Per- and Polyfluorinated Substances (PFAS)

A wide range of persistent substances!

PFAS (per- and polyfluorinated substances), sometimes called highly fluorinated substances, is a large class of chemicals that today may comprise more than 9000 compounds. During the last decade, the exposure and environmental as well as health effects caused by these "forever chemicals" have received increasing attention. This applies in particular to drinking water that has been contaminated at fire training sites. At the same time, PFAS content in other matrices such as soil, food and products has come more into focus. Eurofins offers a wide range of analyses that can be used in the work of identifying this group of chemicals.

Background

Fluorinated substances (PFAS) have many uses, e.g. in fire extinguishing foam (AFFF= Aqueous Film Forming Foam), waterproofing of paper and textiles, in polish products, in the engineering, photo and electronics industries (e.g. metal plating, hydraulic fluids), and as a raw material for non-stick materials (plastics etc). PFAS is associated with a number of health effects, for example, effects on the thyroid gland, liver and fat metabolism. In addition, the hormonal and the immune systems can be affected by long-term exposure, but further research is needed. However, PFAS is not stored in adipose tissue in the same way as many other organic pollutants. Another difference is that PFAS occurs in the form of both mono- and polymers, even though it is the monomers that are of primary importance in the environment.

Production of the two "classic" PFAS substances PFOS (perfluorooctane sulfonate) and PFOA (perfluorooctanoic acid), both with 8 carbons, began as early as the 1940s. Both substances are persistent with very long degradation times. PFOS, PFOA and more recently PFHxS are POPs (persistent organic pollutant) substances in the Stockholm Convention, and long PFCAs (C9-21) are likely to follow. Eurofins has analyzed PFAS for many years in matrices such as water and soil as well as biota and food. Both range and accreditation are extensive in combination with low reporting limits (LOQ).

Water

A major difference between PFAS and many other organic pollutants is that most of the substances have a relatively high water solubility, which applies specially to fluorinated sulfonates and acids (e.g. PFOS approx. 550 and PFOA > 3500 mg/l). The aquatic systems therefore often become a sink for these compounds. Since 2013, PFOS is one of the priority substances in the Water Framework Directive with permitted annual average values of 0.13 and 0.65 ng/l (2013/39/EU). In the new proposal (COM(2022) 540 final) a value of 4.4 ng/l PFOA eqv for the sum of 24 PFAS is given. The same PFAS24 and limit are suggested for the groundwater directive (GWD). This has now been intro-duced as a threshold in SE regulation SGU-FS 2023:1. For PFOS Eurofins can manage down to 0.039 ng/l.

Several cases of contaminated drinking water sources have been detected over the last 10 years. Against this background, national food administrations have introduced guideline values e.g. in Sweden (SE) and Denmark (DK). EU's new drinking water directive (EU 2020/2184; DWD) and EFSA's (EU Food Safety Authority) TWI (tolerable weekly intake) value have further accelerated the development. In DK and SE limit values for PFAS4 (PFOA, PFOS, PFNA, PFHxS according to EFSA) of 2 and 4 ng/l have been adopted. The same applies to PFAS20 according to DWD (limit 100 ng/l) with the addition of 6:2 FTS and PFOSA in DK and the former in SE. In Norway (NO) the 12 PFAS on the priority list of the Environment Agency (Miljødirektoratet) are in focus together with six precursors from an earlier list. In addition, it is likely that the DWD PFAS20 limit will be enforced (Mattilsynet). The same is the case in Finland.

In DK the same guideline values are used for groundwater as drinking water (Miljøstyrelsen). SGI (Swe Geotech Inst) has proposed a value for groundwater at contaminated sites based on PFAS4 (2 ng/l). Eurofins provides both PFAS20-22 and a special PFAS4 pack with extra low LOQ (0.1 ng/l) for clean water.

Soil, sludge and waste

Contaminated areas around e.g. fire training sites have been identified in several places in the Nordics. In SE SGI has calculated new prel guideline values for sensitive (KM; 0.25) and less sensitive (MKM; 1.2 µg/kg DM) land use for PFAS4. In DK there are two soil quality criteria, one for PFAS4 (10) and one for PFAS22 (400 µg/kg DM). In Norway there is a standard (norm) value for PFOS of 100 that likely will be lowered to 2 µg/kg DM, and there are additional EQS values for sediment, down to 0.23 µg/kg DM for PFOS and 71 for PFOA (Miljødirektoratet, 2020).

When using PFAS-containing products, these substances can end up in wastewater and sludge. In DK, the same guideline values are applied for sludge as for soil. A similar approach is found in Norway where the same value as for soil (100 µg/kg DM) is set as max value for PFOS, PFOA and other PFAS (NIBIO, 2019). In the Swedish certification program REVAQ a "risk criterion" of 120 µg/kg DM is given for PFOS in sludge.

When it comes to waste there may also be a need to determine PFAS. This applies not least to PFOS, which in the so-called POP regulation (EU 2019/1021) has a "low-POP" value of 50 mg/kg. The same has been proposed in the EU for PFOA and PFHxS, both with a limit value of 1 mg/kg. Eurofins can both analyze different waste fractions and perform customized leaching tests for PFAS.

Biota and food stuffs

EFSA's TWI value for PFAS4 of 4.4 ng/kg body weight/ week from 2020 has raised the awareness of food, not at least fish. However, research shows that crops can take up PFAS to some extent too. Limit values within the EU for PFAS4 (individual and sum) have been enforced, (EU) 2022/2388. There is also a recommendation for a screening within the union 2022-25 ((EU) 2022/1431). In the Water Framework Directive, in addition to water, there is a limit value for biota (fish) of 9100 ng/kg PFOS and in the new proposal PFAS24 at 77 ng/kg PFOA eqv. Longer PFAS molecules (>C6-C8, depending on structure) are usually considered bioaccumulative and therefore important to determine in biota/food. Certain precursors are also relevant, e.g. PFOSA, that can form PFAS4. Eurofins provides a complete range for these types of samples with leading LOQs.

Products

In various studies, everything from fire-fighting foam (AFFF) to greaseproof paper, ski wax, cosmetics and textiles have been shown to contain PFAS. PFOS has been banned in the EU since 2006 and there are restrictions for PFOA and C9-C14 PFCA. These plus three more are also on the REACH candidate list (SVHC). Moreover, ECHA has proposed bans for PFAS in AFFF and "PFAS as a group". Eurofins can offer both "compliance testing" of banned/restricted PFAS as well as a wide selection of other substances with low LOQ.

As there are thousands of different PFAS there might be a need to show the possible occurrence. This may e.g. relate to the DK ban on fluorinated substances in food packaging (FCM) and programs such as the Nordic Ecolabel. Eurofins can provide TOF (total organic fluorine) analysis as a total measure of both mono- and polymers. The method is developed for paper, contact us regarding other matrices.

Analytical portfolio

Eurofins can analyse around 50 PFAS. This includes "regular" sulfonates/carbonates, telomeres etc. A number of so-called PreFOS (PFOS precursors) can be determined as well as some neutral PFAS e.g. telomer alcohols and "novel" PFAS such as GenX, (A)DONA, F-53B and PFECHS. Linear and sum of branched forms can be reported. The range includes EU PFAS4, DWD20, SLV21, DK22 and UK DWI47. TOP (total oxidizable precursors) is offered for soil and water. The methods are accredited and most compounds/matrices. Delivery times (TAT) are short (5-10 working days) and there are different express options (times may vary in each country).

PFAS - Per and polyfluorinated substances (water, soil/sediment/sludge, biota/food)

Perfluorinated butane acid (PFBA)
Perfluorinated pentane acid (PFPeA)
Perfluorinated hexane acid (PFHxA)
Perfluorinated heptane acid (PFHpA)
Perfluorinated octane acid (PFOA)
Perfluorinated nonane acid (PFNA)
Perfluorinated decane acid (PFDA)
Perfluorinated undecane acid (PFUnA/PFUdA)
Perfluorinated dodecane acid (PFDoA)
Perfluorinated tridecane acid (PFTrA)
Perfluorinated tetradecane acid (PFTA)
Perfluorinated hexadecane acid (PFHxDA)
Perfluorinated octadecanoic acid (PFODA)[1]

Perfluorinated 1-propane sulfonate (PFPrS)[1]
Perfluorinated butane sulfonate (PFBS)
Perfluorinated pentane sulfonate (PFPeS)
Perfluorinated hexane sulfonate (PFHxS)
Perfluorinated heptane sulfonate (PFHpS)
Perfluorinated octane sulfonate (PFOS)
Perfluorinated nonane sulfonate (PFNS)
Perfluorinated decane sulfonate (PFDS)
Perfluorinated undecane sulfonate (PFUnDS)
Perfluorinated dodecane sulfonate (PFDoS)
Perfluorinated tridecane sulfonate (PFTrDS)

Perfluorinated octane sulfonamide (PFOSA)
Perfluorinated hexane sulfonamide (PFHxSA)[1]
Perfluorinated butane sulfonamide (PFBSA)[1]

N-ethylperfluorooctanesulfonamide (EtFOSA)
N-ethylperfluorooctanesulfonamido acetic acid (EtFOSAA)
N-ethylperfluorooctanesulfonamido ethanol (EtFOSE)
N-methylperfluorooctansulfonamide (MeFOSA)
N-methylperfluorooctanesulfonamid acetic acid (MeFOSAA)
N-methylperfluorooctanesulfonamido ethanol (MeFOSE)
Perfluorooctanesulfonamidoacetic acetic acid (FOSAA)

4:2, 6:2 and 8:2 Fluorotelomer sulfonate (FTS)
10:2 Fluorotelomer sulfonate (FTS)[1]
6:2, 8:2 and 10:2 Fluorotelomer acrylate (FTA)[3]
4:2 Fluorotelomer alcohol (FTOH)[3]
6:2 and 10:2 Fluorotelomer alcohol (FTOH)[4,5]
8:2 Fluorotelomer alcohol (FTOH)[4]
3:3, 5:3 and 7:3 Fluorotelomer carboxylic acid (FTCA)[1]

2,3,3,3-tetrafluoro-2-(heptafluoropropoxy) propanoate (GenX; HFPO-DA)[4]
Perfluoro-2-[(propoxy)propoxy]-1-propanoate (HFPO-TA; semiquant)[3]
9-chlorohexadecafluoro-3-oxanonane sulfonate (6:2 Cl-PFAES; F-53B)[1]
11-chloroeicosafluor-3-oxaundecane sulfonate (8:2 Cl-PFAES)[1]
Dodecafluoro-3H-4,8-dioxanonanoate ((A)DONA)[1]
Perfluoro-4-ethylcyclohexane sulfonate (PFECHS)[1]
7H-Dodecanfluorheptane acid (HPFHpA)
Perfluorinated-3,7-dimethyloctane acid (PF-3,7-DMOA)[5]
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)[1]
Perfluoro-(2-ethoxyethane)-sulfonic acid (PFEESA)[1]
Perfluorohexylphosphonate (PFHxPA)[2]
Perfluoro-4-metohxybutane acid (PFMBA)[1]
Perfluoro-3-metoxypropionic acid (PFMPA)[1]
Capstone B (6:2 FTAB)[3]

[1] Water and biota/food only
[2] Water only
[3] Water only, separate method
[4] Separate method, all matrices
[5] Not biota/food

Compounds and matrices offered may vary on each national market

Orders

For more information on compounds, matrices, packages, etc see the homepage of each national Eurofins company (eurofins.dk etc). Sample vessels can be ordered online. If high levels are suspected, state this on the delivery note