

Sampling and Analysis for Per- and Polyfluorinated Alkyl Substances (PFAS)

TECHNICAL BULLETIN

Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and related per- and polyfluorinated alkyl substances (PFAS) have received a substantial amount of attention, not only because they are recognized as ubiquitous environmental contaminants, but also because these compounds persist, bioaccumulate and cause toxicity in some animal studies. PFAS are of particular interest recently because of their emergence as compounds of environmental concern at many sites across North America and around the world.

Because of the physical and chemical behaviour of PFAS in environmental samples (water, soils and tissue), they pose unique analytical challenges. These same physical and chemical characteristics extend these challenges to field sampling protocols and, if not taken into consideration, lead to unreliable sample integrity and data variability. Ultimately, analytical data will not be representative of the true site condition.

Background

PFAS are man-made chemicals that, because of their stability under extreme heat and chemical stress, as well as their surfactant properties, have been used in a variety of applications including:

- Industrial polymers (Teflon™)
- Stain repellants (Scotch Guard™)
- Aqueous firefighting foams (AFFF)

Of particular concern are perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) which are persistent in the environment and can bioaccumulate.

Regulatory Status

Canada

Health Canada has issued the following drinking water screening values for specific PFAS. In July 2018, after reviewing new studies suggesting that PFNA can cause adverse health effects at lower concentrations than previously thought, Health Canada lowered the drinking water screening value for perfluorononanoic acid (PFNA) to 0.02 µg/L.

PFAS Name	Acronym	Drinking Water Screening Value	
		(mg/L)	(µg/L)
Perfluorooctanoic acid	PFOA	0.0002	0.2
Perfluorooctanesulfonate	PFOS	0.0006	0.6
Perfluorobutanoic acid	PFBA	0.03	30
Perfluorobutane sulfonate	PFBS	0.015	15
Perfluorohexanesulfonate	PFHxS	0.0006	0.6
Perfluoropentanoic acid	PFPeA	0.0002	0.2
Perfluorohexanoic acid	PFHxA	0.0002	0.2
Perfluoroheptanoic acid	PFHpA	0.0002	0.2
Perfluorononanoic acid	PFNA	0.00002	0.02

Health Canada has also issued the following soil screening values for PFAS.

PFAS Name	Soil Screening Values (mg/kg)		
	Agricultural/ Residential/ Parkland Land Use	Commercial Land Use	Industrial Land Use
PFOA	0.85	1.28	12.1
PFOS	2.1	3.2	30.5

In its amended Contaminated Sites Regulations (CSR), British Columbia became the first jurisdiction in Canada to regulate PFAS in contaminated sites. Under the Stage 10 amendments to the BC CSR (November 1, 2017).

Matrix	PFOA (ug/L)	PFOS (ug/L)	PFBS (ug/L)
Soil	0.2	0.3	80
Water	0.2	0.3	80

United States

In addition to the USEPA issuing health advisories for acceptable levels of PFOA and PFOS for short term exposure, many States have established drinking water guidelines for PFOA and PFOS among other PFAS including replacement PFAS such as GenX.

Jurisdiction	PFOS	PFOA	PFBA	PFBS	PFHxS	PFNA	GenX
USEPA Office of Water	0.07 (combined)		N/V	N/V	N/V	N/V	N/V
USEPA Region 2	N/V	0.1	N/V	N/V	N/V	N/V	N/V
Alaska	0.6	0.4	N/V	N/V	N/V	N/V	N/V
California	0.2	0.4	N/V	N/V	N/V	N/V	N/V
Delaware	0.2	0.4	N/V	N/V	N/V	N/V	N/V
Illinois	0.2	0.4	N/V	N/V	N/V	N/V	N/V
Maine	0.56	0.13	N/V	N/V	N/V	N/V	N/V
Michigan	0.07 (combined)*		N/V	N/V	N/V	N/V	N/V
Minnesota	0.027	0.035	7	3	0.027	N/V	N/V
New Hampshire	0.2	0.4	N/V	N/V	N/V	N/V	N/V
New Jersey	0.013	0.014	N/V	N/V	N/V	0.013	N/V

*proposed value

Jurisdiction	PFOS	PFOA	PFBA	PFBS	PFHxS	PFNA	GenX
North Carolina	N/V	2	N/V	N/V	N/V	N/V	0.14*
Ohio	N/V	0.4	N/V	N/V	N/V	N/V	N/V
Oregon	300	24	N/V	N/V	N/V	N/V	N/V
Texas	0.56	0.29	N/V	N/V	N/V	N/V	N/V
Vermont	N/V	0.02	N/V	N/V	N/V	N/V	N/V

*proposed value

European Union

The UK Health Protection Agency (HPA) and the Department of Environmental Protection in Germany have advised the following maximum acceptable concentrations of PFOA and PFOS in drinking water:

Agency	PFOA (ug/L)	PFOS (ug/L)
UK HPA	10	0.3
German	0.1	(sum of PFOA and PFOS)

Sample Containers/Hold Times

Water

Samples should be collected in high density polyethylene (HDPE) bottles, provided by the laboratory, and fitted with an unlined (no Teflon) polypropylene screw cap. A minimum of 125 mL of sample is required for low level PFAS analysis. The sample hold time is 14 days with proper storage (1-6° C, minimum exposure to light). Sample containers should be filled completely, to minimize surface-to-volume ratios, thereby reducing the relative impact of adsorption to container walls.

In accordance with USEPA Method 537, chlorinated drinking water samples may require preservation with Trizma® at the time of sampling, to quench the effects of residual chlorine and to buffer the sample at a pH of approximately 7.

Soil and Tissue

Samples should be collected in high density polyethylene (HDPE) wide-mouth bottles, provided by the laboratory, and fitted with an unlined (no Teflon), polypropylene screw cap. A minimum of 50 g of sample is required. In the absence of any regulated sample hold time, Maxxam adheres to a 28 day hold

time for solids and tissues with proper storage (1-6° C, minimum exposure to light).

Because of the ubiquitous nature of PFAS compounds in many modern materials, all batches (lots) of PFAS sample containers provided by Maxxam are “proofed” by the laboratory to demonstrate that they are PFAS-free. Similarly, water used in the field to generate quality control (QC) samples should be PFAS-free. For a nominal fee, Maxxam will provide PFAS-free water which has been “proofed” by the laboratory and is certified to be PFAS-free.

Analytical Method

Maxxam provides analyses for PFAS on a diverse range of environmental matrices, including among others: aqueous firefighting foams (AFFFs), drinking water, groundwater, leachate, soil and other solids and tissue.

Low level water samples undergo solid phase extraction (SPE), to extract, clean up and concentrate the parameters of concern. The extract is then analyzed by isotope dilution liquid chromatography coupled with tandem mass spectrometry (LC/MS/MS).

Water samples having higher contaminant concentrations (often requiring dilution) may be analysed by direct injection isotope dilution LC/MS/MS.

Soil, solids and tissues are homogenized, and then undergo a solid/liquid extraction. Interferences are removed from the liquid extract using solid phase extraction (SPE). The resultant extract is then concentrated and analysed by isotope dilution LC/MS/MS.

Reported Parameters

Maxxam currently reports up to thirty two (32) PFAS including precursors and replacement PFAS (see attached list). Reporting limits (RLs) and method detection limits (MDLs) for

these parameters have been validated at the low parts-per-trillion (ppt).

Analytical Turnaround Time (TAT)

Standard TAT: 10 business days.

Priority TAT: By pre-arrangement only.

Laboratory Accreditation

Maxxam is accredited by the Standards Council of Canada (SCC), the US National Environmental Laboratory Accreditation Program (NELAP) and the US Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) for the analysis of PFAS in environmental matrices.

	Analyte	Acronym
Standard List: 17 PFAS	Perfluorooctanoic acid	PFOA
	Perfluorooctanesulfonic Acid	PFOS
	Perfluorobutanoic acid	PFBA
	Perfluoropentanoic acid	PFPeA
	Perfluorohexanoic acid	PFHxA
	Perfluoroheptanoic acid	PFHpA
	Perfluorooctanoic acid	PFOA
	Perfluorononanoic acid	PFNA
	Perfluorodecanoic acid	PFDA
	Perfluoroundecanoic acid	PFUnA
	Perfluorodecanesulfonic acid	PFDS
	Perfluorododecanoic acid	PFDoA
	Perfluorotridecanoic acid	PFTTrDA
	Perfluorotetradecanoic acid	PFTTeDA
	Perfluorobutanesulfonic acid	PFBS
	Perfluorohexanesulfonic acid	PFHxS
	Perfluoroheptanesulfonic acid	PFHpS
Perfluorooctanesulfonic acid	PFOS	
Perfluorooctane sulfonamide	PFOSA	

	Analyte	Acronym
Extended List: 23 PFAS	N-methylperfluorooctanesulfonamide	MeFOSA
Includes Standard List + 6 analytes	N-ethylperfluorooctanesulfonamide	EtFOSA
	N-methylperfluorooctanesulfonamidoethanol	MeFOSE
	N-ethylperfluorooctanesulfonamidoethanol	EtFOSE
	6:2 Fluorotelomersulfonate	6:2-FTS
	8:2 Fluorotelomersulfonate	8:2-FTS
Comprehensive List: 25 PFAS	N-methylperfluorooctanesulfonamidoacetic acid	MeFOSAA
Includes Extended List + 2 analytes	N-ethylperfluorooctanesulfonamidoacetic acid	EtFOSAA
Complete List: 32 PFAS	Perfluoropentanesulfonic Acid	PFPeS
Includes Comprehensive List + 7 analytes	Perfluorononanesulfonic Acid	PFNS
	4:2 Fluorotelomersulfonic Acid	4:2FTS
	Dodecafluoro-3H-4,8-dioxanonoate	ADONA
	2,3,3,3-Tetrafluoro-2- (heptafluoropropoxy)propanoic acid	GenX
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonate	F53B major
	11-Chlororeicosafuoro-3-oxaundecane-1-sulfonate	F53B minor

For more information, please contact:

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