Latest Trends in PFAS Testing and Regulations Landscape: from ppb to ppq in Water, Serum and beyond

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Evolution of PFAS Testing

2000's

PFOA
PFOS

Mostly water

2010's

C4 – C18

Water
Soil

2020's

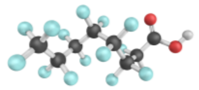
C1 – C18

Water/Soil
Food
Food packaging
Blood/serum
Consumer products

PFAS ≠ PFAS

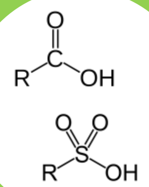
PFAS

Chain Length



C1 – C18 and beyond

Functional Groups

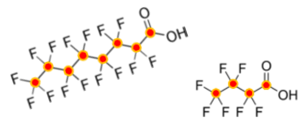


- Carboxylic acid
- Suflonic acid
- Ether
- Sufonamide
- Alcohol (FTOH)
- Cl, N, O replacement

Matrices

- Waters
- Biological fluids
- Cosmetics
- Consumer goods
- Food packaging materials
- Air

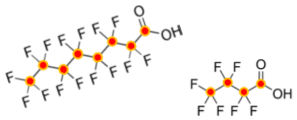
PFAS Measurement Technologies



PFAS

PFAS Measurement Technologies

AOF/EOF



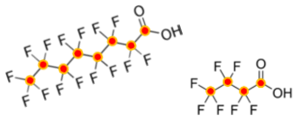
PFAS

PFAS Measurement Technologies

AOF/EOF

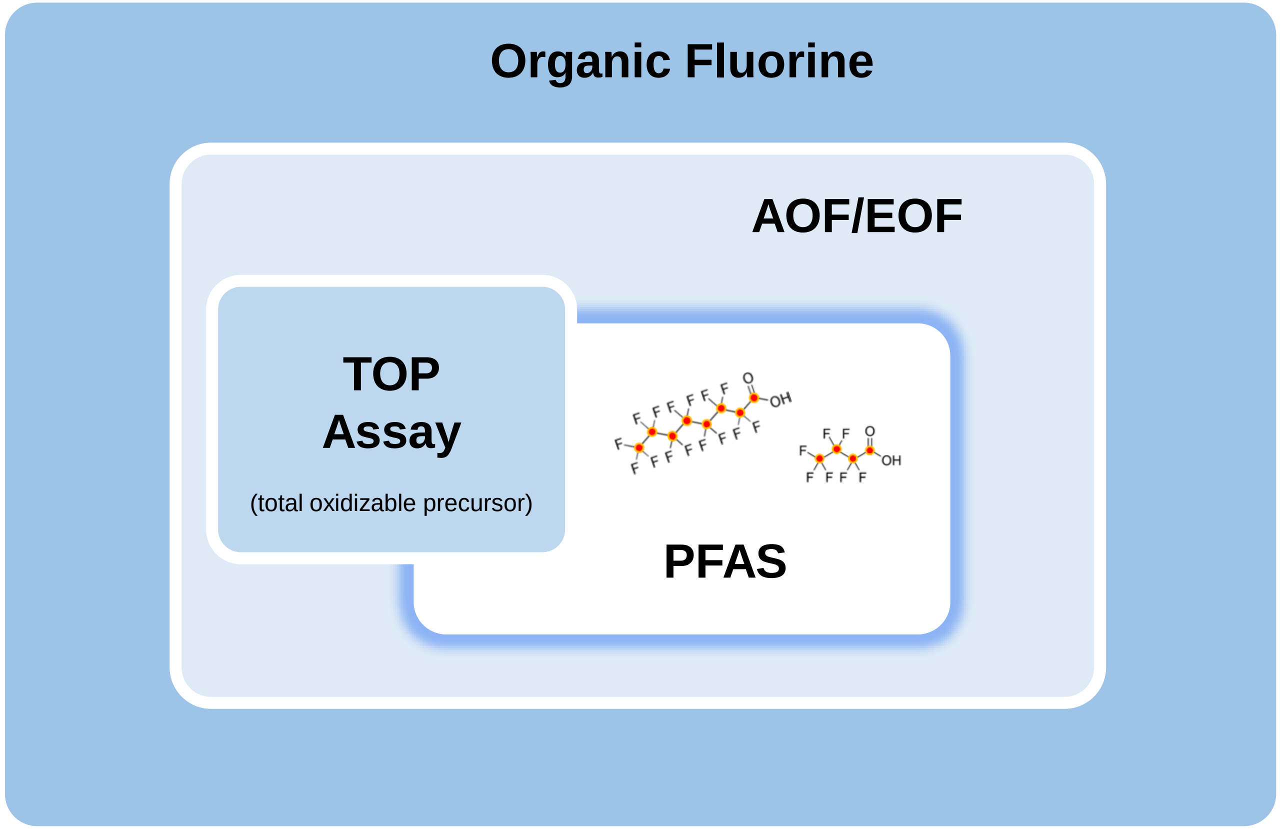
TOP
Assay

(total oxidizable precursor)

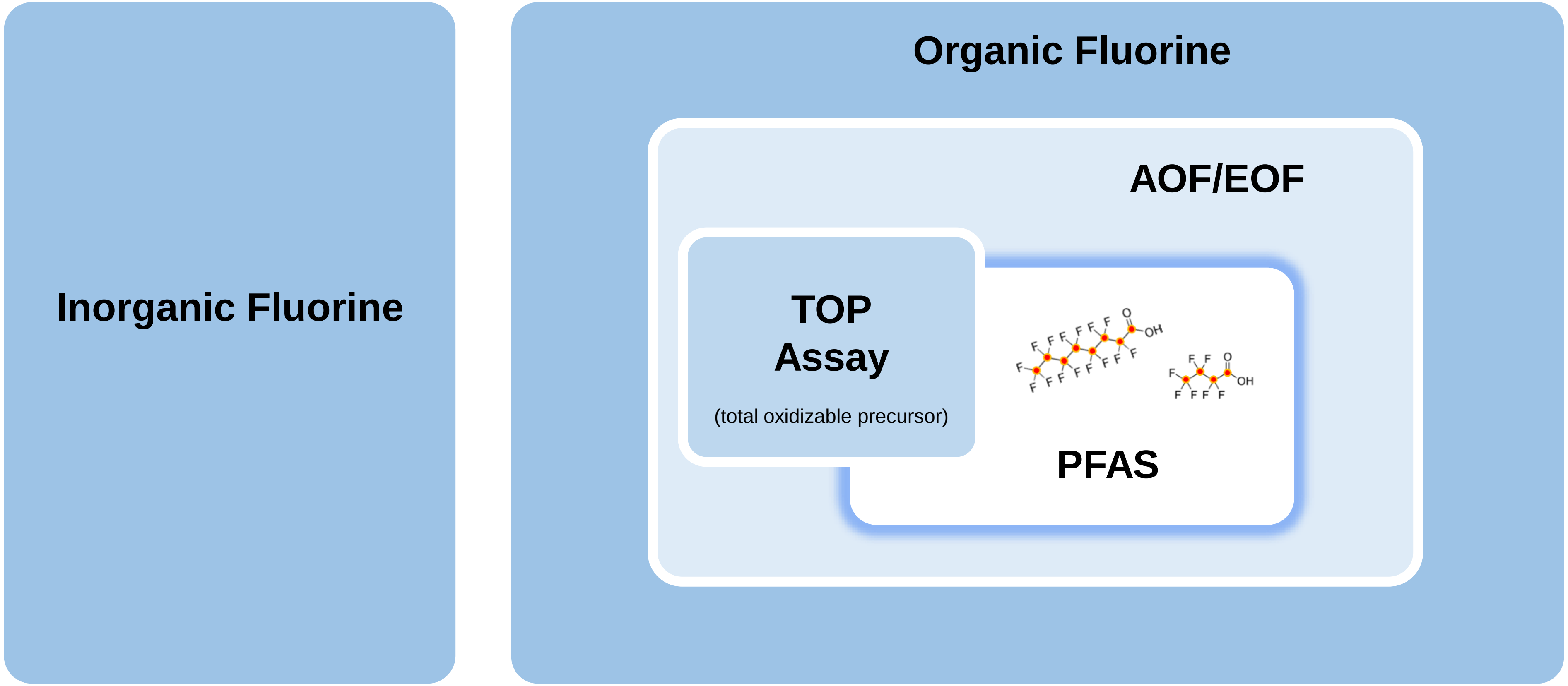


PFAS

PFAS Measurement Technologies



PFAS Measurement Technologies



PFAS Measurement Technologies

Total Fluorine

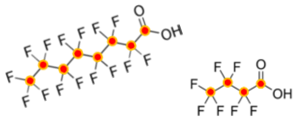
Inorganic Fluorine

Organic Fluorine

AOF/EOF

TOP
Assay

(total oxidizable precursor)



PFAS

PFAS Measurement Technologies

Total Fluorine

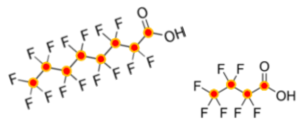
Inorganic Fluorine

Organic Fluorine

AOF/EOF

TOP Assay

(total oxidizable precursor)

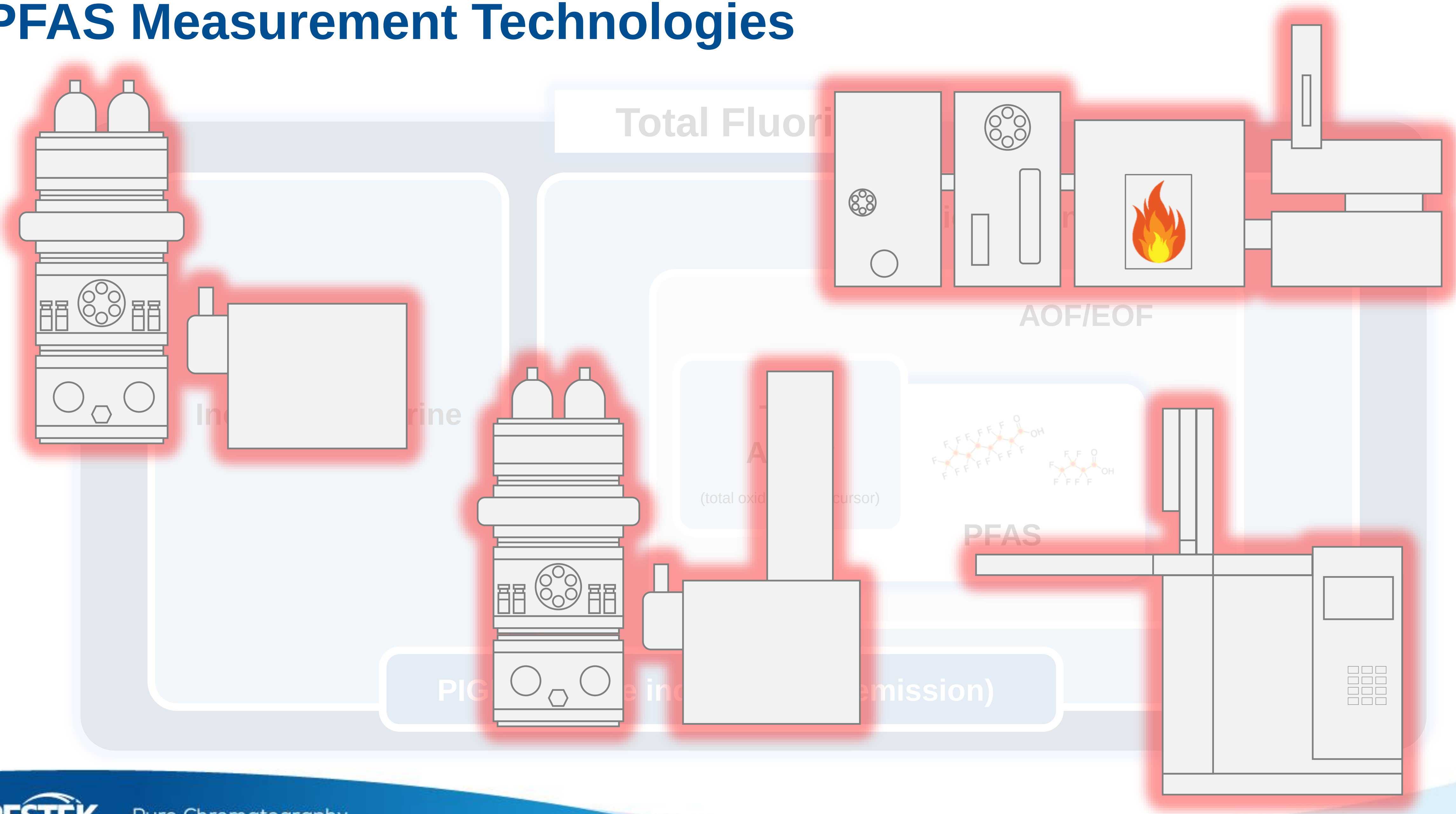


PFAS

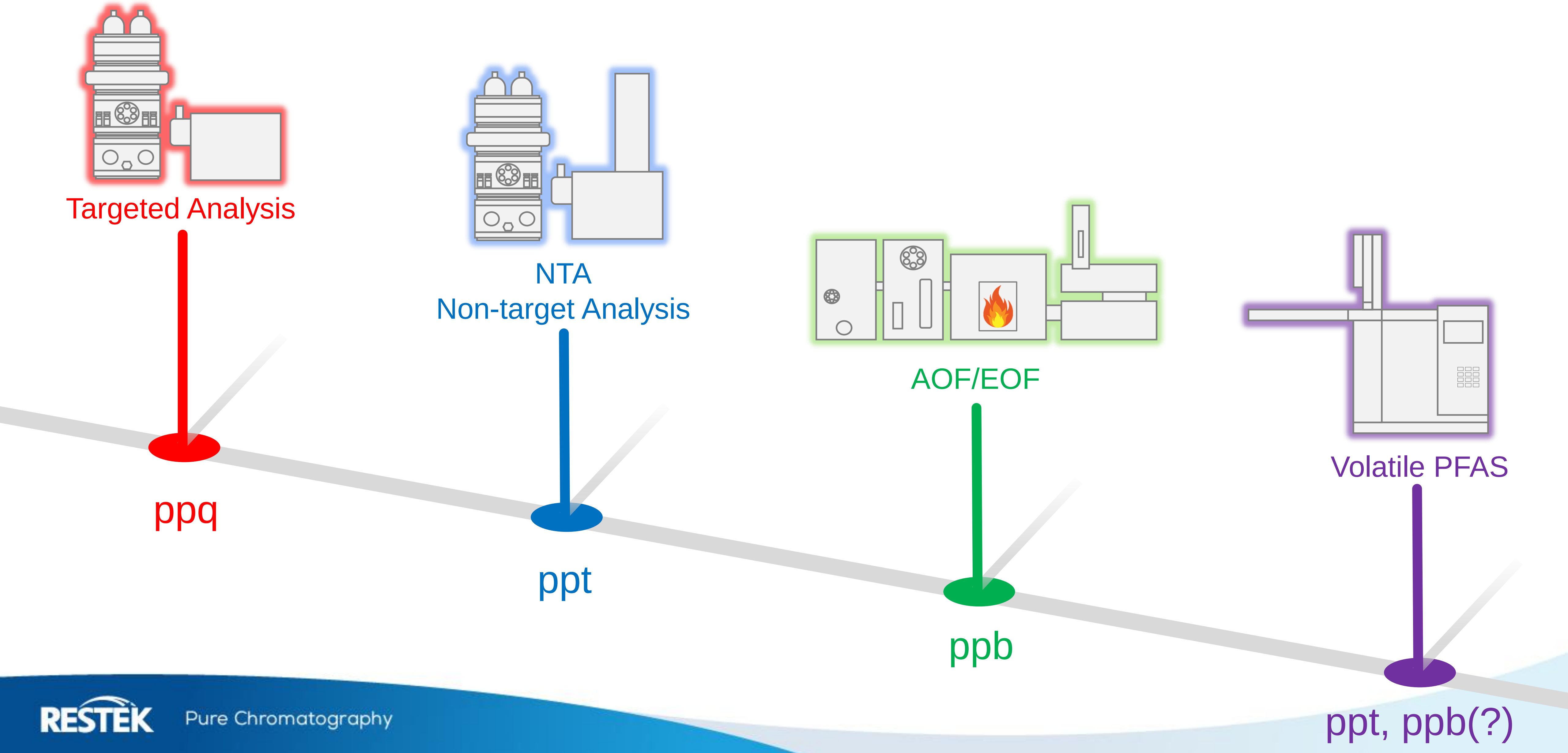
PIGE (particle induced γ-ray emission)

PFAS Measurement Technologies

PFAS Measurement Technologies



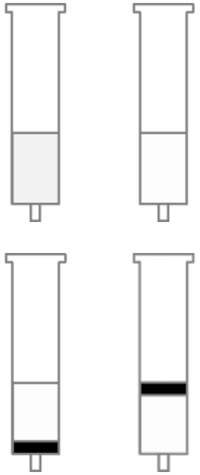
PFAS Measurement Technologies

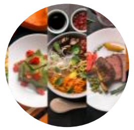


PFAS Sample Preparation Technologies

Direct Injection

SPE





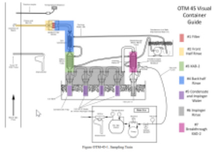
QuEChERS

Thermal Desorption

Air Canisters

Automation / Homogenization Technologies

PFAS Methods



United States Environmental Protection Agency: 537.1 — 533 — 1633 — 8327 — OTM-45 — OTM-50

Department of Defense: QSM 6.0 Table B-24

FDA: FDA C-101.01

ASTM International: D7968 — D7979 — D8421

ISO: ISO 21675 — ISO 23702

DIN: DIN EN 17892 — DIN 38407-42

PFAS Regulations & Guidelines

- PFOA: 4.0 ppt
- PFOS: 4.0 ppt
- PFHxS: 10 ppt
- HFPO-DA: 10 ppt
- PFNA: 10 ppt
- Mixture of PFHxS, PFNA, HFPO-DA, PFBS: 1 HI

MCL: Maximum Contaminant Level
MCLG: Maximum Contaminant Level Goal

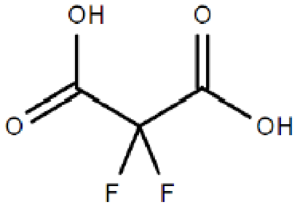
$$\text{Hazard Index (1 unitless)} = \left(\frac{[\text{HFPO}-\text{DA}_{\text{ppt}}]}{[10\text{ ppt}]}\right) + \left(\frac{[\text{PFBS}_{\text{ppt}}]}{[2000\text{ ppt}]}\right) + \left(\frac{[\text{PFNA}_{\text{ppt}}]}{[10\text{ ppt}]}\right) + \left(\frac{[\text{PFHxS}_{\text{ppt}}]}{[10\text{ ppt}]}\right)$$

- EU 2023/915 (food stuffs)
- EU 2022/1431 (food)
- EU 2020/2184 (drinking water)
- EURL POPs Version 1.2 (food)

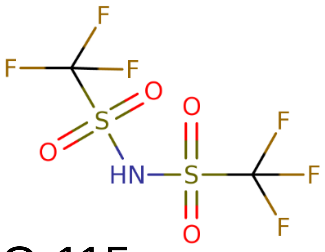
- SMPR 2023.003
(Method submission due April 24th, 2024)

- D8560-24 (airborne PFAS)

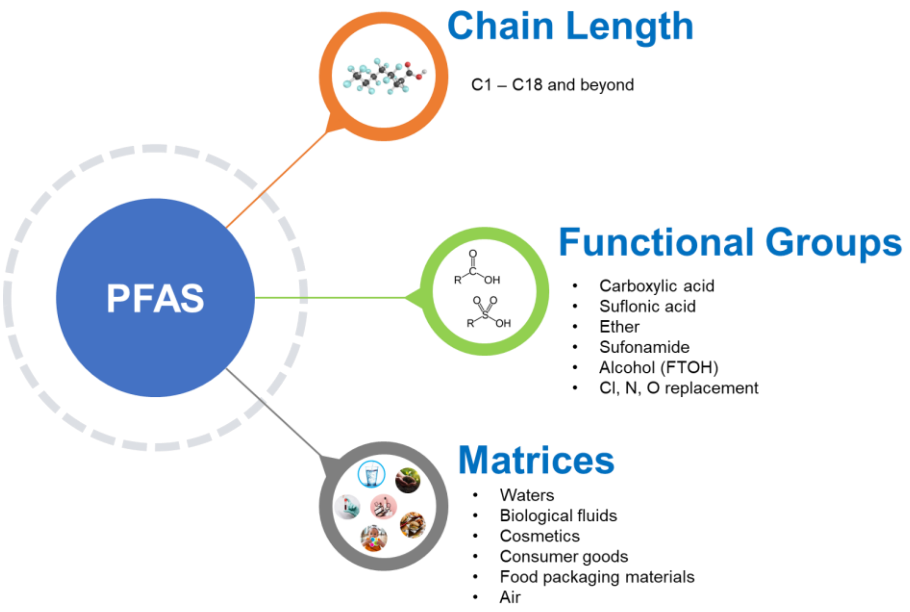
Most Recent Trends in PFAS Analytical Methods



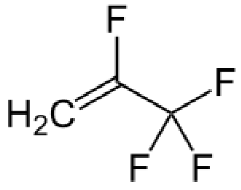
MMF



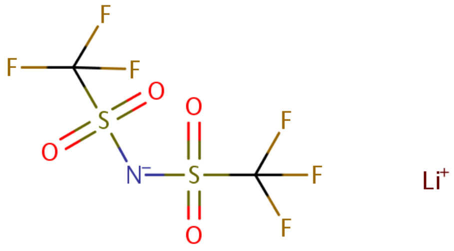
HQ-115



- **Exotic PFAS Method**
- **Conventional reversed phase LC method**
- **Polar X phase LC method (Ultrashort-Chain)**

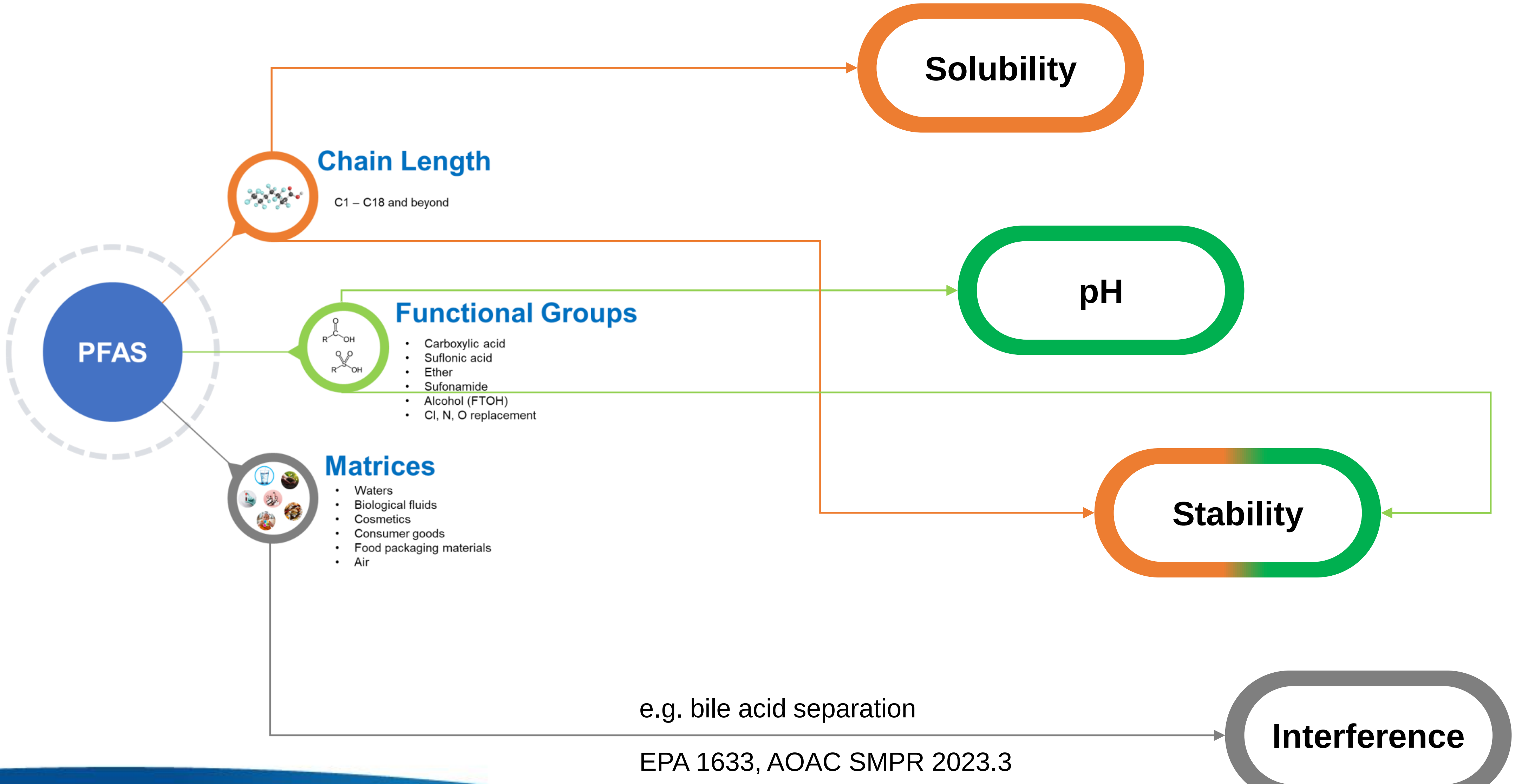


HFO-1234y

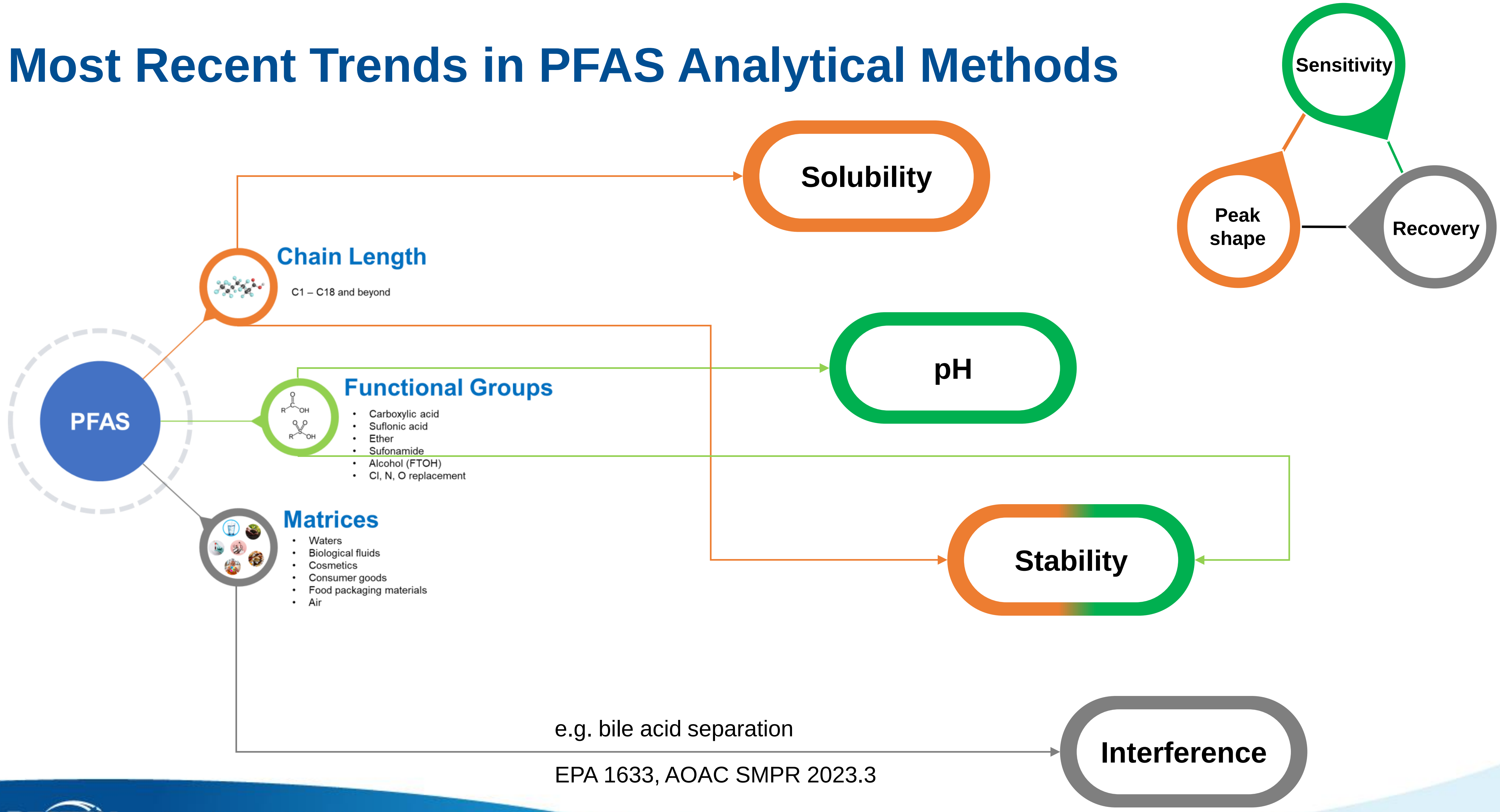


TFSI

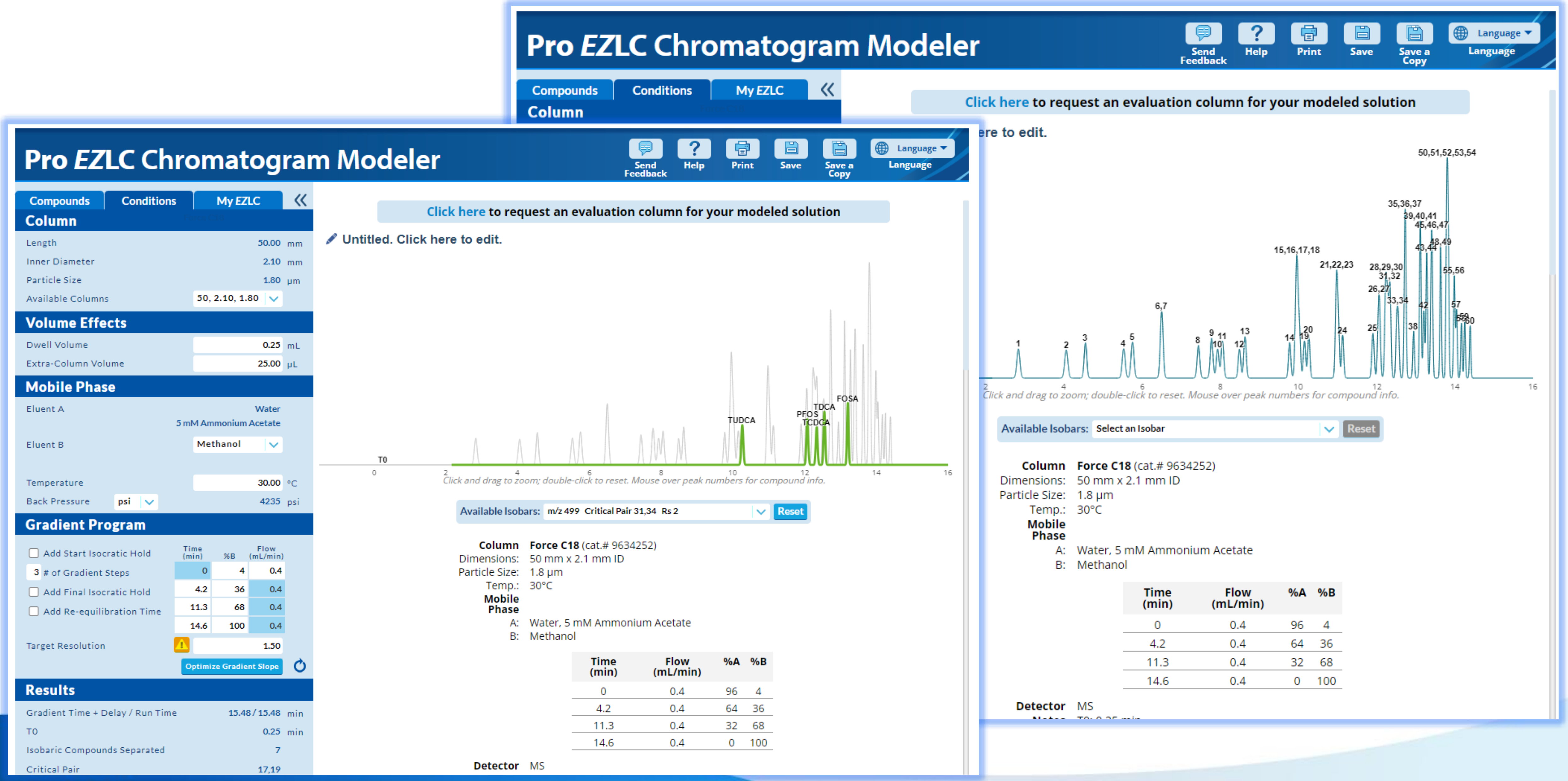
Most Recent Trends in PFAS Analytical Methods



Most Recent Trends in PFAS Analytical Methods

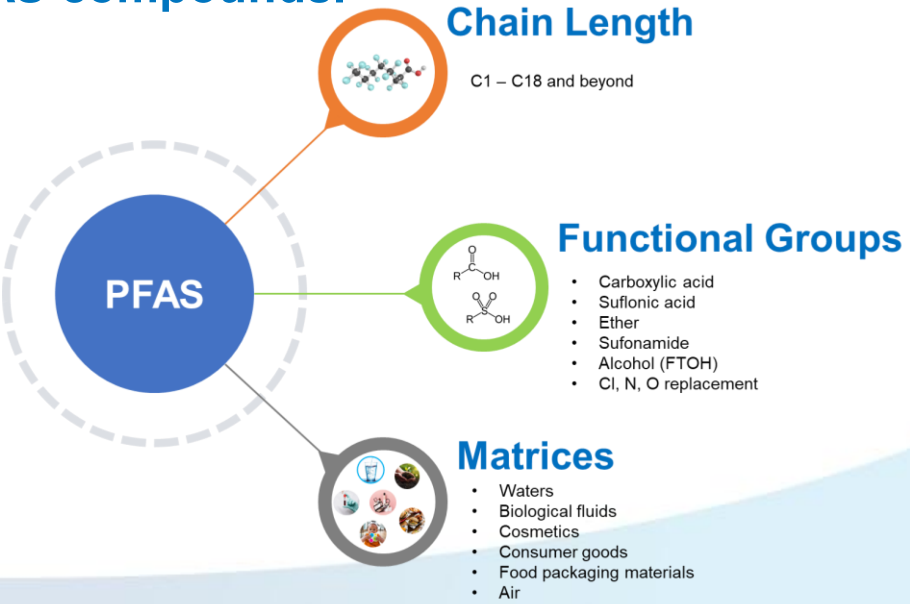


ProEZLC PFAS Chromatogram Modeler



Summary

- **PFAS testing methods and sample preparation technologies have been evolving with newer analyte types of PFAS.**
    - Direct injection
    - SPE (dual bed, WAX, SDVB), QuEChERS, protein precipitation and more
    - NTA (non-target analysis) using Orbitrap or QTOF
    - TOP Assay for precursor measurements
    - Air canisters for air testing
- **"One size fits all." method is not possible due to the variety of PFAS compounds.**
    - Conventional C18 column method
    - Exotic PFAS method with lowered gas temperature
    - Ultrashort-Chain PFAS method using Polar X phase
- **ProEZLC PFAS library can save time in method development.**



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