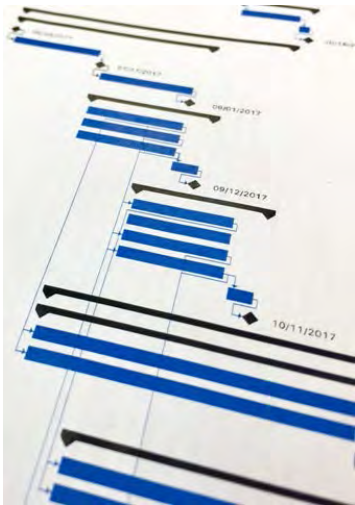


TRUST – PERFORMANCE – PEOPLE

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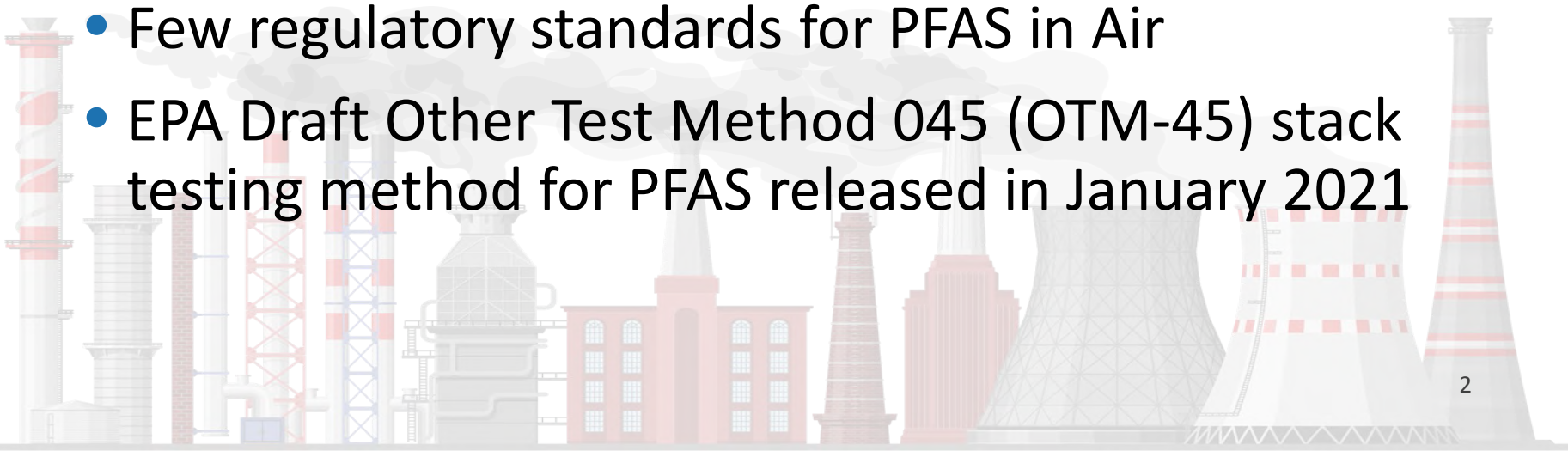
Innovative Sampling and Analysis Techniques for Stack Sampling of PFAS Compounds in Air Emissions from Stationary Sources

June 2021

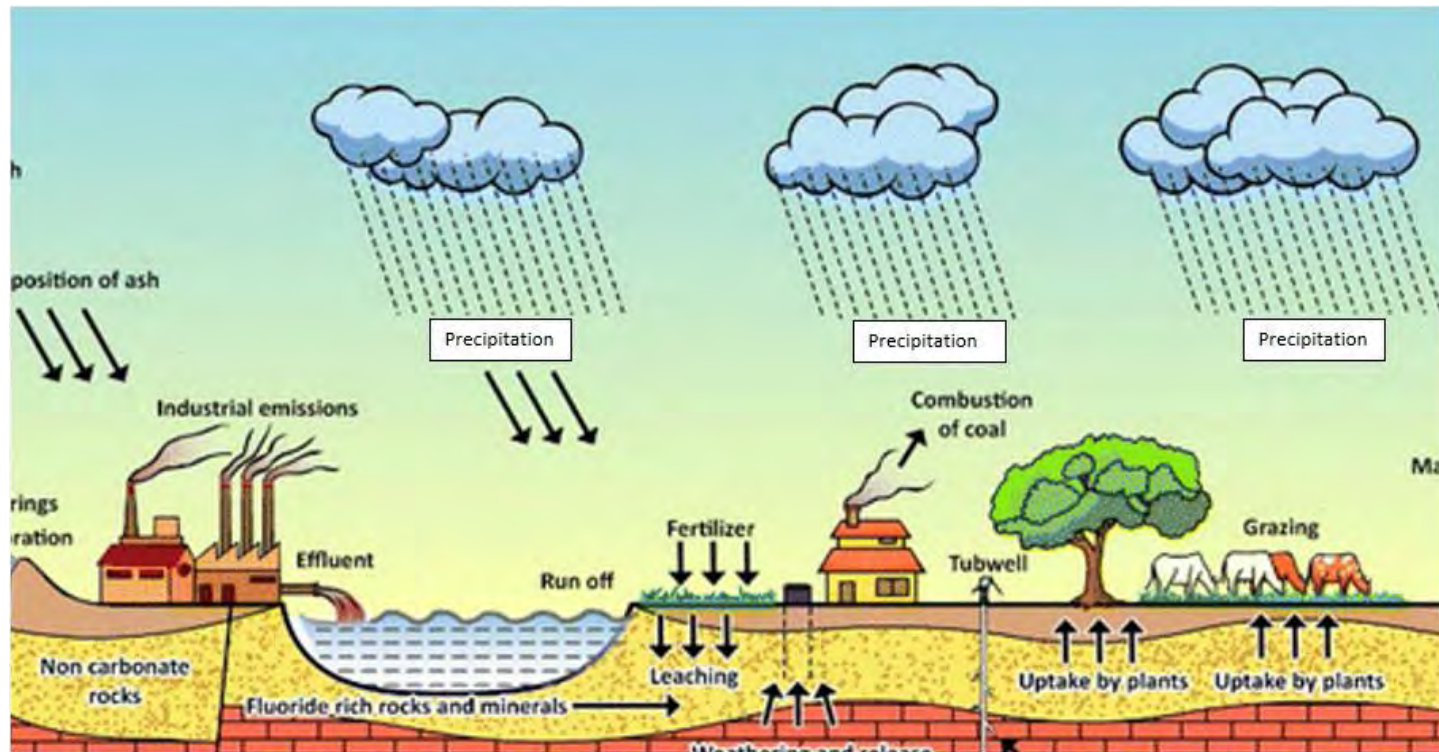
PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

PFAS in Air Source Emissions

- Focus on PFAS has been in Drinking Water, Groundwater, Soil
- Very little focus on Air to date, But that's changing
- No EPA validated ambient air monitoring methods for PFAS
- Few regulatory standards for PFAS in Air
- EPA Draft Other Test Method 045 (OTM-45) stack testing method for PFAS released in January 2021



Why Air?



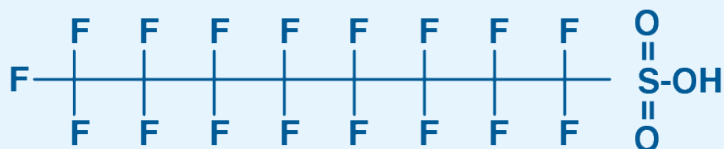
<https://www.picswe.com/>

What PFAS Are We Looking For?

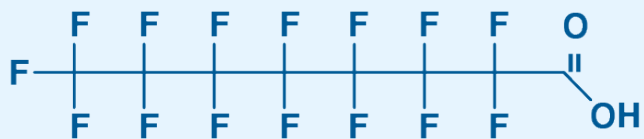
Over 6000 PFAS Compounds

- EPA Method 537.1
 - Solid phase extraction (SPE), liquid chromatography/tandem mass spectrometry (LC/MS/MS), PFAS in drinking water
 - 18 PFAS Compounds
- EPA Method 533
 - Isotope dilution anion exchange, SPE and LC/MS/MS, PFAS in drinking water
 - 25 PFAS Compounds
- EPA Method 8327
 - External Standard Calibration Multiple Reaction Monitoring and LC/MS/MS
 - 24 PFAS Compounds
- EPA Draft Method OTM-45
 - ~50 PFAS Compounds
 - Combination of the target lists from the methods shown above

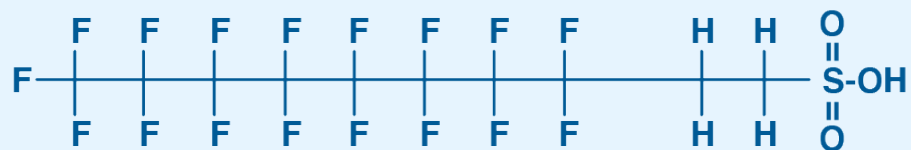
Per vs Poly PFAS



perfluorooctane sulfonic acid
(PFOS, CAS 1763-23-1)



perfluorooctanoic acid
(PFOA, CAS 335-67-1)



8:2 fluorotelomer sulfonate
(8:2 FTS, CAS 039108-34-4)

Draft EPA Method OTM-45

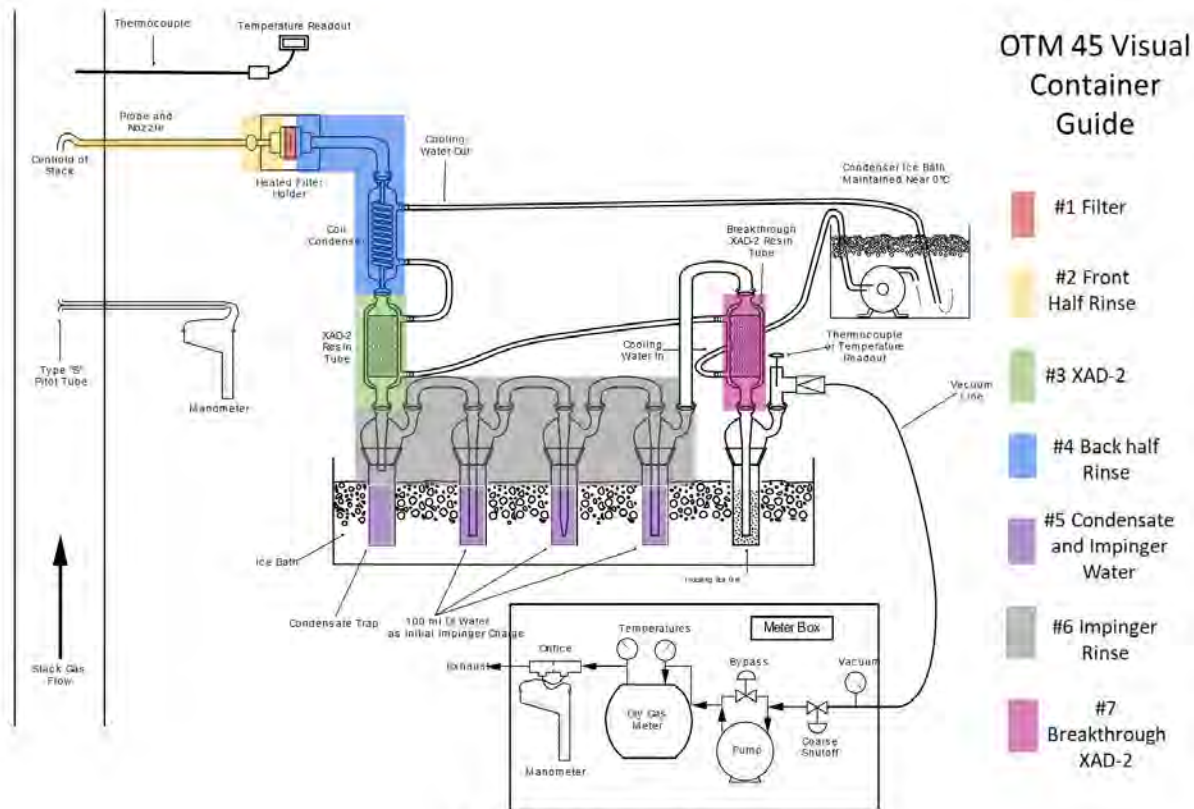


Figure OTM-45-1. Sampling Train

- Isokinetic Sampling Method
- Four Sample Fractions
- Blank train – Proof Blank
- LC/MS/MS Analysis
- Semi-volatile PFAS
- Isotope Dilution – Isotopically Labeled Standards

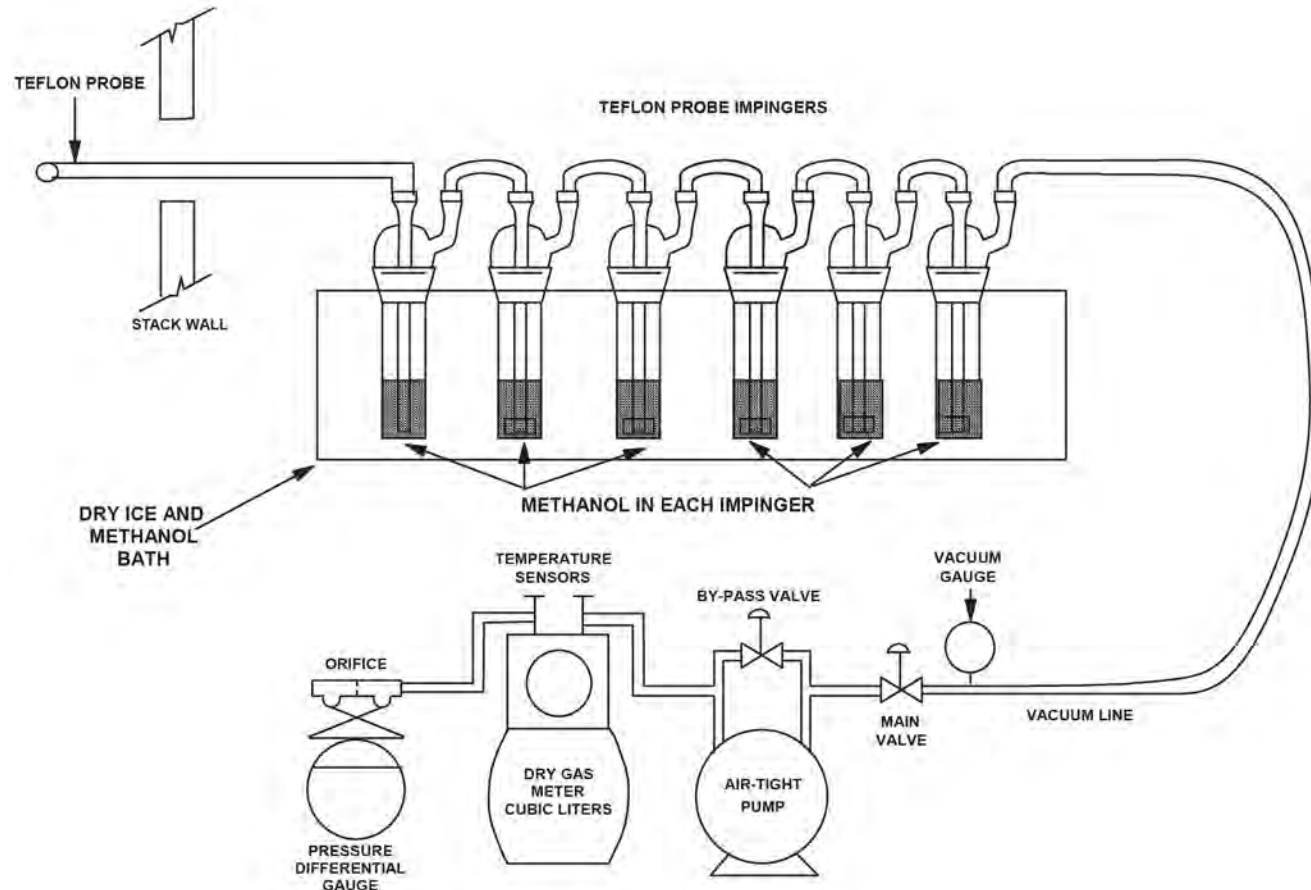
Draft EPA Method OTM-45 Isokinetic Train



Draft EPA Method OTM-45 Isokinetic Train

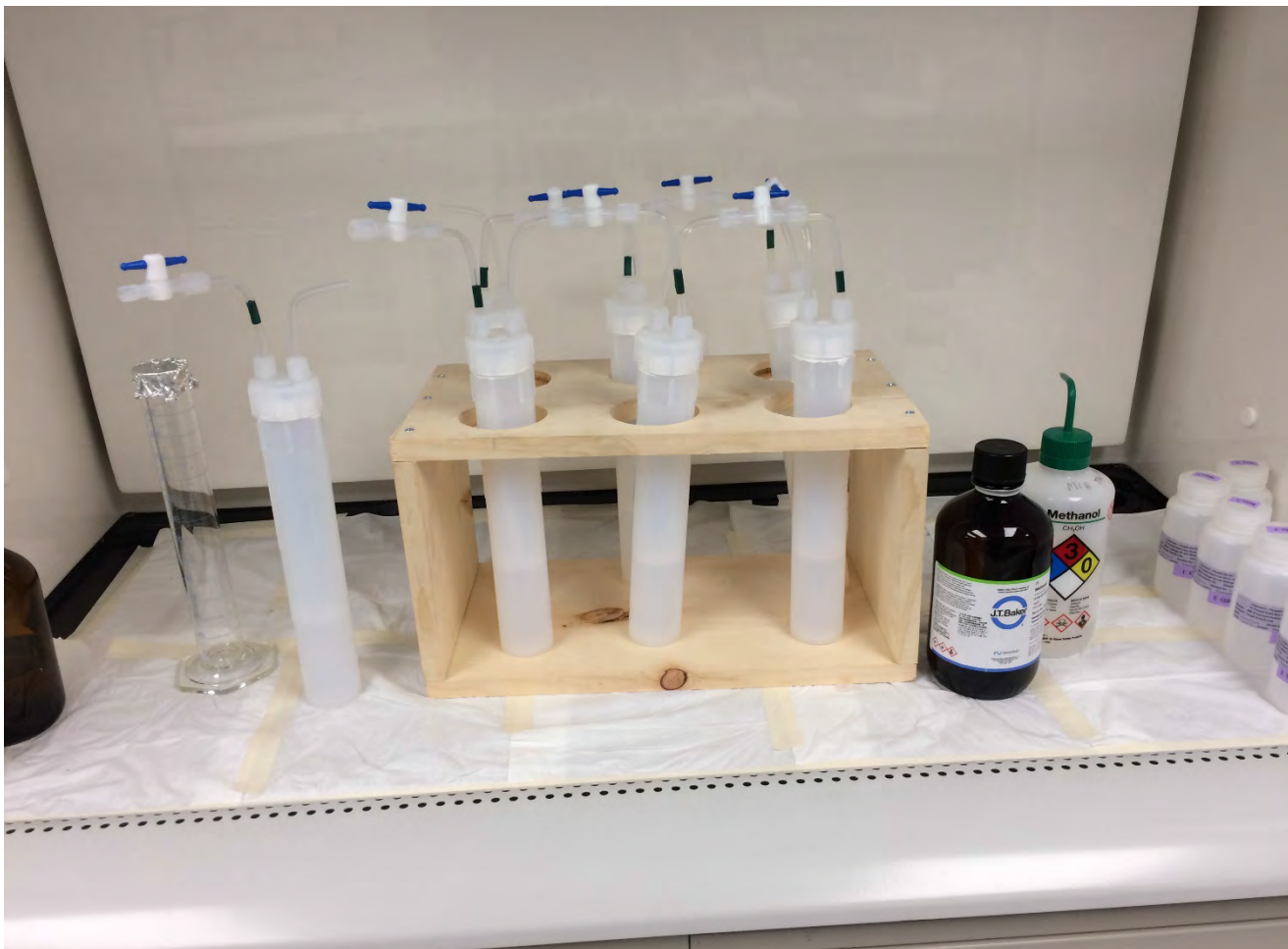


Modified EPA Method 18 Cryogenic Train

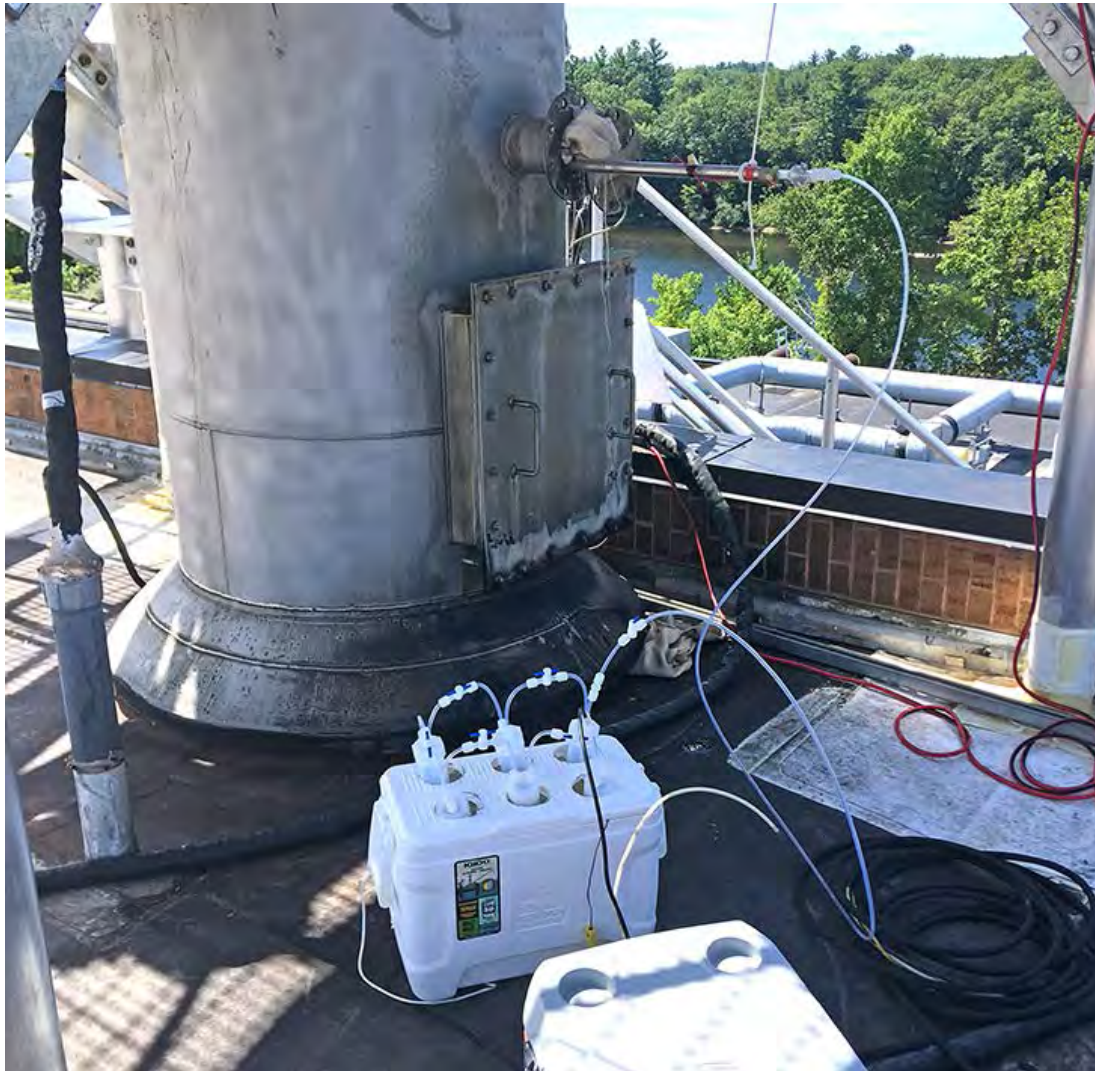


- Non-Isokinetic Sampling Method
- Midget Impingers Multiple Sample Fractions
- GC/MS Analysis
- Methanol Bath Chilled to -100 °F

Modified EPA Method 18 Cryogenic Train



Modified EPA Method 18 Cryogenic Train



Detection Levels

- OTM-45 detection limits
 - 0.05ng to 2.8ng/sample
 - Varies per fraction, per compound, per lab
 - equal to ppq in-stack PFAS concentrations (Table 45-11)
- Modified Method 18 detection limits
 - 2.5ng to 50ng/sample
 - equal to ppt in-stack PFAS concentrations

Other PFAS Sampling/Analytical Methods

- EPA Canister Sampling Method
 - Measure Highly volatile PFAS, non-polar
- Total Organofluorine (TOF) Analysis – Combustion IC
 - Measure Total Fluorine – separate HF
 - Subtract HF measured by EPA Method 26 or other methods
- Total Oxidizable Precursors (TOP) Analysis
 - Converts polyfluorinated precursor PFAS compounds to measurable forms of PFAS
- Time-of-Flight – Non-target Analysis
 - Liquid Chromatography Quadrupole Time-of-Flight Spectrometry
 - Not Quantitative - Determines chemical structure to identify compounds

Processes Tested by Weston

- Chemical Manufacturing
- Coating Operation
- Sewage Sludge Incinerator
- Carbon Regeneration



Potential Sources of PFAS Air Emissions

- Chemical Manufacturing
- Coating Operations
- Sewage Sludge Incineration
- AFFF (DOD)
- Refineries
- Pulp and Paper
- Waste Incineration
- Carbon Regeneration
- Others.....



PFAS Air Pollution Control Systems

- Thermal Oxidation
- Scrubbers
- Carbon Beds
- Air Stripper
- Incineration
- Others??



Future

- EPA 2019 PFAS Action Plan
 - EPA Administrator Michael Regan is from NC
 - April 27, 2021 – EPA Council on PFAS
- EPA Validation and Promulgation of Stack Testing Methods
- Legal action by state regulatory agencies
- Regulatory agencies will determine industries and processes to be regulated, which PFAS compounds to be measured, and will establish air emission limits
- Lawyers, Engineers, Chemists, and..... Stack Testers

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Questions?

