Electrochemical Oxidation of PFAS — Moving from Bench to the Field

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Outline

– Introduction
  • Electrochemical Oxidation Technology (EO) Background
  • EO Applications for PFAS Treatment
– Demonstration Project
– Field Pilot Demonstration
– Key Takeaways
Introduction
Electrochemical Oxidation (EO) is a proven technology that defluorinates and mineralizes short-chain and long-chain PFAS

DE-FLUORO™ utilizes a proprietary, high durability and low-cost electrode that can be in different sizes, forms and shapes for different applications

DE-FLUORO™: Degradation and Electrochemical oxidation of per- and polyfluoroalkyl substances

A compact, highly efficient, cost-effective mobile treatment unit for on-site PFAS destruction treatment

It reduces environmental liability of transporting PFAS-impacted waste off site for treatment/disposal
EO as a Stand-Alone Destructive Technology

- Applicable for smaller volumes and higher PFAS concentrations
- Can treat in batch or flow-through mode
Coupling EO with Separation Technologies

- Applicable for larger volumes and lower PFAS concentrations
- Primary technology separates PFAS from the waste stream
- Primary technology typically generates a concentrated waste stream, with higher PFAS
- EO destroys PFAS in the concentrated waste stream
02
Demonstration Project
DE-FLUORO™ Demonstration Project

Plate Electrodes
- Batch mode
- Large Surface Area
- High reactivity

Membrane Electrodes
- Flow-through mode
- Large surface area
- Scalable

[Images of equipment and components]
## Demonstration Results – Timed Tests

<table>
<thead>
<tr>
<th>Trial #</th>
<th>Sample Description</th>
<th>Initial Total PFAS Concentration (ug/L)*</th>
<th>(PFOA + PFOS) Mass Reduction</th>
<th>Total PFAS Mass Reduction*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AFFF concentrate / product</td>
<td>6,380,000</td>
<td>42.7%</td>
<td>60.0%</td>
</tr>
<tr>
<td>2</td>
<td>IX-R regenerant waste (brine)</td>
<td>408,590</td>
<td>98.5%</td>
<td>92.9%</td>
</tr>
<tr>
<td>3</td>
<td>Remediation derived wastewater-soil washing</td>
<td>13,600</td>
<td>100%</td>
<td>99.2%</td>
</tr>
<tr>
<td>4</td>
<td>Spent C6 AFFF solution</td>
<td>4,620</td>
<td>80.5%</td>
<td>83.3%</td>
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<tr>
<td>5</td>
<td>Remediation derived wastewater-ozone fractionation</td>
<td>1,590</td>
<td>98.9%</td>
<td>90.7%</td>
</tr>
<tr>
<td>6</td>
<td>Source area groundwater 1</td>
<td>455</td>
<td>100%</td>
<td>99.7%</td>
</tr>
<tr>
<td>7</td>
<td>Industrial groundwater</td>
<td>411</td>
<td>100%</td>
<td>99.5%</td>
</tr>
<tr>
<td>8</td>
<td>Source area groundwater 2</td>
<td>27.3</td>
<td>98.3%</td>
<td>83.8%</td>
</tr>
</tbody>
</table>

* Based on concentrations of 27 PFAS compounds
Scalability

Model 1.0

Limited scalability
- Small volume, highly concentrated waste stream
  (e.g., IX-R still bottom, foam fractionation waste stream)

Model 2.0

Scalable
- Small to large scale
- High concentrations
- Full-scale systems already in place for treating non-PFAS contaminants
03
Field Demonstration
Field Pilot at WPAFB

Two Sites at Wright Patterson Air Force Base

Groundwater contaminated with AFFF

- Sites: Hangar, Fire Training Area (FTA)
- Elevated PFAS concentrations at both sites
- Generate performance data for different water quality
Approach - Coupling Approach of IX-R + EO

- **FEED GROUND WATER**
- **IXR**
- **Regenerant Solution**
- **Exhausted Resins**
- **Spent Regenerant**
- **Distillation**
- **TREATED EFFLUENT**
- **Discharge**
- **Regenerant**
- **EO Effluent**
- **EO/DE-FLUORO™**
- **Regeneration Waste (still bottom)**
Field Pilot – Operation

- IX-R groundwater treatment flow rate: 2 to 5 gpm
- Designed to treat 7,000 – 15,000 ppt total PFAS
- Treatment goal: PFOS + PFOA < 70 ppt (Hangar) and ND for PFOS (FTA)
- Treated ~500,000 gallons of groundwater over 5 months at two sites
Field Pilot – Destruction

Still Bottom Waste

UGA Bench Treatment

On-site pilot treatment

Pilot EO Reactor
Key Takeaways

- Our testing has shown that EO can destroy PFAS in multiple types of waste streams with varying water chemistry
- EO can be effective as a stand-alone or coupled treatment technology for PFAS, depending on the treatment scenario
- The EO technology is scalable
- Field pilots and treatability tests are currently being performed with larger pilots near-term
- EO can destroy PFAS on-site; reducing the associated liability of off-site disposal of PFAS-laden wastes