Per and Polyfluoroalkyl Substances (PFASs) at Superfund Sites

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Why are PFAS Relevant for Waste Sites?

- Potential for contamination exists at numerous locations due to pervasive manufacturing and use/release of PFAS.

- Longer-chain PFAS, including PFOA and PFOS, are persistent, toxic, mobile, and bioaccumulative and can have a deleterious effect on human health and the environment.

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

- 315 DoD sites with fire training areas.
- 535 FAA 14 CFR Part 139 airports
- 113 sites in SEMS with possible past Cr plating
- 286 landfills on NPL
- 100s of sites associated with PFAS manufacturers
- Industries: electronics, coatings, photography, mining, paints, inks, lubricants, hydraulic fluids, etc.
- Unlined landfills, land with biosolids application, chemical refineries, etc.

Investigating PFAS at Superfund Sites

- Evaluate for presence of PFAS at sites in investigation stage when appropriate
- NPL sites undergo Five Year Review after remedy implementation when contamination above levels that allow for unrestricted use remain
- If known releases nearby site, investigate if site might be source

Superfund Sites with Known Impacts

- 42 sites total on NPL (Final and Deleted)
- 1 proposed for NPL (Saint-Gobain Performance Plastics, Hoosick Falls, NY)
- 13 private sites
  - Landfills
  - Airports
  - Electroplating
  - Textile coating application
- 30 Federal facilities
  - Airfields
  - Fire training areas

Sites with Known PFAS Impacts

- 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

Sites with Known PFAS Impacts

- PFAS found at sites:
  - AFFF sites: PFCA C4-14; PFSA C4-10; FtS 4:2, 6:2, 8:2; PFOSA, NEtFOSAA, NMeFOSAA
  - Non AFFF sites: PFCA C4-13; PFSA C4-8; FtS 6:2, NMeFOSAA
- Groundwater water levels up to 2000 µg/l
- Soil levels up to 36 mg/kg
- Landfill leachate 5.3 µg/l

Toxicity Values and Health Advisories

- Studies indicate PFOA and PFOS exposure results in multiple health effects
- 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

$$\text{Lifetime HA} = \frac{\text{RfD} \times \text{RSC}}{\text{DWI/BW}}$$

Toxicity and Risk Assessment

- Human health risk from ingestion of contaminated water, soil, or other media (fish, livestock, plants)
- Severity of ecological risks are uncertain particularly higher trophic level risks through food chain bioaccumulation
- OW RfDs are the recommended toxicity values for Superfund and RCRA risk assessments
- RfD also available for PFBS

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)
- Toxicity information only for PFOA, PFOS, and PFBS

Cleanup Challenges

- Few available/questions about performance of cleanup technologies for PFAS
- No Teflon or similar equipment, material, or PPE can be used with sampling and analysis
- EPA Method 537 used for drinking water but no current multi-lab validated methods for other environmental media

Current EPA Work

- Cross-agency analytical workgroup
  - Creating two standardized analytical methods
  - One for soil/sediment/solids
  - One for groundwater/surface water
  - For 24 PFAS analytes
  - 3 different water methods studied for validation
  - 1st water method currently in internal validation

https://www.epa.gov/water-research/pfas-sampling-studies-and-methods-development-water-and-other-environmental-media

Analytical Method Analytes

Analyte Name	Acronym	CASRN linear	Detected at a site	NHANES	UCMR3	Method 537
Perfluorotetradecanoic acid	PFTreA	376-06-7	Y			Y
Perfluorotridecanoic acid	PFTriA	72629-94-8	Y			Y
Perfluorododecanoic acid	PFDoA	307-55-1	Y	Y		Y
Perfluoroundecanoic acid	PFUnA	2058-94-8	Y	Y		Y
Perfluorodecanoic acid	PFDA	335-76-2	Y	Y		Y
Perfluorononanoic acid	PFNA	375-95-1	Y	Y	Y	Y
Perfluorooctanoic acid	PFOA	335-67-1	Y	Y	Y	Y
Perfluoroheptanoic acid	PFHpA	375-85-9	Y	Y	Y	Y
Perfluorohexanoic acid	PFHxA	307-24-4	Y			Y
Perfluoropentanoic acid	PFPeA	2706-90-3	Y			
Perfluorobutyric acid	PFBA	375-22-4	Y			

Analytical Method Analytes

Analyte Name	Acronym	CASRN linear	Detected at a site	NHANES	UCMR3	Method 537
Perfluorodecanesulfonate	PFDS	335-77-3	Y			
Perfluorononanesulfonate	PFNS	68259-12-1	Y			
Perfluorooctanesulfonate	PFOS	1763-23-1	Y	Y	Y	Y
Perfluoroheptanesulfonate	PFHpS	375-92-8	Y			
Perfluorohexanesulfonate	PFHxS	355-46-4	Y	Y	Y	Y
Perfluoropentansulfonate	PFPeS	2706-91-4	Y			
Perfluorobutanesulfonate	PFBS	375-73-5	Y	Y	Y	Y
Perfluorooctanesulfonamide	PFOSA	754-91-6	Y	Y		
Fluorotelomer sulfonate 8:2	FtS 8:2	39108-34-4	Y			
Fluorotelomer sulfonate 6:2	FtS 6:2	27619-97-2	Y			
Fluorotelomer sulfonate 4:2	FtS 4:2	757124-72-4	Y			
N-ethyl-N-((heptadecafluorooctyl)sulfonyl)glycine	NEtFOSAA	2991-50-6	Y	Y		Y
N-(Heptadecafluorooctylsulfonyl)-N-methylglycine	NMeFOSAA	2355-31-9	Y	Y		Y

Current EPA Work

- Sampling protocols sub-workgroup
  - Component of larger analytical workgroup
  - Develop generic SOPs for PFAS field sampling
  - Compiled numerous SOPs to compare and combine with generic SOPs for media sampling
  - Currently revising draft groundwater SOPs based on internal review
  - Surface water, soil, etc. SOPs will follow

Current EPA Work

- Ecological work group analyzing eco-risk
  - Goal is to develop screening levels for biota in ecological risk assessments
  - Currently compiling literature and analyzing
  - Existing developed screening levels being analyzed
- Evaluating human toxicity for other PFAS

Areas of Needing Research

- Inhalation toxicity of PFAS
- Toxicity information on PFAS other than PFOA, PFOS, and PFBS
- Interaction with other contaminants at sites
- Fate and transport

Case Study: Saint-Gobain Performance Plastics Site

- Since 60's facility used for manufacturing, including extruded tapes, circuit board laminates and PTFE coated fiberglass.
- Saint-Gobain purchased the Site since 1999 to manufacture a variety of polymer-based products that utilized PFOA, including high-performance polymeric films and membranes, as well as foams for bonding, sealing, acoustical and vibrational damping, and thermal management

Case Study: Saint-Gobain Performance Plastics Site

- Historical chemical use affiliated with past Site usage may have additionally included petroleum fuels, lubricants, degreasing agents, solvents, paints
- Soil and groundwater believed to be contaminated through stack emissions and potentially other routes still being investigated
- Proposed to the NPL on 9/9/16. HRS scoring consists of soil and groundwater contaminated with trichloroethylene (TCE), vinyl chloride (VC), polychlorinated biphenyls (PCBs), and perfluorooctanoic acid (PFOA) as a result of historical releases from the SGPP facility.

Case Study: Saint-Gobain Performance Plastics Site

- Soil results from 2015 – PFOA ranging from 0.35 mg/kg to 4.1 mg/kg on facility property
- Groundwater results from 2016 – PFOA ranging from 18,000 ng/L to 570 ng/L on facility property
- Off-property municipal and private wells also found to be contaminated
- EPA removal program evaluated soil from residential yards and municipal property around the facility using OW RfD
- No soil results above the removal management level (RML) of 1 mg/kg for sum of PFOA and PFOS
- Investigation ongoing

Case Study: Coakley Landfill

- National Priorities List site in New Hampshire.
- Remedy: Landfill capped/fenced; MNA, GW use restrictions around site.
- Remedy based on non-PFAS contaminants.
- Potentially responsible parties performing work.
- Significant public interest/involvement, in part due to pediatric cancer cluster in area and concerns about a potential link to the site.
- NH Ambient Water Quality Standard – 70 ppt for PFOA, PFOS, or PFOA/PFOS combined.

Case Study: Coakley Landfill

- 2016/2017 PFAS sampling:
  - GW beneath/beyond landfill > NH AWQS (PFOA, PFOS and PFOA/PFOS combined).
  - Off-site Supply Wells < NH AWQS (PFOA, PFOS & PFOA/PFOS detected. Number of wells contained PFOA or PFOS, but not both.)
  - Off-site SW – several samples collected by third party and NHDES. PFOA max. 850 ppt, PFOS max. 400 ppt. This PFOA max. value was the only result to exceed the site-specific SW screening level (760 ppt).

Case Study: Coakley Landfill

- Ongoing work:
  - Monitoring wells & prev. sampled residential wells to be sampled 2/year for two years (5 Year Review Recommendation).
  - Surface water/sediment sampling.
  - Comparison of surface water/sediment results to site-specific screening levels developed for these media.
  - Results from additional sampling will help inform next steps.

Questions?

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