

PFAS Overview

CT PFAS Task Force

Pollution Prevention Committee

September 11, 2019

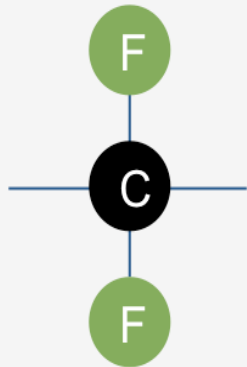


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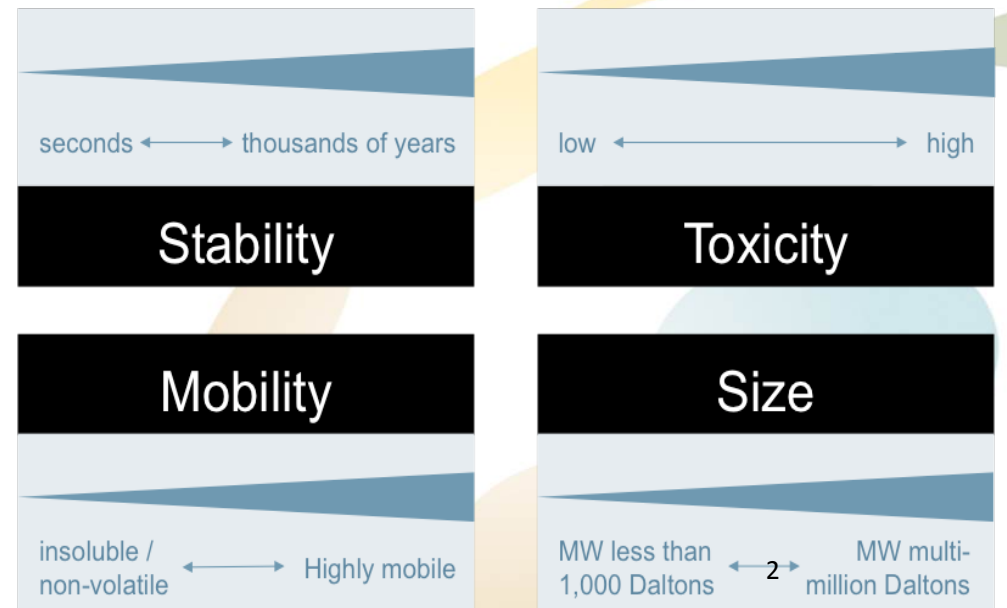
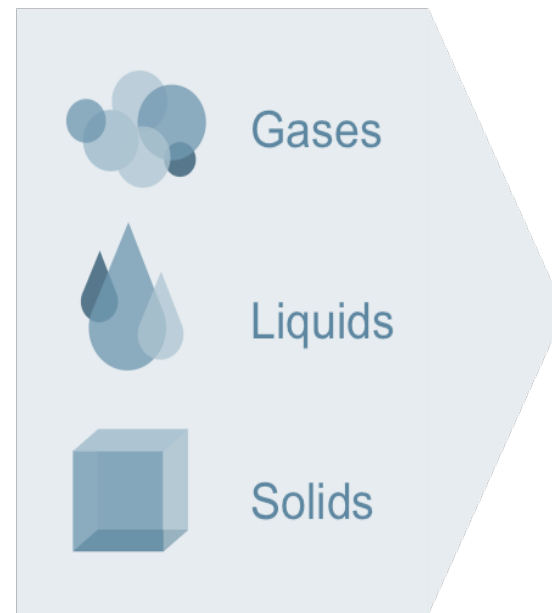
Overview: PFAS includes thousands of substances with very different properties

Similarities



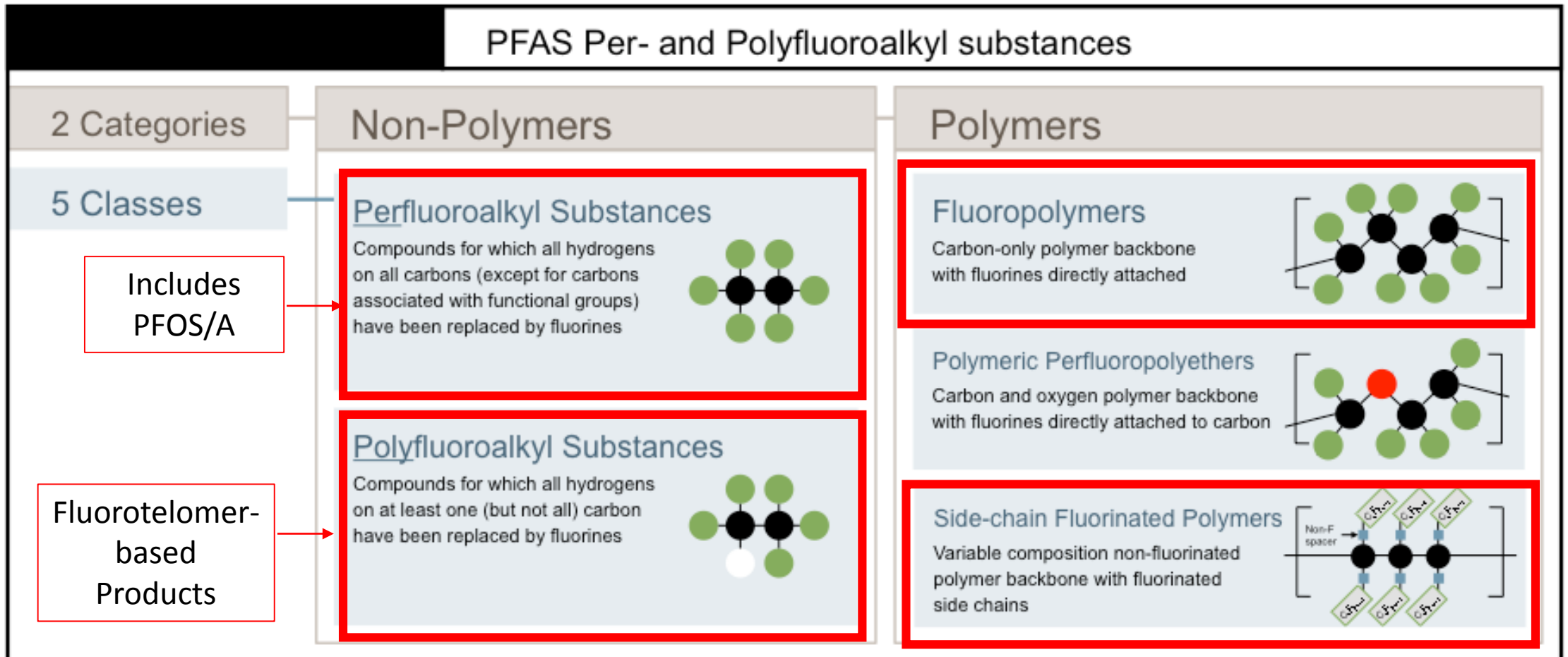
1 fully fluorinated carbon

Differences



PFAS Overview

- Fluorine
- Carbon
- Oxygen
- Hydrogen



Perfluoroalkyl and polyfluoroalkyl substances in the environment: Terminology, classification, and origins. *Integrated Environmental Assessment and Management* 2011, 7, (4), 513-541. <http://dx.doi.org/10.1002/ieam.258>

History of PFAS – PFOS & PFOA

- Properties & Use
 - Stable, hydrophobic (water) & lipophobic (oil and grease), superior surfactants
 - Used as a stain/water repellent, surfactant in class B fire-fighting foams (AFFF), polymerization aid in fluoropolymer manufacturing
 - Voluntarily phased out in U.S., Europe, and Japan by major manufacturers in conjunction with EPA PFOA Stewardship Program
 - Commitments made in 2006, 95% reduction by 2010, and completed phase out by 2015
 - May be manufactured in other countries (e.g., China) but can still be brought into the U.S. for use in certain sectors
- Issues
 - Persistent and bioaccumulative
 - Biological half-lives of 2-3 years
 - Associated with multiple health effects in animal testing
 - Including developmental effects
 - Mobile in water
- Federal Actions
 - Various use restrictions (*i.e.*, SNURs) imposed
 - 2015 proposed SNUR restricting importation of legacy long-chain PFAS
 - Lifetime health advisories (@70 ppt) for drinking water issued in 2016

Fluoropolymers

Material
Properties:

- Chemical resistance, thermal stability, resilience

Toxicity

- High molecular weight polymers that are not bioavailable and do not present a significant risk to human health or the environment
- Meet international criteria for “polymers of low concern”

Polymerization
aids

- Major manufacturers phased out use of PFOA/long-chains and moved to alternatives that regulators have approved with conditions (e.g., strict limits on emissions)

Fluoropolymer Applications

Electronics



High frequency signal transmission; smudge-resistant touch screens

Textiles



Membranes in outdoor apparel, providing a breathable barrier against wind and rain

Medical Devices



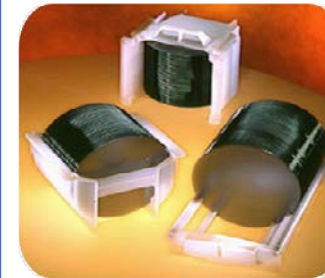
High dielectric insulators in medical equipment that relies on high frequency signals

Aerospace/Auto



Weight reducing fuel lines; heat/chemical resistant wire coatings

Semiconductor Manufacturing



Providing pure environments to transport/store harsh chemicals

Alternative Energy



Insulation properties, durability, and safety enabling lithium batteries, fuel cells and photovoltaic solar panels

Fluorotelomer-based Products

Properties
Provided

- Surface modification & protection
- Water & oil repellency
- Soil resistance and release
- Wetting and spreading

Chain
Length

- Major manufacturers moved to short-chain fluorotelomer-based products

Fluorotelomer-based Products

Healthcare



Garments/Drapes that Protect Against Disease Transmission

First Responder Gear



Treatments and Bulletproof Vests that Maintain Performance in Extreme Conditions

Specialty Paper



Oil/Grease Resistant Food Packaging that is Recyclable, Increases Shelf-Life, Reduces Packaging

Upholstery



Textiles with Water/Oil Repellency, Stain Resistance and Soil Release and Longer Useful Life

Paints and Varnishes



Durable construction materials coatings

Fire Fighting Foam



Class B (Flammable Liquid) Foams with Shorter Extinguishing Time and Burnback Resistance

About Short-Chain Fluorotelomer-based Products

- Accepted for use in consumer products by regulators globally
- Recognized as meeting relevant regulatory standards
- Polymers widely understood not to present toxicity concerns
 - Not bioavailable; not a focus of regulators
- Hazard is characterized by their degradation products (namely PFHxA)
- Supported by a robust body of data
- Studies show short-chain fluorotelomer-based products do not present significant adverse impacts

Short-Chain Fluorotelomers and Acids: Toxicity Data Shows Significantly Higher No Effect Levels

- Extensive suite of toxicity studies available on PFHxA
 - Does not bioaccumulate and NOAEL is ~50x higher than PFOA

Toxicity Endpoint	Example PFHxA studies	Results
Cancer	✓ Klaunig 2015	No
Repro/Developmental	✓ Loveless 2009; Iwai 2014; 2019 [^]	No [^]
Chronic systemic toxicity	✓ Klaunig 2015	NOAEL = 30 mg/kg-day*
Sub-chronic systemic toxicity	✓ Loveless 2009; Chengelis 2009	NOAEL = 100 mg/kg-day
Endocrine disruption	✓ Borghoff 2018	No
Bioaccumulation	✓ Conder 2008	No

Summary

- **Not carcinogenic; not damaging to DNA, neither genotoxic nor mutagenic**
- **Neither a developmental nor reproductive toxicant; Not an ED**
- **Rapid bioelimination, not bioaccumulative**
- **Very low incidence of detection and quantification in serum**
- **Not expected to be harmful to human health or the environment at environmentally relevant concentrations**

*NOAEL of 30 mg/kg-day is for female rats, given a LOAEL from the same study of 200 mg/kg-day for kidney effects. For PFOA, USEPA considered multiple rodent studies, including two in rats: LOAEL of 1 mg/kg-day (Butenhoff 2004) and NOAEL of 0.64 mg/kg-day (Perkins 2004).

[^]Addendum to 2014 Publication Published **2019** *IJT*

Industry Best Practices - Reduces Environmental Release and Potential For Exposure



**Fire
Fighting
Foam
Coalition**

**Best Practice
Guidance for
Use of Class B
Fire Fighting Foams**

March 2016

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1. Use the product only when necessary
2. Use only what you need
3. Reuse/recycle residual liquids if possible
4. Minimize waste and emissions
5. Dispose of all chemicals properly



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**Guidance for Best Environmental
Practices (BEP) for the
Global Apparel Industry**

Including Focus on Fluorinated Repellent Products



May 2014