

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

PFAS

PER- AND POLY-FLUOROALKYL SUBSTANCES

Management of
Environmental & Health Risks

June 4-5-6, 2024 - Paris

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RESTEK

Pure Chromatography

Evolution of PFAS Testing

2000's

PFOA
PFOS

Mostly water



2010's

C4 – C18

Water
Soil



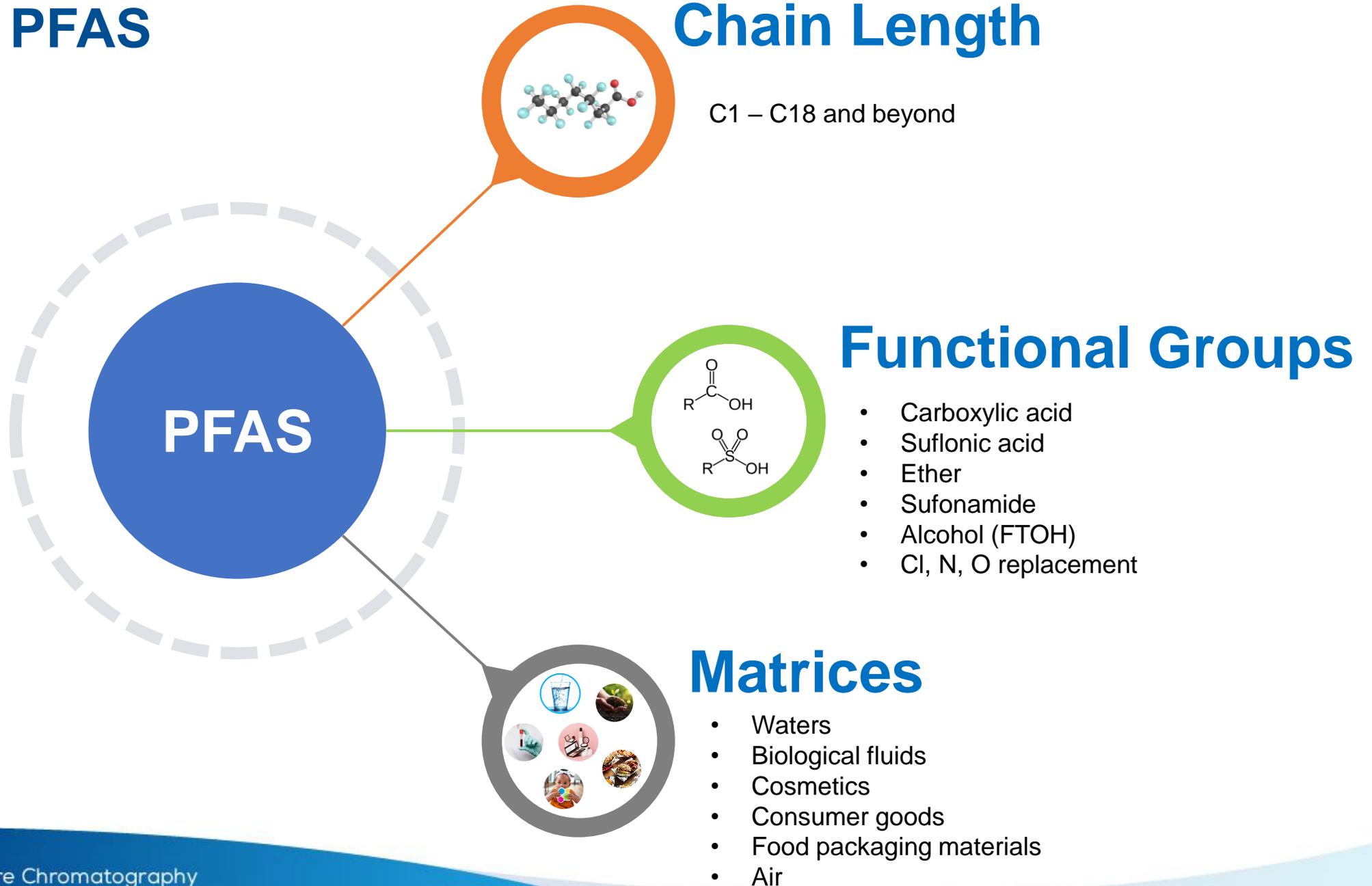
2020's

C1 – C18

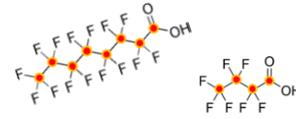
Water/Soil
Food
Food packaging
Blood/serum
Consumer products



PFAS ≠ PFAS



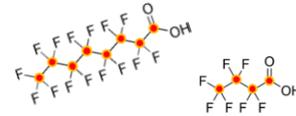
PFAS Measurement Technologies



PFAS

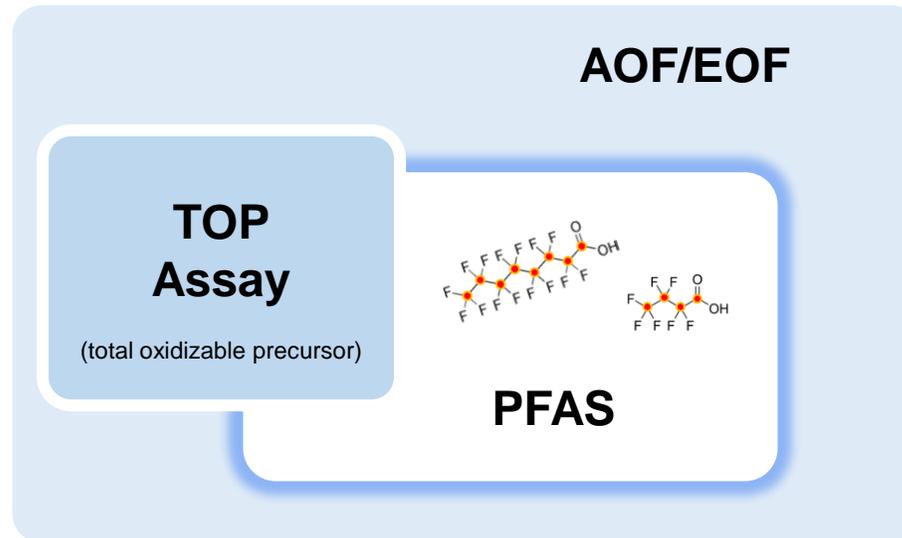
PFAS Measurement Technologies

AOF/EOF

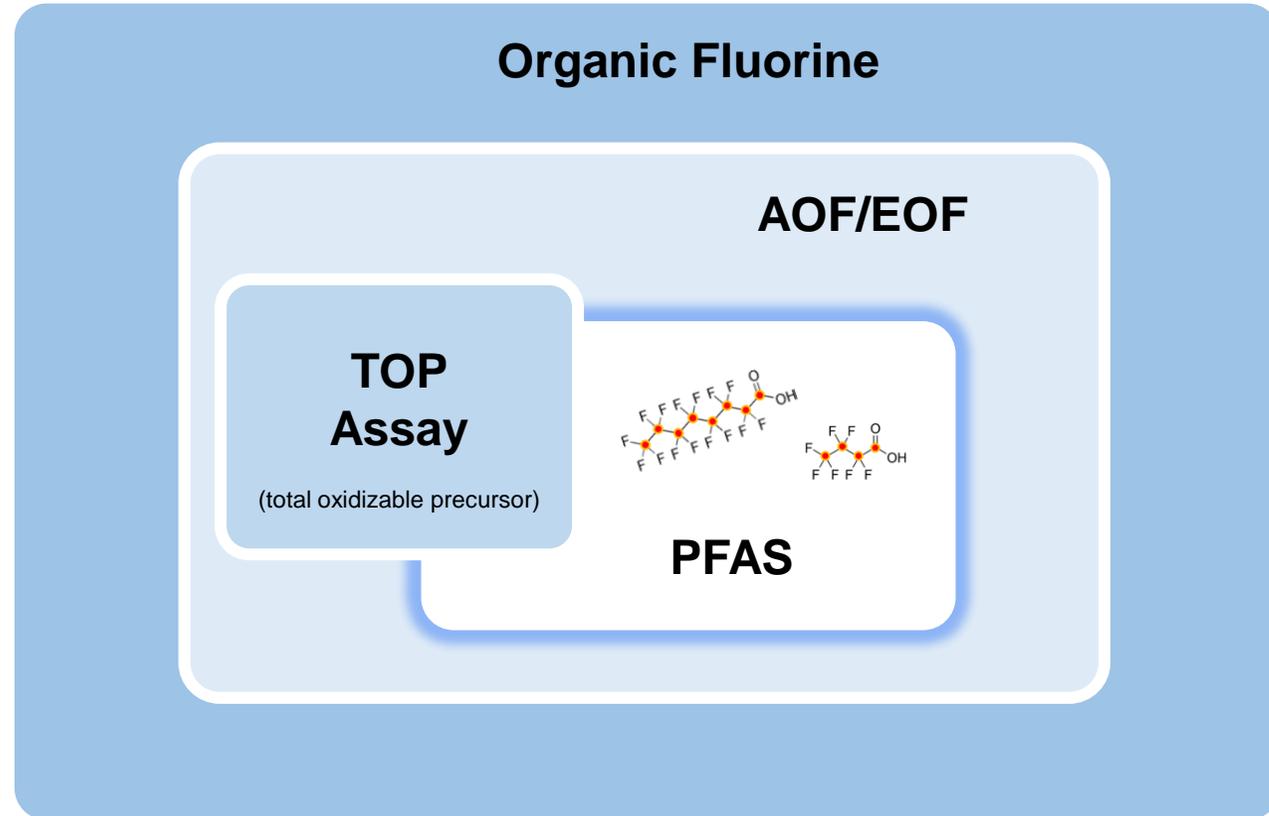


PFAS

PFAS Measurement Technologies



PFAS Measurement Technologies



PFAS Measurement Technologies

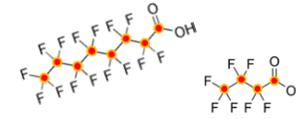
Inorganic Fluorine

Organic Fluorine

AOF/EOF

TOP
Assay

(total oxidizable precursor)



PFAS

PFAS Measurement Technologies

Total Fluorine

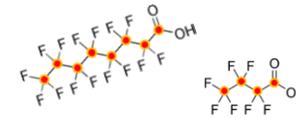
Inorganic Fluorine

Organic Fluorine

AOF/EOF

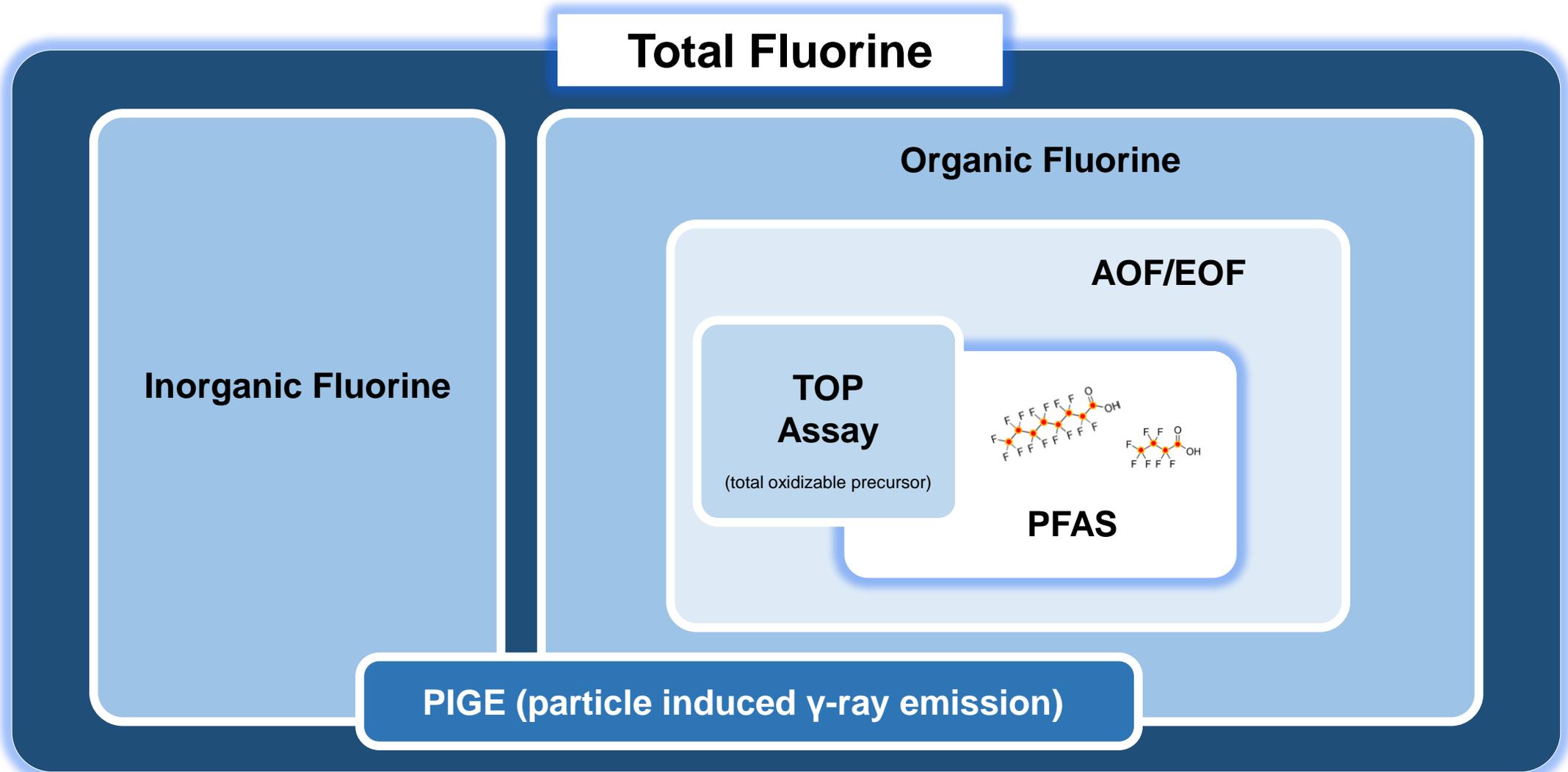
TOP
Assay

(total oxidizable precursor)

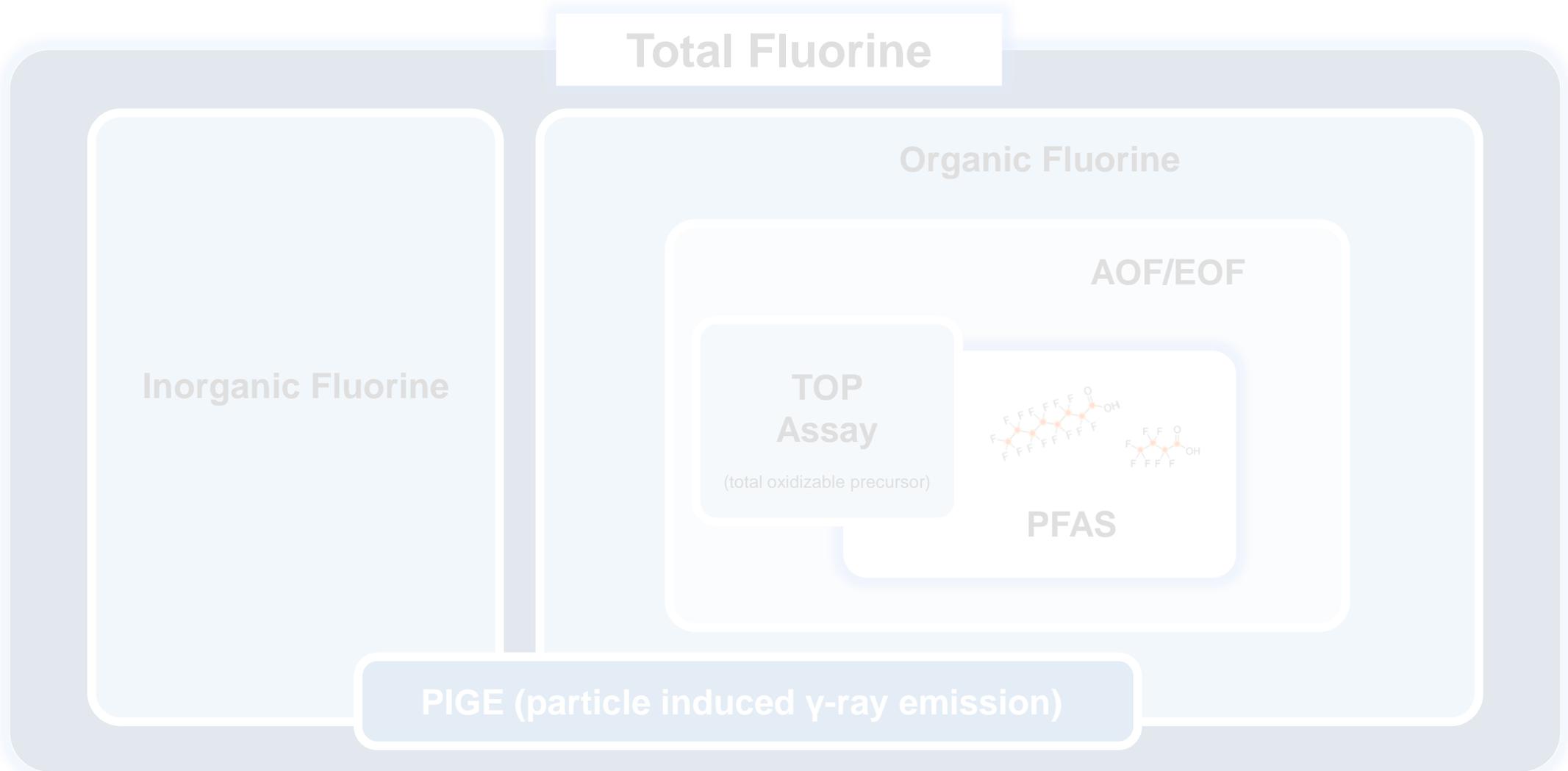


PFAS

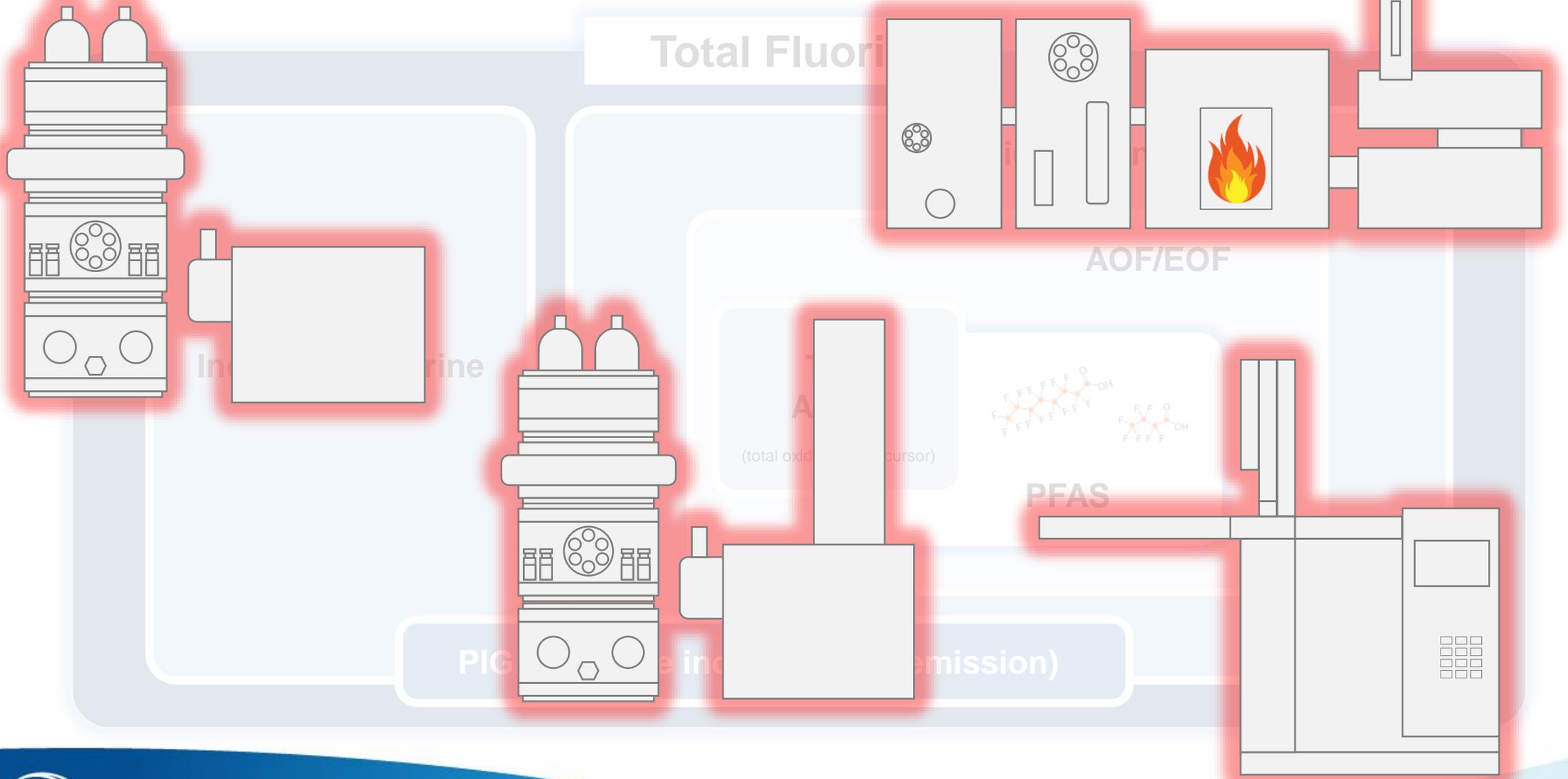
PFAS Measurement Technologies



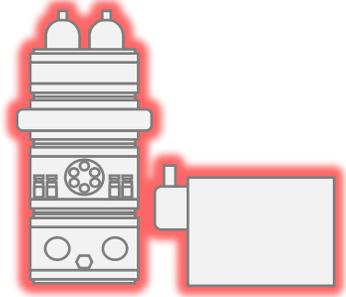
PFAS Measurement Technologies



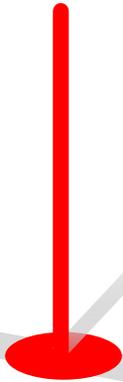
PFAS Measurement Technologies



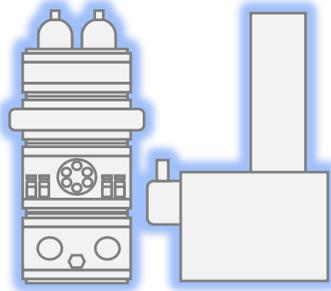
PFAS Measurement Technologies



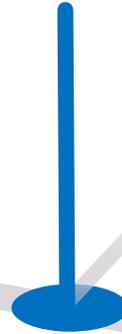
Targeted Analysis



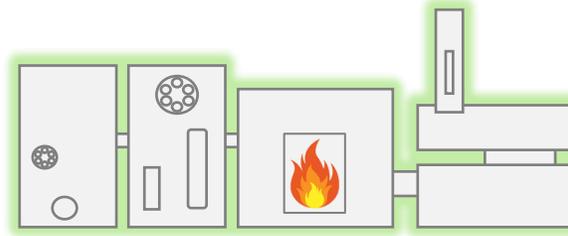
ppq



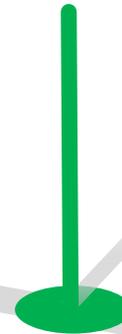
NTA
Non-target Analysis



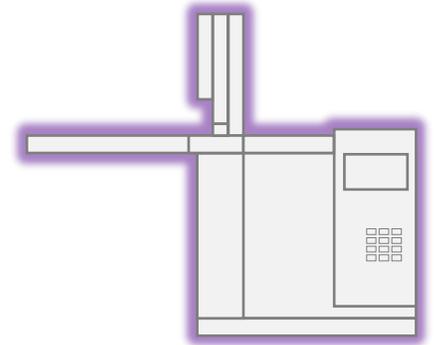
ppt



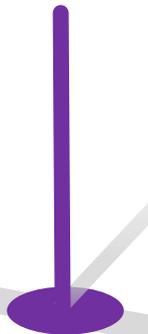
AOF/EOF



ppb



Volatile PFAS



ppt, ppb(?)

PFAS Sample Preparation Technologies



Direct Injection



SPE



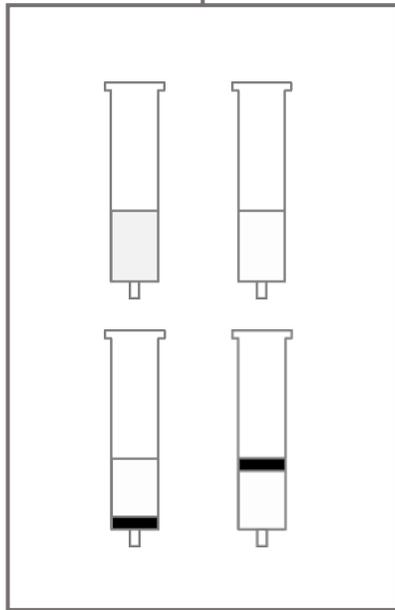
QuEChERS



Thermal Desorption



Air Canisters



Automation / Homogenization Technologies



PFAS Methods



537.1

533

1633

8327

OTM-45

OTM-50



QSM 6.0 Table B-24



FDA C-101.01



D7968

D7979

D8421



ISO 21675

ISO 23702



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

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



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

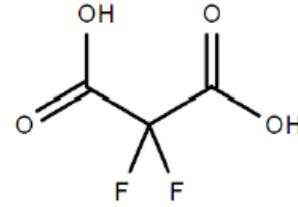
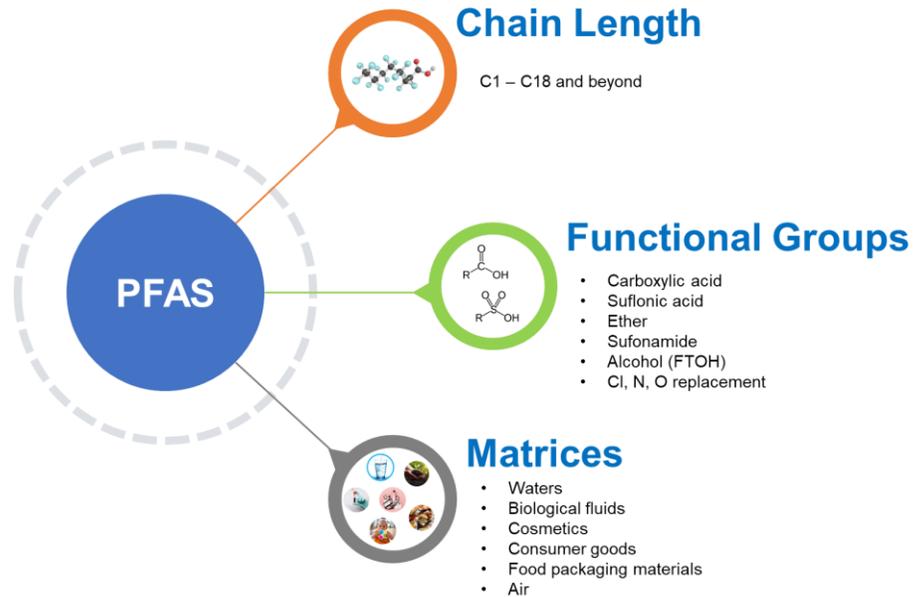


- SMPR 2023.003
(Method submission due April 24th, 2024)

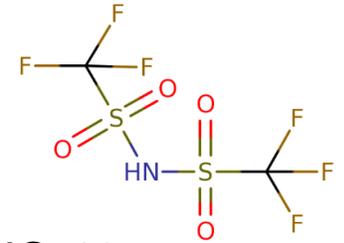


- D8560-24 (airborne PFAS)

Most Recent Trends in PFAS Analytical Methods

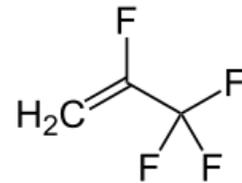


MMF

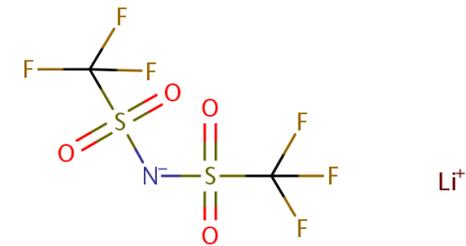


HQ-115

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

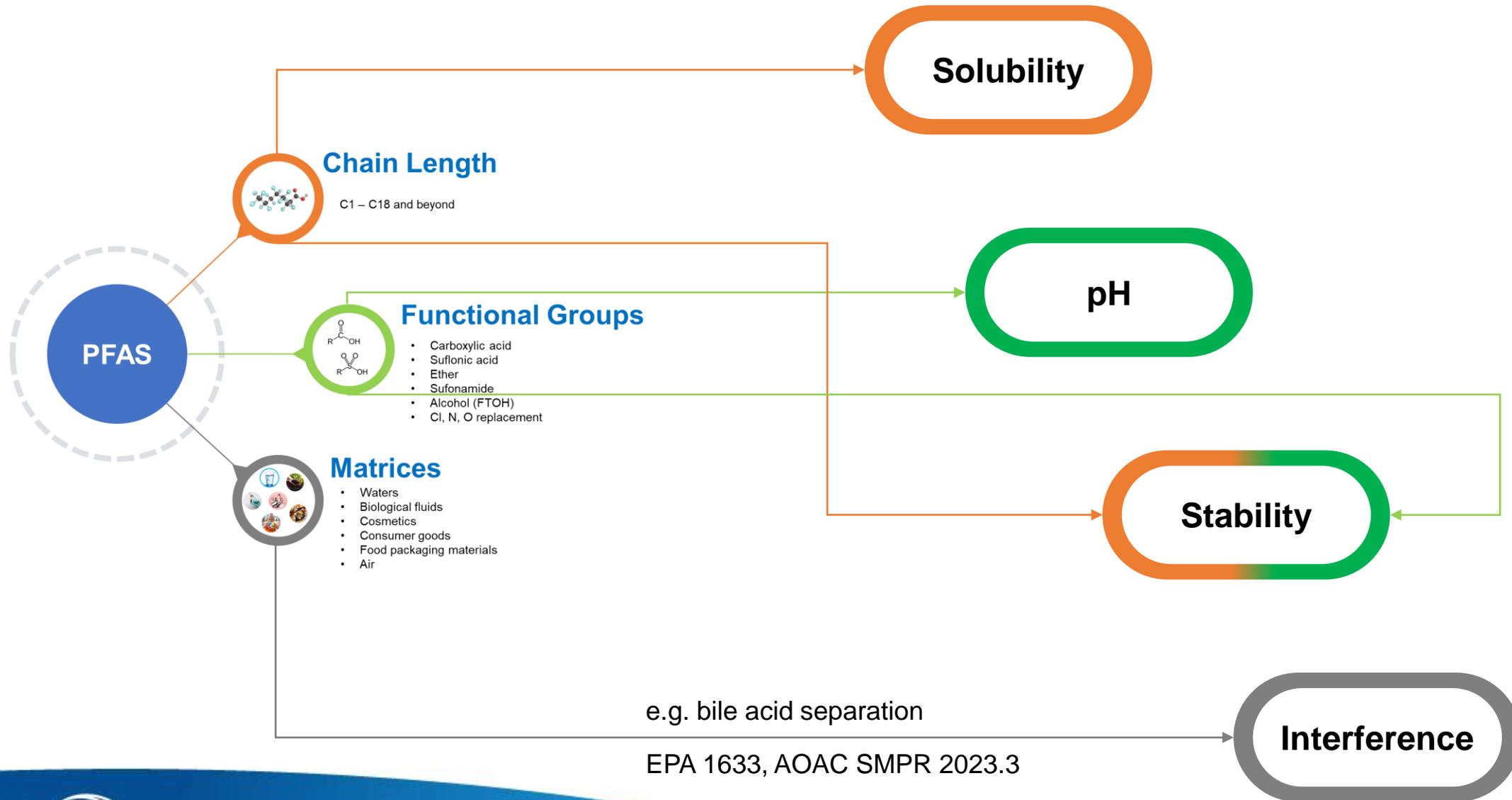


HFO-1234y

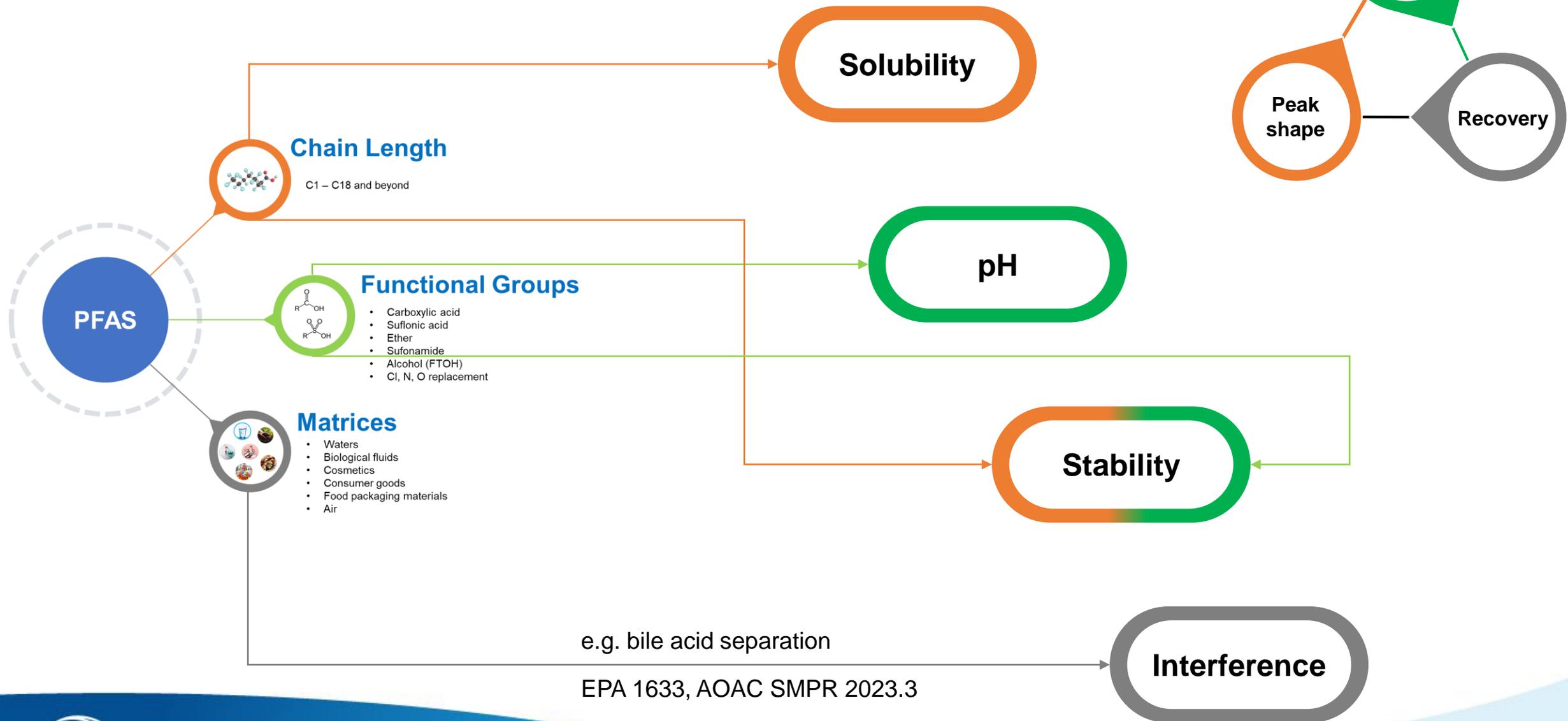


TFSI

Most Recent Trends in PFAS Analytical Methods



Most Recent Trends in PFAS Analytical Methods



ProEZLC PFAS Chromatogram Modeler

Pro EZLC Chromatogram Modeler

Send Feedback Help Print Save Save a Copy Language

Compounds Conditions My EZLC <<

Column

[Click here to request an evaluation column for your modeled solution](#)

here to edit.

Click and drag to zoom; double-click to reset. Mouse over peak numbers for compound info.

Available Isobars: Reset

Column Force C18 (cat.# 9634252)
 Dimensions: 50 mm x 2.1 mm ID
 Particle Size: 1.8 µm
 Temp.: 30°C

Mobile Phase
 A: Water, 5 mM Ammonium Acetate
 B: Methanol

Time (min)	Flow (mL/min)	%A	%B
0	0.4	96	4
4.2	0.4	64	36
11.3	0.4	32	68
14.6	0.4	0	100

Detector MS

Pro EZLC Chromatogram Modeler

Send Feedback Help Print Save Save a Copy Language

Compounds Conditions My EZLC <<

Column

[Click here to request an evaluation column for your modeled solution](#)

Untitled. Click here to edit.

Click and drag to zoom; double-click to reset. Mouse over peak numbers for compound info.

Available Isobars: Reset

Column Force C18 (cat.# 9634252)
 Dimensions: 50 mm x 2.1 mm ID
 Particle Size: 1.8 µm
 Temp.: 30°C

Mobile Phase
 A: Water, 5 mM Ammonium Acetate
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Time (min)	Flow (mL/min)	%A	%B
0	0.4	96	4
4.2	0.4	64	36
11.3	0.4	32	68
14.6	0.4	0	100

Detector MS

Column

Length: 50.00 mm
 Inner Diameter: 2.10 mm
 Particle Size: 1.80 µm
 Available Columns: 50, 2.10, 1.80

Volume Effects

Dwell Volume: 0.25 mL
 Extra-Column Volume: 25.00 µL

Mobile Phase

Eluent A: Water, 5 mM Ammonium Acetate
 Eluent B: Methanol

Temperature: 30.00 °C
 Back Pressure: 4235 psi

Gradient Program

Add Start Isocratic Hold
 3 # of Gradient Steps
 Add Final Isocratic Hold
 Add Re-equilibration Time

Time (min)	%B	Flow (mL/min)
0	4	0.4
4.2	36	0.4
11.3	68	0.4
14.6	100	0.4

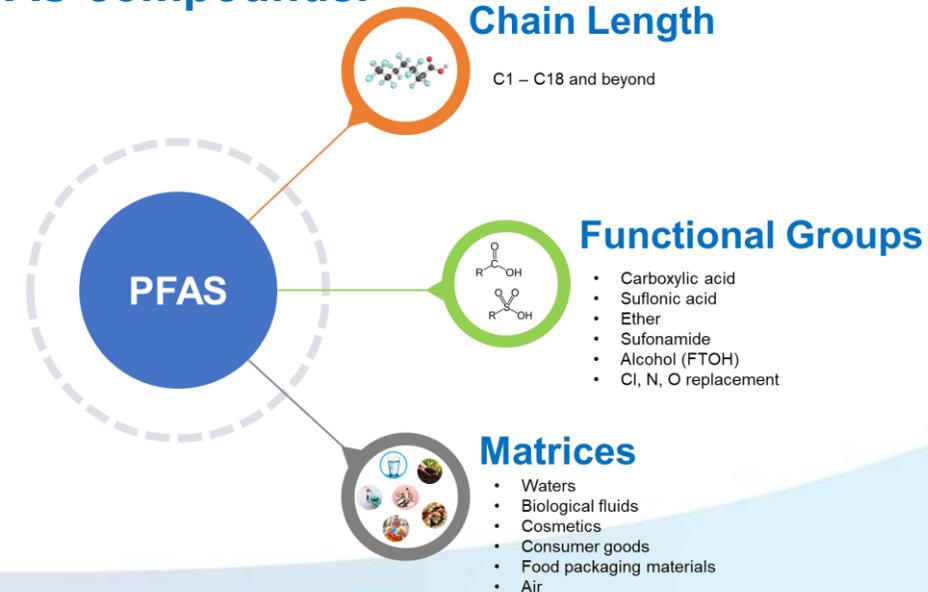
Target Resolution: 1.50 Optimize Gradient Slope

Results

Gradient Time + Delay / Run Time: 15.48 / 15.48 min
 T0: 0.25 min
 Isobaric Compounds Separated: 7
 Critical Pair: 17,19

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.**





QUESTIONS

PFAS

PER- AND POLY-FLUOROALKYL SUBSTANCES

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