FMS
Fluid Management Systems

FMS
Fluid Management Systems
Total Sample Prep Solutions

Complete Sample to Final Result Workflow

Agenda

- Company Overview
- Product Portfolio
- Sample to Result Workflows
- Questions

FMS, Inc.

- Fluid Management Systems
  - Founded in 1986
  - Focus
    - Automating the Sample Prep workflow
  - Markets
    - Agricultural
    - Environmental
    - Clinical
    - Food and Beverage
    - Pharmaceutical
    - Petrochemical

Solid Phase Extraction

Automated

EconoTrace®
Drinking Water

TurboTrace®
Drinking &
Waste Water

TurboTrace® ABN
EPA Methods 625
& 8270

TurboTrace® PFC
Drinking & Waste
Water

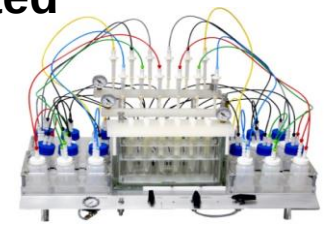
Concentration

SuperVap®
Concentration and
Evaporation

Direct to Vial

Semi-Automated

12 Position EZSPE®
Drinking Water &
Waste Water
Analysis



12 Position EZPFC
Drinking Water & Waste
Water
PFAS/PFOS/PFOA
Analysis

Pressurized Liquid Extraction

PLE®

Solids and Semi-Solids Sample Extraction

Concentration

SuperVap® Concentration and Evaporation

Direct to Vial

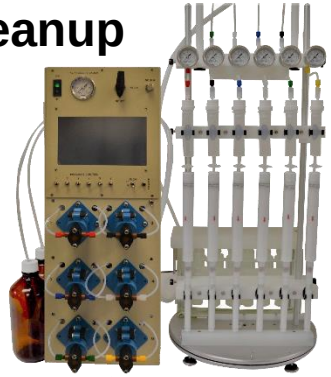
Automated Sample Cleanup

Automated Sample Cleanup

PowerPrep® NG
Dioxin & PCB
Sample Cleanup

EconoPrep®
Dioxin & PCB
Sample Cleanup

EP110®
Zero DCM
Dioxin & PCB
Sample Cleanup



EZPrep +
Dioxin & PCB
Sample Cleanup

Concentration

SuperVap®
Concentration and
Evaporation

Semi-Automated

Ezprep 123®
Dioxin & PCB
Analysis

Direct to Vial

Dioxin/PCBs Sample Analysis Workflow
Hours vs Days

Automated Sample Prep Time 1 up to 8 samples = 2hrs

Extraction
30 Min

+

Concentration
30 Min

+

Sample Cleanup
30 Min

+

Concentration
30 Min

+

GC/MS
45Min

Manual Sample Prep Time = 2 to 4 days

Extraction	Concentration	Sample Cleanup	Concentration	GC/MS
24 hours	60 Min	24 to 48 hours	60 Min	45Min /sample

Sample Cleanup for Dioxin/PCB Workflow

Automated Sample Prep Time

= 80 Minutes

Solid Phase Extraction

35 Minutes

Concentration

45 Minutes

Semi Automated Sample Prep Time

= 80 Minutes

Solid Phase Extraction

35 Minutes

Concentration

45 Minutes

Sample to Result Workflow Strategy

Combine FMS's Sample Prep with Agilent GCs & GC/MS to offer Sample to Result Workflow package for Dioxin/PCB Analysis at a low cost

FMS Automated Sample Prep

+

Agilent GC & GC/MS

=

Sample to Result Workflow

FMS
Fluid Management Systems

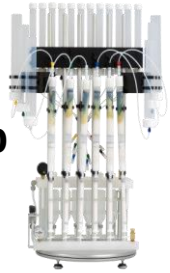
Total Solution Sample Analysis Workflow Strategy

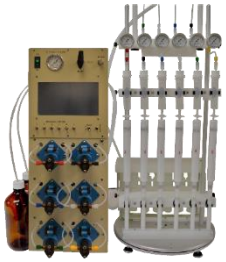
- **FMS and Agilent do not compete**
  - This is unique in our industry
- **Combining solutions with complementary technologies makes sense**
  - Validated Dioxin/PCBs Sample to Result Workflow
- **Growth for both companies**

Sample Prep & GC/MS possible configurations

Extraction

Sample Cleanup





Concentration

Total Prep

+

+

+

+

GC or GC/MS or LC/MS

Market Focus

- Complete Sample Prep and Analysis Workflow:
  - Environmental
  - Food

- Validation Application notes for 3 FMS Systems and Agilent GC/TQ
  - Extraction, Semi-Automated Cleanup and Concentration
  - Extraction, Automated Cleanup, and Concentration
  - Extraction, Low-Cost Automated Cleanup, and Concentration

EZPrep - 13C PCDD/F recoveries no matrix

	Channel-1	Channel-2	Channel-3	Channel-4	Channel-5	Channel-6	Average	STDEV	RSD (%)
2,3,7,8 TCDF	95	82	83	81	88	92	87	5.7	6.5
2,3,7,8 TCDD	93	88	81	79	87	87	86	4.9	5.8
1,2,3,7,8 PCDF	89	85	77	77	77	87	82	5.5	6.7
2,3,4,7,8 PCDF	97	92	86	81	79	91	88	7.1	8.2
1,2,3,7,8 PCDD	97	91	87	87	91	93	91	3.8	4.2
1,2,3,4,7,8 HxCDF	81	77	73	72	78	75	76	3.4	4.5
1,2,3,6,7,8 HxCDF	74	78	71	70	88	77	76	6.6	8.6
2,3,4,6,7,8 HxCDF	80	77	78	74	90	91	82	7.1	8.7
1,2,3,4,7,8 HxCDD	84	78	73	73	85	92	81	7.5	9.3
1,2,3,6,7,8 HxCDD	80	77	77	73	93	79	80	6.9	8.6
1,2,3,7,8,9 HxCDF	84	76	73	72	78	87	79	6.0	7.7
1,2,3,4,6,7,8 HpCDF	74	71	74	72	74	72	73	1.3	1.8
1,2,3,4,6,7,8 HpCDD	84	80	79	72	79	87	80	5.1	6.3
1,2,3,4,7,8,9 HpCDF	84	74	75	74	87	90	81	7.1	8.8
OCDD	72	77	70	71	87	77	76	6.3	8.4

EZPrep - 13C PCB recoveries no matrix

	Channel-1	Channel-2	Channel-3	Channel-4	Channel-5	Channel-6	Average	STDEV	RSD (%)
PCB-81	95	109	93	104	109	100	102	6.9	6.7
PCB-77	105	96	82	93	92	103	95	8.3	8.8
PCB-123	88	95	75	76	84	87	84	7.6	9.1
PCB-118	87	90	76	74	75	87	82	7.2	8.9
PCB-114	88	93	79	82	88	97	88	6.7	7.6
PCB-105	94	90	80	98	86	102	92	8.0	8.8
PCB-126	80	90	78	96	80	92	86	7.6	8.8
PCB-167	84	84	71	72	86	77	79	6.6	8.3
PCB-156	80	83	72	74	86	74	78	5.7	7.3
PCB-157	80	83	76	84	92	73	81	6.7	8.2
PCB-169	88	85	84	95	100	104	93	8.3	8.9
PCB-189	80	83	72	85	90	82	82	6.0	7.3

EP-110 - 13C PCDD/F recoveries 2.5 g corn oil

	Channel-1	Channel-2	Channel-3	Channel-4	Channel-5	Channel-6	Average	STDEV	RSD (%)
2,3,7,8 TCDF	91	93	85	91	74	83	86	7.1	8.2
2,3,7,8 TCDD	86	85	87	86	80	75	83	4.8	5.7
1,2,3,7,8 PCDF	94	90	83	92	95	75	88	7.9	8.9
2,3,4,7,8 PCDF	94	80	85	94	87	80	87	6.1	7.0
1,2,3,7,8 PCDD	93	91	84	92	77	77	86	7.3	8.5
1,2,3,4,7,8 HxCDF	74	72	83	74	77	76	76	3.9	5.1
1,2,3,6,7,8 HxCDF	79	72	82	78	77	89	79	5.5	7.0
2,3,4,6,7,8 HxCDF	84	70	83	84	84	70	79	7.0	8.8
1,2,3,4,7,8 HxCDD	81	75	95	80	79	89	83	7.4	8.9
1,2,3,6,7,8 HxCDD	87	80	82	87	79	86	84	3.6	4.3
1,2,3,7,8,9 HxCDF	91	81	88	90	70	80	83	8.0	9.6
1,2,3,4,6,7,8 HpCDF	79	71	83	79	73	79	77	4.5	5.9
1,2,3,4,6,7,8 HpCDD	83	81	92	83	87	100	88	7.1	8.1
1,2,3,4,7,8,9 HpCDF	91	77	92	91	80	89	87	6.3	7.3
OCDD	70	70	82	70	81	70	74	6.1	8.2

EP-110 - 13C PCB recoveries
2.5 g corn oil

	Channel-1	Channel-2	Channel-3	Channel-4	Channel-5	Channel-6	Average	STDEV	RSD (%)
PCB-81	95	109	93	104	109	100	102	6.9	6.7
PCB-77	105	96	82	93	92	103	95	8.3	8.8
PCB-123	88	95	75	76	84	87	84	7.6	9.1
PCB-118	87	90	76	74	75	87	82	7.2	8.9
PCB-114	88	93	79	82	88	97	88	6.7	7.6
PCB-105	94	90	80	98	86	102	92	8.0	8.8
PCB-126	80	90	78	96	80	92	86	7.6	8.8
PCB-167	84	84	71	72	86	77	79	6.6	8.3
PCB-156	80	83	72	74	86	74	78	5.7	7.3
PCB-157	80	83	76	84	92	73	81	6.7	8.2
PCB-169	88	85	84	95	100	104	93	8.3	8.9
PCB-189	80	83	72	85	90	82	82	6.0	7.3

EZPrep Plus - 13C PCDD/F recoveries no matrix

	Channel-1	Channel-2	Channel-3	Channel-4	Channel-5	Channel-6	Average	STDEV	RSD (%)
2,3,7,8 TCDF	107	89	91	91	86	87	92	7.7	8.4
2,3,7,8 TCDD	102	94	88	85	89	87	91	6.4	7.1
1,2,3,7,8 PCDF	97	85	85	79	92	89	88	6.3	7.1
2,3,4,7,8 PCDF	100	92	90	81	93	90	91	6.2	6.8
1,2,3,7,8 PCDD	102	97	89	81	93	96	93	7.3	7.8
1,2,3,4,7,8 HxCDF	97	90	83	85	92	88	89	5.1	5.7
1,2,3,6,7,8 HxCDF	95	92	82	83	87	89	88	5.2	5.9
2,3,4,6,7,8 HxCDF	102	90	85	87	87	89	90	6.3	6.9
1,2,3,4,7,8 HxCDD	100	91	86	85	88	89	90	5.3	5.9
1,2,3,6,7,8 HxCDD	103	92	87	86	87	83	90	7.1	7.9
1,2,3,7,8,9 HxCDF	100	90	86	83	79	82	87	7.6	8.8
1,2,3,4,6,7,8 HpCDF	85	73	71	74	86	80	78	6.4	8.2
1,2,3,4,6,7,8 HpCDD	90	82	78	75	89	76	82	6.5	8.0
1,2,3,4,7,8,9 HpCDF	89	85	80	79	85	76	82	5.1	6.1
OCDD	76	78	78	72	86	76	78	4.6	6.0

EZPrep Plus - 13C PCB recoveries no matrix

	Channel-1	Channel-2	Channel-3	Channel-4	Channel-5	Channel-6	Average	STDEV	RSD (%)
PCB-81	101	102	99	98	99	100	100	1.5	1.5
PCB-77	113	103	102	99	100	103	103	5.0	4.8
PCB-123	98	95	95	90	94	96	95	2.7	2.8
PCB-118	100	94	95	93	96	101	97	3.3	3.4
PCB-114	97	94	94	89	94	96	94	2.8	2.9
PCB-105	96	94	93	90	94	95	94	2.1	2.2
PCB-126	96	85	89	84	86	92	89	4.6	5.2
PCB-167	94	91	90	85	90	92	90	3.0	3.3
PCB-156	93	90	90	91	89	87	90	2.0	2.2
PCB-157	93	91	87	85	88	90	89	2.9	3.3
PCB-169	98	90	88	85	88	93	90	4.6	5.1
PCB-189	88	85	83	81	82	85	84	2.5	3.0

Total Solution Sample Analysis Workflow

+

FMS to Provide a low-cost Total Solution Sample Prep and Consumables to be sold with Agilent Analytical Instrumentation that offers a Sample to Result Workflow.

FMS will provide :

1. **Sample Prep instrumentation**
1. **Installation and Training**
2. **Consumable Sales & Support**
3. **Technical Support**

FMS Distributors

- LabService Analytica - Italy
- Campro – Germany & Netherlands
- TechnoSpec – Spain
- TetraTek – Turkey
- Unicam – Hungary
- Indonesia – PT. DS Solutions
- Moulas Scientific – Greece
- BCT – China
- Labtech - China
- Bioanalytic – Poland
- Ecros-Analytika - Russia
- KNJ – Korea
- 2H Instruments – Vietnam
- CQA Quimica – Brazil
- Pragolab – Czech republic
- Guyline – Hong Kong
- Bioscreen – India

Who are the Contacts at FMS?

- Initial Interest Inquiries
  - Tom Hall, thall@fms-inc.com 508-400-4660
- Technical Inquiries
  - Ruud Addink, r.addink@fms-inc.com 617-393-2396 ext 462
- Quotes, Customer Facing Materials
  - Sevag Palanjian, sevag@fms-inc.com 617-393-2396 ext 465

High Throughput Extraction and Concentration of Samples for the Analysis of PFAS/PFOS

Tom Hall
thall@fms-inc.com
Fluid Management Systems
Billerica, MA USA

Optimizing the PFAS/PFOS Analysis Workflow

- **Automate the Sample Prep Workflow**
  - **Automate the Solid Phase Extraction Step**
  - **Automate the Concentration/Evaporation Step**

- **Automated, Semi Automated SPE extractions and Concentration**
  - **Reduces Human Error**
  - **Reduces Outside contamination**
  - **Increase Throughput**
  - **Reduces Labor**

- **Use Hyphenated techniques to deliver consistent, reproducible results**
- **Different configurations to handle Matrix type and Budget**

Automated Solid Phase Extraction front end for LC/MS

EconoTrace® PFC

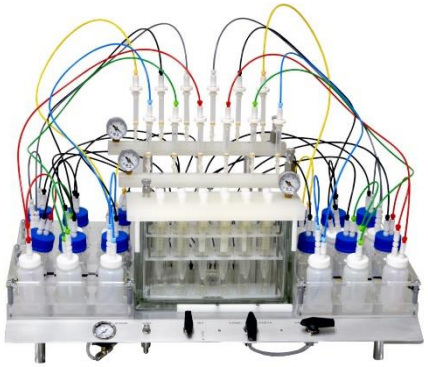
TurboTrace® PFC

TurboTrace®
Parallel
Sequential

LC/MS

Modular and Expandable
Designed for Different Matrices and
Number of Samples to be run per week

Semi-Automated Solid Phase Extraction PFAS/PFOS front end for LC/MS



EZPFC / SuperVap PFC 24

LC/MS

Low Cost, High Throughput
Sample Prep

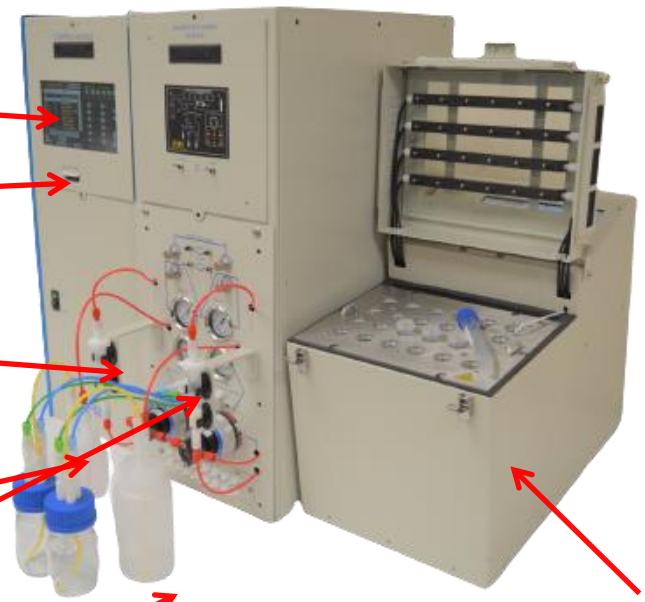
Automated Extraction and Concentration for PFAS/PFOS in Drinking Water

EconoTrace® PFC

Drinking Water, Serum and samples with minimal particulate
Positive Pressure Pumping

LC/MS

EconoTrace SPE



Touch Screen Control

SD Card for Storing and Transferring Methods

Nitrogen Drying

Six Elution and Wash Solvents

Automatic Bottle Rinse

Use any cartridge format

Sample Size 2 ml to unlimited

Delivers Direct to 15 ml Centrifuge tube for Concentration

EconoTrace for Extraction and Concentration of PFAS/PFOS in Drinking Water

Fluid Management Systems

Fully Automated

Modular and expandable from 1 to 4 Modules, 2 to 8 samples

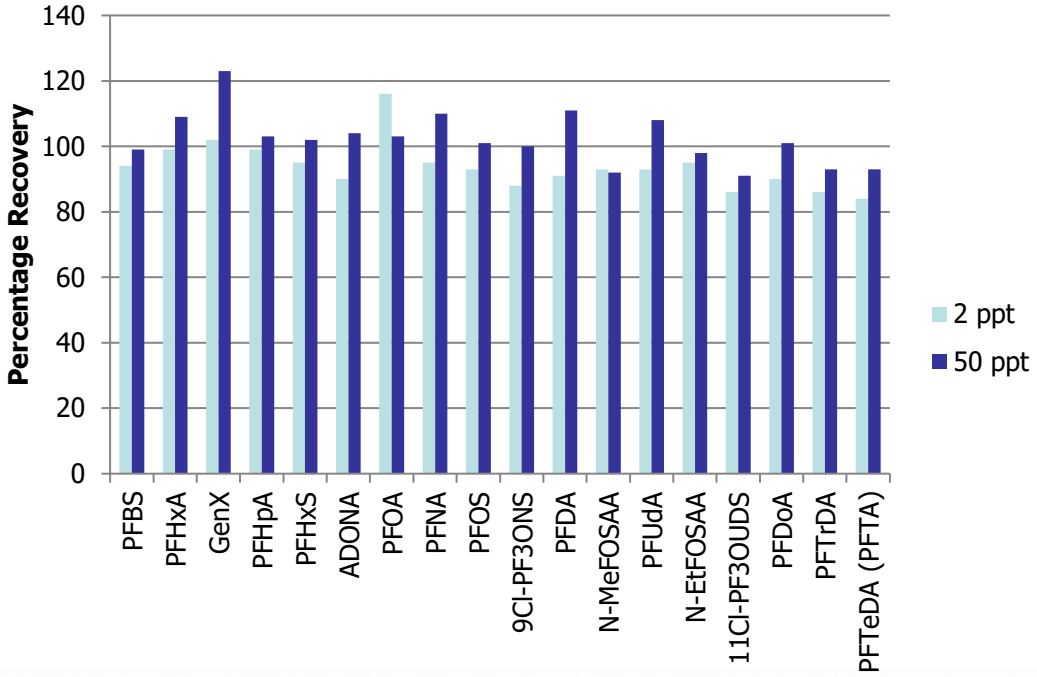
High Throughput Runs
8 Sample Extractions in Parallel

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

Automatic Bottle Rinse

Delivers extract directly to SuperVap Concentrator for final blowdown

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

TurboTrace Parallel Sequential PFC Automated Extraction and Concentration for PFAS/PFOS in Drinking Water and WasteWater

TurboTrace® PFC Parallel Sequential

LC/MS

Wastewater, Particulate Laden Samples
Drinking water Samples
Vacuum Pump or Positive Pressure for loading samples
Positive Pressure Pumping for conditioning, rinsing and elution
Direct to SuperVap Concentrator

TurboTrace for Extraction and Concentration of PFAS/PFOS in WasteWater

Fluid Management Systems

Fully Automated

Modular and Scalable expandable from 1 to 6 Modules

Run 1 to 6 samples simultaneously, up to 30 sequentially

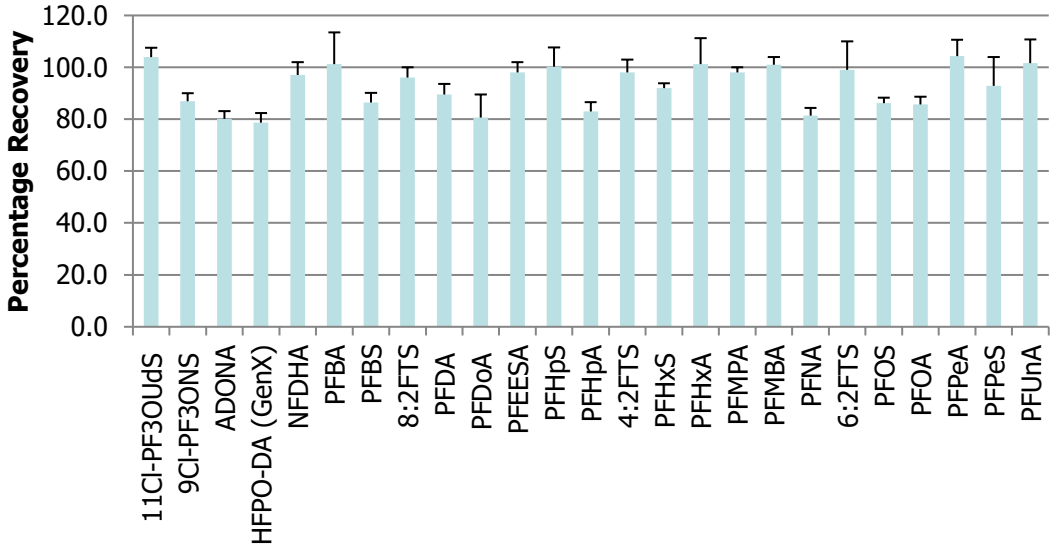
Each Module can Run 5 Samples in a Sequence

Uses Positive Pressure Pumping for Precise delivery of Elution and Wash Solvent

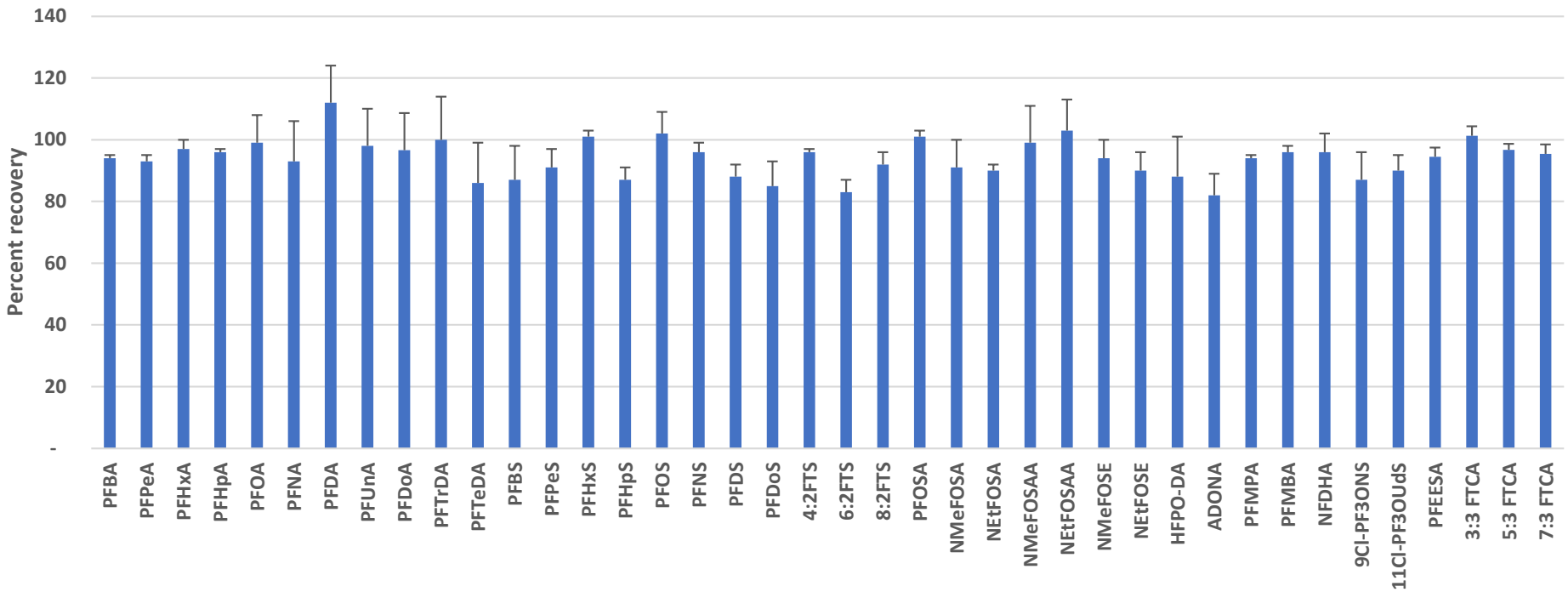
Uses Vacuum with liquid sensor to Load Dirty Samples

Direct Extract delivery to Concentrator for Evaporation

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

EPA 1633
Turbo Trace Parallel/Sequential



Various Blanks EPA 1633

		ch.1	ch.2	ch.3	ch.4	ch.5	stopcock	sample bottle
Name		Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.
3-3 FTCA		0.00	0.00	0.00	0.00	0.00	0.00	0.00
PFBA		0.00	0.00	0.00	0.00	0.02	0.00	0.91
PFMPA		0.00	0.00	0.00	0.00	0.00	0.00	0.00
PFPeA		0.00	0.04	0.03	0.00	0.00	0.13	0.01
PFMBA		0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFPO-DA		0.01	0.00	0.00	0.00	0.00	0.00	0.12
4-2 FTS		0.00	0.00	0.00	0.00	0.00	0.00	0.00
NFDHA		0.00	0.00	0.00	0.00	0.00	0.00	0.01
PFHxA		0.03	0.04	0.02	0.00	0.00	0.00	0.00
PFBS		0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-3 FTCA		0.03	0.00	0.00	0.00	0.00	0.00	0.00
PFHpA		0.00	0.02	0.00	0.02	0.01	0.00	0.00
PFEESA		0.00	0.00	0.00	0.00	0.00	0.00	0.00

Various Blanks EPA 1633

		ch.1	ch.2	ch.3	ch.4	ch.5	stopcock	sample bottle
Name		Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.
ADONA		0.00	0.00	0.00	0.00	0.00	0.00	0.00
PFPeS		0.00	0.00	0.00	0.00	0.00	0.00	0.00
PFOA		0.03	0.01	0.02	0.02	0.00	0.28	0.01
PFNA		0.02	0.03	0.01	0.03	0.05	0.00	0.01
8-2 FTS		0.01	0.00	0.00	0.02	0.01	0.00	0.00
PFDA		0.02	0.02	0.03	0.01	0.02	0.04	0.00
PFDoS		0.00	0.00	0.00	0.00	0.00	0.00	0.00
PFOS		0.03	0.02	0.04	0.02	0.01	0.03	0.05
6-2 FTS		0.01	0.00	0.00	0.00	0.00	0.00	0.02
PFHxS		0.00	0.00	0.01	0.03	0.03	0.05	0.06
PFTrDA		0.01	0.00	0.00	0.04	0.04	0.00	0.03
N-EtFOSAA		0.00	0.00	0.00	0.00	0.00	0.00	0.00
PFHpS		0.00	0.00	0.02	0.03	0.03	0.00	0.00

Various Blanks EPA 1633

	ch.1	ch.2	ch.3	ch.4	ch.5	stopcock	sample bottle
Name	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.	Calc. Conc.
N-MeFOSAA	0.00	0.00	0.00	0.02	0.00	0.00	0.00
PFNS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-3 FTCA	0.00	0.00	0.00	0.00	0.01	0.00	0.01
9Cl-PF3ONS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11Cl-PF3OUdS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PFDoA	0.01	0.00	0.00	0.03	0.02	0.03	0.00
PFUnA	0.00	0.00	0.00	0.00	0.04	0.00	0.04
PFTDA	0.00	0.01	0.00	0.01	0.00	0.04	0.00
PFDS	0.00	0.00	0.00	0.00	0.00	0.00	0.01
PFOSA	0.02	0.00	0.00	0.02	0.03	0.01	0.00
MeFOSE	0.00	0.00	0.00	0.00	0.00	0.01	0.00
EtFOSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-MeFOSA	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-EtFOSA	0.00	0.00	0.00	0.00	0.00	0.00	0.00

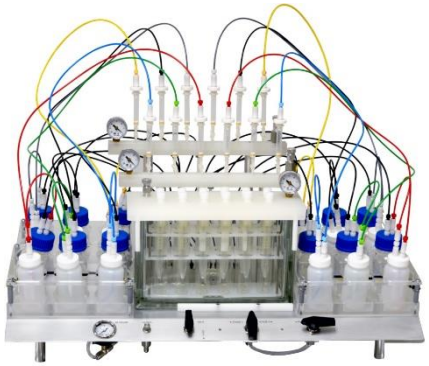
Automated Concentration for PFAs

- SuperVap PFC
  - 24 positions
  - 15ml Conical vials
  - No Teflon

Concentration Functionality

- **Designed for PFAS/PFOS Concentration**
- **Accepts Extracts Directly from FMS Automated SPE systems**
- **Self Installable**
  - **Video unpacking, installation and training video**
- **Preprogrammed with most common temperature settings**
- **Direct to 15ml Centrifuge Tubes**
- **Dry bath heating element**
- **Time based endpoint**

Semi-Automated Solid Phase Extraction front end for LC/MS

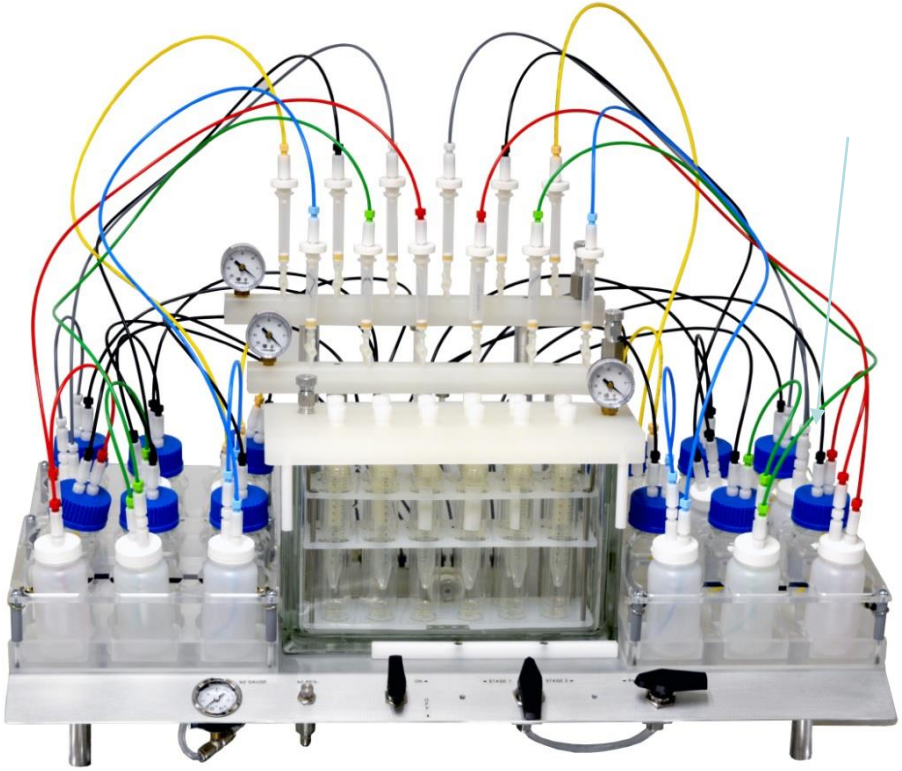


EZPFC

LC/MS

EZPFC®

Drinking Water,
Wastewater,
Particulate laden samples



EZPFC 12 sample

EZPFC Semi Automated SPE

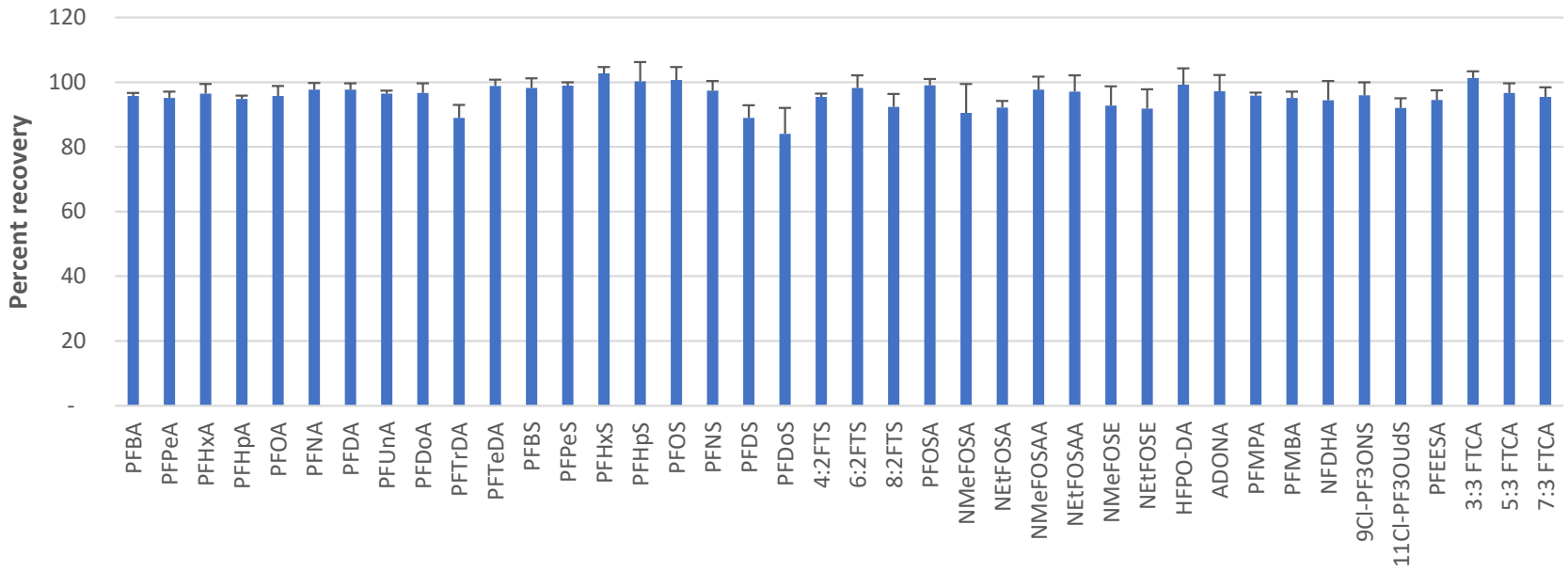
- **Low Cost**
  - Run and Concentrate a batch of 24 samples 2 to 3 hours
- **Self Installable**
  - Unpacking and Installation/training video
- **Easy to Operate**
  - No Computers or Electronics to fail or maintain
- **Semi - Automated**
  - Hyphenates the entire Solid Phase Extraction Process – Extraction, Bottle Rinse, Inline Drying and Direct to 15ml Centrifuge tube for easy Concentration
- **Fast**
  - The fastest sample processing available for SPE
  - Run up to 12 samples simultaneously
  - Vacuum for fast loading of large volume samples
  - Unattended Sample loading walkaway time
- **Closed system**
  - Eliminate potential outside contamination

EZPFC Semi Automated SPE

- **Efficient**
  - Uses all SPE cartridge sizes
  - Dedicated manifold for cartridge conditioning and sample loading
  - Dedicated manifold for extraction and extracts
  - Separates Organic from Aqueous waste
  - Vacuum cartridge drying, Nitrogen cartridge drying or combined
  - Automated Bottle Rinse and Elution
  - Inline Extract Drying
  - Small number of components to clean

EPA 1633

EZPFC



Summary

Automated SPE for PFAS

- **EconoTrace**
  - **Fully automated, positive pressure system, automated bottle rinse, direct delivery to SuperVap Concentrator**
  - **Designed for cleaner samples**
  - **Modular and Expandable**

- **TurboTrace**
  - **Fully automated, Vacuum pump for loading "dirty samples", automated bottle rinse, direct delivery to SuperVap Concentrator**
  - **Designed for Drinking water and WasteWater**
  - **Modular and Expandable**

Semi Automated SPE for PFAS

- **EZPFC**
  - **Low Cost, High Throughput**
  - **2 EZPFC 12 position systems and the SuperVap PFC Concentrator for 24 samples**
  - **Run a batch of 24 in 2 hours**

Who are the Contacts at FMS?

- Initial Interest Inquiries
  - Tom Hall, thall@fms-inc.com 508-400-4660
- Technical Inquiries
  - Ruud Addink, r.addink@fms-inc.com 617-393-2396 ext 462
- Quotes, Customer Facing Materials
  - Sevag Palanjian, sevag@fms-inc.com 617-393-2396 ext 465