Introduction to PFAS

The Cycle of PFAS and Its Evolving Landscape

Northeast Recycling Council

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Performance Fluoropolymer Partnership

- Trade association of manufacturers, processors, and users of fluoropolymers
- Fluoropolymers are a distinct group of PFAS with a unique combination of properties that make them indispensable in many industries
  - Thermal stability over a wide range
  - Chemical stability and corrosion resistance
  - Resistance to UV damage, water, weathering
  - Biological stability
  - High-performance dielectric properties
  - Practically insoluble in water
  - Cannot cross the cell membrane, so not bioaccumulative

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Introduction to PFAS

1. PFAS. What are they?
2. Major groups of PFAS and their uses
3. Final thoughts

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PFAS. What are they?

- Most simply, per- and polyfluorinated substances (PFAS) are organic substances that contain carbon atoms bonded to fluorine atoms.
- PFAS are incredibly diverse in structure and properties.
- The degree of fluorination can vary, the per-PFAS being more thoroughly fluorinated than poly-PFAS.
- The carbon-fluorine bond is the fourth strongest bonds in chemistry.
- The degree of fluorination influences a substance's stability and therefore its uses, its solubility in water or other solvents, and whether (and into what) it might transform in the body or the environment.

PFAS. What are they?

- There is ongoing debate about structural characteristics and whether they qualify or disqualify a substance from being a PFAS.
- Ultimately, regulatory definitions determine what the term “PFAS” means from a compliance and enforcement perspective.
- Regulatory definitions also determine whether you suddenly have a PFAS issue.

Major Groups of PFAS and Their Uses

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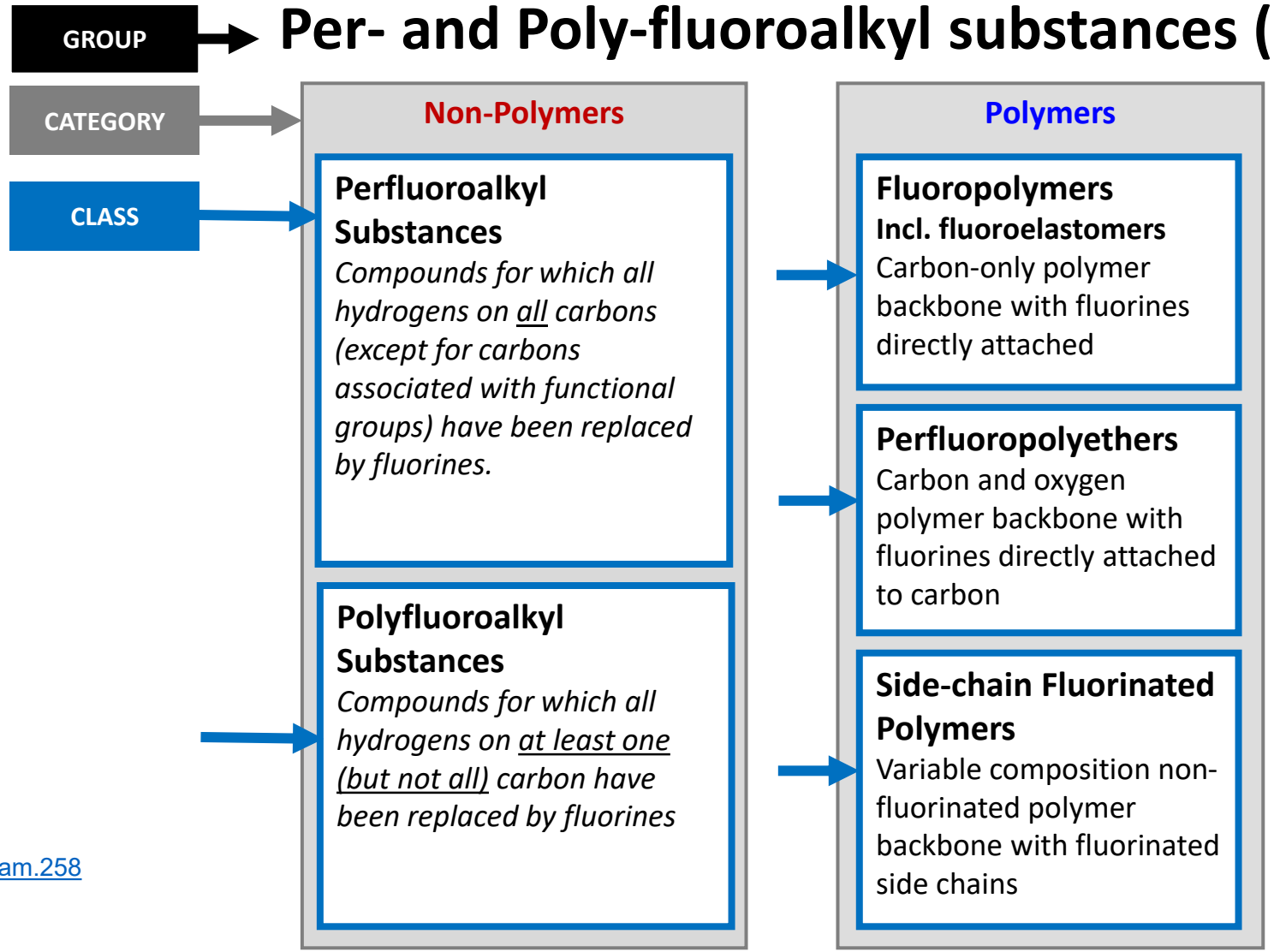
Major Groups of PFAS



Buck et al., 2011.
http://dx.doi.org/10.1002/ieam.258

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Major Groups of PFAS

Non-Polymers

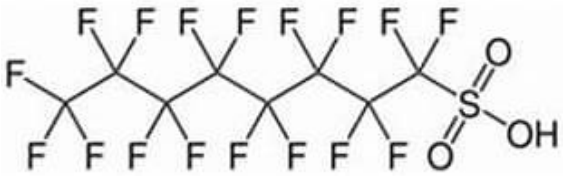
Perfluoroalkyl Substances

Compounds for which all hydrogens on <u>all</u> carbons (except for carbons associated with functional groups) have been replaced by fluorines

Polyfluoroalkyl Substances

Compounds for which all hydrogens on <u>at least one (but not all)</u> carbon have been replaced by fluorines

- Non-polymeric PFAS
  - Small molecules (smaller than polymers)
  - Raw materials for making other chemicals
  - Surfactants and wetting agents
  - Aqueous film-forming foams (AFFF)
- PFOA and PFOS are perfluoroalkyl substances
- Majority of legislative and regulatory activity has focused on non-polymeric PFAS (AFFF restrictions, drinking water limits, etc.)



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Major Groups of PFAS

Polymers

Fluoropolymers
including fluoroelastomers
Carbon-only polymer backbone with fluorines directly attached

Perfluoropolyethers
Carbon and oxygen polymer backbone with fluorines directly attached to carbon

Side-chain Fluorinated Polymers
Variable composition non-fluorinated polymer backbone with fluorinated side chains

- Fluoropolymers (including fluoroelastomers)
  - Hoses, tubes, and pipes for challenging conditions
  - O-rings, gaskets, valve seals, other sealing solutions
  - Filters for pharma, biotech, water treatment, fuel cells
  - Medical devices (stents, cardiac catheters)
  - Wire and cable coatings/jackets
  - Coatings for infrastructure, solar panels, wind turbines
  - Processing aids for LDPE films
- Perfluoropolyethers
  - Commercial and industrial lubricants
- Side-chain Fluorinated Polymers
  - Repellency (water, soil, biological fluids)
  - Grease-proofing plant-based food packaging

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Major Groups of PFAS

FDA Announces PFAS Used in Grease-Proofing Agents for Food Packaging No Longer Being Sold in the U.S.

Constituent Update

February 28, 2024

Today, the FDA announced that grease-proofing substances containing Per and Polyfluoroalkyl Substances (PFAS) are no longer being sold by manufacturers for food contact use in the U.S. market. The completion of the voluntary market phase-out of these substances used on food packaging paper and paperboard, eliminates the primary source of dietary exposure to PFAS from authorized food contact uses.

FDA Announces PFAS Used in Grease-Proofing Agents for Food Packaging No Longer Being Sold in the U.S. | FDA

Final Thoughts

- Different types of PFAS have different properties (size, stability, environmental fate and behavior, etc.).
- Those properties inform which PFAS may be a higher priority in terms of concerns about potential toxicity, exposure, bioaccumulation, etc., and therefore which PFAS may be a higher priority for regulation.
- Casual use of the generic term “PFAS” when only talking about a subset of PFAS or even two or three specific molecules creates confusion.

Thank you!

Questions?

Jay_West@americanchemistry.com

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