant dosing reduces cost & improves ROI
• Less exothermic, safer injections
Soil Matrix

Aqueous Phase

Nanopore

S-ISCO
Soil Matrix

Aqueous Phase

Nanopore

ISCO

Soil Matrix

Soil Matrix
• By adjusting dosage VeruTEK can either
  - destroy in place using S-ISCO – without mobilization or
  - use the SEPR extraction process to mobilize a contaminant for collection

• S-ISCO will lead to the formation of the micelle and simultaneous desorption and destruction

• Dosing based on past experience, treatability study and/or monitoring
Byproducts and Intermediaries

Fate of S-ISCO Components and Contaminants

• VeruSOL surfactants are “readily biodegradable” OECD 301 D
• Generally Regarded as Safe by US FDA
• After only 13 days, VeruSOL-3 was degraded by 90%
Major Consultants

Government Projects
- U.S. Superfund
- Denmark
- Australian DoD
NY Former MGP Cesspool Site

**Background**

Cesspool for MGP coal tar, 1880-1920s

- **Site**: Fine-to-coarse sand;
- Parking lot in residential/commercial neighborhood;
- Subsurface utilities;
- Shallow excavation prior to S-ISCO

- **Contamination**: Coal tar,
- 7,900 kg PAHs & BTEX

- **S-ISCO Treatment**:
  VeruSOL, Sodium Persulfate & Fe-EDTA
  - 15,652yd³ soil, 4 - 28 ft bgs
  - 14 Injection Wells & 45 Monitoring Wells

**Results**

- **COC Mass Reduction**: 85% (7,900-1,176 kg)
- **Met Remedial Criteria for PAHs**
- **Controlled Treatment**: No off-site migration
- **Improved Soil Vapor Concentrations**
- **Cost**: $198/yd³
- 3,000+ on-site hours, no reportable health & safety events

<table>
<thead>
<tr>
<th>Category</th>
<th>Remedial Goal (ppm)</th>
<th>% Samples Attained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total PAHs</td>
<td>500</td>
<td>99</td>
</tr>
<tr>
<td>Carcinogenic Individual PAHs</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Non-Carcinogenic Individual PAHs</td>
<td>50</td>
<td>98</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>10</td>
<td>96</td>
</tr>
</tbody>
</table>
CT Former MGP Site

• **Site:** Urban redevelopment project

**Treatment:**
- **S-ISCO** beneath Excavation (1,900 tons soil)
  - Injections: VeruSOL & alkaline-activated persulfate
- **S-ESCO** Remediation of Excavated Soil (1,200 tons)
  - Application: VeruSOL, peroxide & persulfate

**Results**
- **S-ESCO:** Reduced TPH concentrations by 95%
- **S-ISCO:** Achieved State I/C Criteria for soil & groundwater
- Redevelopment complete
- $57/ton

**S-ESCO Application**

S-ESCO Soil TPH (DRO)

CT Criteria for GB PMC TPH (2,500 ppm)

- Baseline, Pre S-ESCO™
- SP-2N, Post S-ESCO™
- SP-2S, Post S-ESCO™
- SP-NW, Post S-ESCO™
- SP-NE, Post S-ESCO™
- SP-SW, Post S-ESCO™
- SP-SE, Post S-ESCO™

TPH (DRO) (ppm)
TX Pipeline Pumping Station

- In operation 60+ years
- **Geology**: Silty sand
- **Contamination**: Gasoline, MTBE, diesel, kerosene & aviation fuel
  - Persistent LNAPL in monitoring wells;
  - 60,000 ppm TPH-DRO soil concentrations

- **Previous Treatment**: 10 year Extraction System
- **S-ISCO Treatment**: VeruSOLVE-HP + Persulfate Flush
  - Four 500-gallon injections, separated by 7 days each

**Results:**
- **Soil**: 99% TPH/BTEX Reduction
- **Groundwater**: No LNAPL; 99% TPH/BTEX Reduction
- NAPL Source Eliminated

![NAPL saturated pore space](image)

PID reading >4,000+ ppm

![Post - Treatment](image)

- **Sampled Interval**
S-ISCO Delivers Best Results For...

- Sorbed NAPL-phase contamination
- Saturated zone contamination
- Permeable soil
- Around or under structures or utilities
- Deep contamination (>20 ft)
- In Soluble Organic Contamination
  - Hydrocarbons
  - Chlorinated Solvents
Thank You!

www.verutek.com
The cost for S-ISCO implementations $40-$95 per cu/yd includes;
• Design and planning of the remediation
• Supply and injection of the treatment chemistry

Costs depend on;
• Type and concentration of contaminant(s),
• Site lithology and layout;
• Specific remedial goals for the project

Larger sites may have additional costs, e.g. sampling, monitoring,
Expanded Range of Portfolio Options

Transition to Flexible Business Model in 2011 to Increase VeruTEK Market Reach

2010
- Market Opportunity
  - Full Implementation
  - Laboratory Studies

2011
- Market Opportunity
  - Full Implementation
  - Laboratory Studies
  - Chemical Product Sales
  - Technical Assistance