Policy brief on PFAS

PFAS as one of the most persistent synthetic organic pollutants is an emerging environmental threat

Baltic Marine Environment Protection Commission

Policy briefs

What are PFAS?

Per- and polyfluoroalkyl substances (PFAS) are a large family of synthetic organic chemicals with diverse properties and uses. Since carbon-fluorine is one of the strongest chemical bonds, all PFAS or their degradation products are highly persistent in the environment, demonstrating tendency of accumulation. Due to their properties PFAS are actively used in industries such as metal plating, textile and manufacturing of fluoropolymers. These substances are also contained in products such as fire-fighting foam, hydraulic oil and ski waxes.

Environmental contamination by PFAS arises from various sources including facilities where these substances are manufactured or used for industrial production as well as releases from products containing them. Significant PFAS contamination has for example been found in groundwaters near fire-fighting training sites and airports, where the fire-fighting foams are continuously used. The relative importance of each source is temporally variable, specific to each substance and not well quantified. Some PFAS tend to be transported over long distances in air. Two 8-carbon PFAS compounds (PFOS and PFOA) are included in Stockholm Convention list of persistent organic pollutants.

Certain PFAS are known to cause toxic effects for reproduction and can harm the development of fetuses, others demonstrate to cause cancer. Some PFAS are also suspected of interfering with the human endocrine (hormonal) system. Due to their persistence PFAS tend to be accumulated in the environment. Though, long chained (6 or more fluorinated carbons) PFAS demonstrate bioaccumulation and sorption to sediments and soil, whereas short chain PFAS are more mobile in the aquatic environment. Some PFAS, so-called precursors, can also be transformed to other compounds of this group in the environment. Currently more than 4700 different PFAS are known, and as specific components are banned new substances from the same group are often used as a substitution.

Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are included in the HELCOM List of Priority Hazardous Substances, established by Recommendation 31E/1. 2021 Baltic Sea Action Plan considers per- and polyfluoroalkyl substances as contaminants of emerging concern. It addresses the problem by calling to introduce by 2027 measures based on the best available scientific knowledge and technologies to restrict the use and prevent releases of perfluorinated alkyl substances (action HL 21) and, particularly, to limit the use of firefighting foam containing per- and polyfluoroalkyl substances (PFAS) at sea and in the catchment area and promote sustainable alternatives (HL29).

PFAS sources in goods and products.
Source: EuChemS newsletter

Observed facts

Data on concentrations of fifteen compounds belonging to PFAS group, observed in the period from 2004 to 2018, was reported in response to HELCOM call for data on micropollutants in wastewater treatment plants (WWTPs). The data contains more than 3500 individual measurements of PFAS in influents, sludge and effluents from more than 200 wastewater treatment plants.

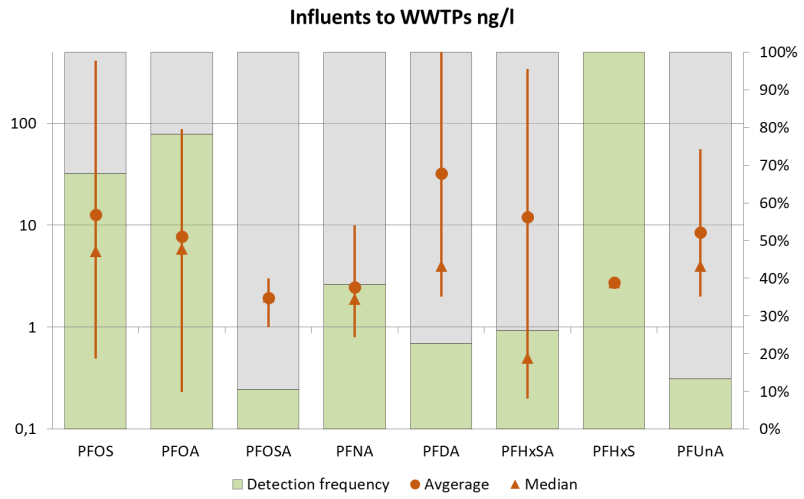
Detection frequency for reported PFAS greatly varies between the compounds, which is to large extent due to variation of analytical detection limits in a range of three orders of magnitude. In some cases, reported detection limits for individual

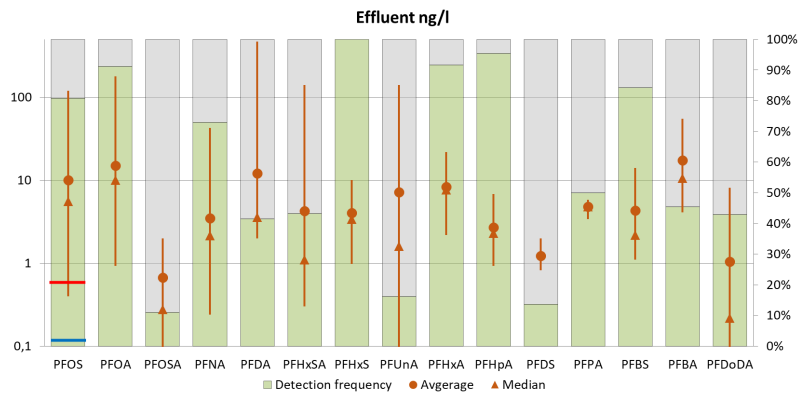
measurements are higher than the annual average Environmental Quality Standards (AA-EQS) established by the EU legislation which subsequently affects the quality of assessment results.

Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are the most frequently measured compounds of this group. They were reported for all three matrixes, being detected in more than 70% of samples and demonstrate one of the highest average concentrations among all reported compounds. Though, individual concentrations of some other compounds were observed at the same level, but scarcity of data does not allow for a reliable assessment.

In general, almost no reduction of concentrations in effluents compared to influents to WWTPs was observed. Even more, PFOA demonstrate remarkable increase of concentration in effluents, which might be the result of degradation of PFOA precursors during the wastewater treatment process. The highest average concentrations of PFOS in sludges and slight reduction of it in effluents compared to influents indicate that PFOS is slightly removed from liquid phase.

The EU legislation sets Environmental Quality Standards (EQS) only for PFOS in inland and marine waters. The average concentration of PFOS in effluents exceeds more than ten times the AA EQS for inland waters and almost hundred times AA EQS for marine environment. Exceedance of the EQSs reached three orders of magnitude in some individual samples.





Concentrations of PFAS in WWTP influents and effluents. Only concentrations above limits of quantification (LOQ) are reflected. Red lines indicate annual average Environmental Quality Standards (AA-EQSs) for inland surface waters and blue line for other surface waters (DIRECTIVE 2013/39/EU). EQS values are used here for indicative comparison but not for the assessment of contamination level.

Key messages

Data on concentrations of PFAS in influents, sludges and effluents from WWTPs compiled through the HELCOM call for micropollutants provides the most comprehensive information on releases of these substances to the aquatic environment from sewage systems in the Baltic Sea region.

The data demonstrates that several toxic substances belonging to PFAS are currently being released to the aquatic environment through wastewater treatment plants across the region and pose remarkable threat to the Baltic Sea marine environment due to their persistency and ability for accumulation, even though monitoring in the marine environment does not reveal exceedance of the Environmental Quality Standards at this moment.

Scarcity of observations together with insufficient quality of analytical procedures do not allow to assess prevalence of various types of PFAS (e.g. long-chained, short-chained etc.) in the effluents.

Conventional wastewater treatment is inefficient for removal of PFAS from wastewater. In some cases, transformation of substances from precursors might even lead to increasing of their concentrations during wastewater treatment process.

Systematic monitoring of PFAS, based on harmonised monitoring programmes, has to be organized across the Baltic Sea region, for the EU member states taking into consideration the established monitoring for the WFD and respective requirements. Analytical methods, providing sufficient quality of measurements, should be elsewhere applied for the monitoring.

Biological effects of PFAS should be further investigated to lay basis for the development of Environmental Quality Standards and subsequently safety requirements for potentially PFAS containing recycling products based on sludges from WWTPs.

General regulation, including restrictions, for the whole PFAS group needs to be developed, based on the best available scientific knowledge to cease continuous contamination of the aquatic environment, and prevent substitution of one toxic PFAS compound by another.

References

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