FMS
Fluid Management Systems

Streamline your Drinking Water Sample Preparation and Analysis

Agenda

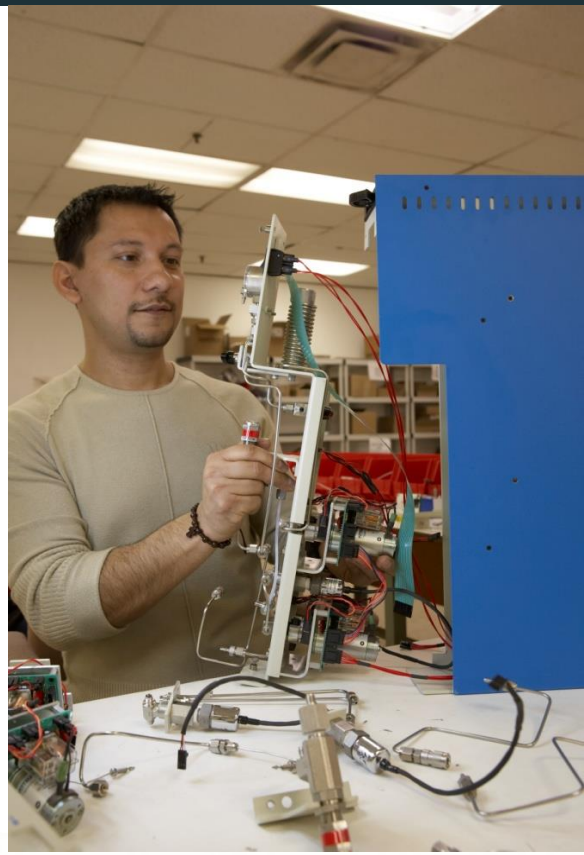
- FMS, Inc. Fluid Management Systems
- Sample Prep vs Analytical Runs in time
- Sample Analysis Workflow
- Sample Prep Workflow
- Total Solution Sample Analysis Strategy

FMS

- **FMS - Fluid Management Systems**
  - **Founded in 1986**
  - **Manufactures Total Solution Sample Preparation and Consumables for GC, GC/MS, LC and LC/MS**

FMS
Fluid Management Systems

Made in the USA



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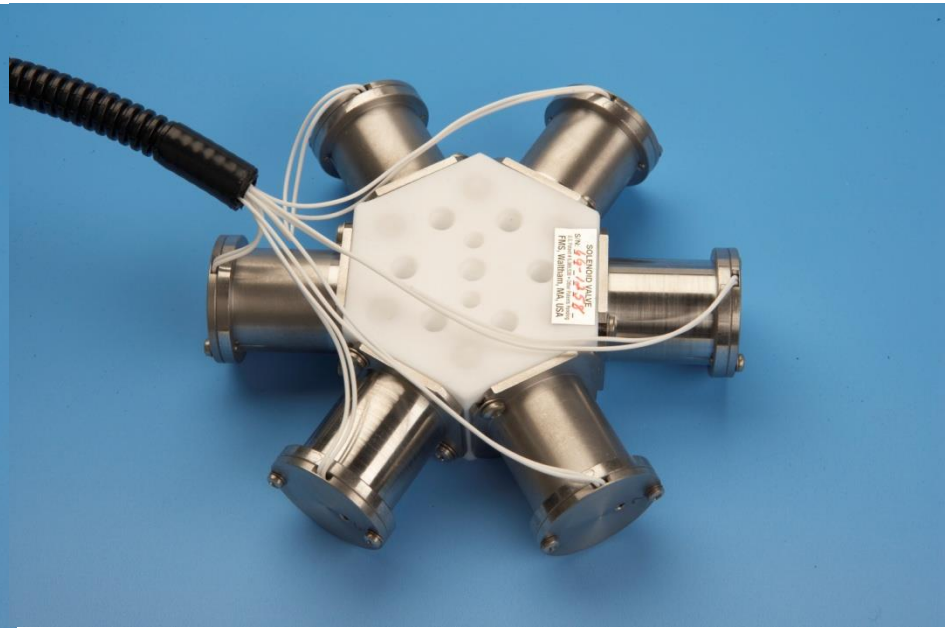
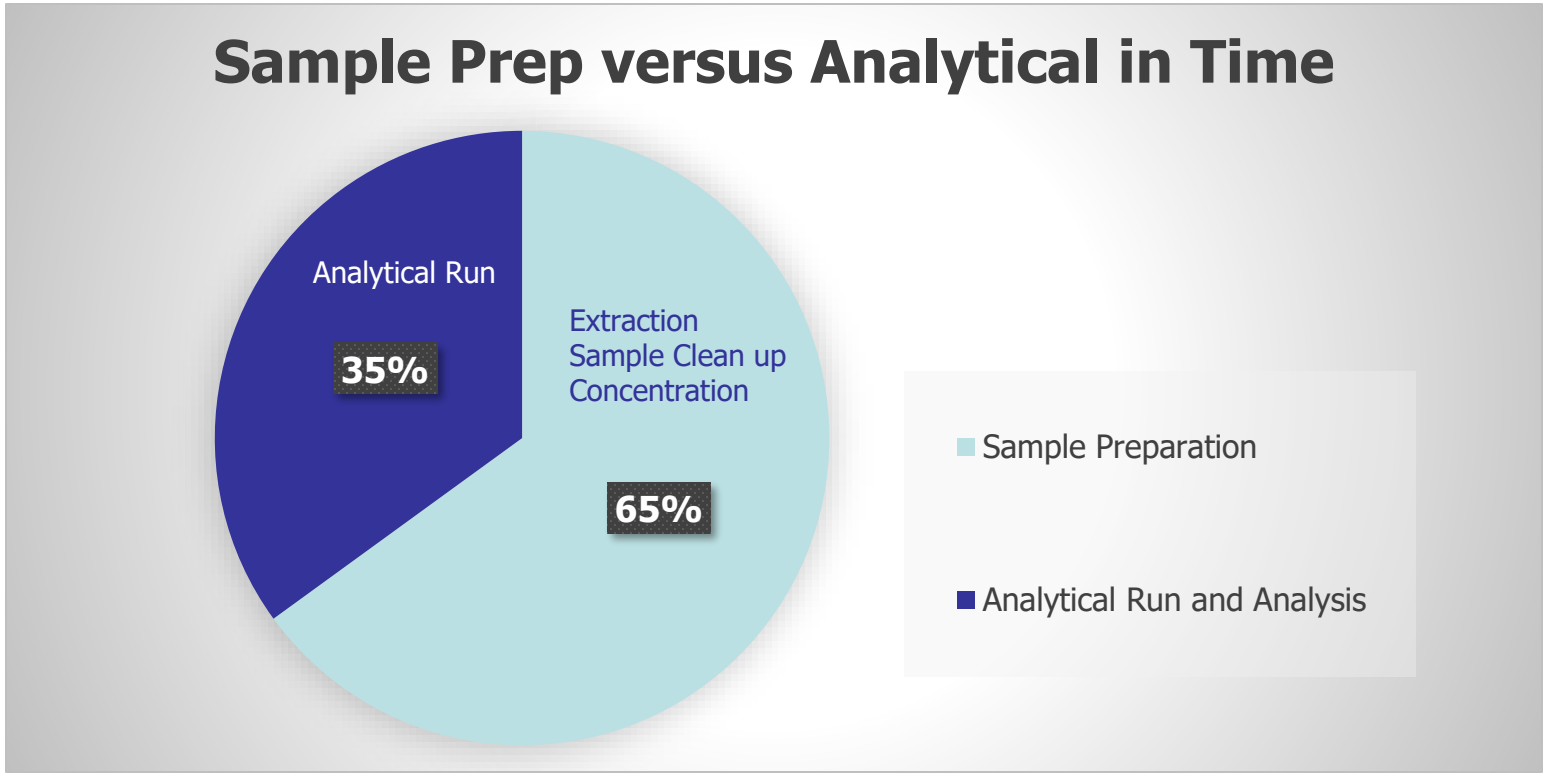
Made in the USA



Class 1000 Cleanroom for Consumables Manufacturing

Laboratory Workflow Breakdown



FMS Sample Preparation Workflow

Sample Preparation consist of three main instruments:
1- Extraction 2- Sample Clean-Up 3- Concentration = Total Prep

PLE Extraction

Solid Phase Extraction

+

PowerPrep Sample Cleanup

+

SuperVap Concentration

=

Total Sample Prep

Solid Phase Extraction front end for GC/MS and LC/MS

EconoTrace®

TurboTrace®

TurboTrace® ABN

TurboTrace® PFC

NanoTrace®

Direct to Vial Concentration

Direct to Vial Concentration

SuperVap® – Concentration System

- 6 Position 250ml Vessel
- 12 Position 50ml Vessel
- 12 Position 20,40,60 ml vial
- 24 Position 2 and 4 ml vial

Automated Concentration for PFAs

- SuperVap PFC
  - 24 positions
  - 15ml Conical vials

Objective

- **Develop as many SPE procedures for the testing lab using a single extraction platform.**
- **Minimize manual steps to lessen error and maximize limited man hours**
- **High Throughput, Low Cost Sample Prep for Liquids**

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Reasons for SPE

- **Reduced solvent**
- **Reduced glassware**
- **Simplified procedures**
- **Automation versus manual protocols = Reproducibility**

Determining Factors

- **Closed System**
- **Handle Sample Volumes of any size**
- **Ability to load samples**
  - **Positive Pressure**
  - **Positive Pressure or Vacuum**
- **Easily handle a wide variety of cartridge designs and sizes without cumbersome modifications.**

Determining Factors

- **Ability to dry cartridges by both vacuum and positive gas pressure (N2 or CO2).**
- **Automated Bottle Rinse**
- **Parallel Extraction**
- **Hyphenate Extraction, Drying and Concentration**

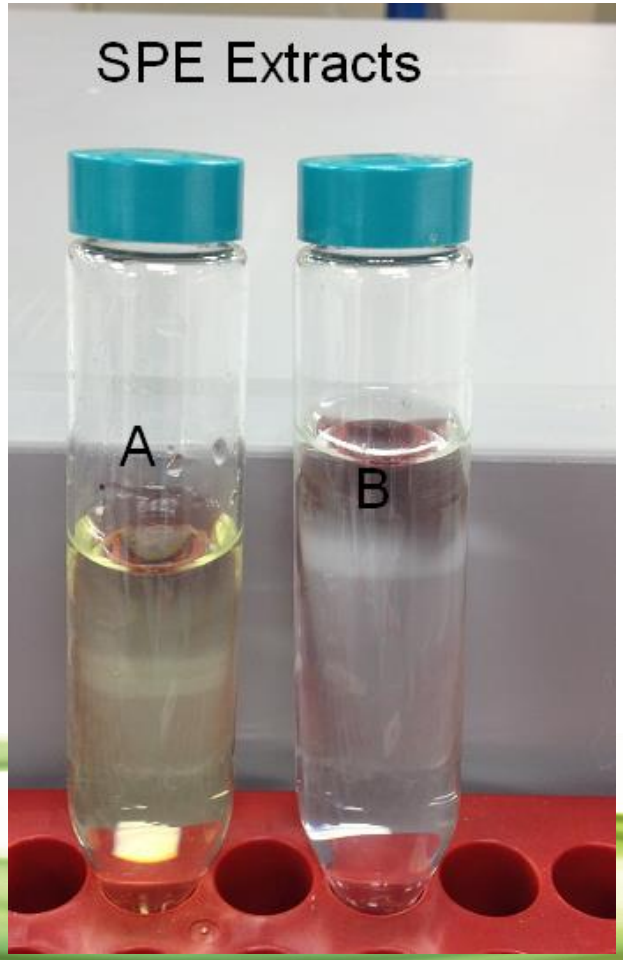
Comparison of LLE/CLE vs. Automated SPE Methods

LLE/CLE	Automated SPE
Open to laboratory background	Closed system
Uses >360mls solvent	Uses <60mls solvent
Shaking / Continuous process	Filtration process
Forms emulsions requiring centrifuging	No emulsions formed
Little Selectivity	Wide Selectivity (adsorbent)
Requires water removal	In-line water removal
	Fast and Unattended

Comparison of LLE/CLE vs. Automated SPE Methods

LLE/CLE	Automated SPE
No Separation of waste	Separates Aqueous and Organic Waste
More volume to evaporate	<60mls solvent to evaporate
Massive solvent emission	6 times less solvent emission
CLE high electrical costs	Easily Capture Solvent
Requires lots of solvent for cleaning	Lower solvent costs
	Lower Disposal Costs

No subsequent Emulsions in Extracts to deal with



Reduced Solvent Usage

Methods

- EPA Method 506 Phthalates and Adipate Esters
- EPA Method 508.1 Chlorinated Pesticides, Herbicides, and Organohalides
- EPA Method 515.2 Chlorinated Acids
- EPA Method 521 Nitrosamines
- EPA Method 525.2 Semi-volatiles
- EPA Method 525.3 Semi-volatiles
- EPA Method 526 Semi-volatiles
- EPA Method 527 Selected Pesticides and Flame Retardants
- EPA Method 528 Phenols

Methods

- EPA Method 529 Explosives
- EPA Method 532 Phenylurea Compounds
- EPA Method 533 Per and PolyFluoroalkyl Substances Anion Exchange
- EPA Method 535 Chloroacetanilide and other Acetamide Herbicides
- EPA Method 537 Selected Per and PolyFluoroalkyl Substances
- EPA Method 537.1 Selected Per and PolyFluoroalkyl Substances
- EPA Method 548.1 Endothall

Methods

- **EPA Method 549.2 Diquat and Paraquat**
- **EPA Method 550.1 PAH's**
- **EPA Method 552.1 Haloacetic Acids and Dalapon**
- **EPA Method 553 Benzidines and Nitrogen Containing Pesticides**

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EconoTrace SPE

EconoTrace SPE

Fully Automated

Modular and expandable from 1 to 4 Modules

High Throughput Runs
8 Sample Extractions in Parallel

Uses Positive Pressure Pumping for Precise delivery of Conditioning Solvent, Sample and Elution Solvent

Automatic Bottle Rinse

Delivers extract directly to a Concentrator

EconoTrace SPE

Touch Screen Control

SD Card for Storing and Transferring Methods

Nitrogen Drying

Six Elution and Wash Solvents

Sample Size 2 ml to unlimited

Automatic Bottle Rinse

EconoTrace SPE

Real Time Graphical Display of Extraction Steps

Up to Eight Extractions in Parallel

Direct to Vial Concentration

Positive Pressure Pumps for precise, consistent delivery of Sample and Solvent

Sample Sizes Unlimited

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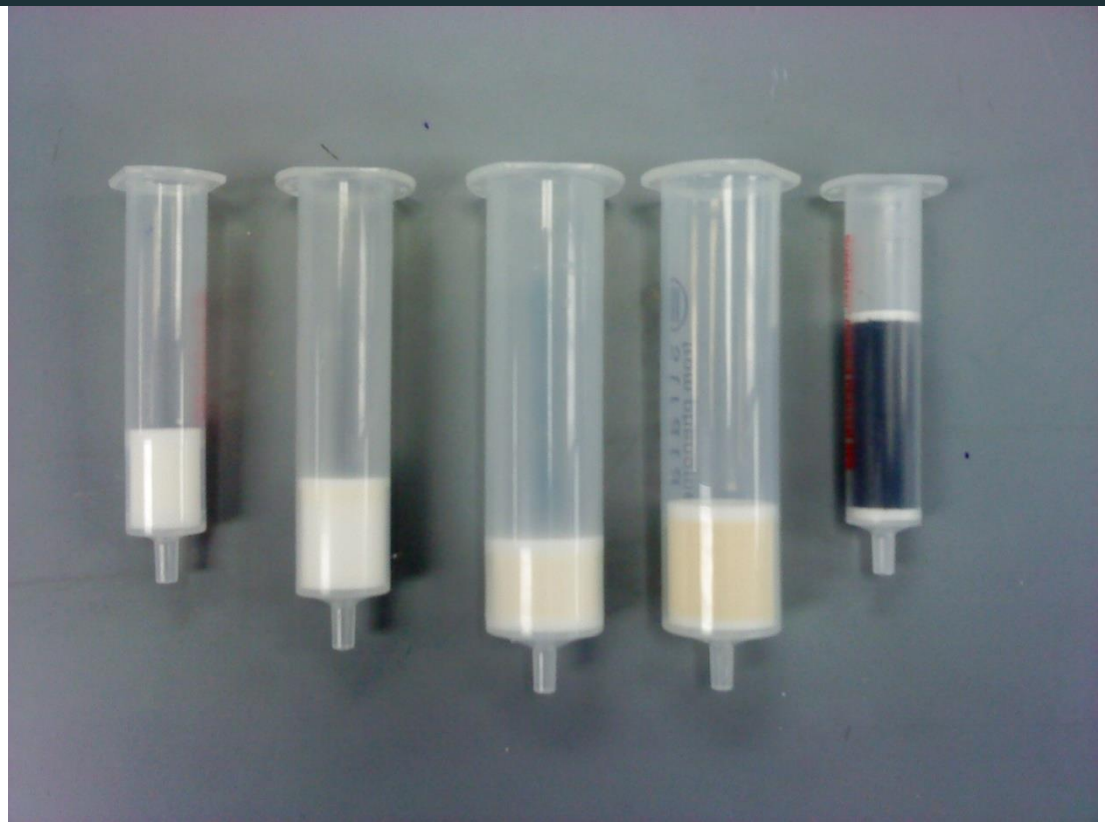
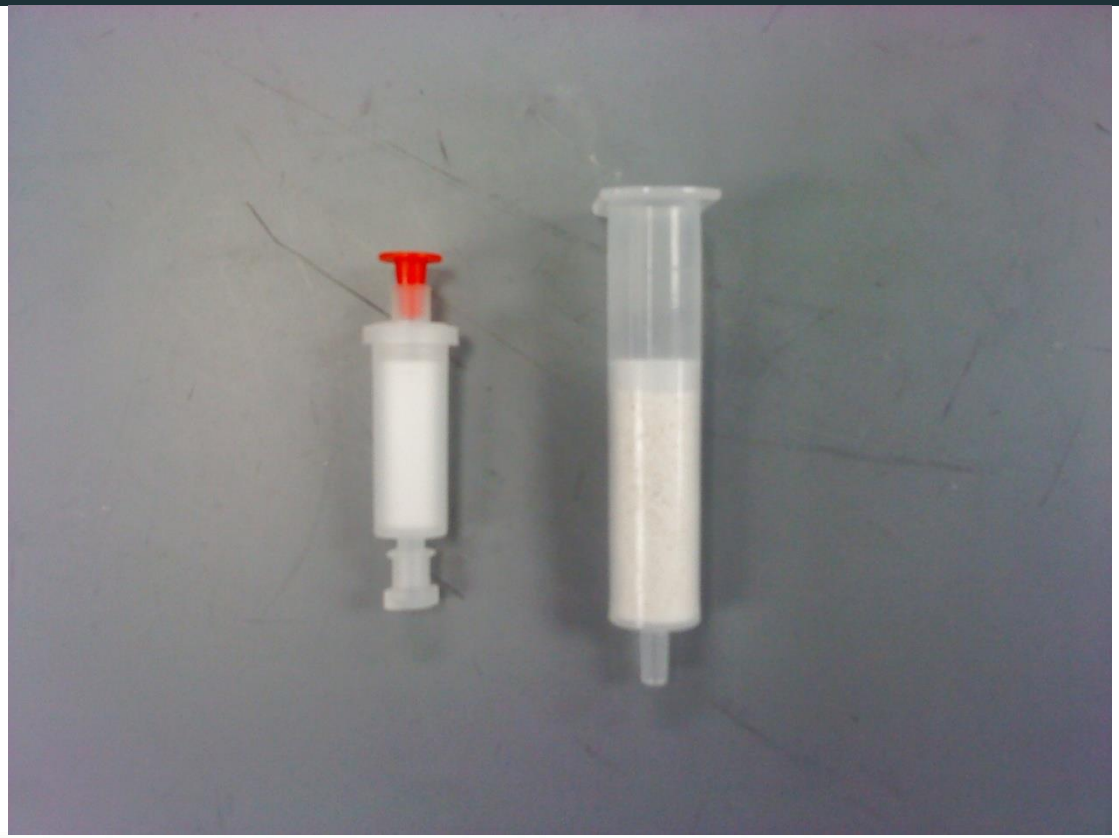
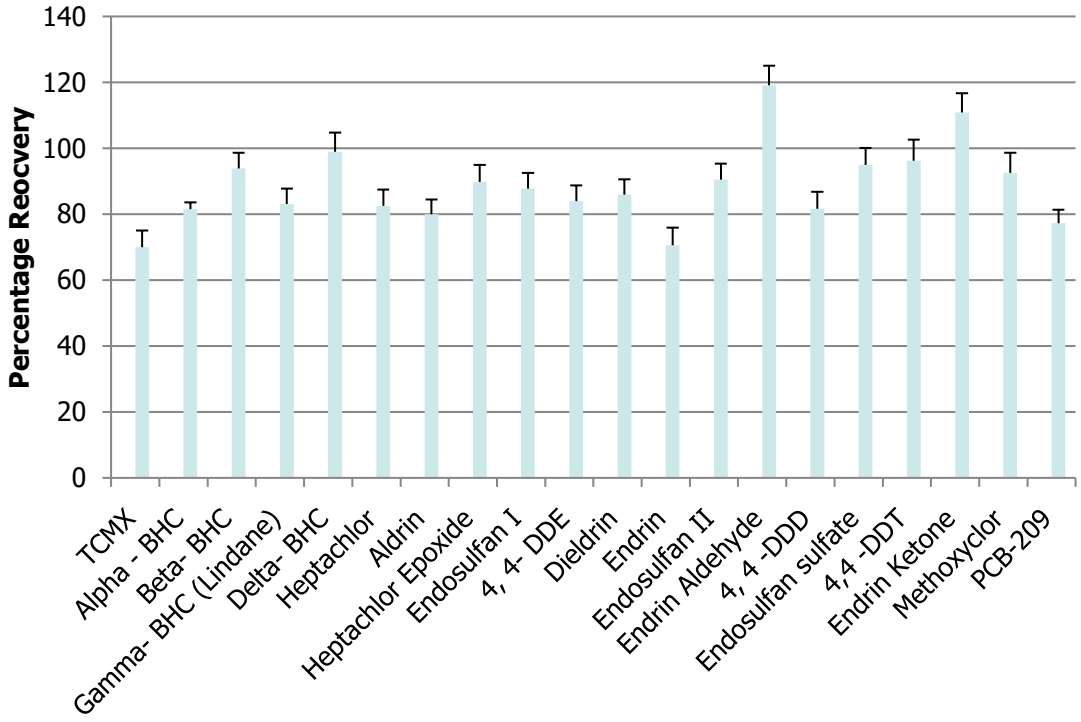
SPE Cartridges



Drying Cartridges



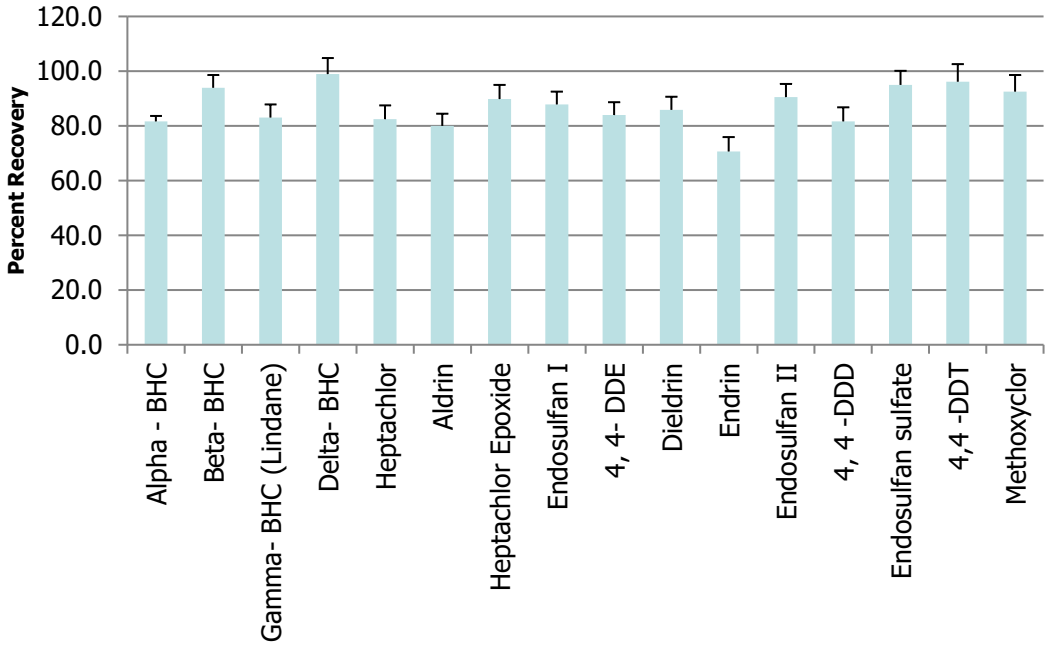
508 OCPs


Percentage Reocvery
140
120
100
80
60
40
20
0
TCMX
Alpha - BHC
Beta- BHC
Gamma- BHC (Lindane)
Delta- BHC
Heptachlor
Aldrin
Heptachlor Epoxide
Endosulfan I
4, 4- DDE
Dieldrin
Endrin
Endosulfan II
Endrin Aldehyde
4, 4 -DDD
Endosulfan sulfate
4,4 -DDT
Endrin Ketone
Methoxyclor
PCB-209

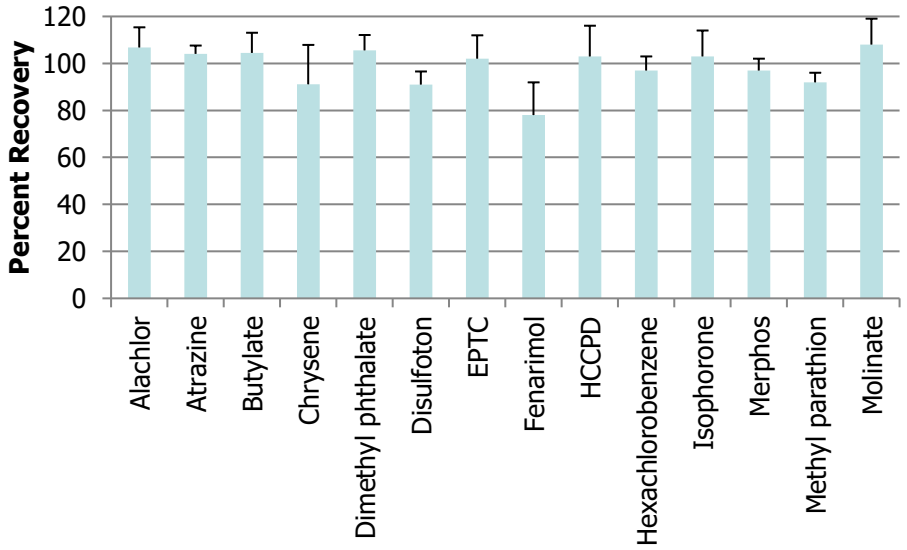
522 1,4-dioxane

Replicate	1,4-dioxane-d8 recovery	1,4-dioxane conc. (ug/L)	STD DEV
1	89.59%	1.056	
2	84.59%	0.962	0.05
3	82.15%	1.03	

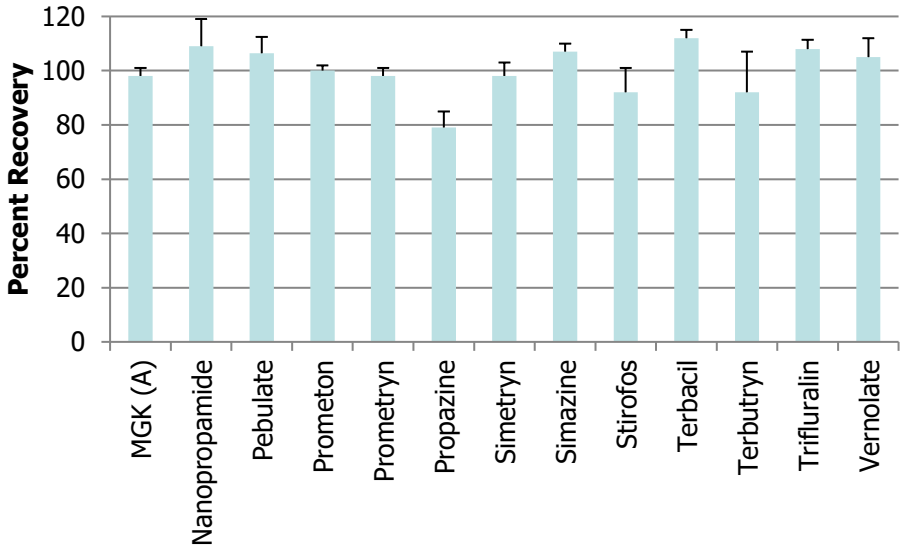
525.3 OCPs (Drinking Water)



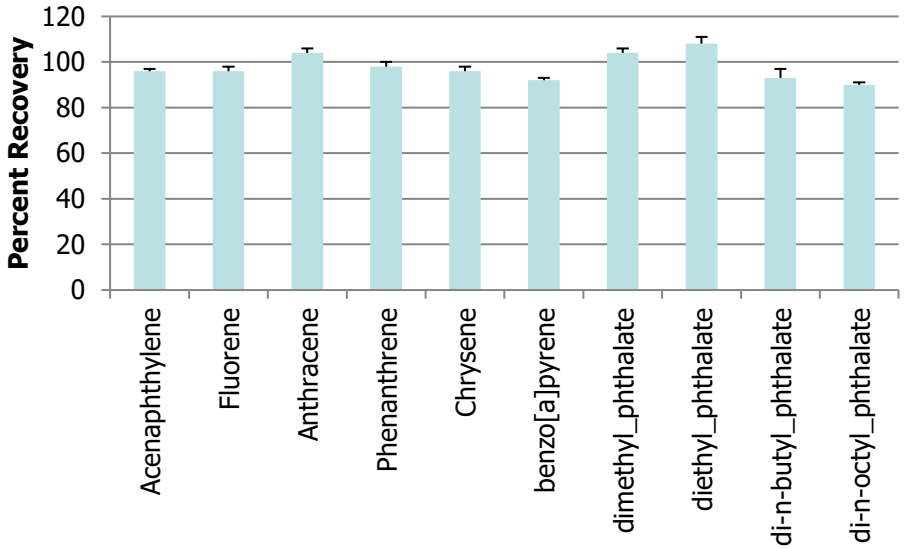
525.3 SVOCs (Drinking Water, 1)



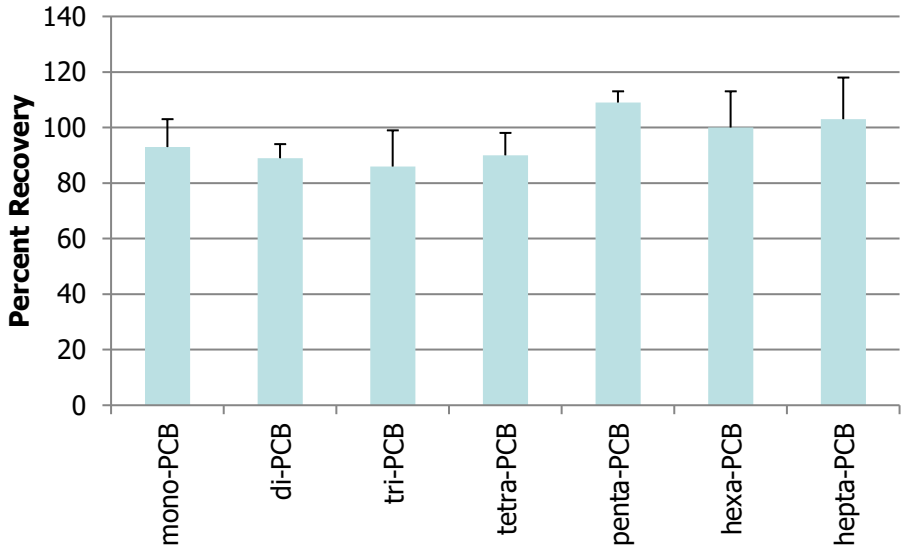
525.3 SVOCs (Drinking Water, 2)



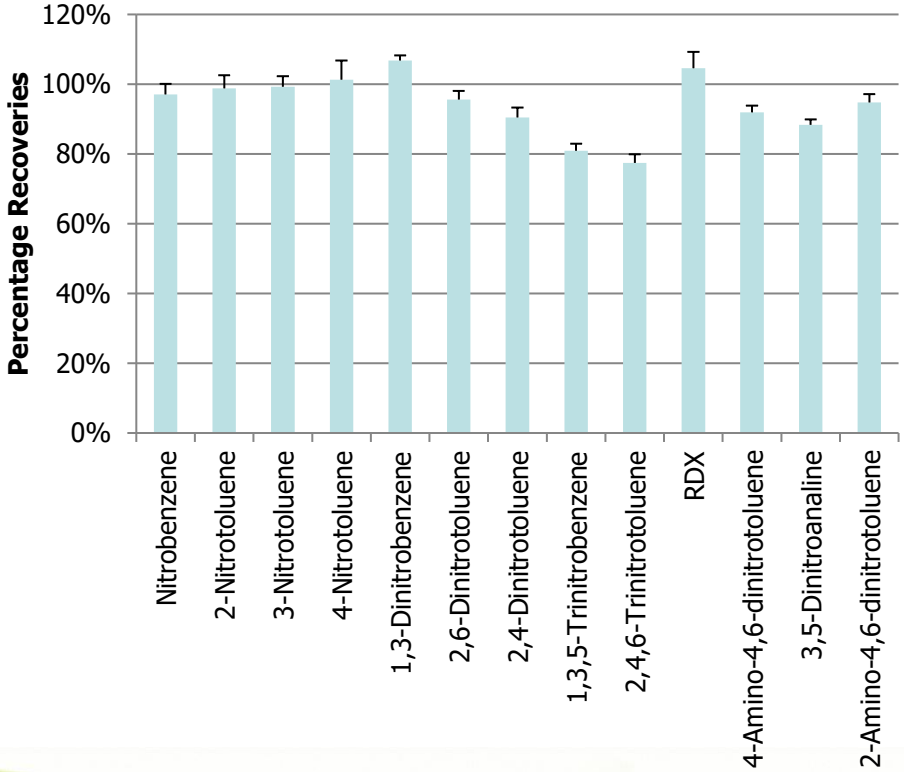
525.3 PAHs and phthalates (Drinking Water)



525.3 PCBs (Drinking Water)



529 Explosives



548.1 Endothall

Table 1.

Replicates	Endothall Concentration	Percent Recovery
Sample #1	47.6 µg/mL	95.2%
Sample #2	49.3 µg/mL	98.6%
Sample #3	48 µg/mL	96.0%
	Std Deviation	2.7%

Table 2.

Replicates	Endothall Concentration	Percent Recovery
RL Sample #1	5.18 µg/mL	103.6%
RL Sample #2	5.55 µg/mL	111.0%
	RPD	4.5%

549.2 Diquat and Paraquat

Table with recoveries for the 549.2 compounds

Compound	% Recovery	Stdev
Diquat	92.7	3.3
Paraquat	84.2	4.9

TurboTrace SPE

For all liquid types

TurboTrace SPE

- **Fully Automated**
- **Modular and expandable from 1 to 6 Modules**
- **High Throughput Runs Sample Extraction in Parallel**
- **Uses Positive Pressure Pumping for Precise delivery of Elution and Wash Solvent**
- **Uses Vacuum or Positive Pressure Pumping to Load Samples**

TurboTrace SPE

Touch Screen Control

SD Card for Storing and Transferring Methods

Six Elution and Wash Solvents

Sample Size 2 ml to unlimited

Automatic Bottle Rinse

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TurboTrace SPE

Real Time Graphical Display of Extraction Steps

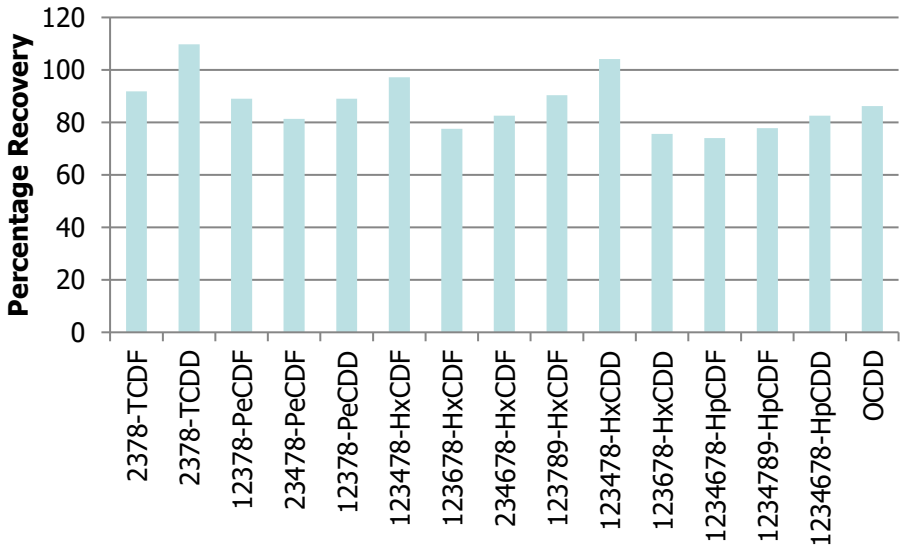
Automatic Liquid Level Sensor

Direct to Vial Concentration

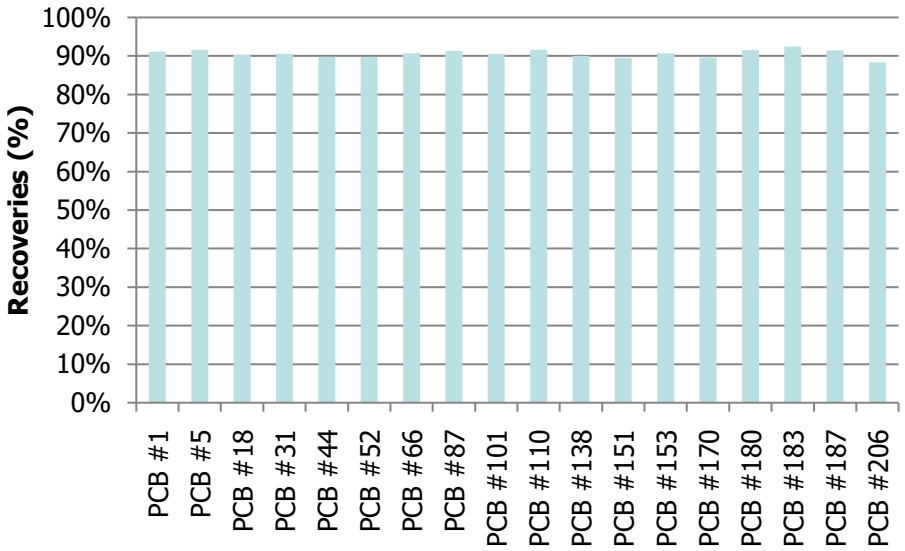
Positive Pressure Pump for precise, consistent delivery of Sample and Solvent

Automated Fast Flow Sample Processing

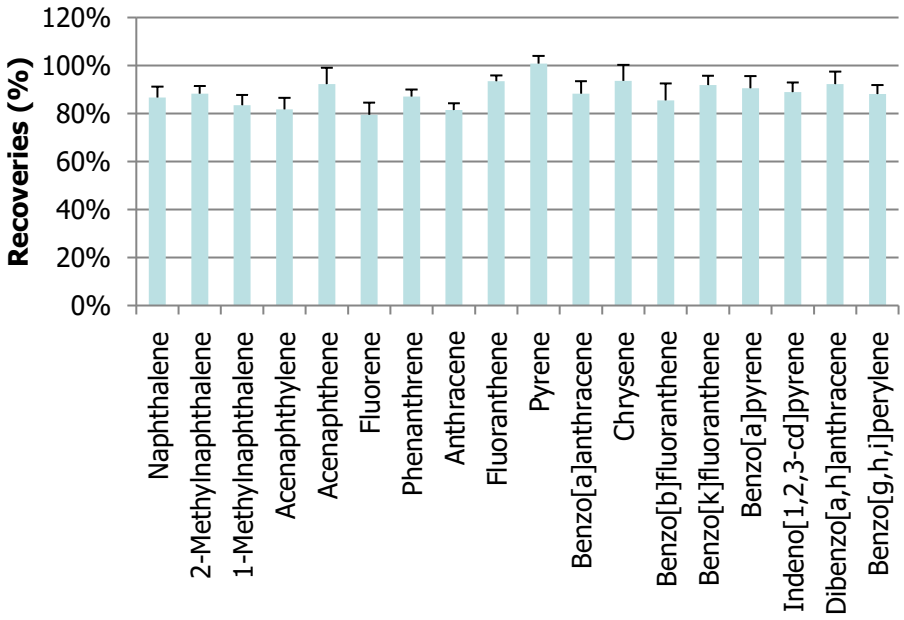
1613 Dioxins/Furans in Water



1668C PCBs in Water



PAHs in Water



SPE Systems for PFAS extraction

EPA Method 533
EPA Method 537

EconoTrace PFC

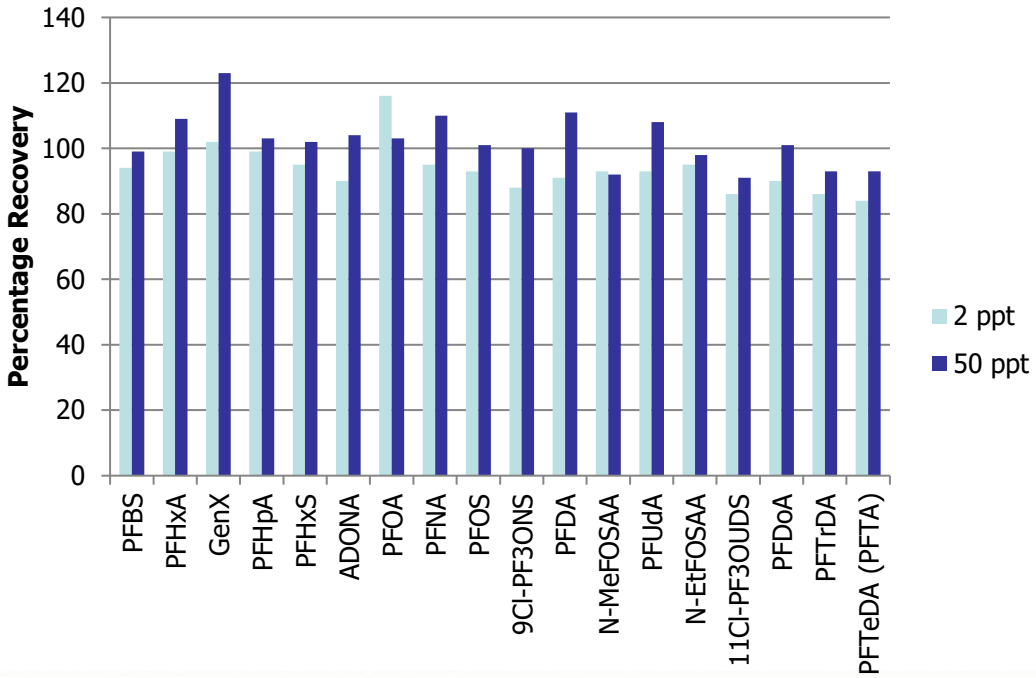
TurboTrace PFC

All Inert Delrin, HDPE, Peek and Stainless Steel Surfaces

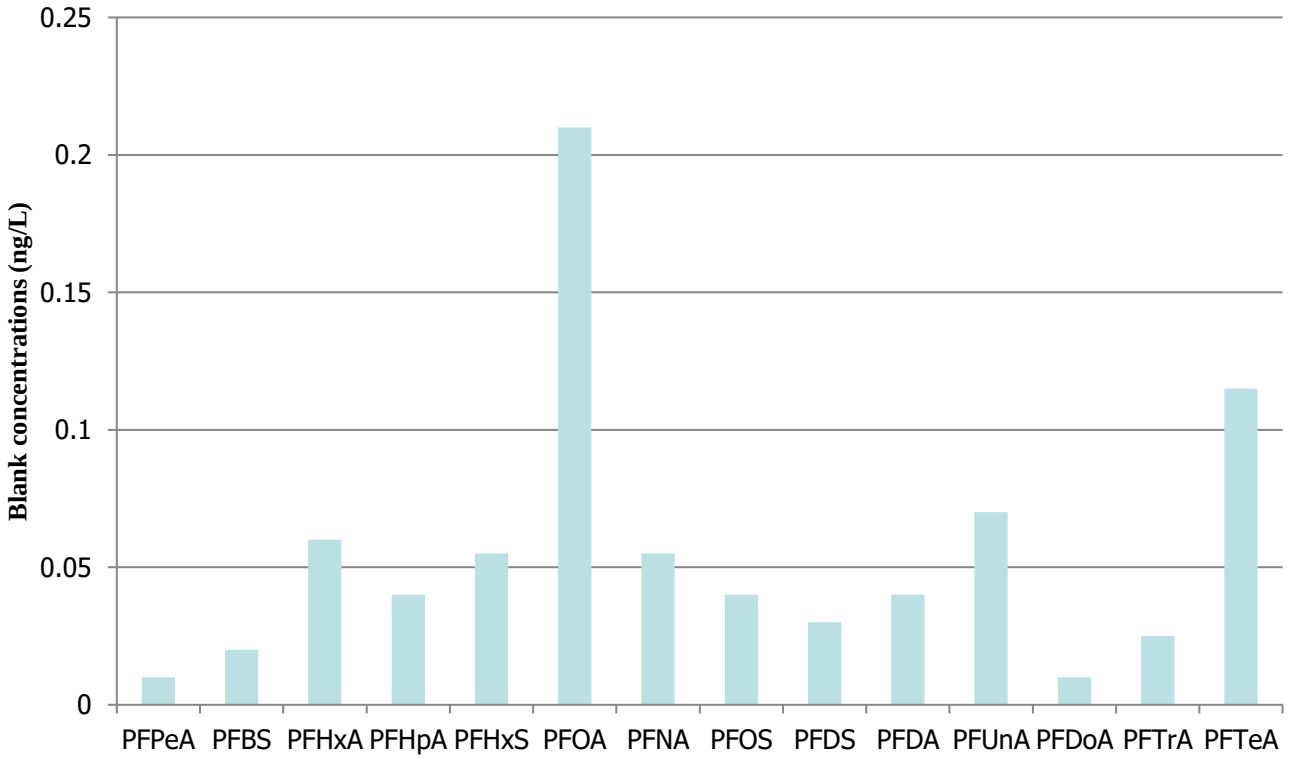
Automated Concentration for PFAs

- SuperVap PFC
  - 24 positions
  - 15ml Conical vials

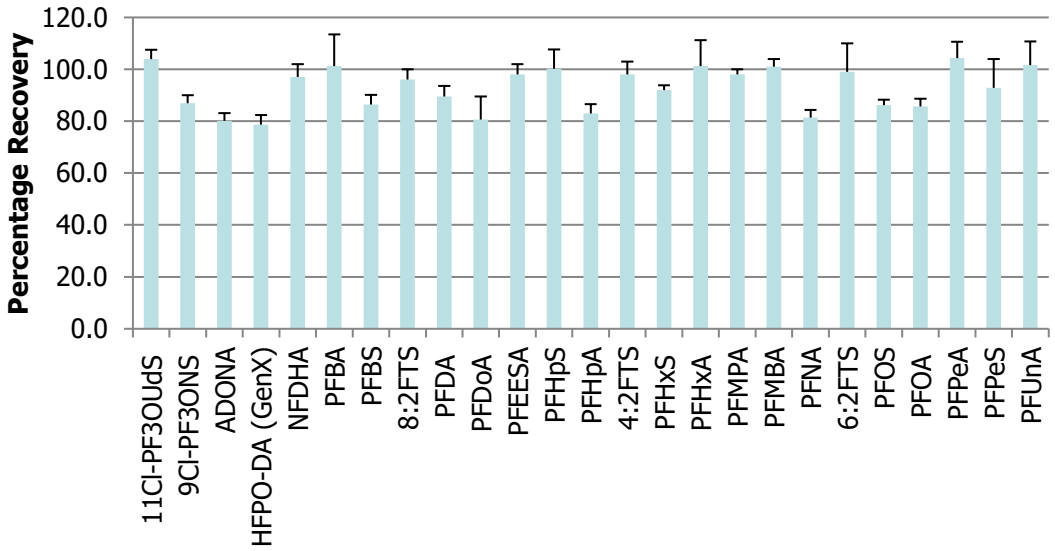
EPA 537.1


Percentage Recovery
140
120
100
80
60
40
20
0
PFBS
PFHxA
GenX
PFHpA
PFHxS
ADONA
PFOA
PFNA
PFOS
9Cl-PF3ONS
PFDA
N-MeFOSAA
PFUdA
N-EtFOSAA
11Cl-PF3OUDS
PFDoA
PFTrDA
PFTeDA (PFTA)
2 ppt
50 ppt

PFAS Background



EPA 533


Percentage Recovery
120.0
100.0
80.0
60.0
40.0
20.0
0.0
11Cl-PF3OUdS
9Cl-PF3ONS
ADONA
HFPO-DA (GenX)
NFDHA
PFBA
PFBS
8:2FTS
PFDA
PFDoA
PFEESA
PFHpS
PFHpA
4:2FTS
PFHxS
PFHxA
PFMPA
PFMBA
PFNA
6:2FTS
PFOS
PFOA
PFPeA
PFPeS
PFUnA

Automated SPE in Summary

- **One Step SPE and Concentration will reduce errors, labor costs, solvent usage and increase your sample throughput**
- **Automates and Combines the Extraction and Concentration steps in Sample Prep Processing**
- **Inline Concentration/Evaporation with direct to GC vial tubes**
- **Provides the Fastest Automated Sample Processing available for SPE Cartridges and Columns**

Automated SPE in Summary

- **Handles a wide range of Sample sizes and matrix types**
- **Uses all SPE Cartridge and Column sizes**
- **Comply with existing methods that require vacuum, positive pressure and precise delivery of sample and solvents**
- **Program and store an unlimited amount of methods**

Summation

- **Automated SPE extractions and Concentration is a very green technique**
  - **Reduces Solvent Use**
  - **Reduces Solvent Disposal Costs**
  - **Reduces Solvent emissions**
  - **Separates Organic from Aqueous Waste**
- **FMS automated SPE systems deliver consistent, reproducible results**
- **Capable of performing inline extract drying**

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Questions?