

Understanding FluoroTechnology

Per- and polyfluoroalkyl substances ([PFASs](#)) is a term that describes a wide and diverse array of chemistry containing fluorine and carbon. This class of chemistry is sometimes inaccurately called “PFCs.” Specific interest and concern from regulators, environmental groups, the media and other stakeholders is focused on a subset of PFAS chemistry: Long-chain perfluoroalkyl acids (PFAAs) and substances that may degrade to form them (known as “precursors”). It is often incorrect to make general statements about properties of the broad family of PFASs, particularly when discussing their safety and environmental impacts.

This document explains some key FluoroTechnology terms and depicts those in an overview visual:

- Long-chain PFAAs
- Short-chain PFAAs
- Non-polymeric and Polymeric Fluorotelomer-based Products
- Fluoroplastics and Fluoropolymers

LONG-CHAIN PFAAS

[Long-chain](#) PFAAs include:

- perfluoroalkane sulfonic acids (PFSAs) with carbon chain lengths of 6 and higher, including perfluorohexane sulfonic acid (PFHxS) and perfluorooctane sulfonic acid (PFOS).
- perfluorocarboxylic acids (PFCAs) with carbon chain lengths of 8 and higher, including perfluorooctanoic acid (PFOA).

Precursors of these substances may be produced or present in products. Examples are long-chain perfluoroalkyl sulfonyl fluoride-based raw materials and long-chain fluorotelomer-based raw materials.

The focus of regulators in many regions of the globe, manufacturers and downstream users is action on long-chain PFAAs and substances or products that may degrade to form them (precursors). Through the [U.S. EPA 2010/15 PFOA Stewardship Program](#), major manufacturers in the U.S., Europe, and Japan have globally phased out long-chain PFAAs and their precursors, moving to alternatives such as, but not limited to, short-chain fluorotelomer-based products. Major downstream users have followed suit. Production and use of long-chain PFAAs continues outside those regions by companies that have not made such stewardship commitments.

SHORT-CHAIN PFAAS

Short-chain PFAAs include:

- PFSAs with carbon chain lengths of 5 and lower, including perfluorobutane sulfonic acid (PFBS)
- PFCAs with carbon chain lengths of 7 and lower, including perfluorohexanoic acid (PFHxA).

Precursors of these substances may be produced or present in products. Examples are short-chain perfluoroalkyl sulfonyl fluoride-based raw materials and short-chain fluorotelomer-based raw materials.

With the phase out of production and use of long-chain PFAAs, responsible industry and downstream users have transitioned to alternatives, including short-chain products that cannot degrade to form long-chain PFAAs. Regulators have held industry to high standards and increased data requirements to ensure that the alternatives are well studied and safe for their intended use. Consequently, short-chain alternatives are some of the most robustly studied new chemicals introduced to the market. Substantial [toxicity](#) and environmental testing data have been generated over several years and submitted to regulators.

FLUOROTELOMER-BASED PRODUCTS

Fluorotelomer-based Products can be non-polymeric or polymeric, and can be based on long- or short-chain intermediates. Fluorotelomer-based raw materials are considered precursors to PFAAs. For example, a long-chain fluorotelomer-based raw material can degrade to form a long-chain PFAA. Stewardship Program participants offer only short-chain fluorotelomer-based products.

Non-Polymeric Fluorotelomer-based Products are fluorotelomer-based derivatives, such as fluorinated surfactants used in firefighting foams and as coatings additives, and fluorotelomer-based raw materials used as feedstock to produce polymeric fluorotelomer-based substances.

Polymeric Fluorotelomer-based Products are also known as “side-chain fluorinated polymers.” These products consist of hydrocarbon backbones with polyfluoroalkyl side chains that stick out like teeth on a comb. These polymers are used to treat textiles, carpets, nonwovens and paper to provide water, soil, oil and stain resistance. The polymers are of a sufficient molecular weight that they are not readily bioavailable or biodegradable, similar to other polymers such as polyethylene. The short-chain polymeric fluorotelomer-based products are safe for their intended uses, and offer a significantly improved health and environmental profile over the long-chain fluorotelomer-based products.

ABOUT THE FLUOROCOUNCIL:

The FluoroCouncil is a global membership organization representing the world’s leading manufacturers of fluoropolymers, fluorotelomers, and other fluorinated surfactants and surface property modification agents. Its member companies are Archroma Management LLC, Arkema France, Asahi Glass Co., Ltd., Daikin Industries, Ltd., Solvay Specialty Polymers, The Chemours Company LLC, Dynax Corporation (*provisional*), and WL Gore (*provisional*).

For more information about the FluoroCouncil, visit www.fluorocouncil.org or contact Jessica Bowman at +1 (202) 249-6737 or Jessica_Bowman@fluorocouncil.org.

FLUOROPLASTICS AND FLUOROPOLYMERS

Fluoropolymers are polymers that have a carbon backbone and contain fluorine atoms directly attached to these carbons. They are specialty plastics, elastomers and liquid polymers used in applications such as wire and cable coatings; linings for pipes, tanks and equipment in chemical and pharmaceutical manufacturing; lubricants; and non-stick cookware. In these applications, they provide important properties such as heat and chemical resistance, and non-stick and unique dielectric properties.

Examples of solid fluoropolymers (fluoroplastics) are PTFE (polytetrafluoroethylene) and PVDF (polyvinylidene fluoride) whereas liquid fluoropolymers are (per)-fluoropolyethers.

Typically, fluoropolymers are of a sufficient molecular weight that they are not bioavailable. They are extremely stable and not biodegradable under normal environmental conditions, similar to other polymers such as polyethylene, etc. Therefore, fluoropolymers themselves have not been the focus of regulatory efforts. Additionally, any use of a fluoropolymer in a food contact application, such as cookware, is reviewed by regulators, such as the U.S. Food and Drug Administration and the European Food Safety Authority, which have all confirmed that fluoropolymers are safe for their intended uses in nonstick cookware coatings and certain food packaging materials.

ABOUT THE FLUOROPOLYMER GROUP OF PLASTICEUROPE:

The Fluoropolymer Product Group of PlasticsEurope is a professional representative body for the European fluoropolymers manufacturers in Europe. Its member companies are AGC Chemicals Europe Ltd., Chemours International Operations sarl., WL Gore & Associates GmbH, Solvay Specialty Polymers SPA., Dyneon GmbH., Arkema, Daikin Chemical Europe GmbH.

For more information about the Fluoropolymer Product Group of PlasticsEurope, visit www.plasticseurope.org or contact Patricia Vangheluwe at +32 (0) 2 676 17 32 or patricia.vangheluwe@plasticseurope.org.



PFAS Overview

