REMOVAL OF PERFLUORINATED COMPOUNDS FROM POST-EMERGENCY WASTEWATER BY ADVANCED OXIDATION PROCESS AND GRANULAR ACTIVATED CARBON ADSORPTION

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At the end of 2014, there were 290 documented military fire training areas, which included a total of 664 point-release sites (DoD, 2015; Hu et al, 2016).

PFAS have very low volatility and are stable and mobile in soil, and have half-life degradations in the environment up to 92 years (EPA, 2012).
• Source water starts with a TOC of ~3 mg/L and increases to ~100 mg/L (Schmidt, 2017).

• TOC may have a higher affinity for adsorption in the GAC, leaving fewer sites for PFAS to adsorb to (Schmidt, 2017).

• Pretreating the water to reduce TOC levels has been recommended as an area of further research (Schmidt, 2017).
The first research objective was to determine whether UV/H$_2$O$_2$ AOP reduces TOC in contaminated AFFF-groundwater.

The second research objective was to determine whether pretreatment with AOP affects PFAS GAC adsorption capacity.
Advanced Oxidation Process

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  - TOC
  - PFAS
  - RSSCT
  - PFOS
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  - PFAS
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Advanced Oxidation Process

\[ + \text{H}_2\text{O}_2 \]

[Diagram of Advanced Oxidation Process system]

[Water treatment equipment: TANK, FILTER, PUMP, UV]

[Chemical equation: \( \text{TOC} + \text{PFAS} + \text{RSSCT} + \text{PFOS} + \text{PFOA} + \text{PFAS} \rightarrow \text{TANK} \rightarrow \text{FILTER} \rightarrow \text{PUMP} \rightarrow \text{UV} \)]
AOP Data – TOC

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AOP Data – PFOS & PFOA

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AOP Data – PFPeA & PFHxDA

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UV/H2O2 AOP PFPeA Concentrations at Various H2O2 Concentrations

0 (mg/L) H2O2 (0-Hr) AOP Test
250 (mg/L) H2O2 (0-Hr) AOP Test
500 (mg/L) H2O2 (0-Hr) AOP Test

UV/H2O2 AOP PFHxDA Concentrations at Various H2O2 Concentrations

0 (mg/L) H2O2 (0-Hr) AOP Test
250 (mg/L) H2O2 (0-Hr) AOP Test
500 (mg/L) H2O2 (0-Hr) AOP Test
Rapid Small Scale Column Test

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Rapid Small Scale Column Test (RSSCT)

RSSCT Process Flow Diagram

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Current Data - RSSCT PFOS

RSSCT results for 9 minute EBCT with and without pre-AOP treatment

TOC degradation of INL water with AFFF at various H₂O₂ concentrations using UV/H₂O₂ AOP

- 500 mg/L H₂O₂ (2-Hr)
- (2) 500 mg/L H₂O₂ (8-Hr)
- 250 mg/L H₂O₂ (8-Hr)
RSSCT PFOS

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PFOS GAC Capacity

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RSSCT results for 9 minute EBCT with and without pre-AOP treatment

PFOA Normalized Concentration (C/C₀)

Throughput (Bed Volumes)

10% Breakthrough

PFOA (w/ AOP) 500 mg/L

H₂O₂ (2-Hr) Initial=0.105 mg/L

#2 PFOA (w/ AOP) 500 mg/L

H₂O₂ (3-Hr) Initial=0.215 mg/L

PFOA (w/ AOP) 250 mg/L

H₂O₂ (3-Hr) Initial=0.151 mg/L
PFOA GAC Capacity

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- To determine the optimal $\text{H}_2\text{O}_2$ concentration and UV contact time during the AOP process, and to further understand the impact to the formation of other PFAS

- To determine the characteristics of the TOC in the INL groundwater, and the characteristics of the TOC once AFFF is in solution

- To conduct a life-cycle cost analysis on implementing the proposed treatment-train
Questions

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