

Status & Updates on Non-destructive Technologies

Scott Grieco, PhD, PE
Global Principal & Technology Director

NYS COE – Healthy Waters

October 6, 2023

PFAS Impacts All Water Sectors

Drinking Water & Reuse

- » Primary By MCL Regulation Targeted before 2024 → Implemented for DW by 2027
- » Impacts to Advanced Water Treatment (*Technology*) and IPR / DPR (*Uses*) → Needs to meet MCLs

Wastewater

- » PFAS being added to NPDES permits (Monitor Only)
- » EPA directive memo issued Dec 2022 – Source identification and Pollutant Minimization Plans
- » Anticipating PFAS regulations under CWA

Treatment Residuals & Biosolids

- » Focus on assessment and reduction strategies
- » Some local guidance issued (MI, ME), but no Federal values
- » EPA is completing biosolids risk assessment targeted for 2024
- » Concern with RO reject discharges

What can remove PFAS?

- **Chemical coagulation/precipitation**
 - Gravity Separation
 - Dissolved Air Floatation
- **Biological aeration**
- **Filtration**
 - Sand/Multimedia filtration
 - Micro/Ultra filtration
 - **Reverse Osmosis (RO)/Nanofiltration (NF)**
- **Disinfection**
 - Ultraviolet
 - Chemical (chlorine, chloramine)
- **Adsorption**
 - GAC
 - **Ion Exchange**



PFAS Technologies – Non-destructive

Category	Transfer
Effective and Practiced	<ul style="list-style-type: none"> - GAC - Ion Exchange (single Use) - Reverse Osmosis (RO)
Maturing and Demonstrated	<ul style="list-style-type: none"> - Foam Fractionation - Fluoro-sorb (single use adsorbent)
Developing	<ul style="list-style-type: none"> - Regenerable Adsorbents - New adsorbents

- Scale-ability
- Range of Concentration
- Application (W vs WW)

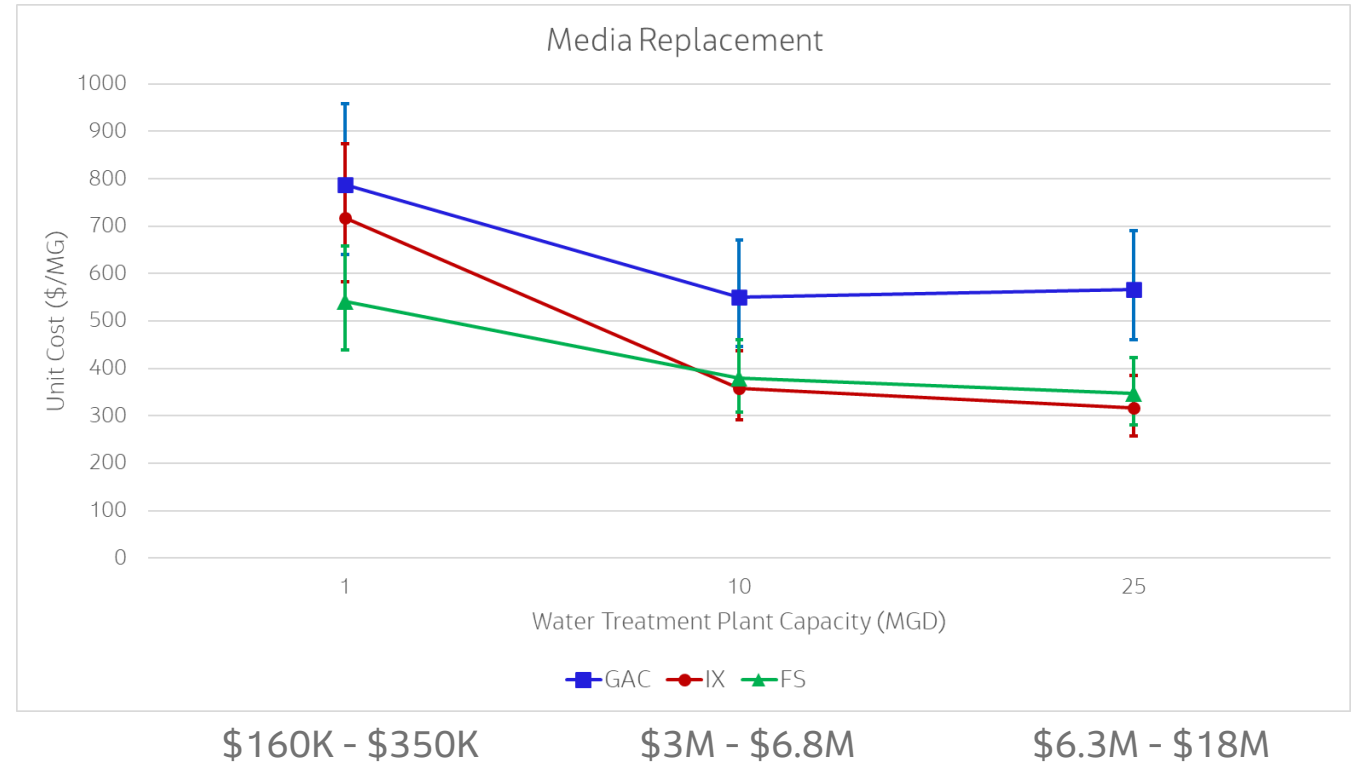
Potential Availability



Example Budgetary Drinking Water Costs (For Illustration Purposes)

Technology	Capital
GAC IX Fluoro-sorb	\$3 – 5 / gal
MF/RO	\$5 – 7 / gal

MGD	Adsorption	RO
1	\$3M – \$5M	\$5M – \$7M
10	\$30M – \$50M	\$50M – \$70M
25	\$75M – \$125M	\$125M – \$175M



Note:

Does not include site specific factors, inflation, media pricing sensitivity, other operating costs, etc.

Assumed GAC = \$2.50/lb ; IX = \$400 ft³ ; FS = \$5.50/lb

Managing Residuals with Transfer Technologies

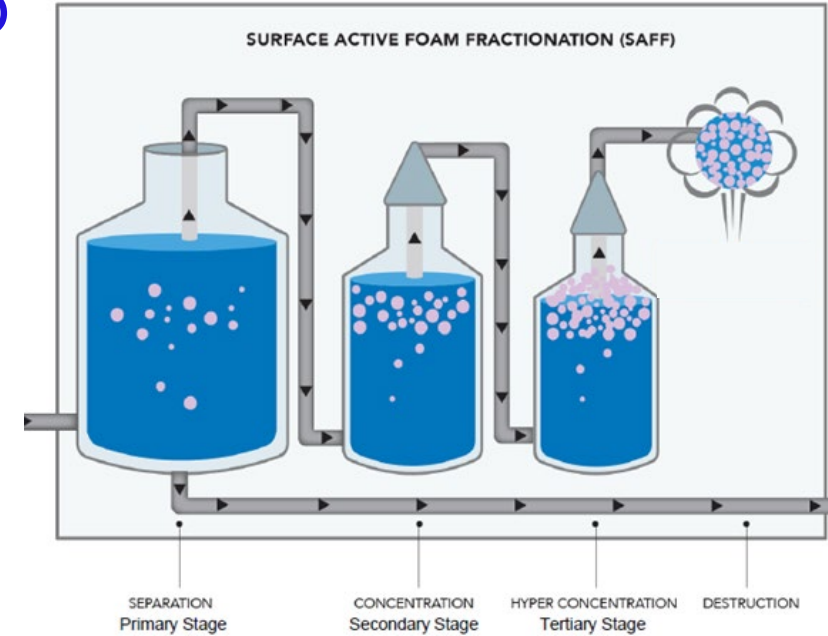
“Transfer” technologies

- Liquid → solid (GAC, Ion Exchange)
- Liquid → liquid (RO reject)

GAC	IX	RO
Multiple use	Single use	Continuous
Reactivate (Off-site)	Disposed (Off-site)	Discharged (May require treatment)

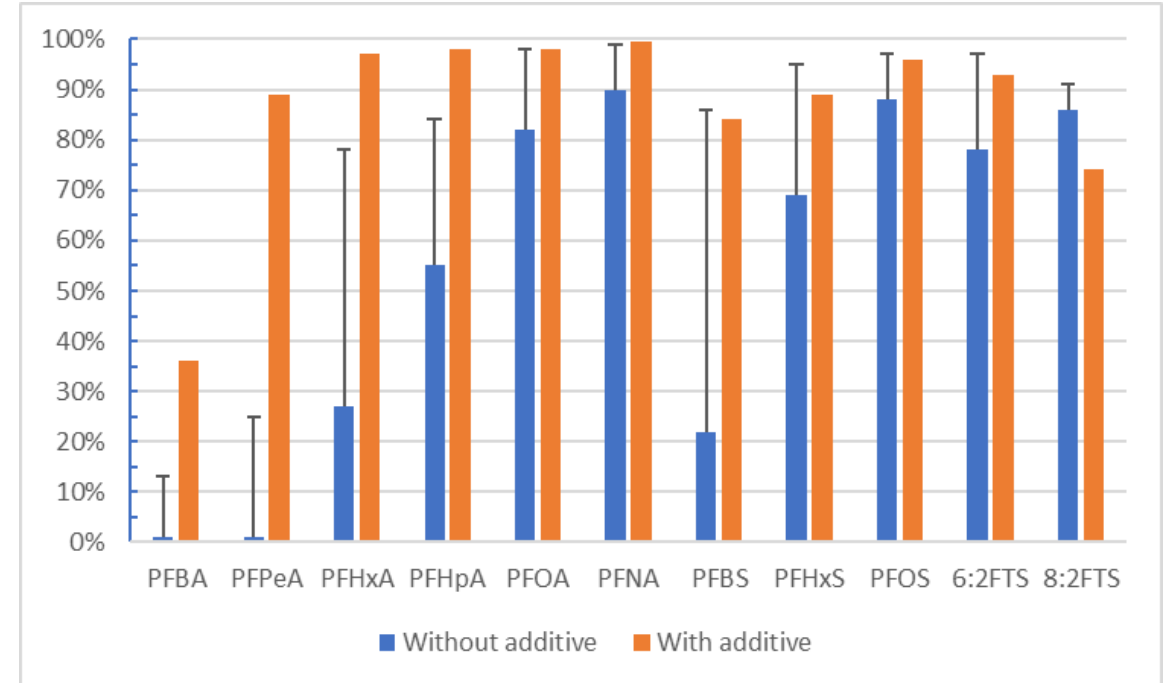
Surface Active Foam Fractionation - SAFF®

- Strips PFAS using air only
- Concentrates PFAS using vacuum
- Removes criteria PFAS down to trace levels
- Field-demonstrated for groundwater/leachate



SAFF[®] Performance

- The more conductive the water, the more effectively SAFF will strip surface active PFAS compounds from solution
- Performance is a function of chain length
- Can be enhanced with additive to reduce surface tension (may not be needed for concentrate)



CETCO Fluoro-Sorb[®] 200

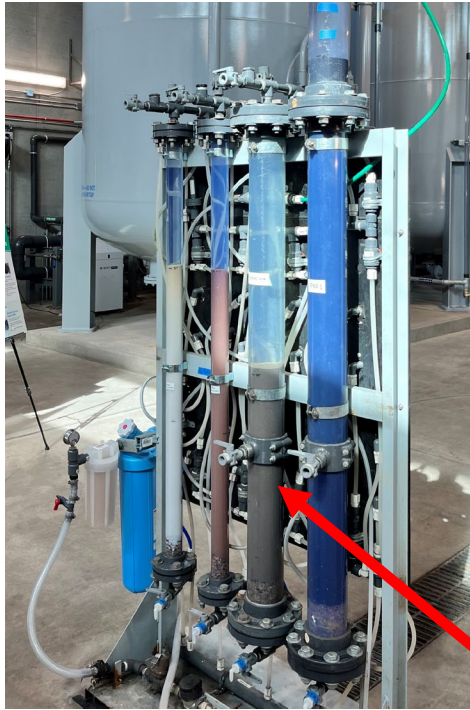
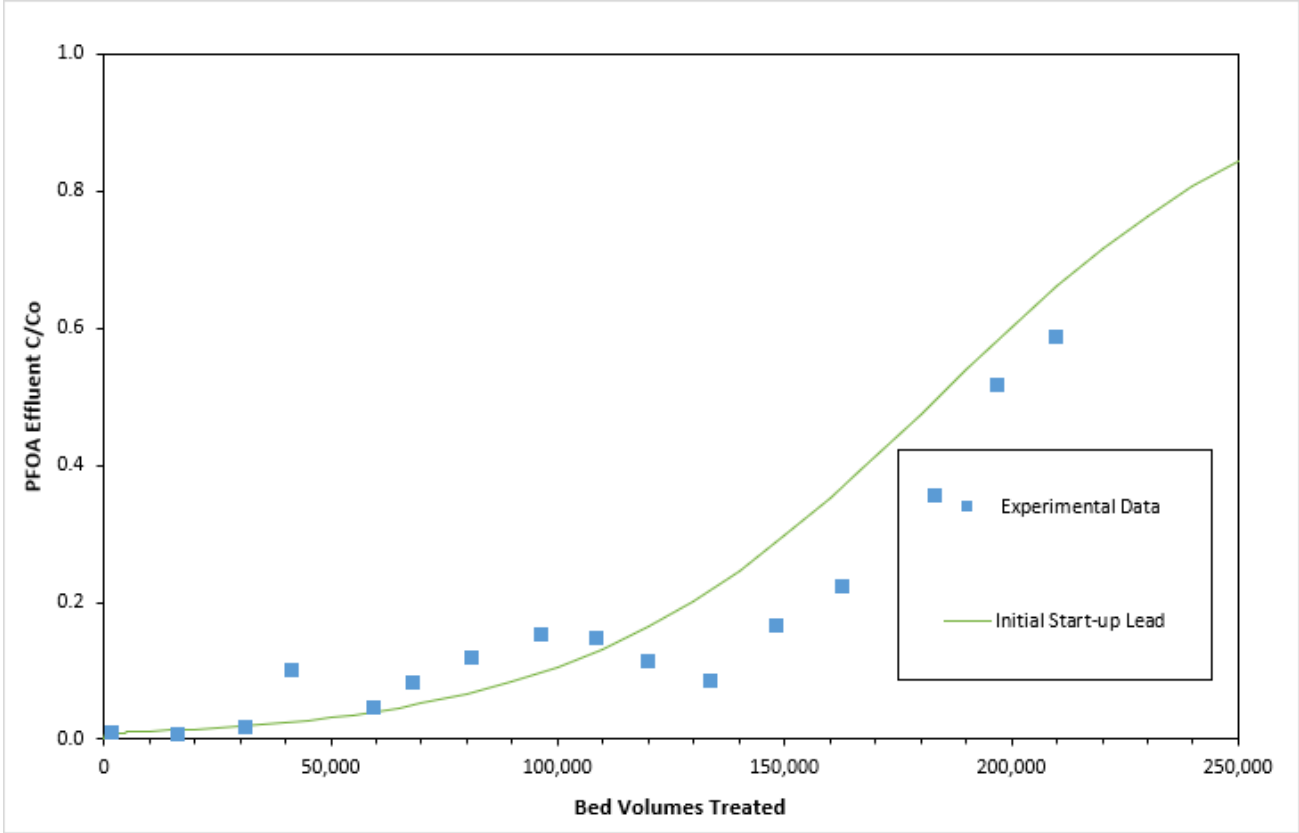
- Granular Material
 - Modified clay-based material
 - 20 x 40 mesh
- Rapid kinetics
 - Design 2 minutes EBCT
- Surface Loading Rate
 - 2 to 14 gpm/ft²
- More selective towards PFAS
 - Minimizes TOC interferences
- Manufactured in USA (ANSI/NSF 61)
- Single use



- New Jersey American Water
 - Beckett Station (Swedesboro, NJ)
- Daily demand 0.8 to 1 MGD
 - Design flowrate 800 gpm
- Shut down in 2018 due to PFAS detections above State MCL



Fluoro-sorb: Pilot testing



Fluoro-sorb: Installed Project



DATA GAPS & RESEARCH NEEDS

Related to Technology

1. Development of predictive tools for adsorption
2. More options
3. Application at Scale

Not related to Technology

1. Improved analytical capabilities at environmental/regulation relevant concentrations
 - Total organic fluorine
 - Screening methods
2. Fate & Transport in Agriculture
 - Water – soil – food pathways
3. Suitable replacement chemicals

Discussion

Scott.Grieco@jacobs.com



Challenging today.
Reinventing tomorrow.

