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Opinion

A World without PFAS?

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are man-made compounds present in many industrial processes and consumer products. The largest volume PFAS are refrigerants and fluoropolymers. These compounds are an integral part of our modern society and are likely to be part of that society in essential applications for years to come. Nevertheless, major concerns on PFAS are expressed over their contributions to global warming and their immunotoxicity in human beings. Therefore, a new pragmatic equilibrium between the unique properties of PFAS and their impact on the earth's ecosphere, including all living organisms, needs to be found in the near future, restricting or eliminating manufacturing and applications of non-essential uses and giving time-limited derogations or even exemptions to critical applications.

Keywords: Per-and polyfluoroalkyl substances; PFAS; Essential uses; Environmental impact; Closing the fluorine loop

Abbreviations: GWP: Global Warming Potential; HFC: Hydrofluorocarbon; HFO: Hydrofluoroolefin; PFAS: Per- and Polyfluoro Alkyl Substances; PFCA: Per- and polyfluoroalkyl Acid; PFOA: Perfluorooctanoic Acid; PFOS: Perfluorooctane Sulfonic Acid; TFA: Trifluoroacetic Acid

Introduction

According to the definition of the European Chemical Agency (ECHA) and with a few exemptions, PFAS are organic materials containing at least one trifluoromethyl group or one difluoromethylene group [1]. An important date for the existential question on PFAS is 7 February 2023, when ECHA published a proposal to significantly restrict or even ban the entire class of PFAS in Europe. Derogations for some sub-classes or applications may be allowed. Countries like Norway, Sweden, Denmark, Germany and the Netherlands are drivers behind the initiative. Since then, PFAS have become a hot topic, especially in Europe, and it will remain one for years to come.

Discussion

PFAS in scope

Volume-wise, the most important PFAS by far are TFA (trifluoroacetic acid) and its derivatives, mostly salts. It is estimated that millions of tons are present in the earth's ecosphere, especially in the deep-sea oceans [2]. The origin is believed to be destruction of man-made PFAS over the past 90 years. As far as annual production is concerned, the most important PFAS subclasses are refrigerants and fluoropolymers. PFOA and PFOS, which are the compounds mentioned the most in the literature, are only minor members of the PFAS-family [3].

In the literature, PFAS are often described as "for ever chemicals " and " bioaccumulative in humans " [4], whereas in reality, refrigerants (which make up about 65% of all currently made PFAS) break down relatively fast in the atmosphere (from days for HFO-1234yf to years for HFC-134a, [5]) and only long chain PFCA having a perfluoroalkyl group of more than 6 carbon atoms (which make up less than 1% of all PFAS) and their derivatives, accumulate in

humans, having a half-life time in humans of several years, while that of TFA is about 1 day [3]. Nevertheless, all PFAS in combination with their degradation products, are considered persistent.

A world without PFAS? The pro's and contra's

PFAS have a unique set of properties, such as for example excellent thermal/chemical/electrical/biological stability, high lubricity and non-stick properties, low surface energies and biocompatibility and therefore can be used in a broad portfolio of high-tech applications, such as cooling of cars, buildings and data centers, in transportation devices such as cars, truck, ships or planes in energy systems such as solar panels, nuclear installations or batteries or in medical drugs and health care tools [6]. Based on these important uses, PFAS have become important parts of our modern society.

But, the extreme stability of PFAS leads to persistence of many PFAS-family members. In combination with a strong IR absorption, some particular PFAS become very potent greenhouse gasses. Persistence and bioaccumulation lead to negative health effects of certain PFAS-subclasses, especially the long chain perfluoroalkyl acids and their derivatives, resulting in immunotoxicity, even at low concentrations [3]. Based on the impact on environment and living species, we can no longer continue using PFAS as we are today.

Finding a new equilibrium between unique properties and ecosphere impact of PFAS

A nuanced and pragmatic equilibrium may be based on the combination of several measures including:

A. Selection of essential uses [7], such as health care or energy related applications and restricting or even banning all the rest. Some examples of essential uses include binders for battery cathodes, coatings for nuclear and chemical installations, semiconductor and chip manufacturing, medical drugs and devices, high voltage switch gear or specialty refrigeration. An important component for this measure is finding and implementing PFAS-free alternatives.

B. Closing the fluorine-loop for essential applications from R&D over manufacturing up to end-of-life [8]. New business models will be needed such as recycling or leasing chemicals.

C. Cleaning up historical and current PFAS contaminations by effective, cost-efficient, pragmatic, fast and large-scale remediation techniques. Remediation should include not only capturing (for example, by absorption, separation or fractionation), but also complete mineralization (break-down to fluorides) and recycling of the formed fluorides in the (fluoro) chemical industry [9].

Some final thoughts

Restriction on PFAS-manufacturing and applications will come soon, probably already in 2027, especially in Europe. It will be critical that also imports from outside Europe fall under the same restrictions/bans. There is still a huge need for more research to reach this new, pragmatic and dynamic equilibrium. Not only improved analytical procedures for all individual PFAS (and thus not only for the somewhat 500 products out of the over 10.000 PFAS, that can be measured accurately now a days), but also toxicological studies on individual components and especially, mixtures there of industrial scale pragmatic remediation methods and fluorine-free alternatives are needed as soon as possible.

Conclusion

Based on the needs of our modern society, but also taking into account the environmental concerns, it is expected that for the near future, PFAS will remain present in our daily life's in essential applications until no-regret replacements can be implemented to create a better and safer world for future generations.

Conflict of Interest

No financial support was obtained. No conflict of interest exists.

References

1. Secundo L, Metrangelo P, Dichiarente V (2025) Current approaches in the classification of PFAS: An Overview. Chem Asian J 20(9): e202500127.
2. Solomon K, Velders G, Wilson S, Matronich S, Longstreth J, et al. (2016) Sources, fates, toxicity, and risks of trifluoroacetic acid and its salts: Relevance to substances regulated under the Montreal and Kyoto Protocols. J Toxicol Environ Health B Crit Rev 19(7): 289-304.
3. Dams R, Ameduri B (2025) Essential Per- and Polyfluoroalkyl Substances (PFAS) in our society of the future. Molecules 30(15): 3220.
4. Wee S, Aris AZ (2023) Revisiting the "forever chemicals ", PFOA and PFOS in drinking water. NPJ Clean Water 6: 57.
5. Overview of Greenhouse Gasses.
6. Glüge J, Scheiringer M, Cousins I, De Witt J, Goldenman G, et al. (2020) An overview of the uses of per- and polyfluoroalkyl substances (PFAS). Environ SCI Proc Impacts 22(12): 2345-2373.
7. Cousins I, Goldenman G, Herzke D, Lohmann R, Miller M, et al. (2019) The concept of essential uses for determining when uses of PFAS can be phased out. Environ Sci Proc Impacts 21(11): 1803-1815.
8. Dams R, Hintzer K (2017) Chapter 1: Industrial aspects of fluorinated oligomers and polymers. In: Ameduri B, Sawada H (Eds.), Fluorinated Polymers, Volume 2: Applications, Royal Society of Chemistry, London, UK.
9. Chambial P, Thakur N, Kushawaha J, Kumar R (2025) Per- and polyfluoroalkyl substances in environment and potential health impacts: Sources, remediation treatments and management, policy guidelines, destructive technologies and techno-economic analysis. Sci Total Environ 969: 178803.