Innovative Pulsed Ozone Microdiffusion Sparge Approach for Tetrachloroethylene Remediation at an Arizona State Superfund Site

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24th St. & Grand Canal WQARF Site

- WQARF = Water Quality Assurance Revolving Fund
- Arizona’s State Superfund Program
Site Hydrogeology

- Most of Phoenix lies in a broad relatively level alluvial valley
- Three hydrogeologic units: Upper, Middle and Lower Alluvial Units
- Site depth to groundwater: ~85 to ~100 ft bgs
- Lithology - intermittent layers of sand, gravel, and silt
- Groundwater flow to the west-southwest
- Groundwater velocity ~70 ft/day
Environmental Visualization System (EVS)
Site Layout

Former soil vapor extraction system

New ozone pilot sparge system
Compound Became a Homeless Shelter

Site location and utilizing previous SVE compound
Intent was to pull ½-in. dia. ozone tubing thru 2-in. dia. SVE PVC lines
Used 50 lbs/day Ozone Sparge Trailer
• PCE in 24AS-01 decreased ~87% from April to June 2020
• All other wells within the 250’ treatment zone saw PCE decrease >20% after initial 6 weeks w/steady decline since
• Ozone detected in monitoring well headspace across the canal
• Significant rise in ORP
Groundwater Redox Over Time

Redox Restored After 14 Day System Shut Down
<table>
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<tr>
<th>Location</th>
<th>Sample Depth (ft bgs)</th>
<th>Date Sampled</th>
<th>Chromium</th>
<th>Copper</th>
<th>Manganese</th>
<th>Nickel</th>
<th>Zinc</th>
<th>Uranium</th>
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<td>98</td>
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<td>&lt;0.040</td>
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Metals all reduced to background within 14 days of system shut down.
Injection Pressure Over Time

- OS-1
- OS-2
- OS-3
- OS-4
- OS-5

Injection Pressure (in psi)

Date

19-Apr-20 9-May-20 29-May-20 18-Jun-20 8-Jul-20 28-Jul-20 17-Aug-20 6-Sep-20
To date more than 5000 pounds of ozone has been injected into site groundwater.
Summary

• EVS-type modeling excellent for refining CSM adequate for advanced and focused remedial approaches
• Pilot testing is critical
• Need to understand O&M requirements of zone sparge systems
• Frequent monitoring and understanding of changes in groundwater chemistry
• Able to achieve dissolve-phase ozone 400+ ft downgradient
• Up to 80% reduction in 6 weeks
• Expand to Full Scale and remediate with 2 years!
Thank You!