

# SMART *Remediation*

*FLUORO-SORB® Adsorbent In-Situ Injection  
Applications for PFAS Sequestration*



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CETCO  
SMART Ottawa

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**CETCO**®

# **FLUORO-SORB® ADSORBENT**

**FOR IN SITU REMEDIATION**

**SMART – OTTAWA 02-08-24**



**FLUORO-SORB® 100**



**FLUORO-SORB® 200**



**FLUORO-SORB® 300**



**FLUORO-SORB® 400**

# AGENDA

- **Introduction to FLUORO-SORB<sup>®</sup> adsorbent**
- **Water Treatment McGill University**
- **Adsorption Mechanism**
- **University of TX at Austin – In-Situ**
- **Case Study - Full Scale In-Situ Stabilization-CN**
- **AST**

# WHAT IS FLUORO-SORB® ADSORBENT?

	FLUORO-SORB 100	FLUORO-SORB 200	FLUORO-SORB 300	FLUORO-SORB 400
<b>Specific Gravity</b> <i>Test Method: ASTM C604*</i>	1.735 g/cm <sup>3</sup>	1.759 g/cm <sup>3</sup>	n/a**	1.784 g/cm <sup>3</sup>
<b>Max. Index Density</b> <i>Test Method: ASTM D4253</i>	989.9 kg/m <sup>3</sup> (61.8 lb/ft <sup>3</sup> )	770.5 kg/m <sup>3</sup> (48.1 lb/ft <sup>3</sup> )	850.6 kg/m <sup>3</sup> (53.1 lb/ft <sup>3</sup> )	865.2 kg/m <sup>3</sup> (54.0 lb/ft <sup>3</sup> )
<b>Min. Index Density</b> <i>Test Method: ASTM 4254</i>	877.8 kg/m <sup>3</sup> (54.8 lb/ft <sup>3</sup> )	691.0 kg/m <sup>3</sup> (43.1 lb/ft <sup>3</sup> )	786.5 kg/m <sup>3</sup> (49.1 lb/ft <sup>3</sup> )	785.4 kg/m <sup>3</sup> (49.0 lb/ft <sup>3</sup> )
<b>Permeability</b> <i>Test Method: ASTM D2434</i>	2.2 x 10 <sup>-3</sup> cm/s	2.1 x 10 <sup>-2</sup> cm/s	4.8 x 10 <sup>-2</sup> cm/s	8.5 x 10 <sup>-2</sup> cm/s
<b>% Passing, No. 18 (1.0 mm) Sieve</b> <i>Test Method: ASTM C136</i>	100%	100%	72%	65%
<b>% Passing, No. 40 (0.42 mm) Sieve</b> <i>Test Method: ASTM C136</i>	46%	8%	3%	1%
<b>Applications</b>	ISS DAF Treatment	Pump & Treat PRB ISS	High organics Wastewater Treatment	Pump & Treat PRB

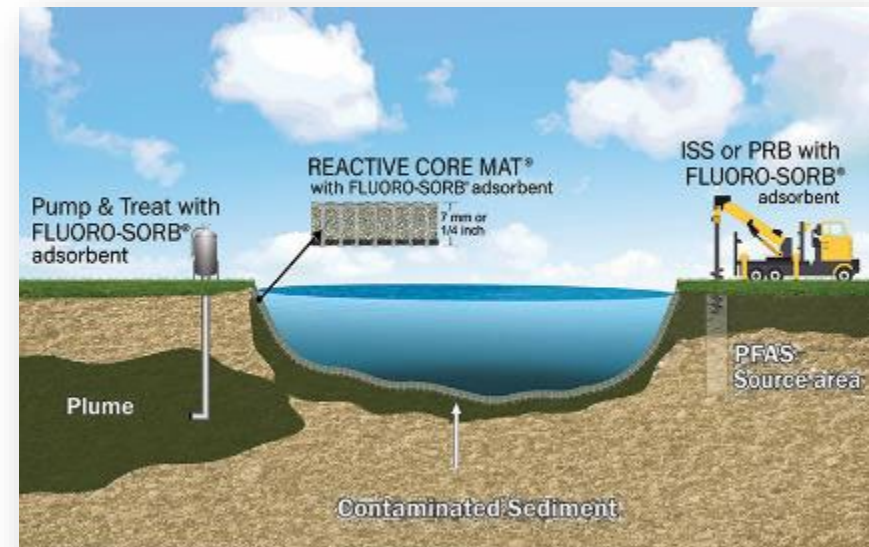


\*Ignition Temperature 110°C \*\* Product is 70/30 blend of anthracite/FLUORO-SORB 200

# FLUORO-SORB® ADSORBENT - BENEFITS

## Versatility in Deployment

- Groundwater/Drinking Water Filtration
  - Standalone
  - Pre- or post-treatment
- **Passive Groundwater**
  - PRB
- **Source Zone Treatment**
  - ISS
- Sediment Capping
  - REACTIVE CORE MAT® composite geotextile mat



## Outperforms Other Products

- Higher sorption kinetics
- Better sorption capacity
- Less effect from competitive adsorption
- Can be used in conjunction with other products

## Fully Commercialized

- Lab & field pilot tests completed
- May 2019 product launch

# GROUNDWATER TREATMENT

## Four Adsorbents

**FLUORO-SORB<sup>®</sup> 200**  
adsorbent



GAC



Hardwood Biochar



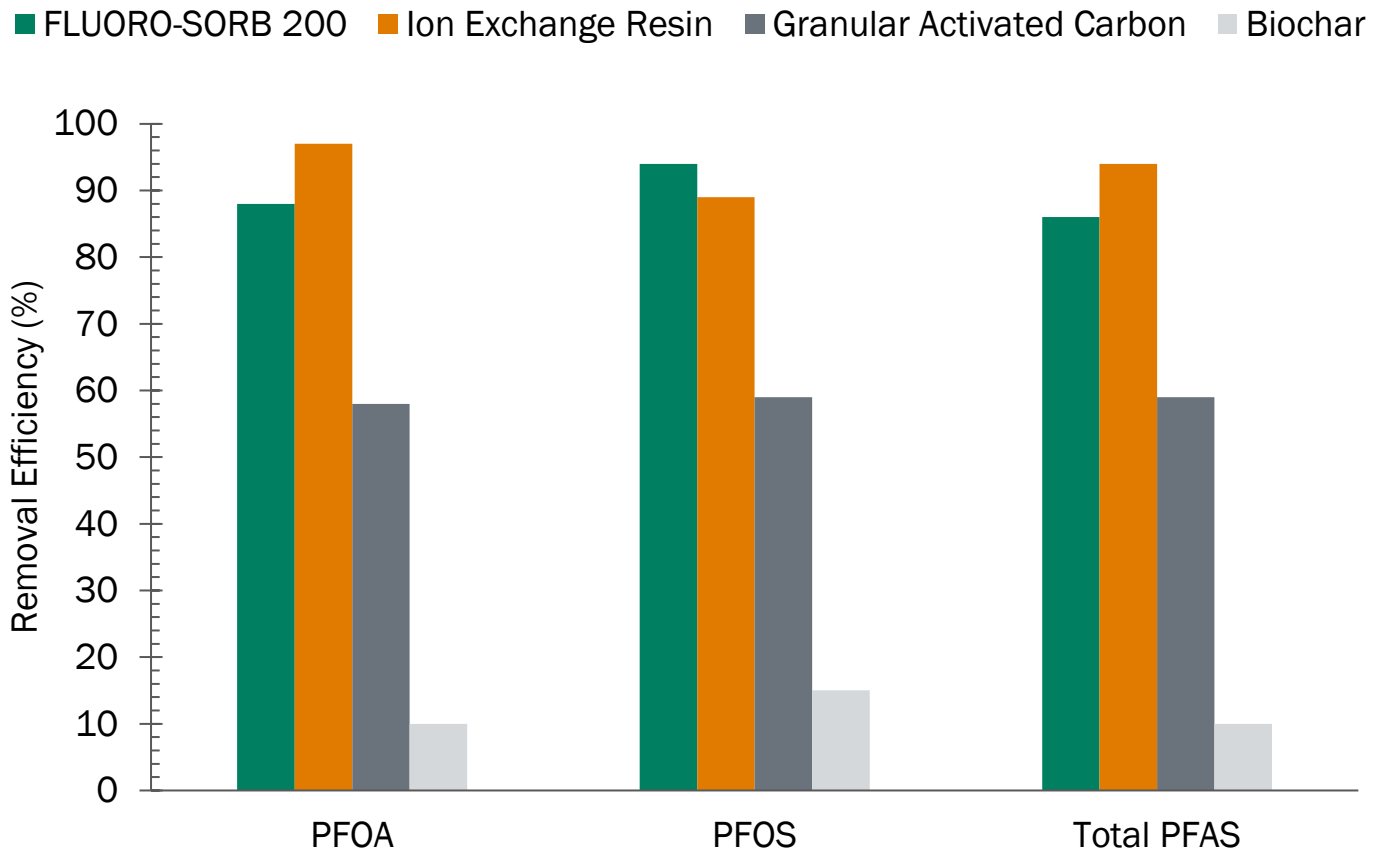
Ion Exchange Resin



# COMPARATIVE ASSESSMENT

- Total PFAS: IER > FLUORO-SORB® 200 > GAC > Biochar
- Long Chains: IER ≈ FLUORO-SORB® 200 > GAC > Biochar

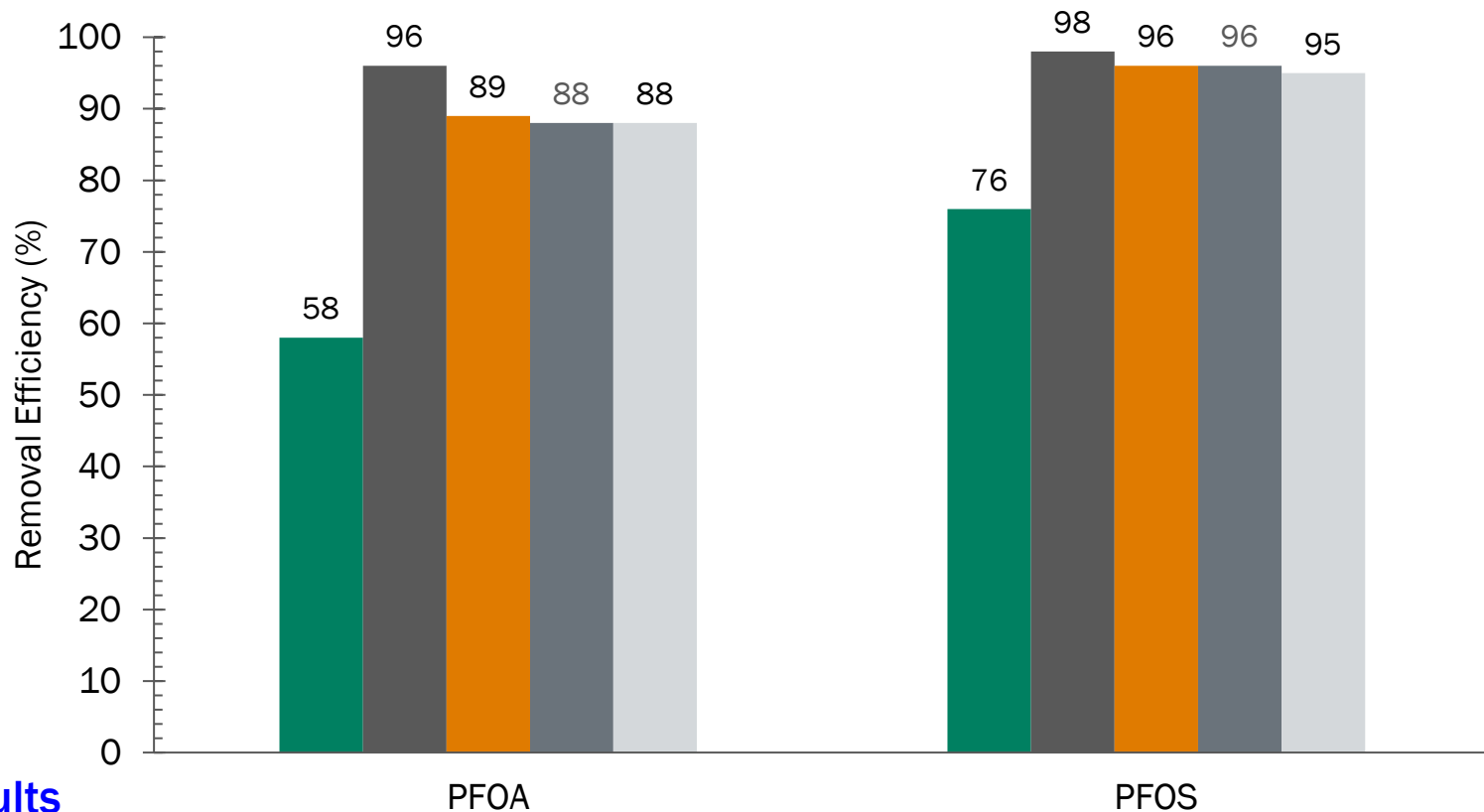
40 mg adsorbent + 500 mL AFB groundwater;  
7-day equilibrium



# IMPACT OF CO-CONTAMINANTS

- **FLUORO-SORB<sup>®</sup>** adsorbent can effectively treat mixed waste streams and is proven to not be negatively impacted by co-contaminants

■ NOM 100.0 mg/L ■ Diesel 100.0 mg/L ■ 1,4 Dioxane 1.0 mg/L ■ BTEX 1.0 mg/L ■ TCE 1.0 mg/L

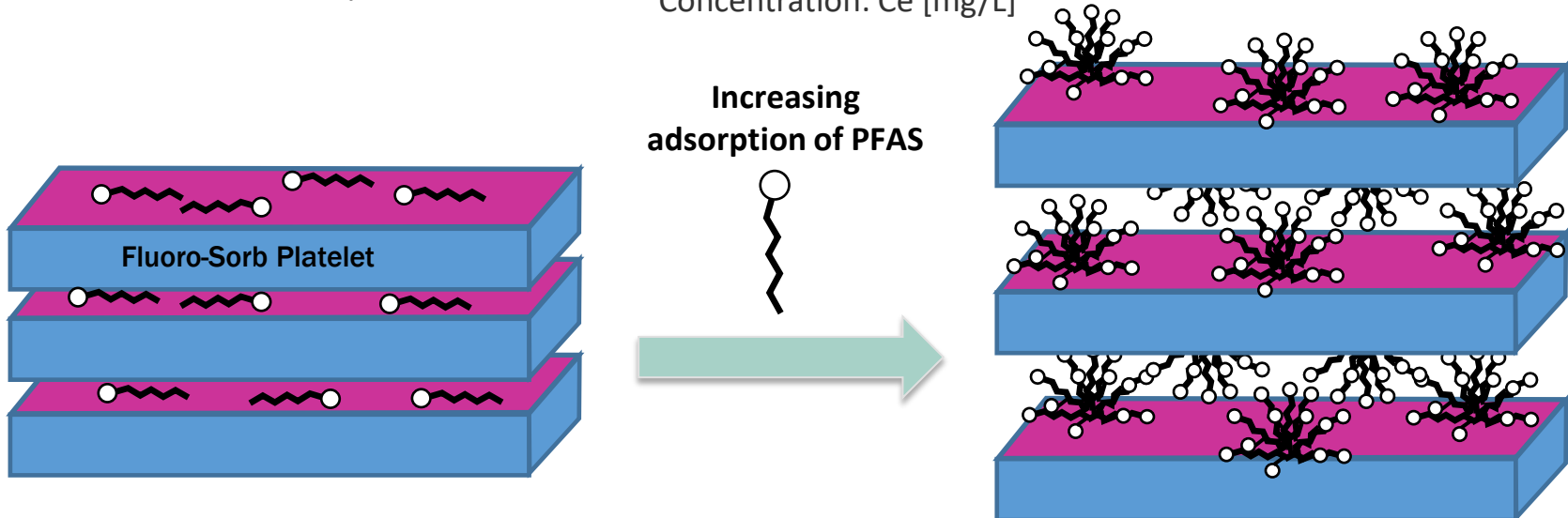
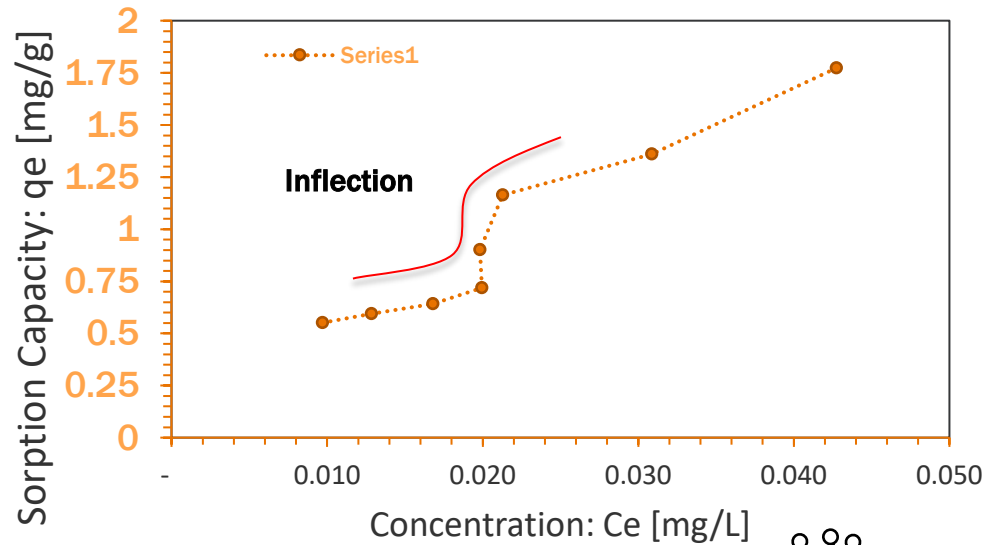




# GROUNDWATER TREATMENT – CONCLUSIONS

- **FLUORO-SORB<sup>®</sup> 200 adsorbent is highly effective in removing PFAS from real AFFF-impacted groundwater**
  - **FLUORO-SORB 200 is superior to GAC and biochar, and comparable to ion exchange resin for most of PFAS**
  - **FLUORO-SORB 200 is proven to be effective in mixed waste groundwater conditions**

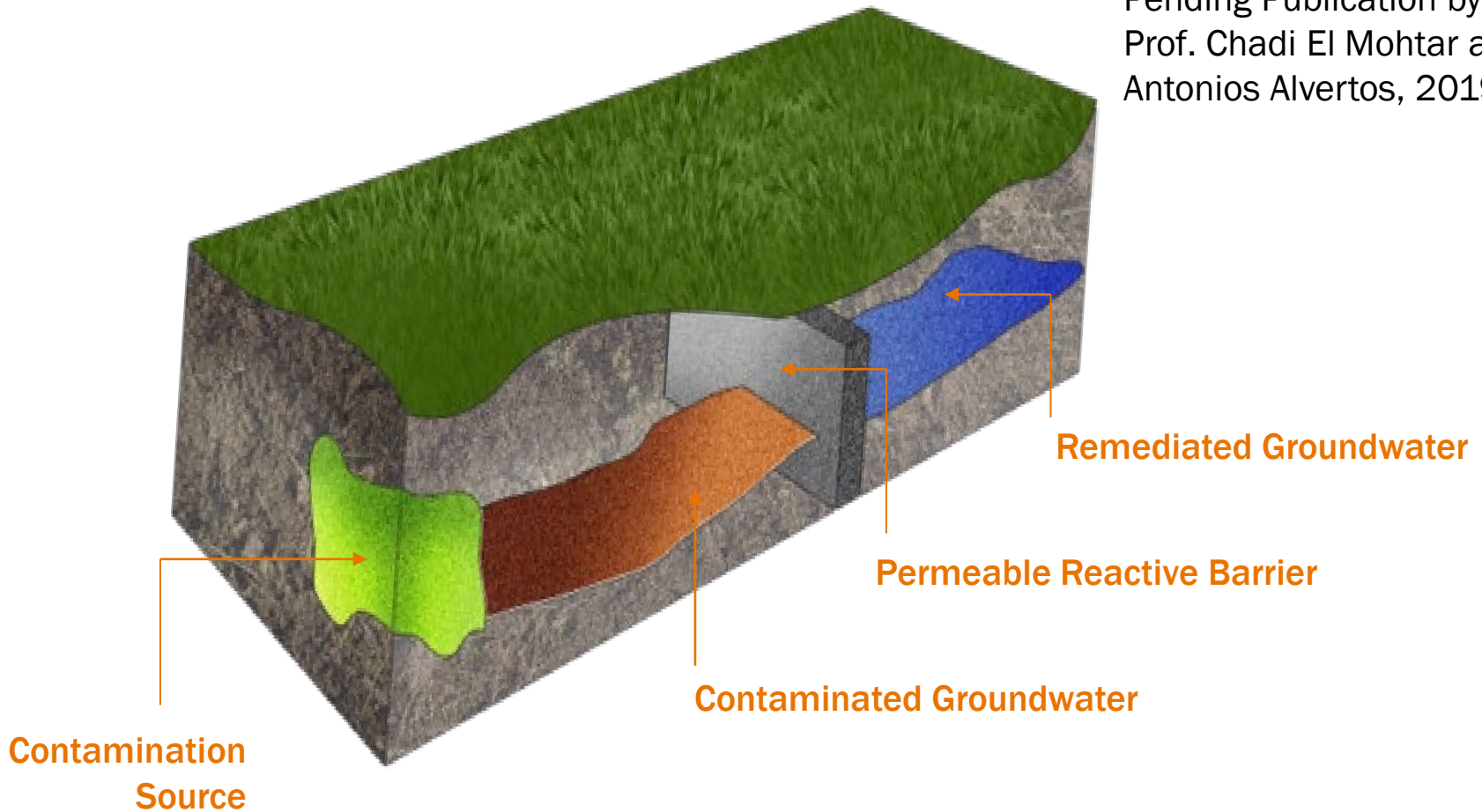
# PFAS SORPTION MECHANISM



# SOURCE ZONE TREATMENT & STABILIZATION

## ONGOING RESEARCH AT THE UNIVERSITY OF TEXAS

Pending Publication by  
Prof. Chadi El Mohtar and  
Antonios Alvertos, 2019



# PFAS SOLIDIFICATION/STABILIZATION

## BENCH AND FIELD PILOT TESTING

### Bench Testing

Leach Fluid: DI Water at pH = 7.9						
Sample	Control 1 Soil/GW	Control 2 Soil/GW Cement	AIOH/ Carbon Blend	AIOH/Carbon Blend w/ Cement	FLUORO- SORB	FLUORO- SORB with Cement
PFAS Sum (mg/L)	228	1.17	0.75	245	0.30	0.04

Adapted from *IN-SITU STABILIZATION OF PFAS IN GROUNDWATER*, Peter Storch, Proceedings of Cleanup 2017 Melbourne, Victoria

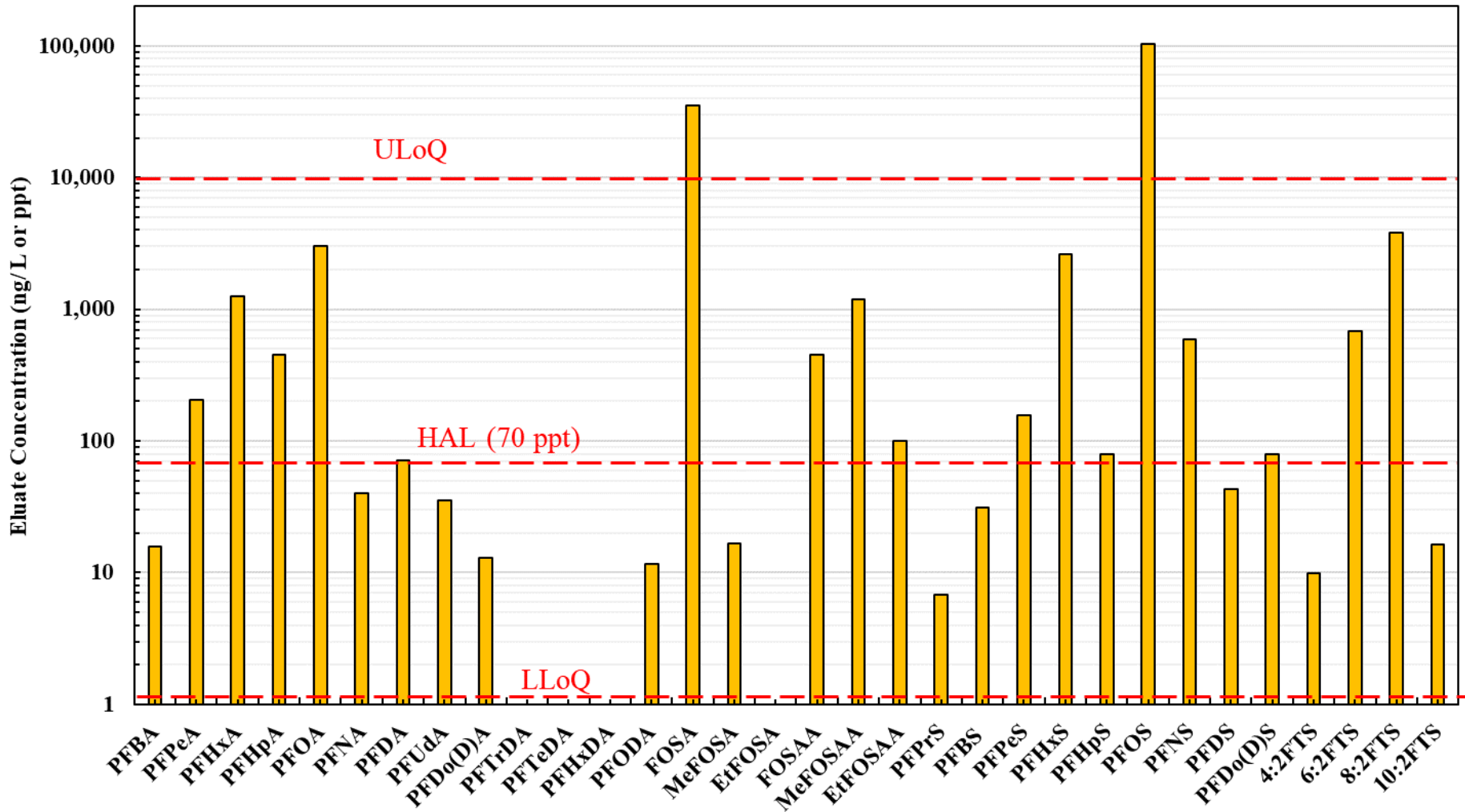


### Field Pilot Testing

- Repeated bench testing, FLUORO-SORB® adsorbent selected for field pilot
- 5% FLUORO-SORB® adsorbent, 10% Portland Cement
- Installed in 2018
- Annual SPLP testing to verify long-term performance

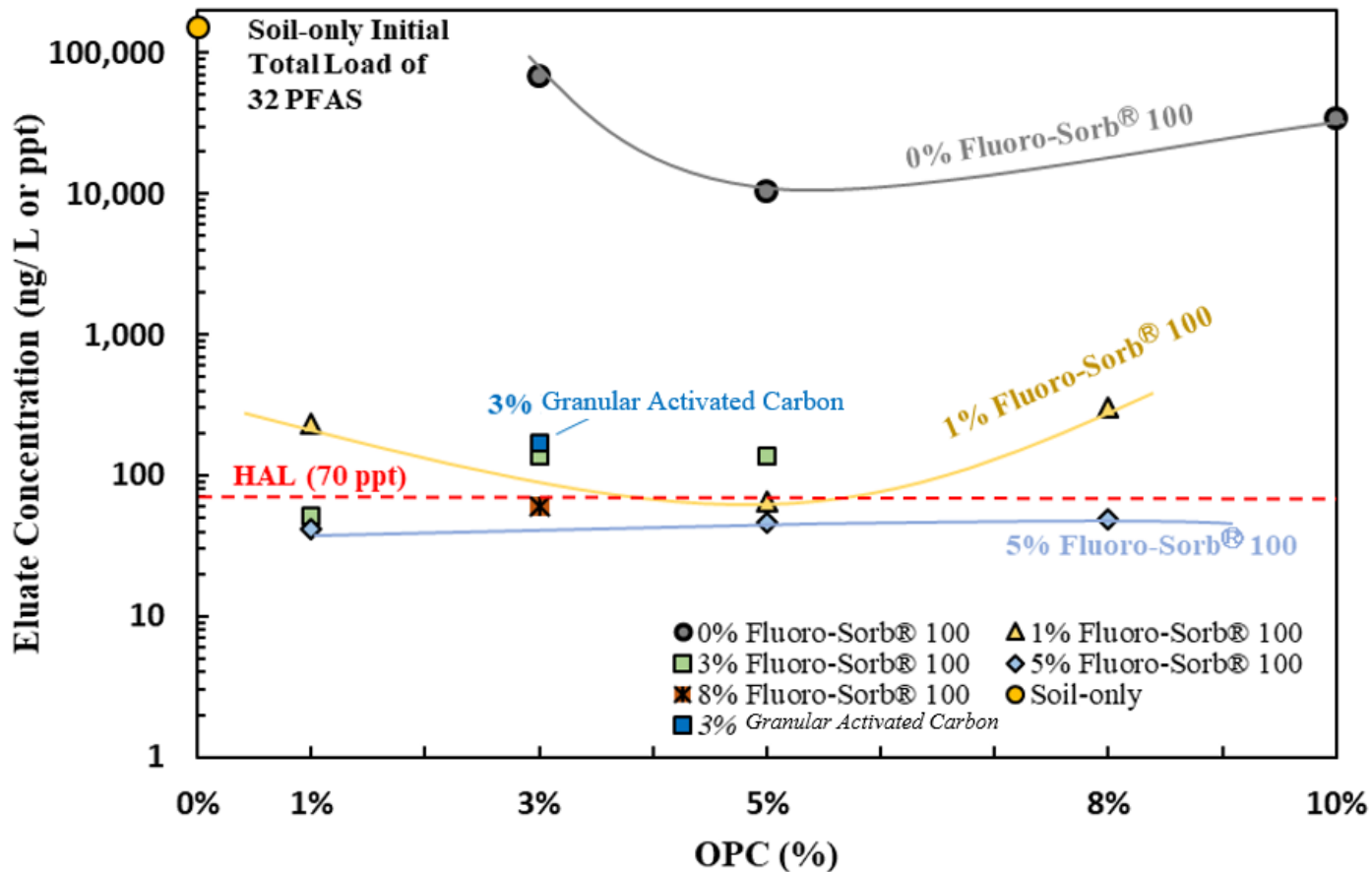


# CHARACTERIZATION OF IN-SITU SOIL



# US EPA LEAF METHOD 1313 & 1316

## IMPACT OF FLUORO-SORB® 100 ADSORBENT & ORDINARY PORTLAND CEMENT





# INJECTION OF FLUORO-SORB

- **CETCO has partnered with AST/VERTEX – For Insitu injection of Fluoro-Sorb for PRBs and Source Control**
- **Pilot Completed in 2022**
- **Several projects in the planning stage**



# SLURRY – TO GROUND





## In-Situ Remediation of PFAS: Thoughts on Modified Clay

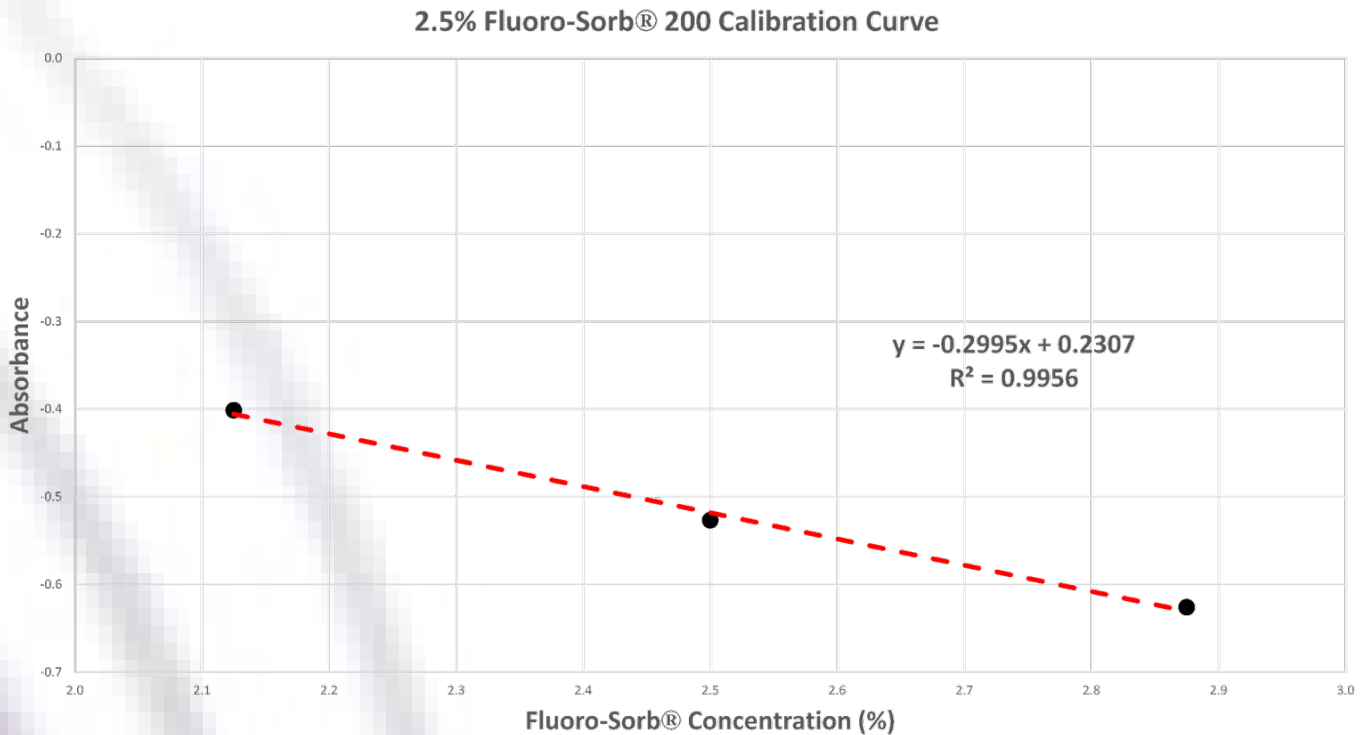
- Amenable to semi-quantitative QA/QC testing



**Colourmetric Dye Adsorption Testing for MC**

## In-Situ Remediation of PFAS: Thoughts on Modified Clay

- Amenable to semi-quantitative QA/QC testing



## Colourmetric Dye Adsorption Testing for MC



# COMMERCIALIZATION

- **FLUORO-SORB<sup>®</sup>** adsorbent is produced in our ISO9001:2015 certified production plant in the United States
- We encourage you to run trials on FLUORO-SORB – we provide:
  - Free samples
  - Testing program and data review input
  - Sampling and shipping instructions
  - Complete Isotherm testing program
  - Slipstream column testing unit
- All four FLUORO-SORB products meet NSF/ANSI 61 Certification



Certified to  
NSF/ANSI 61

The conditions for maintaining this certificate of registration are set forth in the SRI registration agreements R20.3 and R20.4. Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2015 requirements may be obtained by consulting the organization.

**Scope of ISO 9001:2015 registration:** “Manufacture and supply of purified clays, nanomomers, and clay products.”

**Initial SRI Registration date:** April 22, 2004

**Current registration period:** April 20, 2019 through April 19, 2022

**OUR STANDARDS. YOUR PEACE OF MIND.**



**CETCO®**

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