Do We Have Enough PFAS-Characterization Tools?

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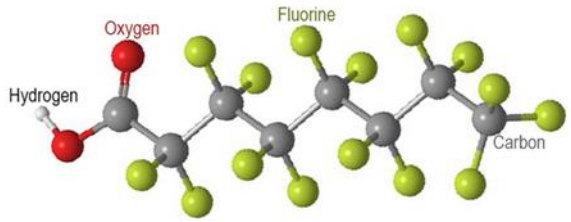
Agenda

- Introduction
- Why We Care About PFAS
- Types of Analyses
- Non-specific Analyses
- Specific Target Analyses
- Non-target Analyses
- Things to Consider
- Take Aways

Introduction

- Environmental samples are complex mixtures of native and introduced components.
- They contain the target analytes, non-target analytes, and native components in disproportionate measures.
- The complexity of samples makes characterization a challenge.
- Matrix interferences can hinder detection.
- The tools available will dictate how much we know about samples.



Why We Care About PFAS

- **Potential health effects for people (www.epa.gov/pfas).**
  - Reproductive effects such as decreased fertility or increased high blood pressure in pregnant women.
  - Developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes.
  - Increased risk of some cancers, including prostate, kidney, and testicular cancers.
  - Reduced ability of the body's immune system to fight infections, including reduced vaccine response.
  - Interference with the body's natural hormones.
  - Increased cholesterol levels and/or risk of obesity.

Why We Care About PFAS (Cont.)

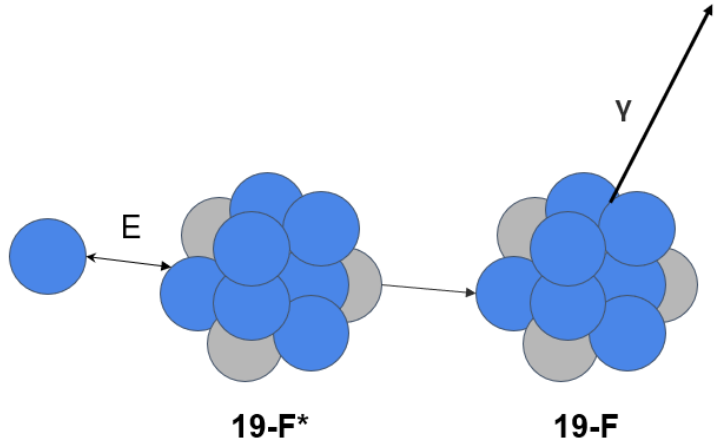
- We introduced these compounds into the environment.
- PFAS and precursor contamination have proliferated and persisted in the environment.
- There are MANY sources of PFAS (https://www.epa.gov/pfas/pfas-explained).
- Good news, several tools are available for characterization.

Types of Analyses

- **Non-specific:**
  Identify and quantitate a group or class of analytes.
- **Targeted Analyses:**
  Qualitative, identify and quantitate specific analytes.
- **Non-targeted Analyses:**
  Tentatively identify analytes and provide a relative concentration.

Non-specific Analysis (PIGE)

- **Particle-induced Gamma-ray Emission (PIGE)**
  - Used for textile/consumer product samples
  - Quantitative
  - Solids
  - Any fluorine detected - not specific to PFAS/precursor
  - Surface evaluation of total fluorine up to 250 µm in depth
  - No US EPA methods



Non-specific Analysis (CIC)

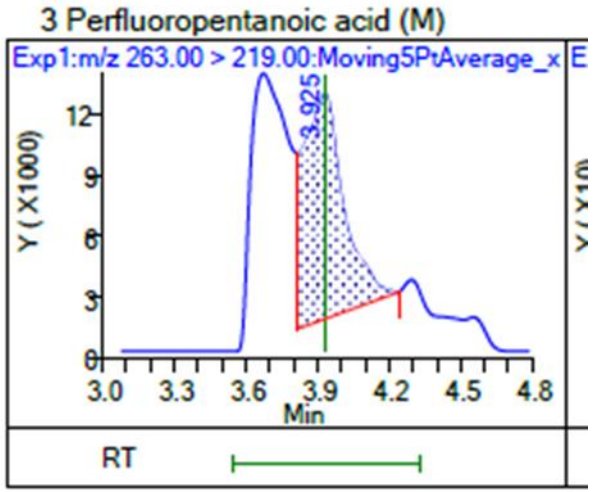
- **Combustion ion chromatography (CIC)**
  - Utilized for environmental and consumer product samples
  - Quantitative
  - Any fluorine-containing compound
  - Solid and liquid
  - One US EPA method
  - Several potential CIC analyses

Non-specific Analysis (CIC) (Cont.)

- **CIC Range of Analytes**
  - Total Fluorine (organic and inorganic)
  - Absorbable Organic Fluorine (US EPA Method 1621) (organic fluorine obtained by sorbent)
  - Extractable Organic Fluorine
  - Total Organic Fluorine
  - Polymers are not captured.
  - Separation of organic and inorganic fluorine can be problematic.
  - Coextraction or not-extracted is a problem.

Targeted Analyses

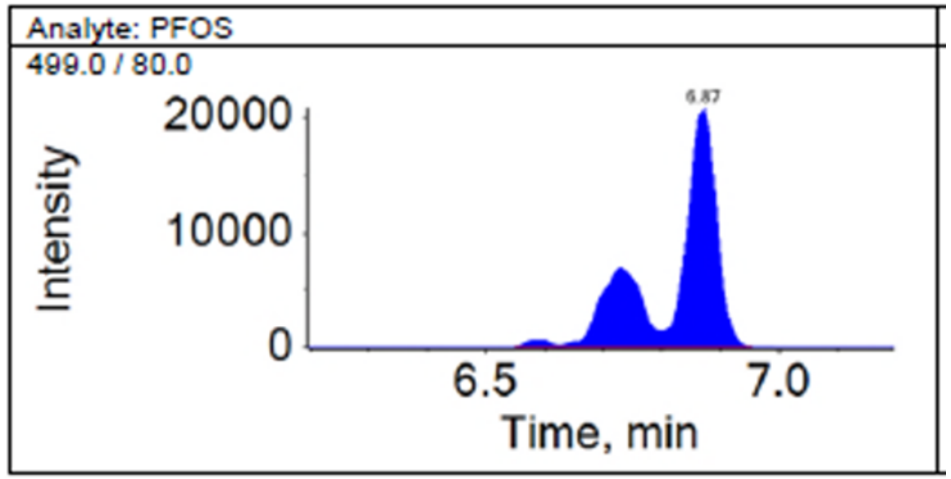
- **Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC/MS/MS)**
- **Gas Chromatography/Mass Spectrometry/Mass Spectrometry (GC/MS/MS)**
  - Utilized for environmental/pharma samples
  - Quantitative
  - Limited to PFAS/precursor with available reference standards
  - Solid, liquid, and air



Targeted Analyses

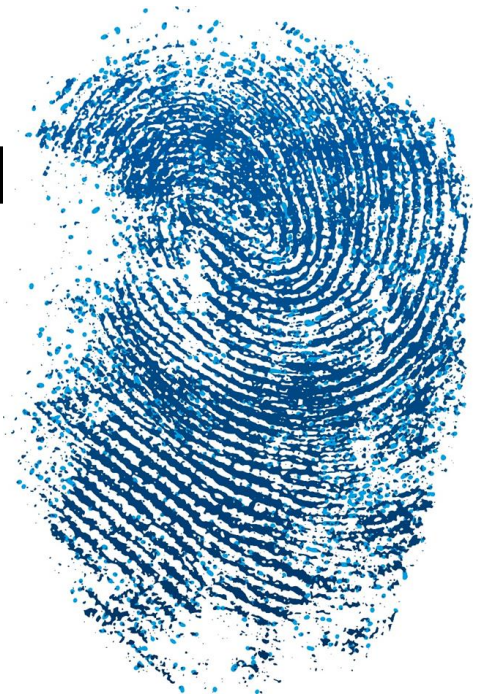
- Several US EPA methods (533, 537.1, and 1633A)
- OTM-45 and OTM-50
- Very sensitive
- Any PFAS/precursor without a standard is a potential interferent.
- Polymers are not captured.
- Total oxidizable precursors (TOPS) Assay can help a little by capturing some precursor compounds.

Technical



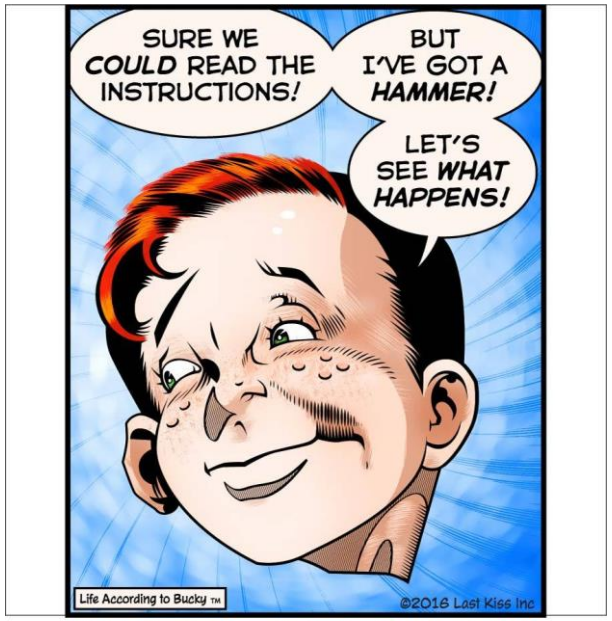
Non-Targeted Analysis

- **LC/MS/MS**
- **GC/MS/MS**
  - Utilized for environmental/pharma
  - Semi-quantitative (no reference standard
  - Qualitative identification by reference
  - Solid and liquid
  - Polymers are not captured
  - No US EPA methods



Things to Consider

- Things to consider for your project:
  - What matrices are involved?
  - Is your matrix difficult (inorganic fluorine, particulates)?
  - Specific analytes or total needed?
  - If specific, are there standards available?
  - What reporting limits are needed?
  - What QC is needed?
  - Keep the objective in focus.



1942 Art: Lou Fine Re-Creation: Diego Jourdan Pereira

Things to Consider

- Published method or laboratory SOP?
- Analyte extraction or direct analysis?
- Based on the objectives, is a combination of analyses needed?
- Consider having the data evaluated once generated.
- Are on-specific PFAS/precursors needed?
- Forensic data needed?

Take Aways

- Use a knowledgeable consultant to support the project.
- Have your data validated so you know the good/bad of it.
- Combination of methods will help define what you know.
- PIGE and CIC for non-specific fluorine.
- Targeted analysis with limited number of reference standards.
- Non-targeted analysis lacks quantitative certainty.
- Polymers with fluorine are not addressed by most techniques.
- Enough tools? ***Like most things in life, that depends.***

What Questions Do You Have?

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