What are PFAS, and what are issues with them?

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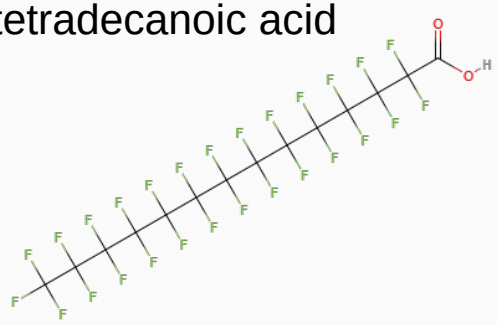
Per- and Polyfluoroalkyl Substances

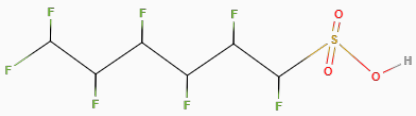
- Group of thousands of chemicals
  - Subgrouped by functional groups
  - Most subgroups have range of chain lengths
- Highly fluorinated
- Highly resistant to degradation
- Highly mobile
- Varying (and unknown) levels of toxicity

PFAS

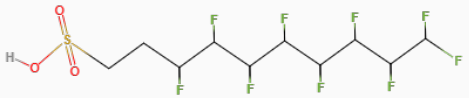
- Perfluorotetradecanoic acid (PFTreA)



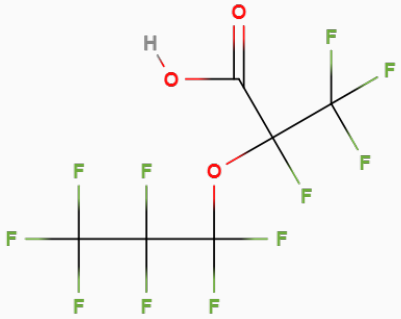
- Perfluorohexanesulfonic acid (PFHxS)



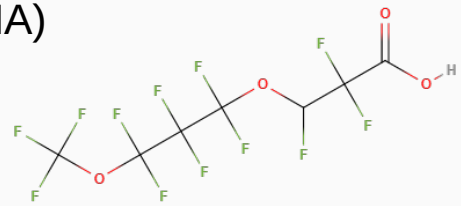
- Fluorotelomer sulfonic acid 8:2 (FtS 8:2)



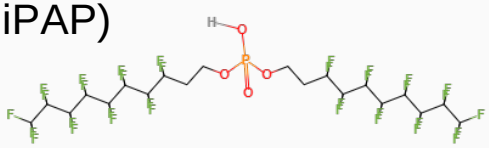
- Perfluoro(2-methyl-3-oxahexanoic) acid (GenX)



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



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



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 water levels up to 2,000 µg/l
  - Soil levels up to 36 mg/kg
  - Landfill leachate 5.3 µg/l
- Biota: fish, deer, honey

Toxicity Values and Health Advisories

- Reference dose (RfD) for PFOA and PFOS is 0.00002 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, and PFHxS
- Various state toxicity values and advisories

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

Analysis Methods in Progress

- Draft SW846-8327 direct inject method for 24 PFAS in non-potable waters
- Draft SW846-8238 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 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

Questions?

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Extra slides