

What are PFAS, and what are issues with them?

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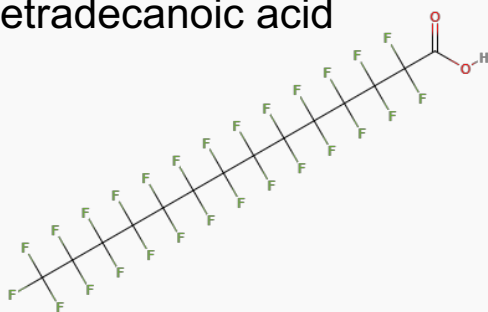


Per- and Polyfluoroalkyl Substances

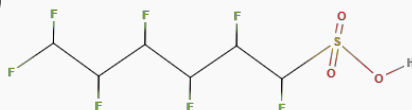
- Group of thousands of chemicals
 - Subgrouped by functional groups
 - Most subgroups have range of chain lengths
- Highly fluorinated
- Highly resistant to degradation
- Highly mobile
- Varying (and unknown) levels of toxicity

PFAS

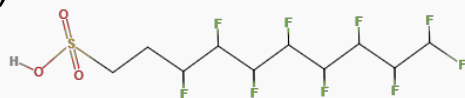
- Perfluorotetradecanoic acid (PFTreA)



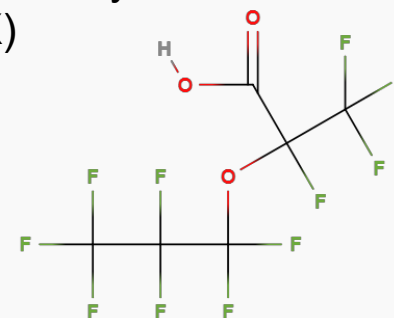
- Perfluorohexanesulfonic acid (PFHxS)



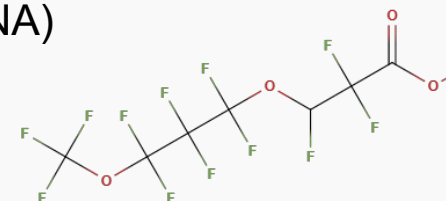
- Fluorotelomer sulfonic acid 8:2 (FtS 8:2)



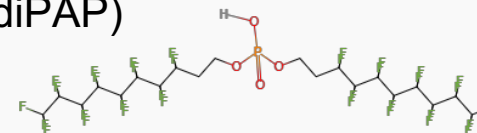
- Perfluoro(2-methyl-3-oxahexanoic) acid (GenX)



- 4,8-dioxa-3H-perfluorononanoic acid (ADONA)

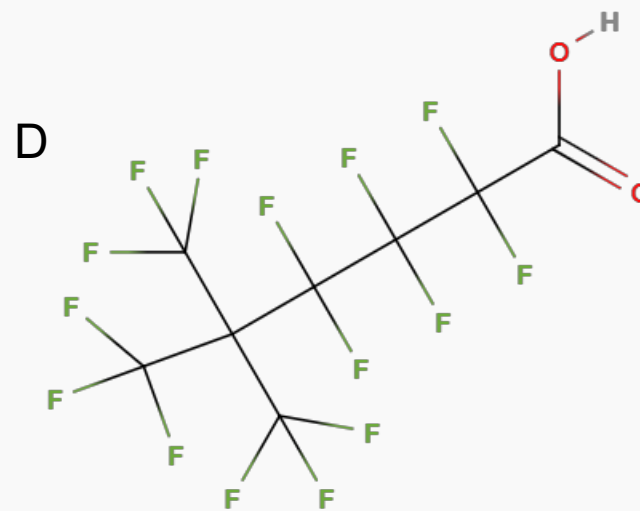
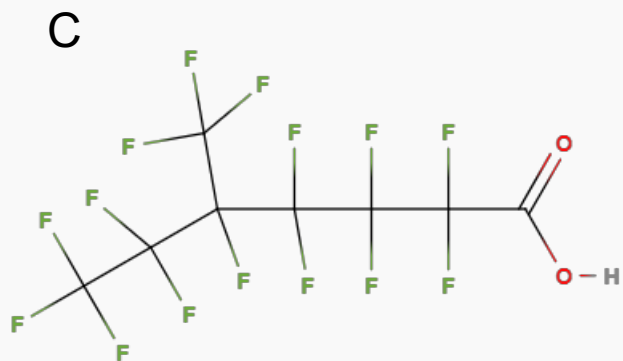
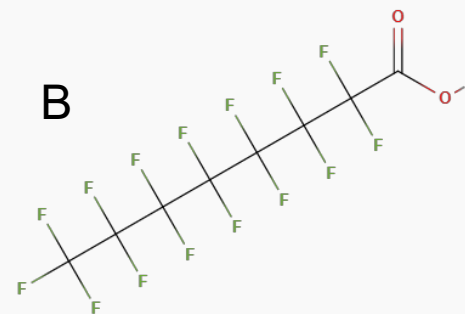
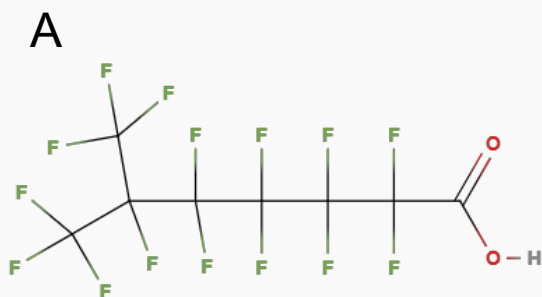


- 8:2 Fluorotelomer phosphate diester (8:2 diPAP)





Pop Quiz: Which is PFOA?





What are PFAS used for?

PFAS are used in a wide variety of industries and commercial products for their valuable properties, including fire resistance, dust suppression, and oil, stain, grease, and water repellence.

- ◆ Fire fighting foams (AFFF)
- ◆ Food surfaces (Teflon)
- ◆ Polishes, waxes, paints
- ◆ Stain repellants on carpets and upholstered furniture
- ◆ Cleaning products
- ◆ Dust suppression for chrome plating
- ◆ Electronics manufacturing
- ◆ Oil and mining for enhanced recovery
- ◆ Performance chemicals (hydraulic fluid, fuel)



Overview of Potential PFAS Universe

- Industries:
 - Metal plating
 - Plastic and textile coatings
 - Chemical and plastics manufacturing
 - Car washes
- Waste disposal
 - Unlined landfills
 - land with biosolids application
- AFFF users:
 - Airports, train yards, etc.
 - Fire training areas
 - Chemical refineries



PFAS Releases

- Contamination routes vary
 - AFFF usage, testing, storage – groundwater, soil, wastewater
 - Biosolids application – soil to groundwater
 - Landfills – leachate to groundwater or wastewater
 - Manufacturing – wastewater and air deposition



PFAS Releases

- PFAS found at sites: PFCA C4-14; PFSA C4-10; FtS 4:2, 6:2, 8:2; PFOSA, NEtFOSAA, NMeFOSAA
- Media affected:
 - Groundwater
 - Soil
 - Surface water
- Biota: fish, deer, honey



Toxicity Values and Health Advisories

- RfD for PFOA and PFOS is 2×10^{-5} mg/kg/d
 - Lifetime Drinking Water Health Advisory is 70 ppt
 - HA is based on sum of both PFOA and PFOS concentration
- OW Oral Slope Factor of 0.07 (mg/kg-day)⁻¹ for PFOA, but RfD is risk driver
- PPRTV RfD for PFBS
- Draft ATSDR MRL for PFOA, PFOS, PFNA, PFHxS
- Various state toxicity values, risk levels, and standards



Toxicity and Risk

- Risk = Toxicity x Exposure
- Some states use OW toxicity values in different exposure equations
- PFOA/PFOS/PFNA/PFHxS similar toxicity; PFBS less toxic

PFAS	Author	RfD (mg/kg day)
PFOA	OW	2.00E-05
PFOS	OW	2.00E-05
PFOA	ATSDR (draft)	3.00E-06
PFOS	ATSDR (draft)	2.00E-06
PFHxS	ATSDR (draft)	2.00E-05
PFNA	ATSDR (draft)	3.00E-06
PFBS	PPRTV	2.00E-02
PFBS	ORD (draft)	1.00E-02
HFPO-DA	OW (draft)	8.00E-05
HFPO-DA	NCDHHS	1.00E-04



Current Analysis Methods

- Method 537.1 for 18 PFAS in drinking water
- ASTM Method 7979 single-lab validated for PFAS in non-potable waters using direct inject
- ASTM Method 7968 single-lab validated for PFAS in soils using direct inject



Current Analysis Methods

- Many commercial labs use Modified Method 537.1 for analysis. How is it modified?
 - A. Modified for other media
 - B. Modified for other analytes
 - C. Modified to use isotopic dilution
 - D. All of the above
 - E. Other
 - F. Yes? Maybe?



Analysis Methods in Progress

- Draft SW-846 Method 8327 direct inject method for 24 PFAS in non-potable waters
- Draft SW-846 Method 8328 solid phase extraction isotopic dilution method for 24 PFAS in non-potable waters and solids
- Draft direct inject method for 24 PFAS in soils



Sampling

- PFAS are ubiquitous so precautions must be taken to avoid contamination of samples
- Existing wells may have PFAS leaching components which can cause contamination
- Consideration needed of personal care products and clothing for potential contamination



Cleanup Challenges

- Since PFAS are not CERCLA hazardous substance
 - cost recovery under CERCLA is not available
 - CERCLA authorities can be triggered if PFAS release or threat of release presents an imminent and substantial danger to public health or welfare (contaminant or pollutant)
- No federal MCLs
- Numerous states have derived different advisories and cleanup levels



Cleanup Challenges

- Final toxicity information only for PFOA, PFOS, and PFBS
- EPA Method 537.1 used for drinking water but no current multi-lab validated methods for other environmental media



Cleanup Challenges

- Dispersion potential differs by type and length
 - Shorter seem to migrate faster
 - Migration depends on carbon content of soil
 - FtOH are volatile, but others can be dispersed by air as particulates
- Ecological uptake differs
 - Animals seem to bioaccumulate sulfonates
 - Plants seem to uptake carboxylic acids



Cleanup Challenges

- Water (drinking, ground, etc.) remediation
 - GAC
 - Ion exchange
 - Reverse Osmosis
 - Potential incompatibility with other contaminant remediation
- Soil
 - Oxidation
 - Dig and haul

A large, faint watermark of the Environmental Protection Agency (EPA) logo is centered on the page. The logo consists of a circular border containing the text "UNITED STATES" at the top and "ENVIRONMENTAL PROTECTION AGENCY" at the bottom. In the center of the circle is a stylized flower with a scalloped top and three leaves.

Questions?

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