

## Testing of extended Perfluorinated Compounds (PFCs)

### INTRODUCTION

PFOS, PFOA and some polyfluorinated organic compounds are considered toxic, persistent, and bio-accumulate. As a result they were included in the Stockholm convention listing and the draft NEPM in Australia (now ratified). These PFC chemicals are being increasingly identified in the environment. In June 2009 ALS gained accreditation for PFOS & PFOA in waters. Subsequently ALS added soil testing capabilities and included 6,2 FTS. The latest ALS R&D project has now delivered NATA accreditation for 20 PFC compounds of concern in soil and water.

### PRIMARY HISTORICAL USES OF PFOS

While the fire fighting foams are known to have contained PFOS (e.g. light water) other usages are less commonly known. In Europe PFOS has been used in:

- Textile impregnation and surface protection
- Impregnation of packaging (paper/cardboard)
- Cleaning agents, waxes/polishes for cars/floors
- Surface coating, paint and varnish
- Oil production and mining
- Photographic industry
- Electrical and electronic parts
- Semiconductor industry
- Aviation hydraulic fluids
- Pesticides
- Medical devices
- Metal plating
- Fire-fighting foams (see adjacent photo)

PFOS and other PFCs have also been found in cookware, water repellants, fibre protectors and carpets among many other common industry products in Europe.

### METHOD INFORMATION

#### ALS METHOD CODE

EP231-PFC

EP231-PFC-LL (ultra trace)

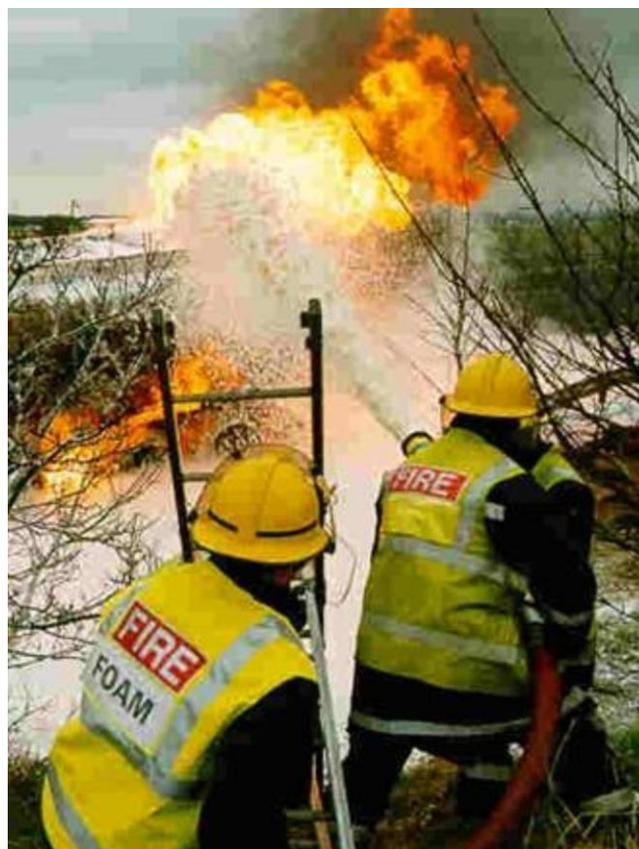
#### LIMITS OF REPORTING (LOR)

EP231-PFC: Water: 0.01 to 1 µg/L

EP231-PFC-LL: Water: 0.002 to 0.1 µg/L

EP231 Soil and Sediment: 0.2 to 5 µg/kg

Method Reference: In house



### OCCURRENCE OF PFCs

Perfluorosulfonates and perfluorocarboxylic acids are known to have been emitted into the environment through the use of aqueous film forming foams (AFFFs). AFFFs contain proprietary mixtures of fluorinated substances that might include PFOS. PFOS, PFOA, fluorinated compound precursors and breakdown products are being found in a surprising number of locations globally. Chief among these are older sites with on-site fire-fighting capabilities such as airports and oil refineries. A significant study in Norway<sup>(1)</sup> surveyed and detected 19 compounds at four fire-training facilities. Other manufacturing facilities are also increasingly coming to attention of environmental practitioners.

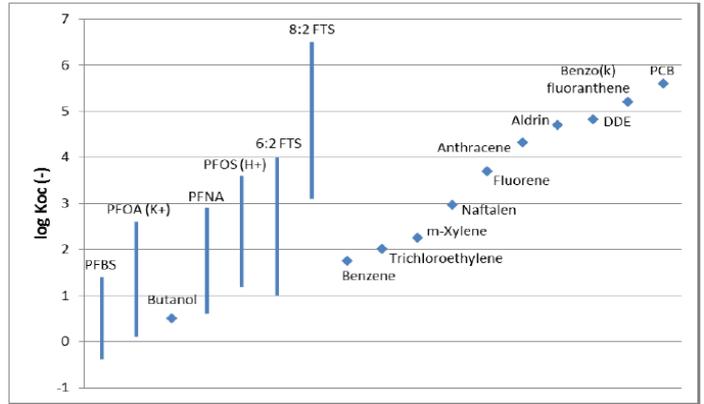
### IMPACTS ON REMEDIATION STRATEGY

One of the principal issues with remediation strategies for PFOS and PFCs are the extreme differences in physiochemical properties. Consequently, remediation strategies that may work for one compound may not prove successful for others. As a result remedial strategies are complex based upon the individual chemicals identified in the environment and their toxicity profile. For example, some compounds such as 6:2 FTS are relatively volatile while others are almost completely non-volatile.

## REMIEDIATION STRATEGIES (Cont'd)

For these reasons understanding a broad range of PFCs in your samples is important before assessing remediation strategies.

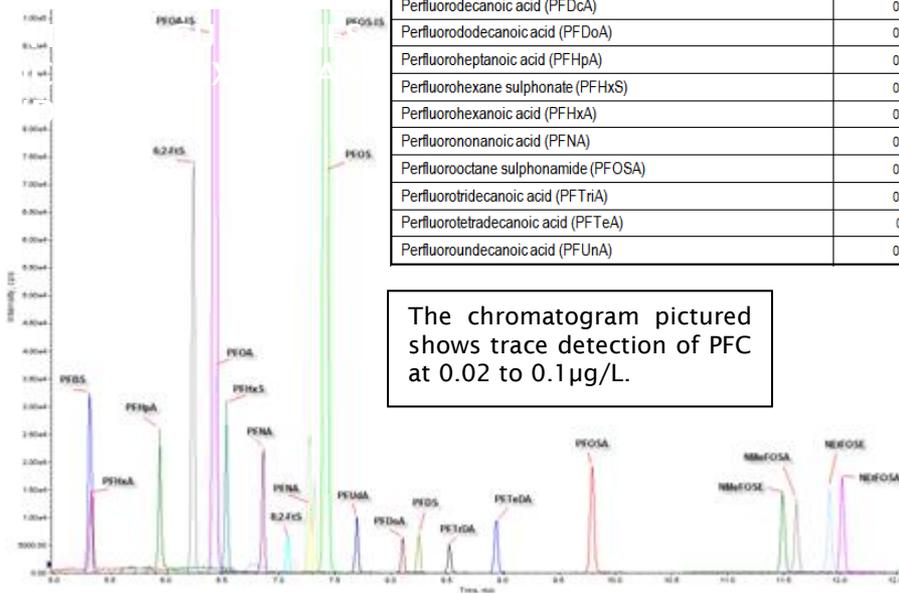
The partition coefficients between organic carbon and water are shown adjacent (Koc) for various PFCs as well as common soil and groundwater contaminants. Several of the PFCs are common firefighting sites where firefighting foam had been used<sup>(2)</sup>.



## ANALYSIS OF PFOS, PFOA AND EXTENDED PFC COMPOUNDS

Analysis of PFOS, PFOA and PFCs is via LC/MS/MS providing trace detection limits appropriate for current regulatory requirements. The full suite can be obtained by quoting method EP231-PFC or EP231 PFC-LL on COCs. Adjacent is the full listing of the current PFCs determined by ALS and LORs under both methods.

PFOS/PFOA and extended PFCs	Standard Level in Fresh water		Trace in fresh or saline water		Soil and Sediment	
	Method Code	EP231 / EP231PFC	EP231-LL / PFC-LL	EP231-LL / PFC-LL	EP231/EP231PFC	EP231/EP231PFC
	Units	µg/L	µg/L		mg/kg	
Perfluorooctane sulphonate (PFOS) by EP231 or EP231-PFC		0.01	0.002		0.0005	
Perfluorooctanoic acid (PFOA) by EP231 or EP231-PFC		0.01	0.002		0.0005	
6:2 Fluorotelomer sulphonate (6:2 FTS) by EP231 or EP231-PFC		0.1	0.01		0.005	
8:2 Fluorotelomer sulphonate (8:2 FTS) by EP231 or EP231-PFC		0.1	0.01		0.001	
The following additional compounds are reported by method EP231-PFC or PFC-LL only						
N-Ethyl-heptadecafluorooctane sulphonamide (N-Et-FOSA)		0.05	0.005		0.001	
N-Ethyl-heptadecafluorooctane sulphonamidoethanol (N-Et-FOSE)		1	0.1		0.001	
N-Methyl-heptadecafluorooctane sulphonamide (N-Me-FOSA)		0.5	0.05		0.001	
N-Methyl-heptadecafluorooctane sulphonamidoethanol (N-Me-FOSE)		1	0.1		0.001	
Perfluorobutane sulphonate (PFBS)		0.02	0.002		0.0002	
Perfluorodecane sulphonate (PFDCS)		0.02	0.002		0.0002	
Perfluorodecanoic acid (PFDoA)		0.02	0.002		0.0002	
Perfluorododecanoic acid (PFDoA)		0.05	0.005		0.0002	
Perfluoroheptanoic acid (PFHpA)		0.02	0.002		0.0002	
Perfluorohexane sulphonate (PFHxS)		0.02	0.002		0.0002	
Perfluorohexanoic acid (PFHxA)		0.02	0.002		0.0002	
Perfluorononanoic acid (PFNA)		0.02	0.002		0.0002	
Perfluorooctane sulphonamide (PFOSA)		0.02	0.002		0.0002	
Perfluorotridecanoic acid (PFTriA)		0.05	0.005		0.0002	
Perfluorotetradecanoic acid (PFTeA)		0.5	0.05		0.001	
Perfluoroundecanoic acid (PFUnA)		0.05	0.005		0.0002	



The chromatogram pictured shows trace detection of PFC at 0.02 to 0.1 µg/L.

## GENERAL SAMPLING & PRESERVATION REQUIREMENTS

PFOS/PFOA analysis requires an unpreserved, chilled 60mL HDPE bottle for water (excluding Super UT) and normal ALS jars for soils and sediments, preferably with 1cm headspace (ALS remove the top portion next to seal prior to analysis and there is no requirement to remove Teflon seals). Please ensure a note is made on the COC informing the laboratory whether water samples are saline as saline samples can only be determined by method EP231-PFC-LL.

Samples should be analysed within 180 days. PTFE (Teflon) plus rubber should be avoided during sampling and storage for waters (e.g. tubing, bailers). For further information please contact your local ALS Client Services team.

## REFERENCES

<sup>(1)</sup> Screening of Polyfluorinated Compounds at Four Fire Training Facilities in Norway, Norwegian Pollution Control Authority publication TA-2444/2008.

<sup>(2)</sup> Remedial Methods and Strategies for PFCs – Niklas Torneman (conference abstract).

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