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New Analytical Method for Testing Fluorotelomer Alcohols in Water

Fluorotelomer alcohols (FTOHs) are one of the major classes of per- and polyfluoroalkyl substances (PFAS). They are also one of the most well-known precursors of perfluorocarboxylic acids (PFCAs) including perfluorooctanoic acid (PFOA) and perfluorohexanoic acid (PFHxA). Their presence in surface water, groundwater and drinking water supplies represents a potential risk to human health and the environment. The ALS R&D team has recently validated a sensitive, robust and selective analytical method (pending UKAS accreditation) to quantify FTOHs using gas chromatography-triple quadrupole tandem mass spectrometry (GC-MS/MS).

Figure 1: Illustrative picture

Introduction

The widespread application of fluorotelomer-based substances has resulted in the extensive occurrence of FTOHs in the environment. Recent studies have focused on FTOH sources, fate, transport, and distribution in environmental media, exposure, and human health risks (references provided below).

Use of FTOHs

FTOHs are used in the synthesis of various surfactants and as intermediates in the manufacture of a variety of products with a wide range of applications including textiles, polymers, paints, adhesives, waxes and cleaning agents. FTOHs act as surfactants, lubricants and intermediate products in the manufacturing processes and can be emitted into the atmosphere during the production of fluoropolymers. Due to their high volatility, FTOHs can also undergo long-range environmental transport. Landfill leachate (Titaley et al., 2023) and wastewater treatment works are potential sources of FTOHs (Wang et al., 2020).

FTOHs are a constituent in aqueous film-forming foams (AFFF) formulations and are a byproduct in fluorotelomer-based AFFF. 8:2 FTOH concentrations in AFFF ranged from 8 to 26.5 mg/L (Favreau, 2017). The detection of FTOHs at AFFF-impacted sites is therefore likely to increase as analytical methods improve.

Fate and Transport

Ferum et estem aut es mi, vercipsam FTOHs have been found ubiquitous in water (Ayala-Cabrera et al., 2020; Dimzon et al., 2017). Studies have also shown that FTOHs can breakdown into other persistent, bioaccumulative PFCAs in water by various biotransformation mechanisms (Dinglasan et al., 2004; Ellis et al., 2004; Wang et al., 2009; Yu et al., 2018; Zhao et al., 2013). FTOHs could therefore be considered an indirect source of PFCAs in the environment.

Exposure

Being a major precursor of common PFCAs, FTOHs may cause similar adverse health effects to human health and the environment. Human exposure to FTOH mainly occurs through ingestion pathways such as diet and drinking water (Bach et al., 2016). Because they are widely used, FTOHs have been found in various types of water sources including drinking water (Ayala-Cabrera et al., 2020; Bach et al., 2016), wastewaters (Dimzon et al., 2017; Ma et al., 2022), industrial wastewater influents and effluents (Ayala-Cabrera et al., 2020; Dauchy et al., 2017; Ma et al., 2022), surface water (Bach et al., 2016; Portolés et al., 2015), and rainwater (Kongpran et al., 2014; Mahmoud et al., 2009).

Sampling Requirements

Samples should be collected in 40 mL volatile vials, with Teflon septa containing 2 mL of methanol. Vials should not be over-filled spilling methanol but with Zero headspace achieved, when collecting the sample. Samples should be returned to the laboratory as soon as possible due to the short holding times.

Table 1: Sampling and Analysis Requirements

Test Method Instrumentation	GC-MS/MS-PCI
Fixative Agent	2 mL MeOH
Sample containers (Ref STL 92)	2 x 40ml clear VOC vial
Holding Time	5 days

Laboratory Analysis

The use of GC-MS/MS with positive chemical ionisation (PCI) improves sensitivity, selectivity, and reliability of determining FTOHs and provides detection limits as per Table 2.

Table 2: Summary of Reporting

Fluorotelomer Alcohol	Abbreviation	CAS Number	Detection Limit
6:2 Fluorotelomer Alcohol	6:2 FTOH	647-42-7	5 ng/L
8:2 Fluorotelomer Alcohol	8:2 FTOH	678-39-7	5 ng/L

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