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AECOM

Electrochemical Oxidation Field Demonstration for PFAS Destruction

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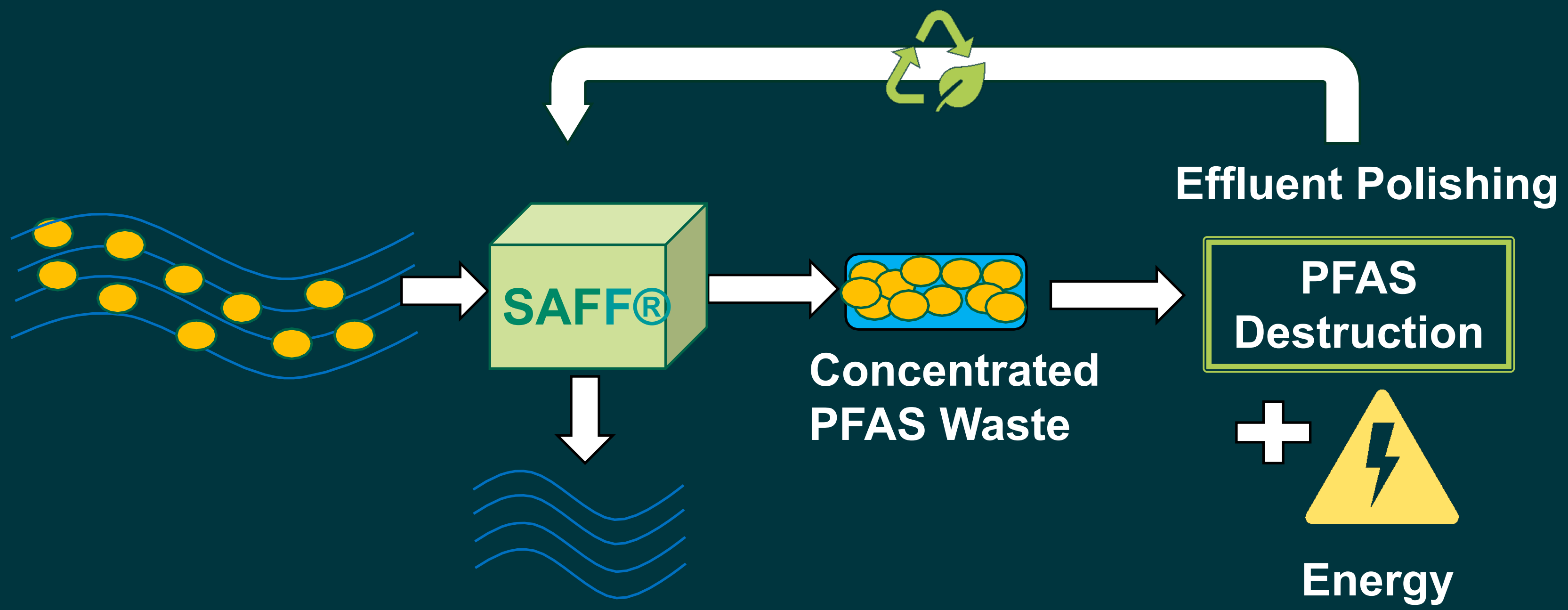
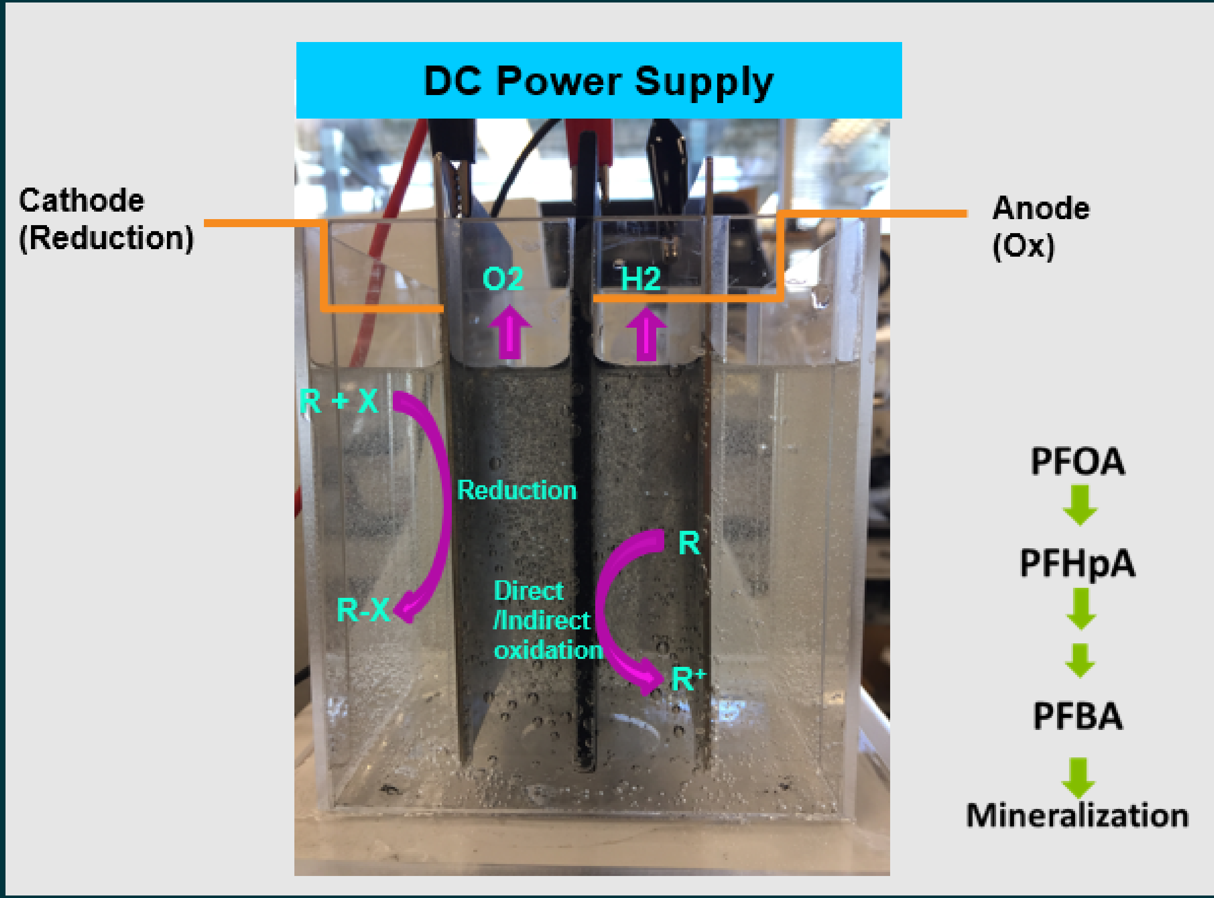
Project Objectives

- Evaluate effectiveness of per- and polyfluoroalkyl substances (PFAS) treatment using electrochemical oxidation (EO) coupled with surface active foam fractionation (SAFF®)
- Improve engineering design and system operations applying lessons learned
- Incorporate results into a feasibility study comparing other coupled technologies



How Electrochemical Oxidation Works



- Current applied across anode-cathode pair
- Direct oxidation as electrons are transferred from PFAS via direct contact at the anode
- Additional advanced oxidation mediated by hydroxyl radicals generated in reactor
- Electron transfer sequentially defluorinates PFAS
- Sequence leads to complete mineralization, i.e., formation of carbon dioxide and fluoride ions in solution
- Proof of concept began at bench-scale

Reference: Liang, et al. "Electrochemical oxidation of PFOA and PFOS in concentrated waste streams." Remediation Journal 28.2 (2018): 127-134

DE-FLUORO™ Full-Service Solution

PREDICTION

- Bench-scale testing & analysis at Testing Facility
- Prompt data for decision making

CONFIRMATION

- Demonstration program - On or Offsite
- Informs design of a full-scale treatment program

Application for this project

DESTRUCTION

- Customized system deployment to meet treatment objectives
- Turn-key destruction solution
- Lease, operation & maintenance plans available

CONFIRMATION
PREDICTION
DESTRUCTION
DE-FLU•RO™
PFAS DESTRUCTION TECHNOLOGY

Concentration Followed by Destruction

PFAS Impacted Groundwater (30,000-40,000 gpd)

Surface Active Foam Fractionation

Clean Water Discharged to Surface Water

PFAS Concentrate <0.5 gpd

EO Destruction

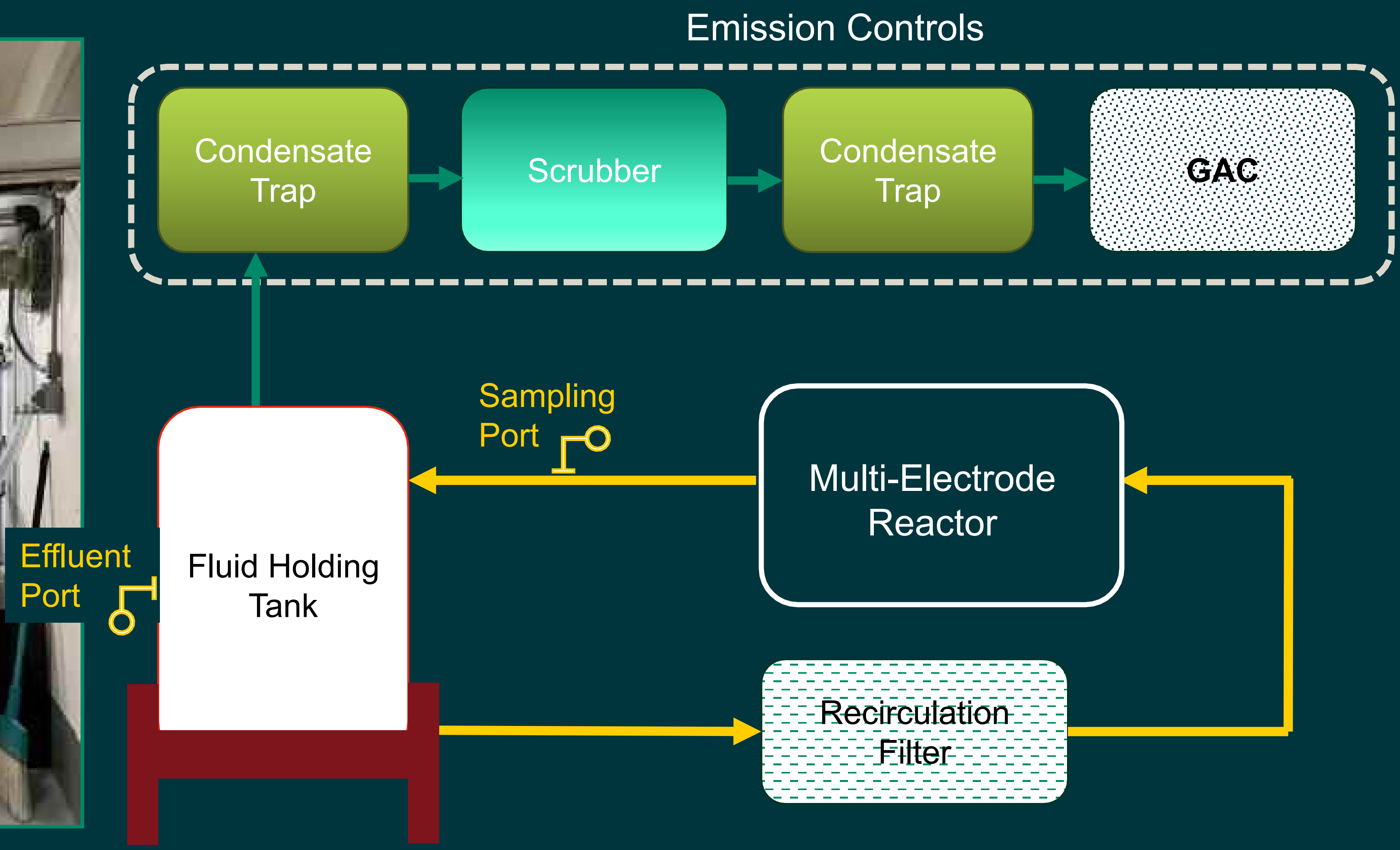
Recirculated Effluent

PFAS Concentrate from SAFF

	PFOA	PFOS	PFHxS	Total PFAS	TOF
	Nanograms per liter (ng/L)				
Influent Groundwater	281	939	34.1	2,254	2,100
SAFF Concentrate 1	100,000	474,000	6,420	595,929	580,000
SAFF Concentrate 2	110,000	436,000	6,390	562,164	490,000
Concentration Factor	~350-440	~450-500	~190	~250	~230-275

TOF: Total Organofluorine

DE-FLUORO™ Self-Contained System - Process Flow



GAC: Granular Activated Carbon

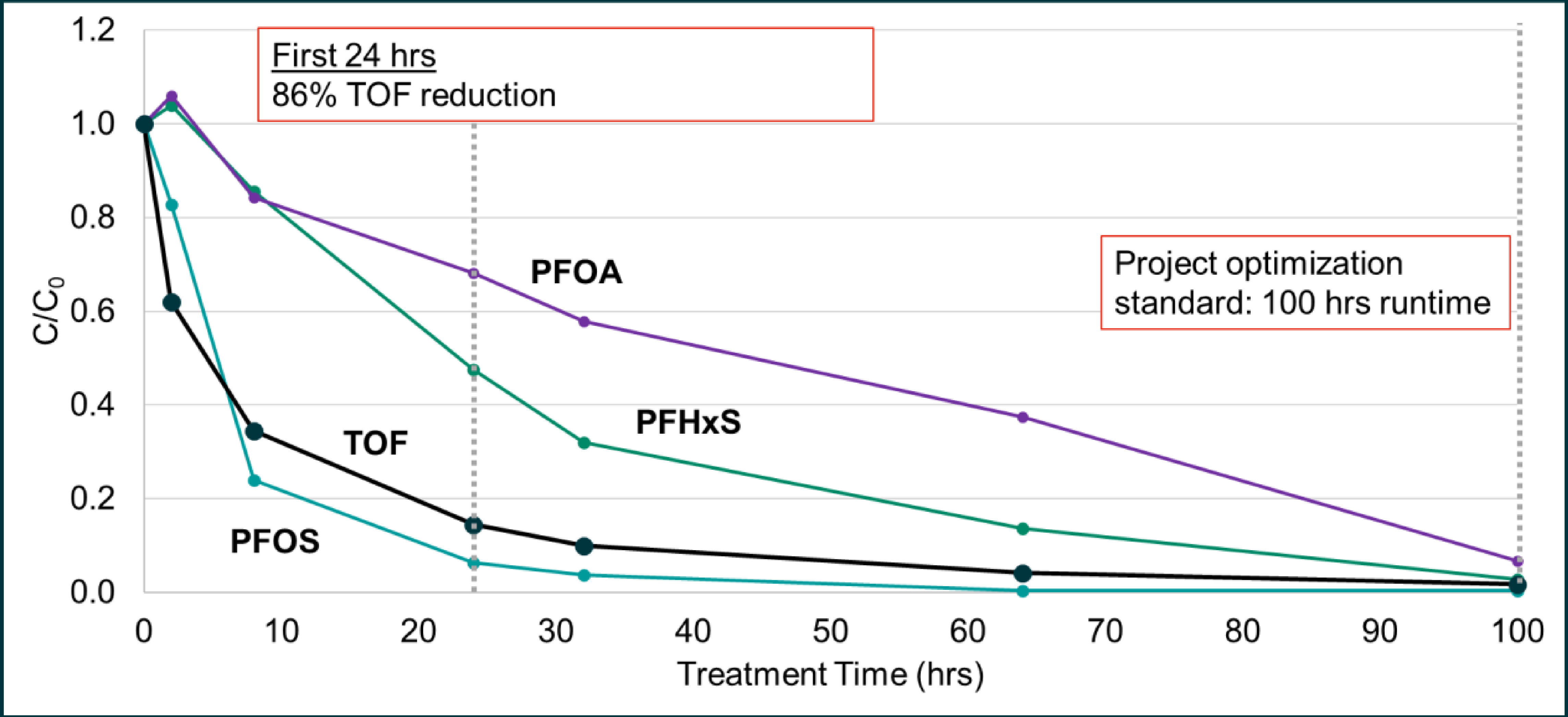
Demonstration Control Parameters

Field optimization of following parameters:

- Air flow rate across holding tank
- Electrode current
- pH and electrolyte additives--feed rates and locations
- Temperature

✓ Results inform full-scale implementation

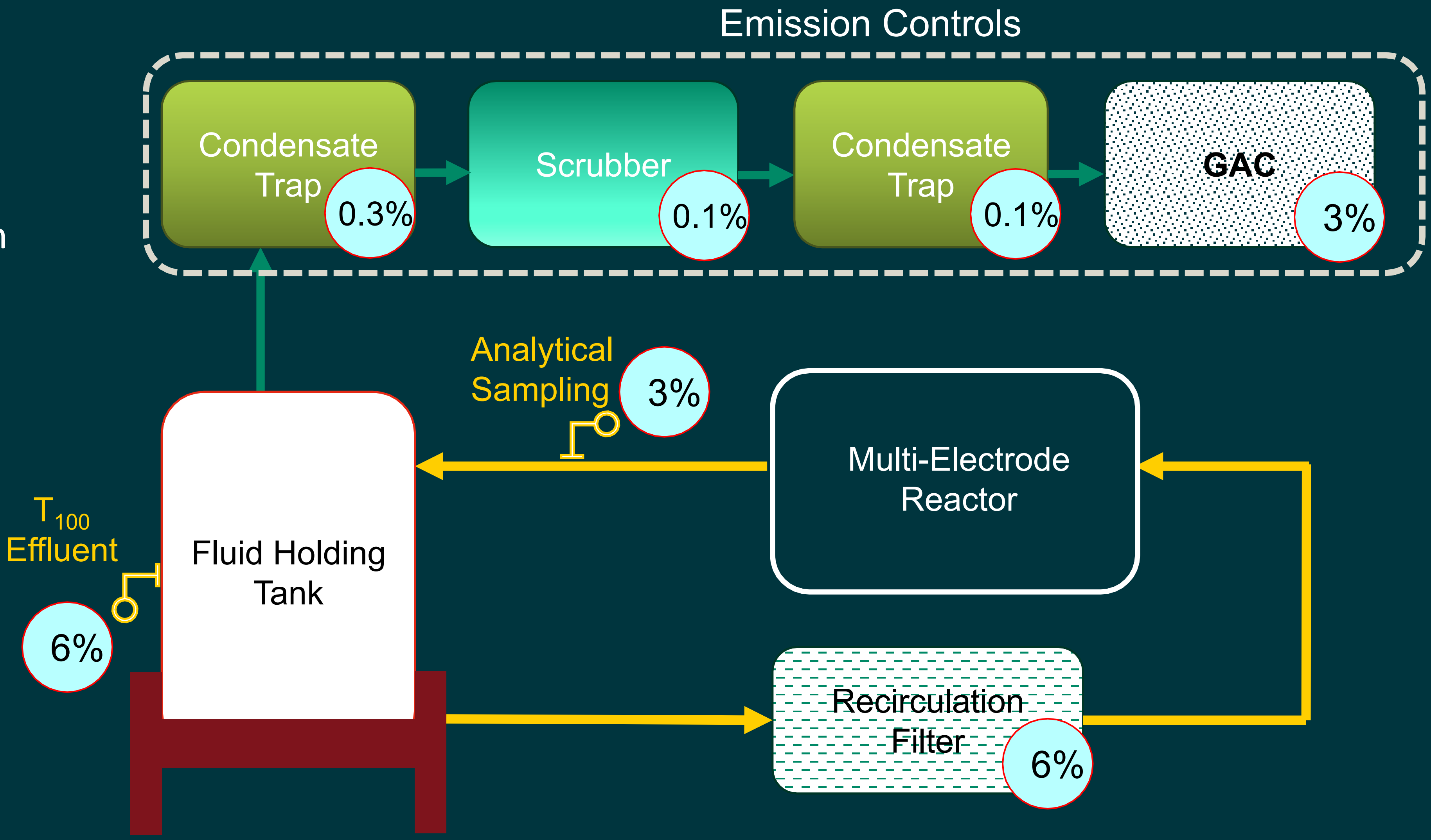
Process Optimization: PFAS Reduction



TOF Used to Evaluate Fate of PFAS

- Total Organofluorine by Method MLA-119
- Accounting for TOF demonstrates destruction effectiveness
- System elements are monitored

TOF	Percentage
Initial	**100%**
∑Components	13%
Effluent	6%
Balance	81%



Lessons Learned: Air Emission System

Aerosolization can be minimized through operational settings

Optimization

- Managed emissions of H_2 and HF
- Controlled aerosolization of PFAS

In air emission system GAC and scrubber:

- Experiment 1: 6% of initial total PFAS
- Experiment 2: 3% of initial total PFAS

Lessons Learned: Foam

Minimizing foam ensures PFAS are being destroyed and not transferred into foam

- If foam is not dissipated, effluent concentrations do not reflect destruction
- In practice we incorporated foam management and controls

Lessons Learned: Closed Loop Operation

Closed loop treatment train enables flexibility in PFAS treatment optimization

- Optimizes performance
- Controls by-products
- Reduces overall energy consumption by limiting destruction within optimal range
- PFAS waste does not leave the site (reducing liability)

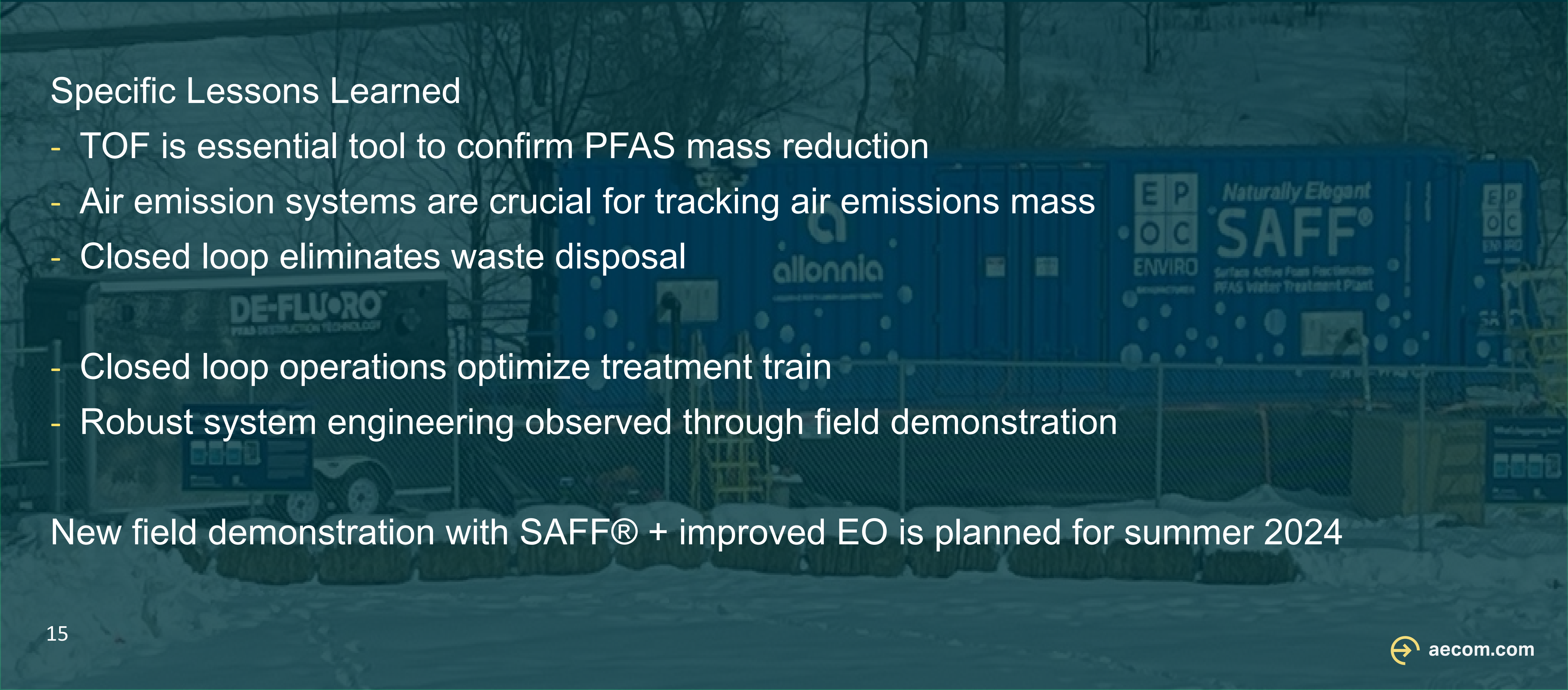
Lessons Learned: Operating Temperature Range

Technology safely functions under wide range of climatic conditions and maintains high destruction efficiency.

- Operated in ambient temperature ranging from -5°F to 90°F
- Improved weather-proofing and chiller performance
- Demonstrates EO's ability to cope with extreme conditions

Summary

✓ **Confirmed effectiveness of PFAS treatment using EO coupled with SAFF®**



Specific Lessons Learned

- TOF is essential tool to confirm PFAS mass reduction
- Air emission systems are crucial for tracking air emissions mass
- Closed loop eliminates waste disposal

- Closed loop operations optimize treatment train
- Robust system engineering observed through field demonstration

New field demonstration with SAFF® + improved EO is planned for summer 2024

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THANK YOU!

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