PFAS – Passive Water Sampling with DGT

A Tool for Time-Weighted Monitoring

PFAS are a diverse group of organic contaminants widely detected in aquatic environments. Reliable monitoring of PFAS at low concentrations is essential due to their environmental persistence and potential toxicity. Diffusive Gradients in Thin Films (DGT) is a well-established passive sampling technique that enables in situ accumulation of dissolved contaminants over time. By integrating analyte uptake, DGT provides time-weighted average (TWA) concentrations, offering a representative assessment of water quality.

Background

PFAS (per- and polyfluoroalkyl substances) encompass a large class of anthropogenic chemicals characterized by their exceptional chemical stability, resistance to degradation, and mobility in aquatic systems. They originate from a wide range of industrial and consumer applications, including fire-fighting foams, textiles, and surface treatments, resulting in widespread environmental occurrence even in remote regions. Their persistence, potential for bioaccumulation, and toxicological relevance necessitate robust long-term monitoring strategies.

Passive sampling techniques have gained increasing importance for environmental monitoring as they accumulate the dissolved fraction of contaminants directly in situ. Passive samplers continuously collect analytes over extended deployment periods and may thus improve detection of temporal variations and episodic pollution events.

DGT is a kinetic passive sampler based on controlled diffusion of analytes through a well-defined diffusive layer to a binding phase with high affinity. A typical DGT device consists of a filter membrane, a diffusive gel and a binding layer such as weak anion exchange (WAX) resin. The uptake of analytes follows Fick's first law of diffusion and is governed by the diffusion coefficient (D), the thickness of the diffusion layer, the exposed area, and the deployment time. Diffusion coefficients for PFAS typically range on the order of 2–6.5 × 10^{-6} cm^2 s^{-1} at 25°C, depending on molecular size and structure, and are temperature dependent.

The time-weighted average concentration (TWA) is calculated from the accumulated mass using established DGT equations, providing quantitative results without the need for extensive site-specific calibration under appropriate flow conditions. This makes DGT suitable for convenient long-term monitoring of PFAS in freshwater, marine, and wastewater systems.

Sampling

The DGT technique is widely established for trace metals and provides comparable time-weighted measurements of the labile metal fraction. Similar deployment, handling, and storage procedures apply for DGT sampling of PFAS and thus combined monitoring strategies for PFAS and metals using similar field protocols can be achieved if required. The inclusion of a field blank is also recommended.

Handling and Preparation - DGT samplers are supplied in sealed plastic bags containing a small volume of electrolyte solution and must be stored refrigerated at approximately 4°C. Samplers must remain moist at all times and should only be removed from their packaging immediately prior to deployment. Clean handling procedures are essential; the white membrane surface must not be touched.

Deployment - Samplers are attached using a suitable line (e.g., fishing line >0.4 mm) and deployed in the water column, preferably in flowing water while avoiding excessive turbulence or air bubbles. The active sampling window must remain fully submerged throughout the deployment period. Accurate recording of deployment time (hours) and water temperature is essential. Monitoring of pH is recommended, with optimal performance typically within pH 5–9.

Exposure Time and Conditions - Typical deployment periods range from 3 to 21 days depending on target concentrations and required detection limits. Uptake rates are influenced by temperature, and therefore water temperature should be recorded to allow accurate calculation of diffusion coefficients. Biofouling is generally minimal for deployments up to two weeks.

Retrieval and Post-Sampling Handling - Upon retrieval, samplers should be removed carefully and rinsed with deionized or distilled water to remove adhering particles. The sampler should not be dried. After rinsing, it is placed in a clean, labelled PE or PP plastic bag with excess air removed and stored refrigerated (4°C) until shipment. Samples should be transported to the laboratory as soon as possible under cooled conditions. Deployment time (hours) and average temperature (°C) must be given on the order form.

Eurofins Testing & Analysis

Eurofins offers advanced analysis of PFAS accumulated in DGT samplers ensuring high sensitivity and selectivity. The analytical package includes 22 PFAS compounds with diffusion coefficients derived from DGT Research and peer-reviewed scientific literature, based on experimental data. Limits of quantification (LOQ) are established per sampler (ng/DGT) and recalculated to ng/L concentrations based on compound-specific D values, water temperature, and deployment duration.

PFAS package – DGT	Code
PFAS 22 DGT (incl ng/L calculation)	PLWDF

The extent of the 22 PFAS covers both common perfluoro-carboxylic acids (PFCA) and perfluorosulphonic acid (PFSA) with carbon chain lengths between C4-C13 (PFCA) and C4-C9 (PFSA) – see table. This range includes PFAS4 (PFOS, PFOA, PFHxS and PFNA) and other frequently observed PFAS in water such as PFBA, PFBS, PFPeA and PFHxA. In addition, three fluorotelomer precursor compounds 4:2 - 6:2 - 8:2 FTS and two sulphonamides PFBSA and PFOSA can be determined. The PFOA replacement chemical and fluoroether – GenX – is also offered. LOQs for ng per sampler are between 0.05-0.4 and computed optimal LOQs at 3 weeks deployment 0.13-1.6 ng/L (see table).

Table 1. Limit of quantification (LOQ) for 22 PFAS presented as ng/sampler and corresponding calculated concentration values in ng/L. Concentrations are derived at one- and three-weeks (w) deployment. A temperature of 25 °C is used in both cases.

PFAS – DGT Samplers	LOQ (ng/DGT)	LOQ 1 w (ng/L)	LOQ 3 w (ng/L)
Perfluorinated butanoic acid (PFBA)	0.15	1.2	0.38
Perfluorinated pentanoic acid (PFPeA)	0.05	0.41	0.14
Perfluorinated hexanoic acid (PFHxA)	0.05	0.46	0.15
Perfluorinated heptanoic acid (PFHpA)	0.1	0.84	0.28
Perfluorinated octanoic acid (PFOA)	0.3	3.1	1.0
Perfluorinated nonanoic acid (PFNA)	0.4	4.8	1.6
Perfluorinated decanoic acid (PFDA)	0.1	1.4	0.48
Perfluorinated undecanoic acid (PFUnDA)	0.1	2.0	0.65
Perfluorinated dodecanoic acid (PFDoDA)	0.05	0.92	0.31
Perfluorinated tridecanoic acid (PFTrDA)	0.05	1.2	0.40
Perfluorinated butane sulfonic acid (PFBS)	0.05	0.40	0.13
Perfluorinated pentane sulfonic acid (PFPeS)	0.05	0.42	0.14
Perfluorinated hexane sulfonic acid (PFHxS)	0.05	0.49	0.16
Perfluorinated heptane sulfonic acid (PFHpS)	0.05	0.44	0.15
Perfluorinated octane sulfonic acid (PFOS)	0.05	0.54	0.18
Perfluorinated nonane sulfonic acid (PFNS)	0.05	0.90	0.30
Perfluorinated butane sulfonamide (PFBSA)	0.05	0.51	0.17
Perfluorinated octane sulfonamide (PFOSA)	0.05	0.62	0.21
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	0.05	0.40	0.13
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	0.2	2.0	0.67
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	0.05	0.78	0.26
Hexafluoropropylene oxide dimer acid (HFPO-DA; GenX)	0.05	0.49	0.16

Orders

For ordering of DGT samplers, pricing information and delivery times please contact your local Eurofins laboratory or sales representative. To ensure availability and proper planning, *orders should be placed at least three weeks prior to the intended sampling campaign*.