Stefan Posner
stefan.posner@ri.se

About PFAS in short - definition

Content

Introduction

Per- and polyfluorinated substances (PFASs) constitute a large group of man-made very stable substances, which have been used in industrial and consumer applications for more than six decades. OECD / UNEP has identified about 4700 PFAS substances, where we have limited or no knowledge of most of these substances.

Figure 1: *The basic structure of PFAS*

Note:
Green: *is the perfluorinated tail where the number of carbons decide whether this is a shorter or a longer chain PFAS,* $C_n F_{2n+1}$ -
Blue: *is the spacer that decides whether we have a telomere or an ECF based PFAS*
If the spacer is $CH_2 – CH_2$ *- then we have a telomer (the telomerization/"DuPont" Process),*
If the spacer is a SO_2 *- we have an ECF based PFAS (the ECF / "3M" process)*
Grey: *could be a vast variety of non-fluorinated functional groups depending on the intended use of the fluorinated surfactant.*

Initially, most attention was paid to perfluorooctane sulphonate (PFOS) and perfluorooctanoate (PFOA), two PFASs which are the ones most studied in terms of their toxic properties and the presence in the environment and in the blood of man. In recent years, other PFASs have also been recognized.

Over the past twenty years, PFAS has gained increased attention globally, as they have been demonstrated in relatively high levels in animals, such as polar bears in the Arctic. The substances are also found in human blood, even in new-borns. There is much to suggest that, the longer the high-fluorinated carbon chain, the higher the toxicity and the greater the potential for bioaccumulation.

Some PFASs decompose very slowly or not at all in nature, while others are transformed into extremely persistent substances. Many of them are bioaccumulate, i.e. they accumulate in living organisms. Because PFASs are fat- and water-repellent, they are not stored in fatty tissue as other bio accumulative substances. They bind to proteins and stored in other organs of the body, for example in the liver and in the blood.

The PFASs studied have shown some to be carcinogenic, reproductive and / or immuno toxic (affecting our ability to defend ourselves against diseases).

PFASs are a growing threat to our drinking water and food during continued use as they do not break down and are increasingly being enriched in the environment and finally in living organisms such as man, which ultimately results in the toxic effects these substances can cause.

PFAS terminology

The current terminology for PFAS is illustrated, as described by the OECD and other related recent publications the past decade. The general term ‘‘perfluoroalkyl(ated) substance’’, with the acronym PFAS.

PFAS are:

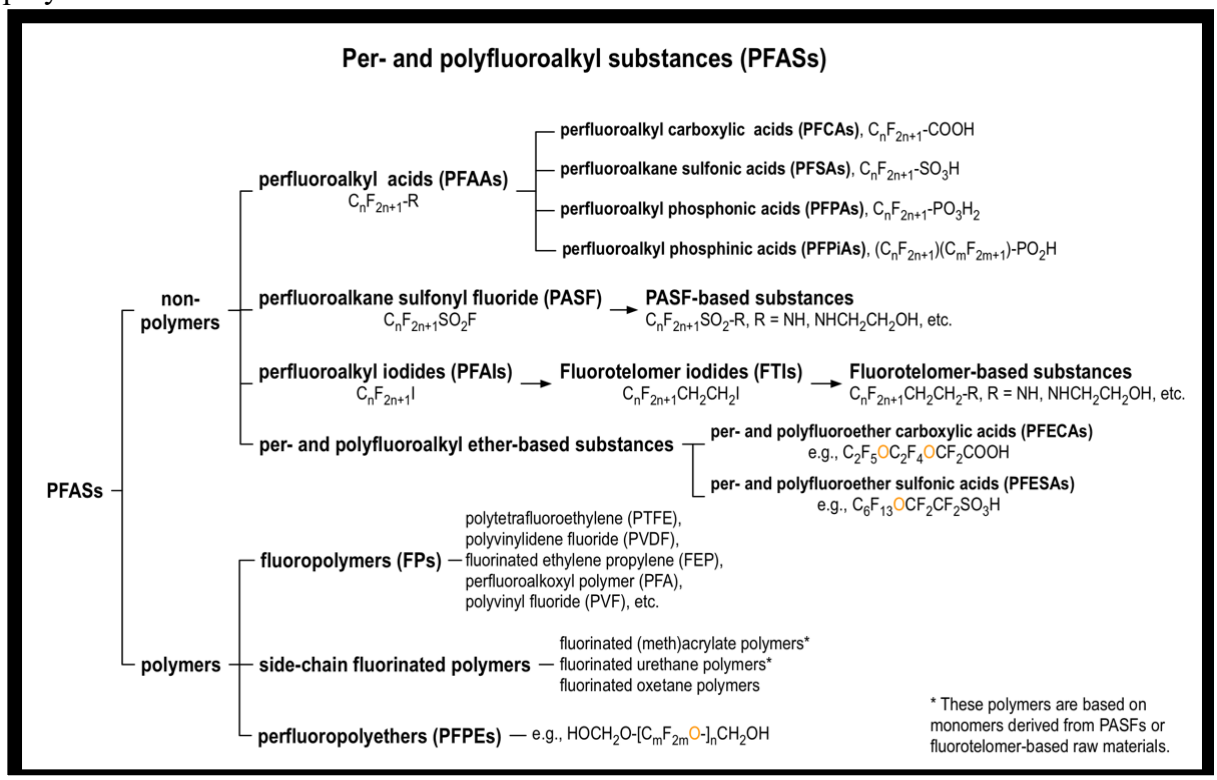
- either linear or branched chemicals that contain one or more perfluoroalkyl moieties, $-C_nF_{2n+1}$
- or cyclic and/or ethers, that additionally include the generic perfluoro moiety formula $-C_nF_{2n}$.
- any chemical that is addressed by name as ***---perfluoro—***

In the past, many authors began using the acronym PFC as short for per- and polyfluorinated chemicals and have defined it in many ways where the meaning of the acronym PFC is unclear and not well defined since it can also apply to perfluorocarbons, used in official Kyoto Protocol documents. Since its adoption of the Kyoto Protocol in 1997 the PFC abbreviation specifically designate to one of the families of greenhouse gases regulated by this important multilateral international agreement. However, both PFCs and PFASs belong to the overall family of fluorinated chemicals and, hence, are today considered too closely related to share a common acronym.

In recent sources the family of PFAS chemicals and polymers are described as illustrated in figure 2 below, where some are addressed as non-polymers and some as polymers.

Stefan Posner
stefan.posner@ri.se

Figure 2. Overview of the current PFAS chemistry and terminology of polymers and non-polymers.



Long chain vs short chain PFAS

PFASs, especially the perfluoroalkyl acids and their anions, are frequently referred to as ‘‘long-chain’’ or ‘‘short-chain’’. The OECD/UNEP currently defines ‘‘long-chain’’ as:

- Perfluoroalkyl carboxylic acids with eight carbons and greater (i.e. with 7 or more perfluorinated carbons) and, perfluoroalkane sulfonates with six carbons and greater (i.e. with 6 or more perfluorinated carbons).

- The ‘‘long-chain’’ definitions for PFCAs and PFSAs are different in number of C atoms because a PFSA (e.g. PFHxS, $C_6F_{13}SO_3H$) with a given number of carbons (6 in the example given) has a greater tendency to bioconcentrate and/or bioaccumulate than a PFCA with the same number of C atoms

Although the OECD definition does not include perfluoroalkyl substances other than carboxylates and sulfonates, one may consider that a perfluoroalkyl chain with 7 or more C atoms, e.g., C_7F_{15}–, is, in any case considered as ‘‘long’’.

Stefan Posner
stefan.posner@ri.se

Some key actions – Zurich Policy meeting 2017[1]

In November 2017 the Swiss Government hosted an international policy meeting among governments and scientists to conclude a roadmap for improved understanding mapping and phase out of PFAS by regulatory means in the coming years.

Some of the key conclusions from this meeting are listed below.

- Coordinated Scientific and Regulatory Efforts
- A Grouping Approach for Addressing PFASs
- Novel Schemes to Place Specific Focus on High (or Very High) Persistence
- Further Information on PFASs to Fill in Critical Knowledge and Data Gaps
- Working toward a Phase out of Nonessential Uses of PFASs and Developing Safe Alternatives
- Raising Awareness of PFAS-Related Issues among Policy-Makers and the General Public
- Developing and Improving PFAS Analytics

Essential use by definition

When there are reasons for continued use of Chemicals of Concern (CoC) e.g PFAS and its alternatives, some criteria need to be fulfilled to declare these uses as essential

- for health and life protection
- when critical for the functioning of society
- when no available technically and economically feasible alternatives or substitutes, that are acceptable from the standpoint of environment and health.

If one or more of these criteria are not met, the use cannot be considered as essential.

In short about the author to this text; Stefan Posner

Polymer and textile chemist with over 30 years' experience in research on chemicals in textiles and polymeric materials in cooperation with international companies, authorities and academia in several international projects over the years.

Stefan is since many years working with legal preparatory work on chemicals for UNEP Stockholm Convention, EU Commission and several National Authorities and is deeply involved in research to substitute hazardous chemicals with a certain focus on highly fluorinated substances and flame retardants but other groups of hazardous chemicals have been in focus in the past.

[1] https://ehp.niehs.nih.gov/doi/10.1289/ehp4158