P-Fast & Furious!!!

Rapid Developments in Regulations Involving Per- and Polyfluoroalkyl Substances (PFAS) and a Case Study on a Proven Adsorption Technology

AnneMarie Sanford – Member, Dickinson Wright PLLC

Frank Cassou – CEO, Cyclopure, Inc.

Austin Angeline, Environmental Consultant, Trinity Consultants

The following topics will be discussed as they relate to PFAS regulation:

- General Federal Updates
- Toxic Substances Control Act
- Toxics Release Inventory
- National Drinking Water Standards
- National Pollutant Discharge Elimination System Permitting
- Comprehensive Environmental Response, Compensation, and Liability Act
- Resource Conservation and Recovery Act
- Air Emissions Reporting and Permitting

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General Federal Updates

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National Defense Authorization Act (NDAA)

- Authorizes national defense funding levels
- Typical mechanism for PFAS legislation
  - For example, adds new PFAS to list of TRI chemicals
- 2024 amendments of note
  - Substantial funding for PFAS remediation activities
  - Modifies timing and reporting on activities of the PFAS Task Force
  - Increases duration for technology development prizes through 2026
  - Requires submittal of a report assessing state of testing/remediation by Department of Defense (DOD) of military installations contaminated with PFAS

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EPA Significant New Use Rules (SNURs)

- 2020
  - Rules on use of long-chain PFAS that have been phased out in U.S.
  - No import of PFAS for use as surface coatings
- 2022/2023
  - Fluorination processes used in plastics manufacturing
  - Informed facilities of risks from this process
- 2024
  - Issued order to facilities directing the phase-out of plastics fluorination
  - Latest SNUR prohibits manufacture/import of 329 “inactive” PFAS

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Toxic Substances Control Act (TSCA)

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PFAS TSCA One-Time Reporting Rule

- Proposed reporting/recordkeeping requirements for PFAS [TSCA Section 8(a)(7)]
- Rule finalized September 2023 (40 CFR Part 705)
- Applies to manufacturers/importers of PFAS since January 2011
- **NO *DE MINIMIS* EXEMPTIONS or low activity threshold for small manufacturers**
- Report within 18 months of effective date of rule (November 13, 2023)
  - Within 24 months if small manufacturer (and only article imports)
- Expected to provide data on more than 1,400 PFAS

Per- and polyfluoroalkyl substances or *PFAS* means, for the purpose of this part, any chemical substance or mixture containing a chemical substance that structurally contains at least one of the following three sub-structures:

(1) R-(CF_2)-CF(R')R'', where both the CF_2 and CF moieties are saturated carbons

(2) R-CF_2OCF_2-R', where R and R' can either be F, O, or saturated carbons

(3) $CF_3C(CF_3)$R'R'', where R' and R'''' can either be F or saturated carbons.

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Information to Report

- Company and plant site information
- Chemical-specific information
- Categories of use
- Manufactured amounts each year since January 1, 2011
  - Individual amounts for each PFAS compound
- Byproduct reporting
- Environmental and health effects
- Worker exposure data
- Disposal data

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Additional PFAS One-Time Reporting Information

- Article importer and R&D substance reporting
- Exemptions from reporting
  - Import of municipal solid waste streams intended for disposal or destruction
  - Federal agencies which import PFAS not for commercial advantage
- Duplicative reporting
  - No need to submit for years PFAS data already reported
    - Chemical Data Reporting (CDR) rule
    - Greenhouse Gas (GHG) Reporting rule
    - Toxics Release Inventory (TRI)
- Differences to existing CDR requirements
  - New rule covers chemicals not added to TSCA inventory
  - No reporting thresholds
  - No exemptions for small manufacturers and small governments

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Toxics Release Inventory (TRI)

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Current PFAS Subject to TRI Program

- Reporting Year 2023
  - Nine additional PFAS reportable for RY23 (189 total)
  - *De minimis* exemption still applies
  - Reporting threshold is 100 lbs
- Reporting Year 2024 (final as of October 10, 2023)
  - Seven additional PFAS will be reportable (196 total)
  - *De minimis* exemption will be removed
  - Range reporting option will be removed

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Designation as Chemicals of Special Concern

- **NO *DE MINIMIS* EXEMPTIONS**
  - Previously, a *de minimis* exemption of 1% by weight (0.1% by weight for PFOA)
  - *De minimis* exemptions for supplier notifications under SARA 313 also removed
- Now classified as Chemicals of Special Concern
  - Other examples: lead and mercury
  - Form A cannot be used, must report on Form R
- Effective for reporting year 2024 (reports due 7/1/2025)
- Updated supplier notification beginning with first chemical shipment in 2024
  - See Question 876 of GuideME questions and answers
  - Potential trickle-down effect
- No changes to article exemption

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PFAS on SDS

- Specific chemicals

Components

Chemical name	CAS-No.	Concentration (% w/w)
N-[3-(Dimethyloxidoamino)propyl]-3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluoro-1-octanesulfonamide	80475-32-7	>= 30 - < 50
Ethanol	64-17-5	>= 30 - < 50

Actual concentration is withheld as a trade secret

- Generic definition

Chemical Name	Weight %*	CAS #
Water	> 56	7732-18-5
Hexylene Glycol	< 19	107-41-5
Proprietary mixture of fluorosurfactants and hydrocarbon surfactants	< 5	N/A

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National Drinking Water Standards

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Unregulated Contaminants Monitoring Rule (UCMR)

- UCMR3 – initial mechanism for establishing PFAS drinking water standards
- UCMR5
  - Monitoring to occur between 2023-2025
    - Public water systems serving > 3,300 customers
    - 800 randomly selected systems serving < 3,300 customers
  - 29 total PFAS to be tested
    - EPA publishes data quarterly (UCMR5 Data Finder)
    - Approx. 24% of total expected results
- More than initial 29 PFAS can be monitored, but legislation is lagging behind technology

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Drinking Water Contaminants Candidate List (CCL)

- EPA publishes CCL every five years under Safe Drinking Water Act
- Used to determine which chemicals to monitor under UCMR
  - After UCMR monitoring, National Drinking Water Standard may be proposed
- EPA published CCL5 at the end of 2022
  - Process starts with around 23,500 potential contaminants
  - List was distilled down to around 300 contaminants in Preliminary CCL5
  - Final detailed evaluation resulted in adding 66 chemicals, 3 chemical groups, and 12 microbes
  - Lists PFAS as a class of chemical with specific structural definition
  - Next time candidates are selected for next UCMR, EPA can select the PFAS class

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Proposed Drinking Water Standards

- Final rule for PFAS Primary Drinking Water Standards expected Spring 2024
- Maximum Contaminant Levels (MCLs)
  - 4 parts per trillion (ppt) standard for PFOA and PFOS
  - Proposes Hazard Index approach for mixtures of four other PFAS compounds

$$HI = \sum_{i=1}^{n} HQ_i = \sum_{i=1}^{n} \frac{E_i}{RfV_i}$$

HI = Hazard Index

HQ_i = Hazard Quotient for Chemical i

E_i = Exposure for chemical I

RfV_i = Reference value or corresponding Health-Based Water Concentration

- Public water system requirements
  - Monitor for these six PFAS
  - Notify public of PFAS levels
  - Reduce levels of PFAS in drinking water if exceeding standards

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National Pollutant Discharge Elimination System (NPDES) Permitting Program

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Effluent Limitations Guidelines (ELGs)

- National standards for wastewater discharges implemented via discharge permits
  - Concentration limits
  - Periodic pollutant monitoring
  - Control technologies and best management practices
    - Product elimination or substitution when reasonable alternative is available
    - Accidental discharge minimization
    - Equipment decontamination or replacement where there is legacy PFAS contamination
- Effluent Guidelines Program Plan 15 (published January 31, 2023)
  - EPA will not pursue further action for various industrial categories
  - EPA will continue to monitor PFAS use/discharges from other industrial categories

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Summary of Plan 15 Actions

Industrial Category	Plan 15 Action
Landfills	Plan 15 announces that after collecting and analyzing data on PFAS found in landfill leachate, EPA has determined that revisions to the ELGs for the Landfills Category are warranted. The Landfill ELG should include pretreatment standards. EPA studies have indicated the potential effectiveness of granular activated carbon, ion exchange, and reverse osmosis.
Textile Mills	EPA intends to expand the detailed study of the Textile Mills Category to gather information on the use and treatment of PFAS-associated discharges. For this expanded study, EPA intends to use a mandatory questionnaire issued to a nationally representative sample of textile mills.
Publicly Owned Treatment Works (POTWs)	EPA intends to initiate a POTW Influent Study of PFAS, which will focus on collecting nationwide data on industrial discharges of PFAS to POTWs, including categories recently reviewed. EPA intends to undertake this study to verify sources of PFAS wastewater and help POTWs assess the need for control measures at the source.
Electrical and Electronic Components (E&EC)	EPA is not pursuing further action for the E&EC Category at this time but will continue monitoring this category for PFAS discharge data through the POTW Influent Study.
Pulp, Paper, and Paperboard Category and Airports	EPA will continue to monitor PFAS use and discharges from these source categories.

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State NPDES Adoption

- EPA guidance
  - Issued to address state-specific NPDES programs
  - Provides recommendations on how to address PFAS in NPDES permits
  - Quarterly monitoring for 40 PFAS compounds
  - Recommended monitoring methods
    - Method 1633 (finalized late January 2024)
    - Testing for adsorbable organic fluorine (AOF) as proxy for total PFAS
- No widespread adoption by states yet
  - General reluctance due to lack of resources
  - Some movement seen in MA, CO, NY, SC

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Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

&

Resource Conservation and Recovery Act (RCRA)

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PFAS as CERCLA Hazardous Substance

- September 6, 2022
  - Proposed rule designating PFOA and PFOS as hazardous
  - Increase transparency around releases of PFOA and PFOS
  - Immediately report releases exceeding the reportable quantity (1 lb in 24-hr period)
  - No requirement to report past releases
  - Expected to recommend non-enforcement against passive receivers
  - Final rule publication estimated for Spring 2024
- Phase I Environmental Site Assessments (ESA)
  - PFAS inquiries/analyses would be required (ASTM International's E1527-21)
- Further considering other PFAS, PFAS precursors, and PFAS as a class.

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PFAS as a RCRA Hazardous Substance

- EPA must undertake a two-step process
  - List PFAS as Hazardous Constituent in 40 CFR 261 App. VIII
  - Publish findings regarding health/environmental harm due to improper disposal/treatment/storage/etc.
- February 2024 – nine PFAS proposed for addition as Hazardous Constituents
  - Subject to corrective action requirements (e.g., investigation and clean-up)
- Second proposed rule clarifying that PFAS can be cleaned up via RCRA corrective action process
- Designation as hazardous under RCRA automatically qualifies as hazardous under CERCLA

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Air Emissions Reporting and Permitting

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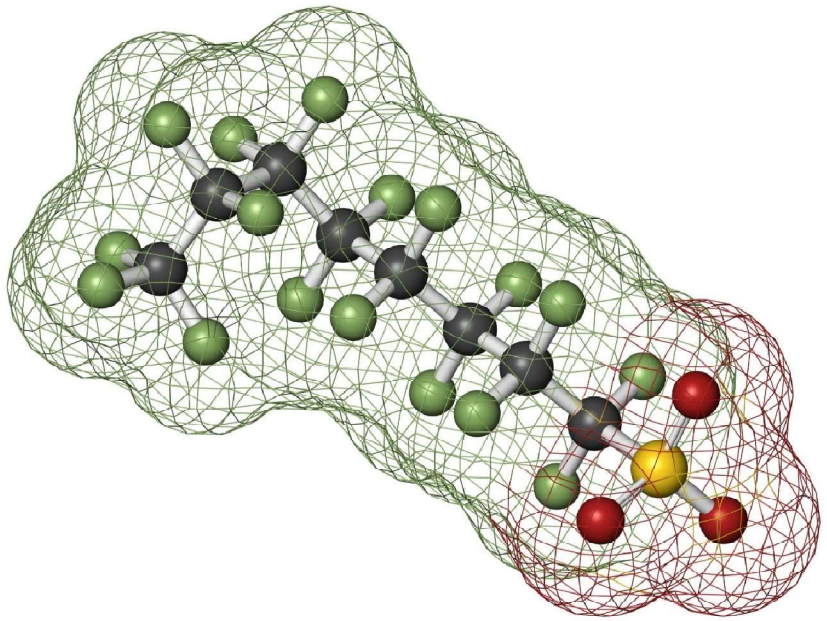
Clean Air Act Implications

- No PFAS have been designated as hazardous air pollutants (HAP)
  - EPA has suggested adding PFOA and PFOS as HAP
  - Designation as HAP under Clean Air Act rolls those pollutants into CERCLA
- Some PFAS considered under state-wide air toxics programs
  - MI, MN, NH, NJ, NY, TX
  - Emissions primarily semi-volatile PFAS and aerosol-bound PFAS
- July 25, 2023
  - Proposed rule to update Air Emissions Reporting Requirements (AERR)
  - Allow EPA to annually collect HAP emissions data for point sources
  - EPA considering mechanisms to roll PFAS into this final ruling by adding to 40 CFR 51 Subpart A Tables

DICKINSON WRIGHT

P-FAST AND FURIOUS IN THE REAL WORLD



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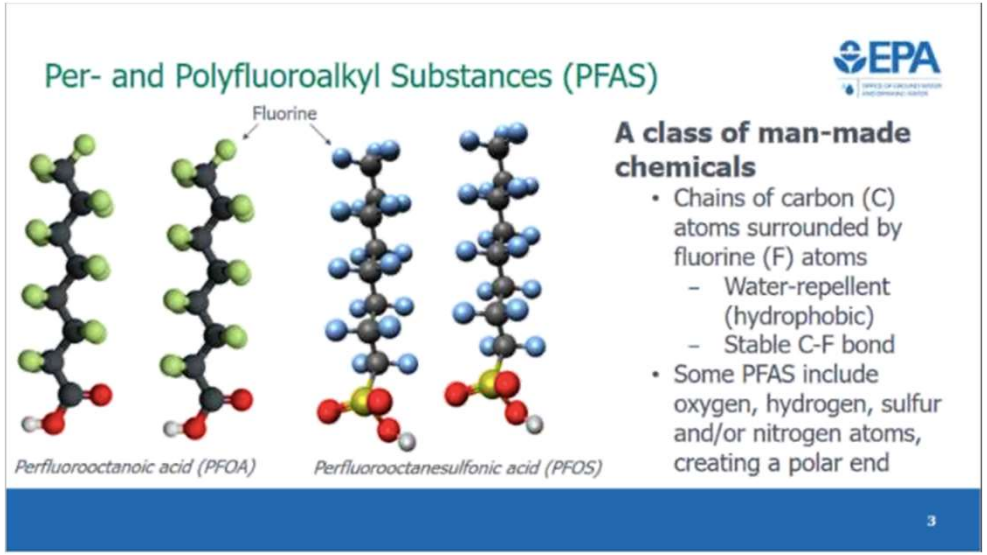
INTRODUCTION

- Real World Challenges Associated with Implementing PFAS Regulations
- Lessons Learned from Michigan
- Case Studies
- Final Thoughts

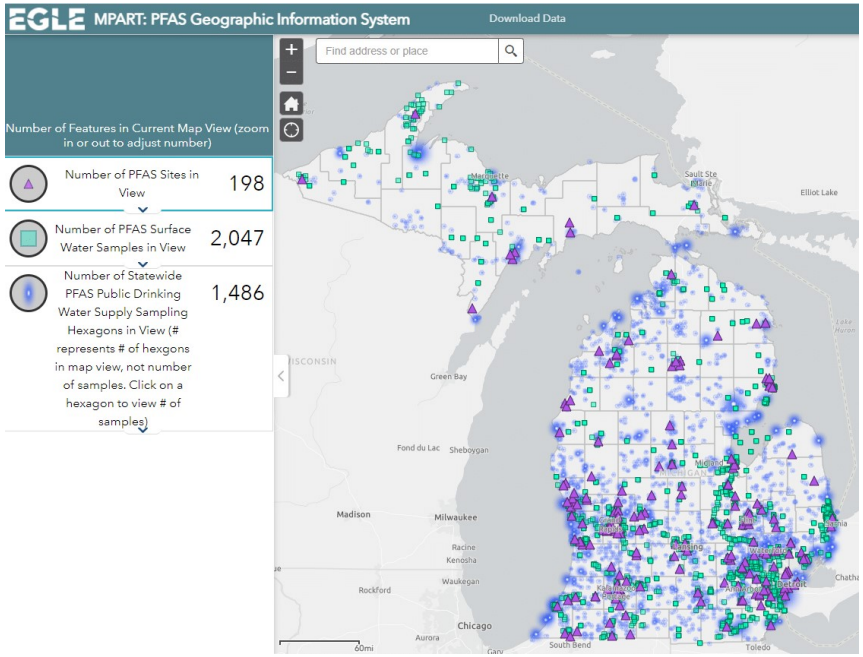
CHALLENGES

- How will new requirements be implemented?
- Technical challenges to achieving compliance
- Cost
- Timeline
- Is compliance feasible?



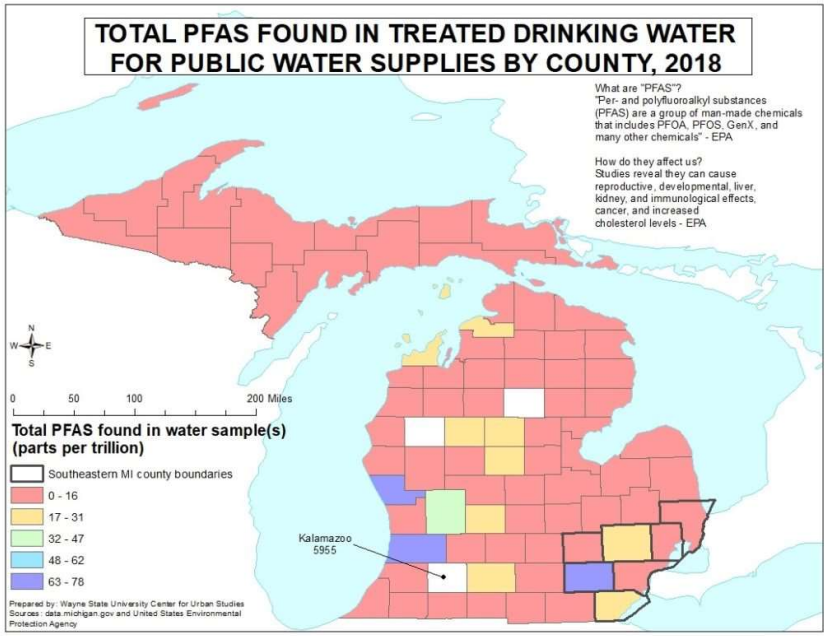
LESSONS LEARNED FROM MICHIGAN

- 2014 Surface Water Criteria
- Michigan's PFAS Action Response Team ("MPART") was established in 2017
- January 9, 2018 Adopted MCLs and groundwater cleanup criteria for PFOA and PFOS
- August 2020, cleanup criterial for groundwater updated to include 7 PFAS



LESSONS LEARNED FROM MICHIGAN

- 2018 Industrial Pretreatment Program ("IPP") PFAS Initiative
- 2018 Statewide testing of Michigan's public water supplies
- Evaluation of industrial storm water discharges
- PFAS limits in NPDES permits



Case Studies

CHROME PLATER

PFAS-IMPACTED GROUNDWATER INFILTRATING SEWER SYSTEM

FINAL THOUGHTS

March 19, 2024

DEXSORB® Cyclodextrin Adsorbent for PFAS

Get to know DEXSORB and its use to Make Water Safe

- **Water Testing** – Test products for tap water, surface water, and groundwater
- **Home Drinking Water** – Filtration products for countertop and whole home
- **Environmental Waters** – Engineered systems for water treatments

Contact Us | contact@cyclopure.com | (312) 639- 5009 |
2430 N. Halsted St., 4th Floor, Chicago, IL 60614

Making Water Safe. For Everyone. Everywhere.

cyclopure

Cyclopure Develops Novel Adsorbents for Water Purification.

Founded 2016

Technology Center in Chicago IL

Leadership

Frank Cassou
CEO
(Tech Executive)

Dr. Irwin Jacobs
Lead Investor
(Founder QUALCOMM)

Dr. Gerhard Schmid
Vice Chairman
(CEO Emeritus, Wacker Chem)

Technology Overview

DEXSORB®

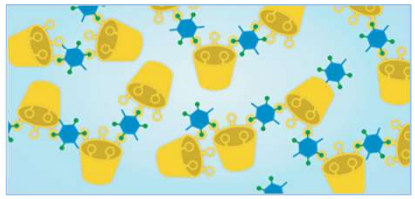
Adsorbent for PFAS.

DEXSORB® Powder

- High surface area
- 300x10^{18} cavities per gram
- Easy access to cavities
- High kinetics and capacity

DEXSORB® Granules

- Flow through hydraulics
- Not affected by competing organics and ions
- Preserve kinetics and capacity



Renewable beta-cyclodextrins designed for hydrophobic interaction with PFAS

Equal Performance in Diverse Waters

Surface Water

Drinking Water

Ground water

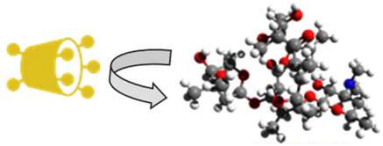
Waste water

Leachate

Molecular Selectivity with High Capacity

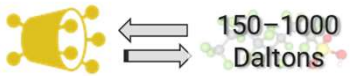
PFAS

Uniform 0.78 nm cyclodextrin cups provide **Molecular Selectivity** to all PFAS targeted in EPA Roadmap.



NOM, FOG & Ions

Size-Exclusion avoids competition by natural organic matter, FOG (fat, oil and grease) and inorganic ions.



Molecule

DEXSORB® can selectively uptake compound with molecular weight of **150–1000 Daltons.**

Commercial Overview

DEXSORB® Commercial Implementations

Manufacturing Scale
Toll Partner
(**400 tons**/year)

Consumer Products

Water Test Kit for PFAS

- Launched in **2020**
- NIEHS Funded
- Sold over **8,000** kits in **50** states

Purefast® Filter

- Launched in **June 2022**
- NSF Funded
- Sold over **5,000** filters to date

Whole Home Point-of-Entry Filter

- Launched in **August 2023**

Engineered Treatment Systems in Diverse Water Environments

Groundwater Pump-and-Treat

Drinking Water

RO Concentrate

Industrial Wastewater

Water Test Kit Pro: PFAS

Grab Sample

DEXSORB® Point-of-Site Sampling

Water Test Kit Pro with DEXSORB is a first-ever method to provide test-site PFAS extraction, eliminating the need to collect and ship water. Analysis of water samples is validated to EPA Methods 537, 533, and 1633.

We test for **55** PFAS, with an industry best reporting limit of **1.0** ppt.

Widespread Commercial Use

To date, we have tested and reported on over **10,000** water samples in all **50** States across the U.S. Our water test kits have been used to test tap water, rivers, lakes, and streams by consumers, state agencies, research institutions, and environmental groups.

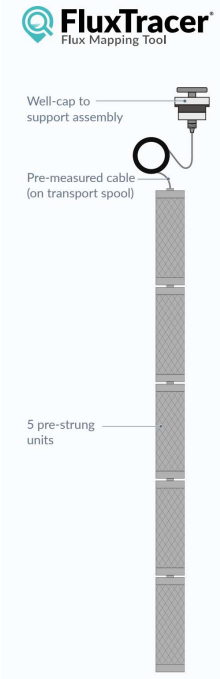
Water Test Kit Pro is listed by the National Institute of Environmental Health Sciences (NIHES) as a Sensor Technology for the 21st Century.

Water Test Kit Collection Cup

- Collection: Fill the collection cup with 250mL of water sample
- Extraction: Pass water through the DEXSORB extraction disc
- Elution: Recover PFAS analytes with standard elution process
- Analysis: Use isotope dilution for PFAS quantification
- Method validated against the EPA Method 537.1

FluxTracer with DEXSORB By Regenesis

Sampler cartridges can be deployed in monitoring wells to measure PFAS mass flux for geographical modeling.



REGENESIS

A global leader in technology-based solutions for the environment with an emphasis on contaminated site remediation.

FluxTracer®

Flux Mapping Tools are easy-to-use devices that vertically delineate contaminant mass flux and groundwater speed within an existing monitoring well to help site characterization and remedial designs.

REGENESIS Introduces FluxTracer Flux Mapping Tool for CVOCS and PFAS – a Precise Measurement Tool for Groundwater Mass Flux and Velocity

R&D Scientists, Joshua Moreno and Dr. Yen Ling in the REGENESIS lab hold a FluxTracer unit. (Photo: Business Wire)

DEXSORB for Home Drinking Water

PFAS Filtration for Countertop. + Whole Home. + OEM.

Cyclopure Direct to Consumer

Purefast Countertop Filter

Purefast Home80
80,000 Gallons

Purefast Home20
20,000 Gallons

OEM Partners

PoE Systems

ENPRESS LLC
Where Innovation Flows™

PoU Filters

MICRO FILTER

Purefast® Countertop Filter: PFAS

For Brita Pitchers

DEXSORB® PFAS Filter for Brita Pitchers

Cyclopure's DEXSORB® granular adsorbent is combined with activated carbon to provide a first-ever PFAS filter for a counter-top pitcher. Cyclopure designed Purefast Filter Cartridge to be compatible with Brita pitchers.

Product Performance Data Sheet

Substance	Effluent concentration	Influent challenge concentration	NSF % Reduction Requirement
NSF Standard 42– Aesthetic Effects			
Chlorine (Taste & Odor)	Non-Detect	2 (mg/L)	>50%
NSF Standard 53– Health Effects (PFAS Micropollutants)			
PFOA	Non-Detect	500 (ng/L)	Combined concentration 70 ng/L
PFOS	Non-Detect	1000 (ng/L)	

Cyclopure internal testing demonstrates reduction of 9 additional PFAS (PFHxA, PFHxS, PFNA, PFDA, PFHpA, PFPeA, PFBS, PFBA, HFPO-DA (GenX)) to non-detect for 65 Gallons capacity based on influent concentration of 40 ppt per PFAS.

The Purefast® filter is tested and certified by NSF International against NSF/ANSI Standard 42 for material requirements only.

INDEPENDENTLY NSF CERTIFIED COMPONENT

NSF Certification for 65 Gallons

Tested by NSF International to a capacity of **65** gallons for the reduction of chlorine (NSF/ANSI 42) and for PFOA/PFOS reduction (NSF/ANSI 53).

Each Purefast® filter comes with a pre-paid mailer to return used cartridges to our lab for safe disposal.


Top


Bottom

Front

Purefast® Home: Point-of-Entry

Water System for PFAS Removal

Purefast Home80 and Purefast Home20

Cyclopure's Purefast Home80 and Purefast Home20 with DEXSORB are the only whole home systems able to remove PFAS to non-detect. DEXSORB® is certified under NSF 61 as safe for drinking water treatment.

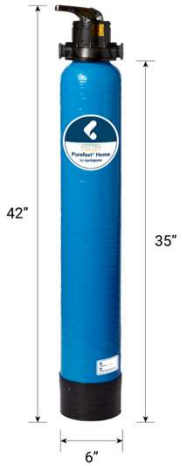
Product Performance Data Sheet

Internal testing demonstrates full removal of 8 PFAS (i.e., PFOA, PFOS, PFHpA, PFHxS, PFNA, GenX, PFBS, and PFDA) at an influent concentration of 50 ppt per PFAS.

Substance	Influent Challenge Concentration	Effluent Concentration	US EPA Proposed Drinking Water Limit
PFOA	50 ng/L	Non-Detect[1)]	< 4 ng/L
PFOS	50 ng/L	Non-Detect	< 4 ng/L
PFHpA	50 ng/L	Non-Detect	NA
PFHxS	50 ng/L	Non-Detect	Hazard Index[2)] < 1.0
PFNA	50 ng/L	Non-Detect	Hazard Index < 1.0
GenX	50 ng/L	Non-Detect	Hazard Index < 1.0
PFBS	50 ng/L	Non-Detect	Hazard Index < 1.0
PFDA	50 ng/L	Non-Detect	NA

Product Specifications

Purefast® Home80



- **Operating Temperature**: 40-120°F
- **Pressure Drop Spec**: < 5 psi @ 5 gpm
- **Max Operating Pressure:**
  - *PFH80: 100 psi*
  - *PFH20: 90 psi*
- **Rated Flow Rate**: 5 gpm
- **Peak Flow Rate**: 10 gpm
- **Media**: DEXSORB for PFAS and activated carbon for taste and odor.
- **Treatment Capacity**(Based on Rated Flow Rate):
  - *PFH80: 80,000 gallons*
  - *PFH20: 20,000 gallons*
- **PFH80**: 3-1"NPT threaded connections for inlet, outlet and commissioning
- **PFH20**: Compatible with Big Blue Filtration System

Purefast® Home20

DEXSORB® Media

NSF

Certified to NSF/ANSI/CAN 61

PFAS Adsorption For Every Water Source.

PFAS Adsorption

PFAS-impacted water

DEXSORB

PFAS-free water

(Packed Bed Filtration)

PFAS Concentration

Used Regeneration Solution

DEXSORB

Solvent Recycling

(Backwash)

Regeneration Solution

Destruction

PFAS Destruction Technologies (HALT, SCWO, Electrochemical, Mechanochemical)

PFAS Waste

Field Treatment Operation

Centralized Regeneration + Concentration Operation

Landfill Leachate Treatment Pilot in Michigan.

System Configuration

PFAS Removal Performance

Raw Leachate – 21,000 gallons treated

Concentration (ng/L)	Influent	Effluent
PFOS	310.8	< 12 ng/L
PFOA	1046.4	< 170 ng/L
PFHxS	538.5	< 210 ng/L
PFBS	3658.0	< 67,000 ng/L
PFNA	57.4	< 30 ng/L

- Operation Duration: **20** days
- Backwash: **None**
- Backpressure: **< 10** psi

MI EGLE WQV Compliant

Media Loading: 60kg per vessel in Lead-Lag configuration
Flow Rate: **1.0** gpm (average)

Influent PFAS Level: 22-26 ppb
EBCT – 35 Min Per Vessel

Industrial Wastewater GAC Replacement.

Michigan Metal Plating Plant

Avg. Flow Rate: **140 GPM**
Peak Flow Rate: **200 GPM**

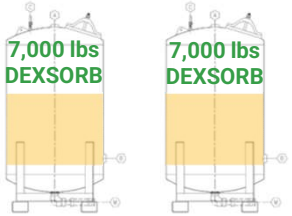
Pilot System Operation

Pilot Flow Rate: **0.5 GPM**

Current GAC Treatment System

GAC packed bed filtration (four 20,000-lb vessels) for removal of **PFOS and 6:2 FTS;** **Replace 20,000 lbs GAC every 6 weeks**

Proposed DEXSORB System



DEXSORB packed bed filtration (two 7,000-lb vessels) for removal of **PFOS and 6:2 FTS;** **Replace 7,000 lbs DEXSORB every 36 weeks**

RO Concentrate Pilot Greensboro NC.

System Configuration

Media Loading: 60kg per vessel in Lead-Lag configuration
Flow Rate: **1.0** gpm (average)

PFAS Removal Performance

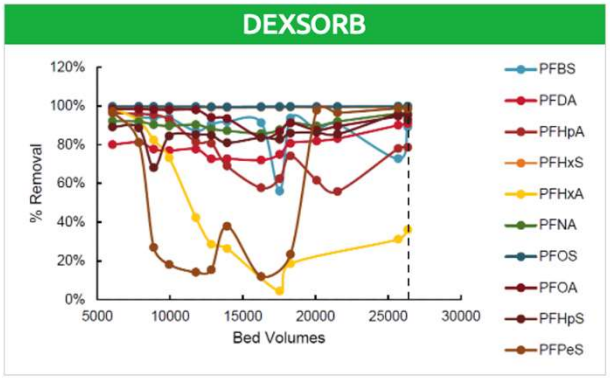


Figure 4-29. Concentrate Pilot Results – PFAS of Interest (Column 3 – NS)

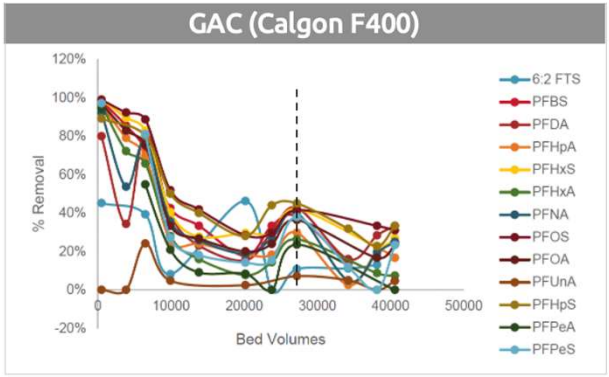


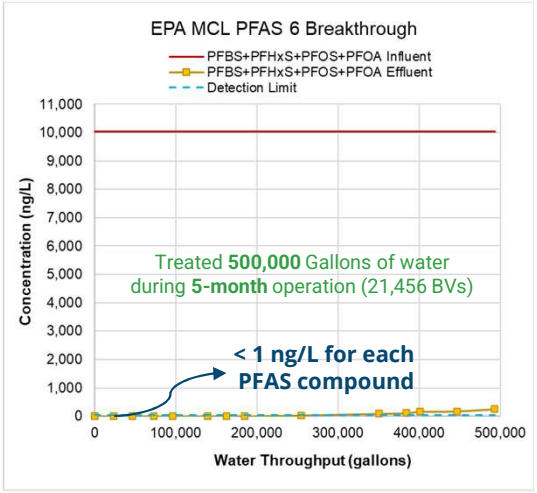
Figure 4-36. Concentrate Pilot Results – PFAS of Interest (Column 2 – Calgon, EBCT – 10 minutes)

DEXSORB at U.S. Military Installations

Military Base PFAS Pilot in CA.

PFAS Sequestration

Pump and Treat AFFF-Impacted Groundwater:



- EBCT: 5 + 5 minutes (Lead-Lag configuration)
- Average Flow Rate: 2.3 gpm
- TOC > 10 mg/L
- EPA MCL 6 PFAS Level = 10,028 ng/L

Total PFAS Level = 15,959 ng/L

1,600x

300 gallons of PFAS-Laden Regeneration Solution

5,000x

100 gallons of concentrated PFAS-Laden Regeneration Solution

PFAS Desorption

- Up-Flow Rate = **1 gpm**
- Total Regeneration Solution Volume = **300 gallons**
- **1 week** for regeneration process

DEXSORB provided **5,000x** of PFAS concentration factor in this field demonstration

Remediation of AFFF-Impacted Groundwater Using Novel Cyclodextrin Adsorbent (DEXSORB®)

ER23-8379

POINT OF CONTACT

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Objective

The use of aqueous film-forming foam (AFFF) has led to per- and polyfluoroalkyl substances (PFAS) impacting groundwater throughout the United States. To remediate PFAS-impacted groundwater, treatment technologies capable of high capacity PFAS sequestration from water and concentration of PFAS waste for efficient processing by available destruction technologies are required to ensure full elimination of PFAS waste streams. Conventional adsorption technologies used to remove PFAS from water typically involve single-use granular activated carbon (GAC) or strong anion exchange resins (IXR) that result in large volumes of PFAS-laden solid waste. Cyclopure developed a novel DEXSORB® adsorbent, made with renewable β-cyclodextrins, with high capacity to sequester PFAS from water. Importantly, spent DEXSORB media can be desorbed under ambient conditions providing complete recovery and concentration of extracted PFAS. The objective of this project is to

Naval Air Station Joint Reserve Base Willow Grove

Horsham Township, Pennsylvania in the United States

A US Navy Grumman C-1A Trader taxiing at NAS Willow Grove in 1987

Travis Air Force Base

Near Fairfield, California in the United States of America

A McDonnell Douglas KC-10A Extender of the 60th Air Mobility Wing at Travis Air Force Base during 2015

Naval Air Warfare Center Warminster

Aerial view of the NADC in the early 1970s

Case Study 1: Drinking Water Treatment in Newburyport MA.

Background and Pilot System Setup.

Pump and Treat PFAS-Contaminated Surface Water: Bartlett Pond, Newburyport MA

Water Quality

Parameter	Value
pH	6.5 – 7.0
Turbidity	2 – 7 *NTU*
TOC	1.0 – 1.5 *mg/L*

MA PFAS6 MCL = 20 ng/L

Bartlett Pond is offline due to detected PFAS contamination.

MA PFAS6

Concentration (ng/L)	Average Influent
PFOS	32.6
PFOA	5.0
PFHpA	4.2
PFHxS	20.9
PFNA	ND
PFDA	ND
Total	62.7

Joint Project with AECOM

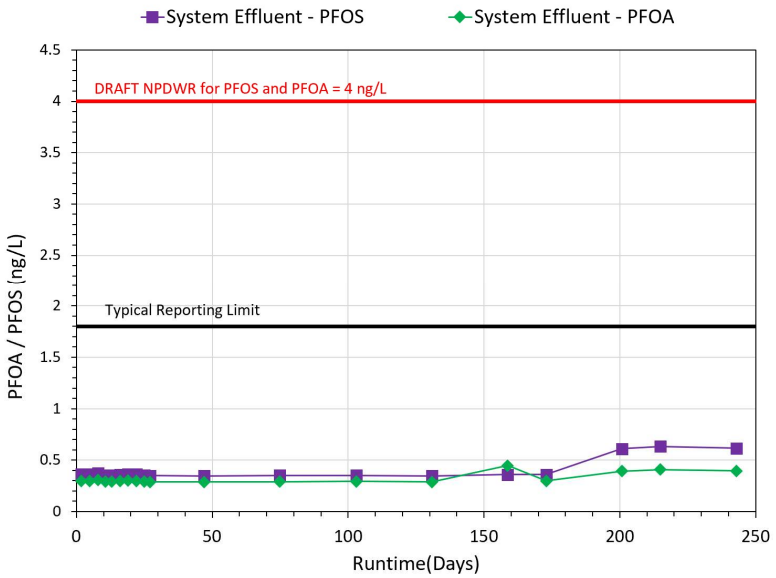
Demonstrate Cyclopure's DEXSORB® can effectively remove MA PFAS6 from raw drinking water source.

January 12, 2024:
From Mass DEP:
Pilot Study Report **Approval** for DEXSORB
(Activity # 22-WS22-0019)

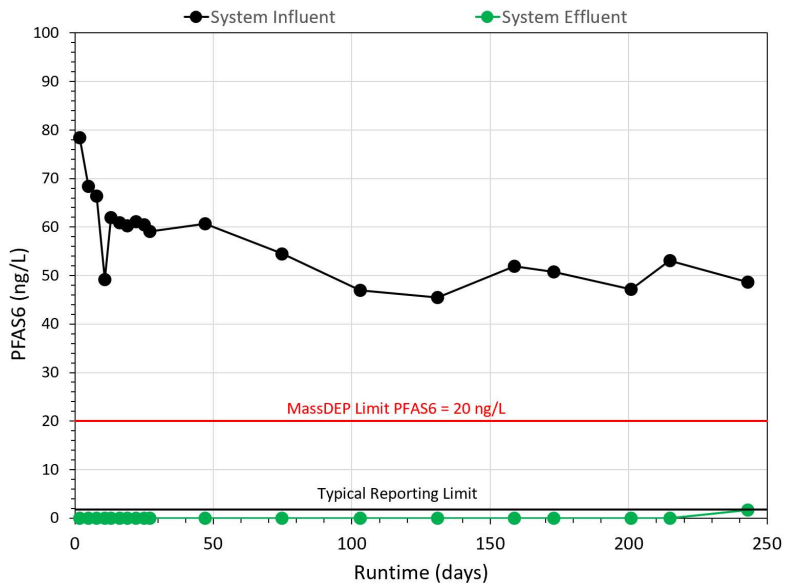
Case Study 1: Drinking Water Treatment in Newburyport MA.

PFAS Removal Performance.

PFOS/PFOA Removal Data



MA PFAS6 Removal Data



- **510,000 gallons** of water treated, **195,500 L/kg** specific throughput.
- **Complete removal (<1.0 ppt)** of MassDEP PFAS6.
- Received **New Technology Approval** from MassDEP.

Case Study 2: Drinking Water Treatment in Lynnfield MA.

Background and Pilot System Setup.

Pump and Treat PFAS-Contaminated Spring Water: Pocahontas Spring, Lynnfield MA

Former bottling facility, now used as Vending House Building.

Raw spring water sample tested in Feb 2022 with MA PFAS6 over **20 ng/L**.

MA PFAS6 MCL = **20** ng/L

MA PFAS6

Concentration (ng/L)	Average Influent
PFOS	4.5
PFOA	11.1
PFHpA	5.9
PFHxS	1.9
PFNA	1.2
PFDA	ND
Total	**24.6**

Joint Project with Tata & Howard

TATA & HOWARD

Case Study 2: Drinking Water Treatment in Lynnfield MA.

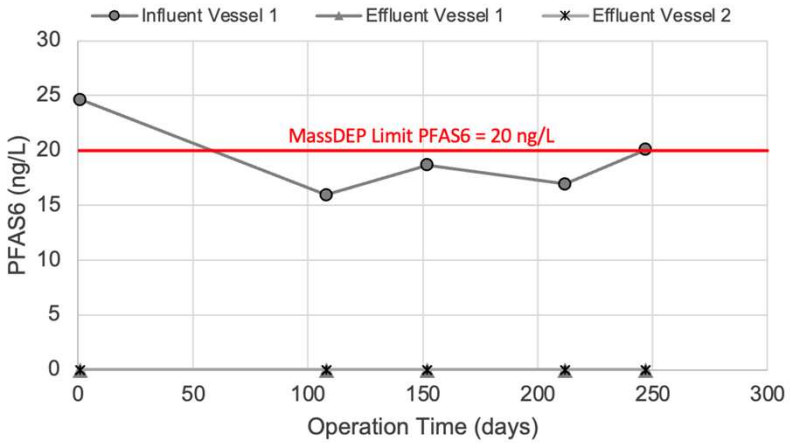
Pilot System Operation and PFAS Removal Performance.

DEXSORB PBF System Design:

EBCT: **5 + 5** minutes (Lead-Lag configuration) / Flow Rate: **1.3** gpm (average); **2.5** gpm (max)

System Performance & Operation

MA PFAS6 Removal Data:



- Smooth operation with **minimal pressure drop (< 5 psi)** for over 9 months.
- No operational was backwash needed.

- **530,000 gallons** of water treated, **200,600 L/kg** specific throughput.
- **Complete removal to non-detect** of MassDEP PFAS6.
- **PFAS6 < 2 ppt** in lead vessel at over **8 months**.

DEXSORB PBF Lead-Lag System

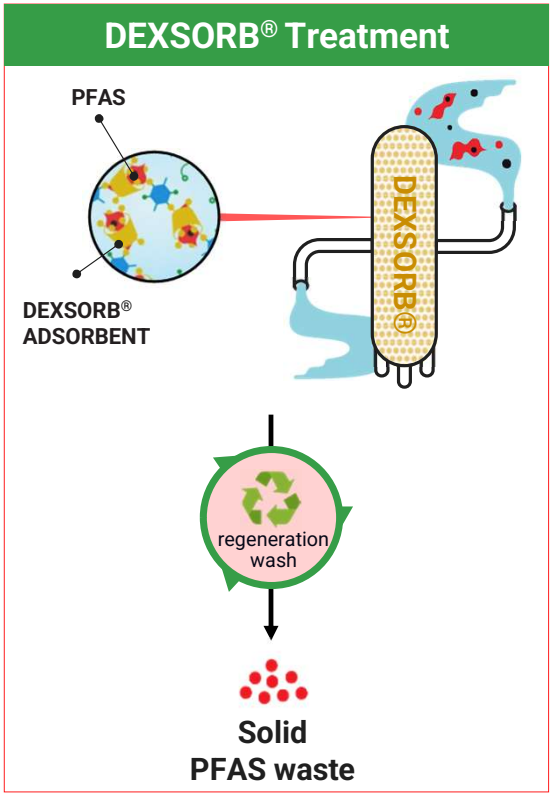
DEXSORB Desorption

DEXSORB concentrates PFAS into solid form

EPA October 2022 PFAS Roadmap Proposes to Limit Disposal of PFAS Waste at Landfill

DEXSORB® can treat PFAS in diverse water sources

Regenerated DEXSORB® can be reused to full capacity



Drinking Water

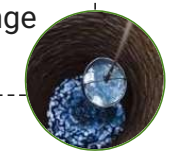
POE vessel with 300,000-L treatment capacity at 20 ppt PFAS challenge

6 mg PFAS

Groundwater Remediation

450 L/min flow rate, 12-month operation at 16 ppb PFAS challenge

3.8 kg PFAS



Landfill Leachate Treatment

300 L/min flow rate, 4-month operation at 35 ppb PFAS challenge

1.8 kg PFAS