Remediation of PFAS

OxyZone® Processes: Bench Scale & Field Demonstration

NEWMOA Workshop
PFAS in The Northeast: State of Practice & Regulatory Perspectives
May 8 - 10, 2017
Who We Are

EnChem Engineering

EnChem Engineering, Inc. possesses the underlying technical environmental remediation expertise and effective remediation processes, facilities and staff to solve the most complex emerging contaminant environmental challenges.

We have been a hazardous waste consultant to the U.S. Environmental Protection Agency; the US Air Force and Fortune 500 companies.
OxyZone®

- Patented persulfate-based oxidant mixture
- OxyZone® chemistry generates a mixture of hydroxyl, sulfate, perhydroxyl, and superoxide radical species
- Safe to apply under buildings
- Small site footprint, generation entirely enclosed
- Proven to be effective for in-situ treatment of conventional organic contaminants
Field Demonstration at the JBLE Fire Training Area (FTA) in Hampton, VA

- Historical military FTA where Aqueous Film-Forming Foam (AFFF) released
- Complex geology, shallow GW, low GW velocity, tidal influenced
- Mix of contaminants in site soil & GW at very high concentrations (NAPL)
  - Total Chlorinated solvents (PCE, TCA, DCB): 10 – 250 mg/l
  - Total Petroleum hydrocarbons (BTEX): 0.1 – 5 mg/l
  - Total SVOCs (mostly phenolics): 0.5 – 50 mg/l
  - Total of 9 detected PFAS: 28 – 280 ug/l
  - PFOS (the dominant PFAS): 7 – 200 ug/l
FTA Field Demonstration Results for Chlorinated VOCs using Membrane Interface Probe (MIPs):

- Significant overall reduction in Chlorinated VOCs
- PFAS concentrations too low to be detected by MIPS
FTA Field Demonstration
Groundwater Results for PFAS

April 2013

OxyZone® Injections: May & July-August 2013

October 2013

February 2014

Total PFAS

PFOS only
Field Demonstration
Treatment Results for PFAS

Overall OxyZone® Impact on PFAS: Lines of Evidence Approach

1. Decrease in total groundwater concentration of PFAS

2. PFOS:
   • highest soil concentration of all (detected) PFAS
   • greatest reduction in groundwater concentration

3. Statistical comparison of wells within Test Cell to those outside Test Cell showed PFAS concentrations decreased within Test Cell, not outside

4. Groundwater concentrations of conservative tracer chloride showed no (dilution) impact from injections
Bench Scale Lab Results:

AFFF Site Contaminated Groundwater – High Undetected PFAS – 750% Fluoride Recovery
PFAS Case Study Results

Field Demonstration

• OxyZone® was selected by the EPA & Air Force for a field demonstration to treat mixed organic contaminants in-situ
• 9 different PFAS were discovered during baseline testing and monitoring
• Groundwater data analysis supported a statistically significant reduction in PFAS concentrations (-21% to -79%) in groundwater, indicating that OxyZone® processes successfully degraded PFAS in-situ in the presence of high concentrations of other organics

Bench Scale Testing

• Up to 99.9% destruction (to less than 0.2 ppb) of PFOS and PFOA
• 80 - 750% defluorination of PFAS organofluorine to fluoride anion

Conclusion

- Results indicate that OxyZone® has the capability to decrease PFAS to very low concentrations, either in-situ or ex-situ.
Implementation Options:

Above Ground Reactor For Re-Injection

Enclosed Soil Reactor for Vadose Zone Soils

In-Situ Groundwater Recirculation System:

- In-situ OxyZone® treatment of saturated soil and groundwater
- Could supplement existing pump and treatment system

Other Options:

- Horizontal injection wells on plume transect
- Vertical injection wells on plume transect
Questions?
Thank You for your Interest

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