


Streamline your Sample Preparation and Analysis Workflow for PAHs (PolyAromatic Hydrocarbons) in Water



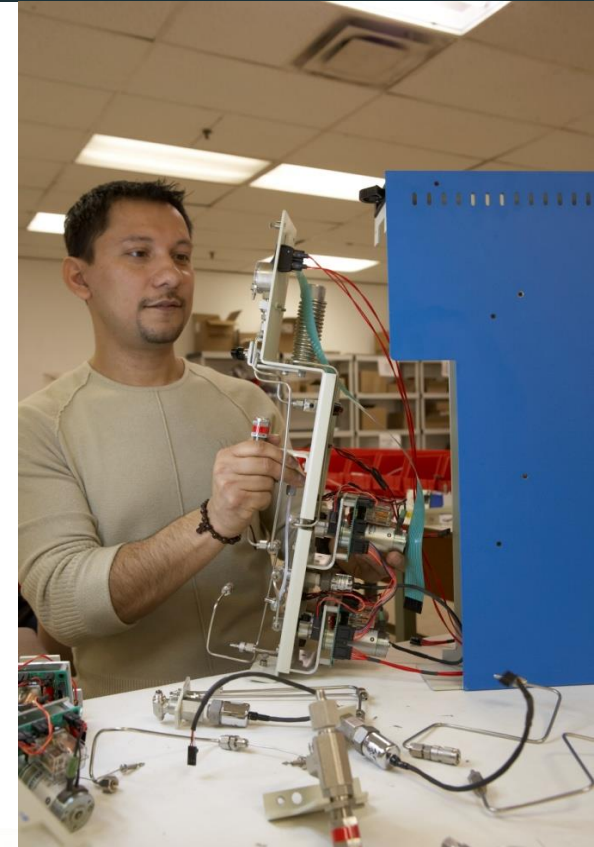
Agenda

- **FMS, Inc. Fluid Management Systems**
 - **Sample Prep vs Analytical Runs in time**
 - **Sample Analysis Workflow**
 - **Sample Prep Workflow**
 - **Sample to Results Strategy**
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- **FMS - Fluid Management Systems**
- **Founded in 1986**
- **Manufactures Total Solution Sample Preparation and Consumables for GC, GC/MS, LC and LC/MS Analysis**

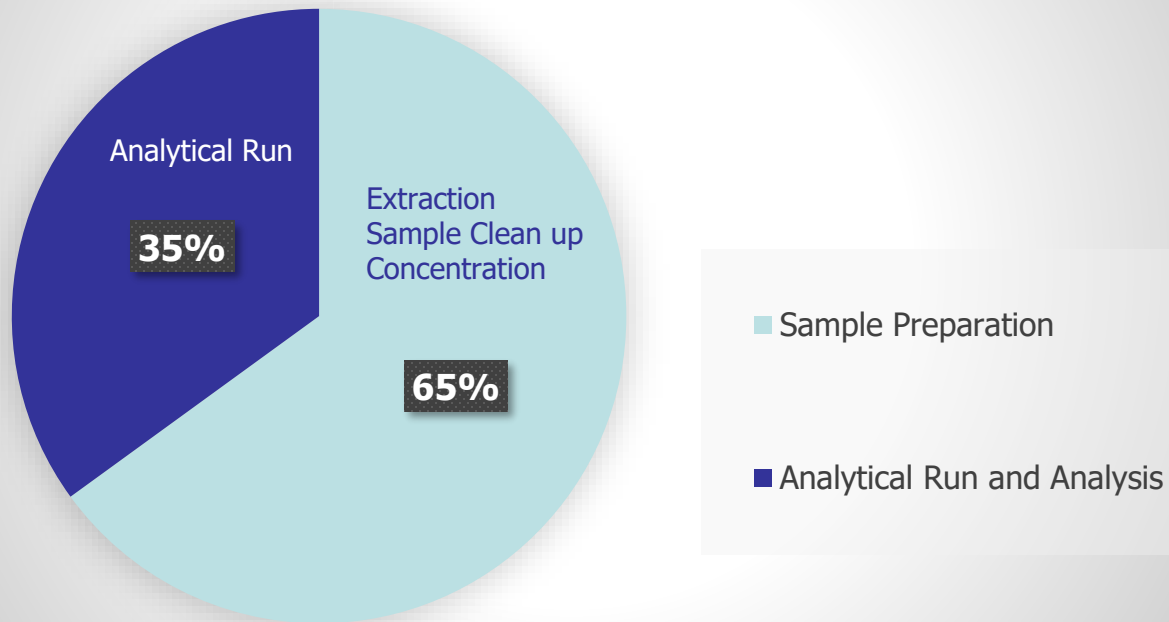


Made in the USA



Laboratory Workflow Breakdown

Sample Prep versus Analytical in Time



Polycyclic Aromatic Hydrocarbons

- Polycyclic aromatic hydrocarbons (PAHs) consist of fused aromatic rings.
- PAHs are a class of compounds that occur naturally in coal, crude oil and gasoline. petroleum and produced as byproducts of fuel burning. They result from burning coal, oil, gas, wood, garbage and tobacco.
- Some have been identified as carcinogenic, mutagenic, and teratogenic.
- PAHs are found in the environment primarily in soil, sediment, and oily substances.
- In surface and ground water they indicate a source of pollution.
- Their volatility makes extraction and concentration of aqueous samples challenging.



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®



Agilent GC/MS



Agilent LC/MS

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

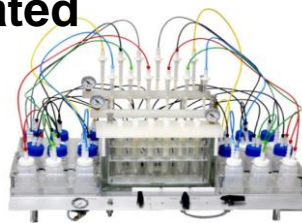


Direct to Vial

Semi-Automated



12 Position EZSPE®
Drinking Water &
Waste Water
Analysis



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

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
- 24 Position PFAS 15ml vial



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**



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**
- **Direct delivery to Concentrator and GC Vial**
- **Hyphenate Extraction, Drying and Concentration**

Comparison of LLE/CLE vs. Automated SPE Methods

LLE/CLE

Open to laboratory background

Uses >360mls solvent

Shaking / Continuous process

Forms emulsions requiring centrifuging

Little Selectivity

Requires water removal

Automated SPE

Closed system

Uses <60mls solvent

Filtration process

No emulsions formed

Wide Selectivity (adsorbent)

In-line water removal

Fast and Unattended



Comparison of LLE/CLE vs. Automated SPE Methods

LLE/CLE

No Separation of waste

More volume to evaporate

Massive solvent emission

CLE high electrical costs

Requires lots of solvent for cleaning

Automated SPE

Separates Aqueous and Organic Waste

<60mls solvent to evaporate

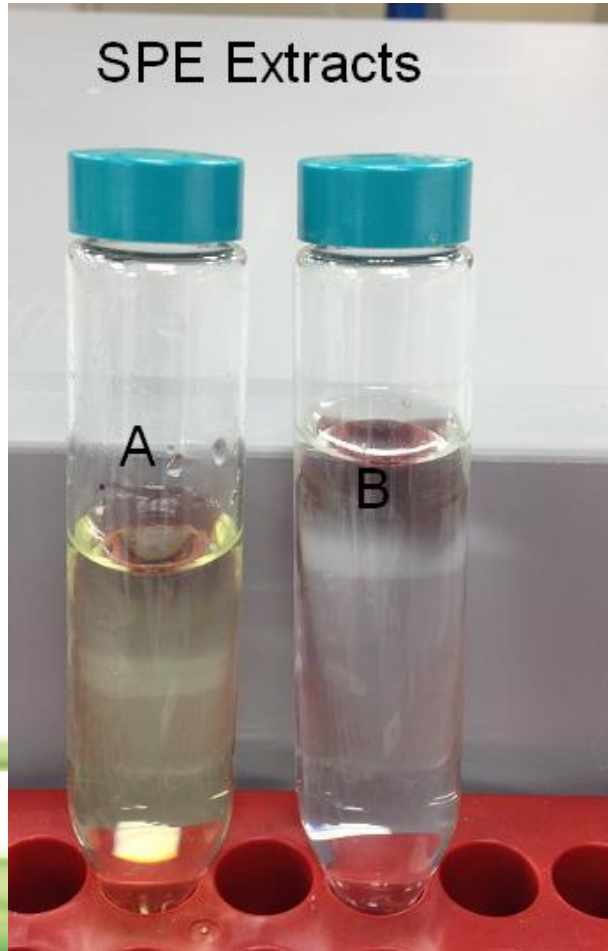
6 times less solvent emission

Easily Capture Solvent

Lower solvent costs

Lower Disposal Costs

No subsequent Emulsions in Extracts to deal with



Reduced Solvent Usage



EconoTrace SPE



Positive Pressure Pumping



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



EconoTrace SPE

Fully Automated

**Modular and expandable
from 1 to 4 Modules**

**High Throughput Runs
8 Sample Extractions in Parallel**

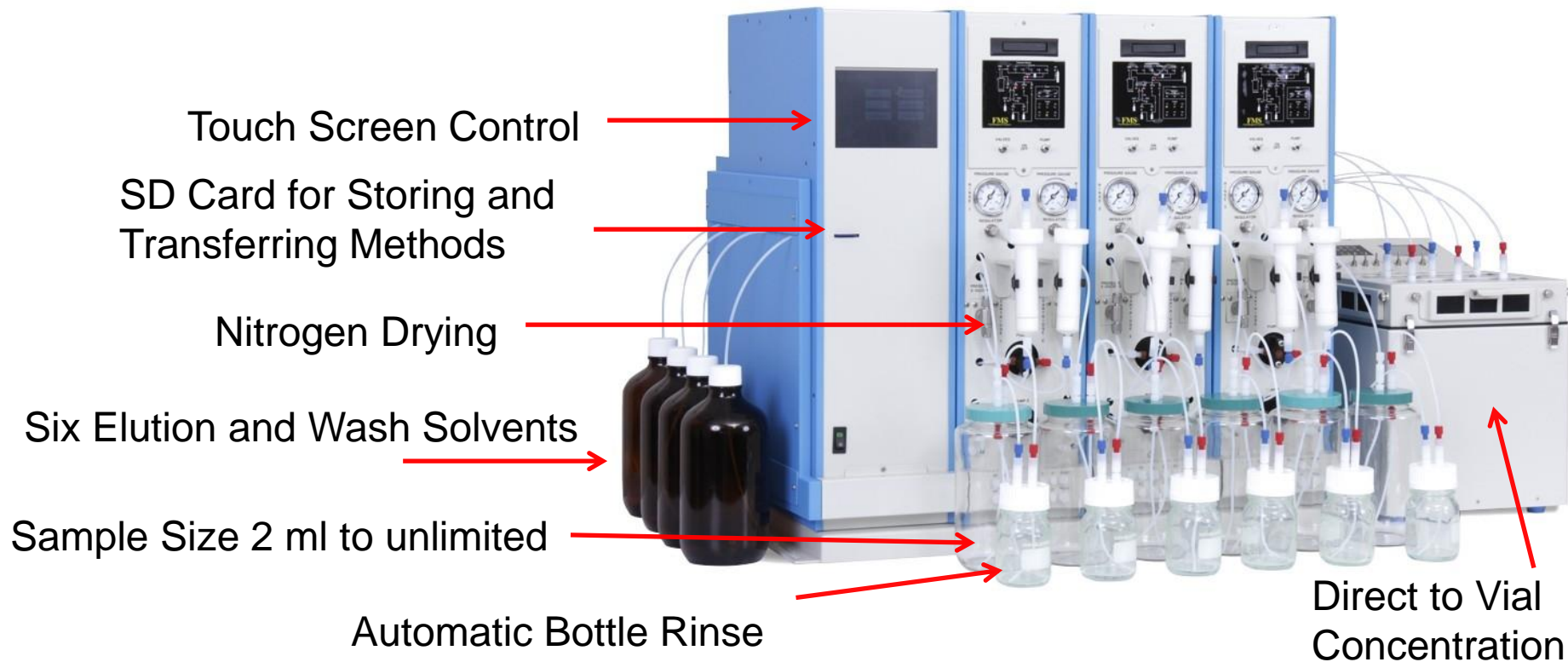
**Uses Positive Pressure Pumping
for Precise delivery of
Conditioning Solvent,
Sample and Elution Solvent**

Automatic Bottle Rinse

Delivers extract directly to a Concentrator



EconoTrace SPE



Sample Sizes Unlimited



SPE Cartridges



Drying Cartridges




TurboTrace SPE

For all liquid types



Methods

- **EPA Method 500 series**
 - **EPA Method 600 series**
 - **EPA Method 8000 series**
 - **ASTM, etc.**
 - **Dirty or Clean Matrices**
 - **Positive or Vacuum Sample Delivery**
- 

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**

Automatic delivery of Extract to Concentrator



TurboTrace SPE

Touch Screen Control

**SD Card for Storing and
Transferring Methods**

Automatic Liquid Level Sensor

Six Elution and Wash Solvents

Sample Size 2 ml to unlimited

Automatic Bottle Rinse

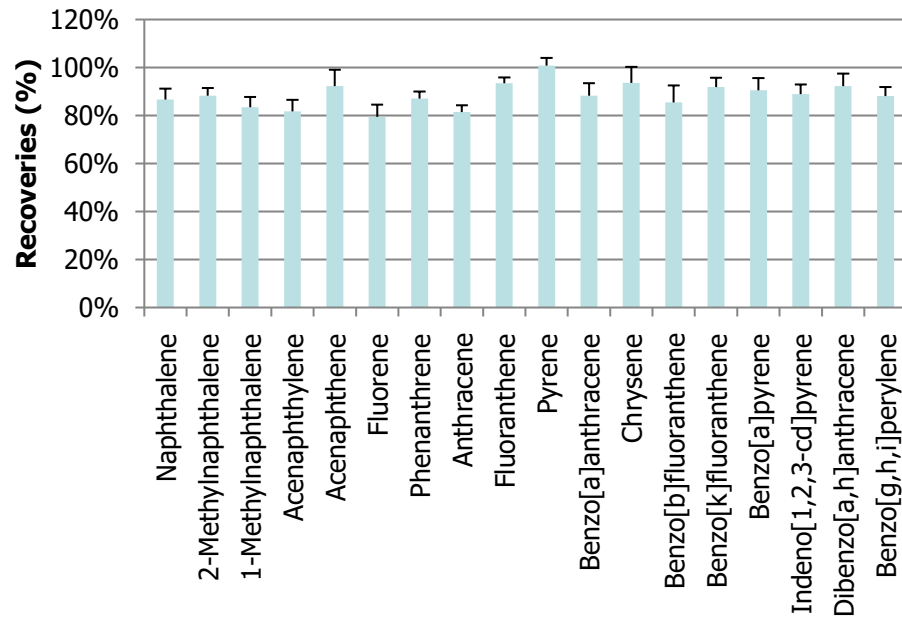
**Direct to Vial
Concentration**



Automated Fast Flow Sample Processing

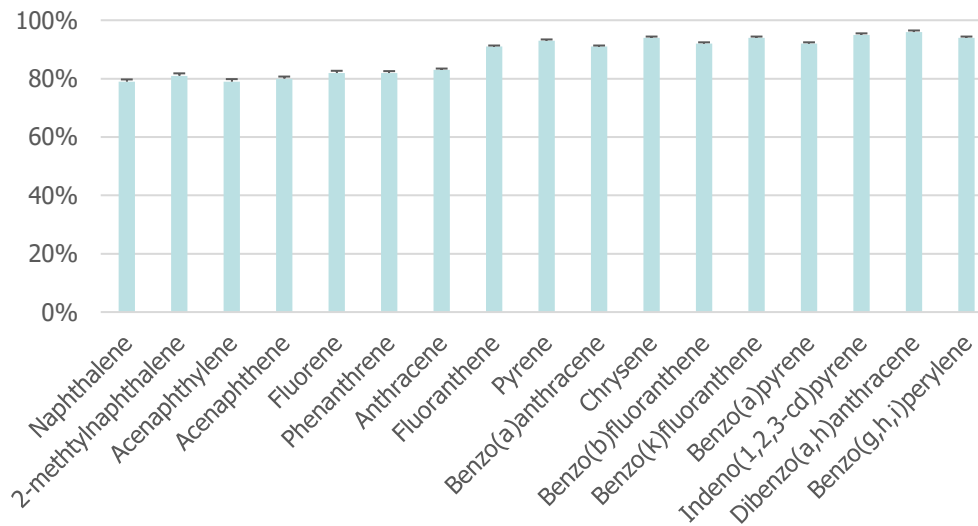


PAHs in Drinking Water



PAHs in Water using EconoTrace

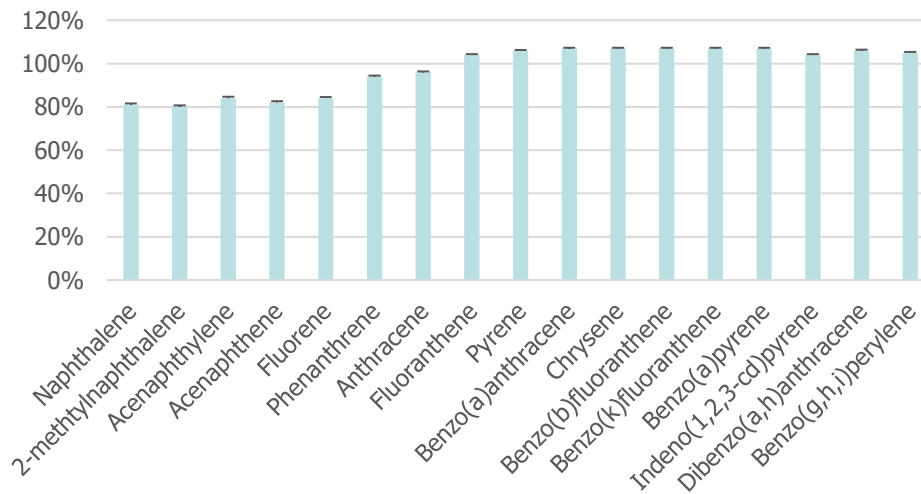
PAHs recoveries EconoTrace



Average
recoveries, n=6,
5 ug PAH/L

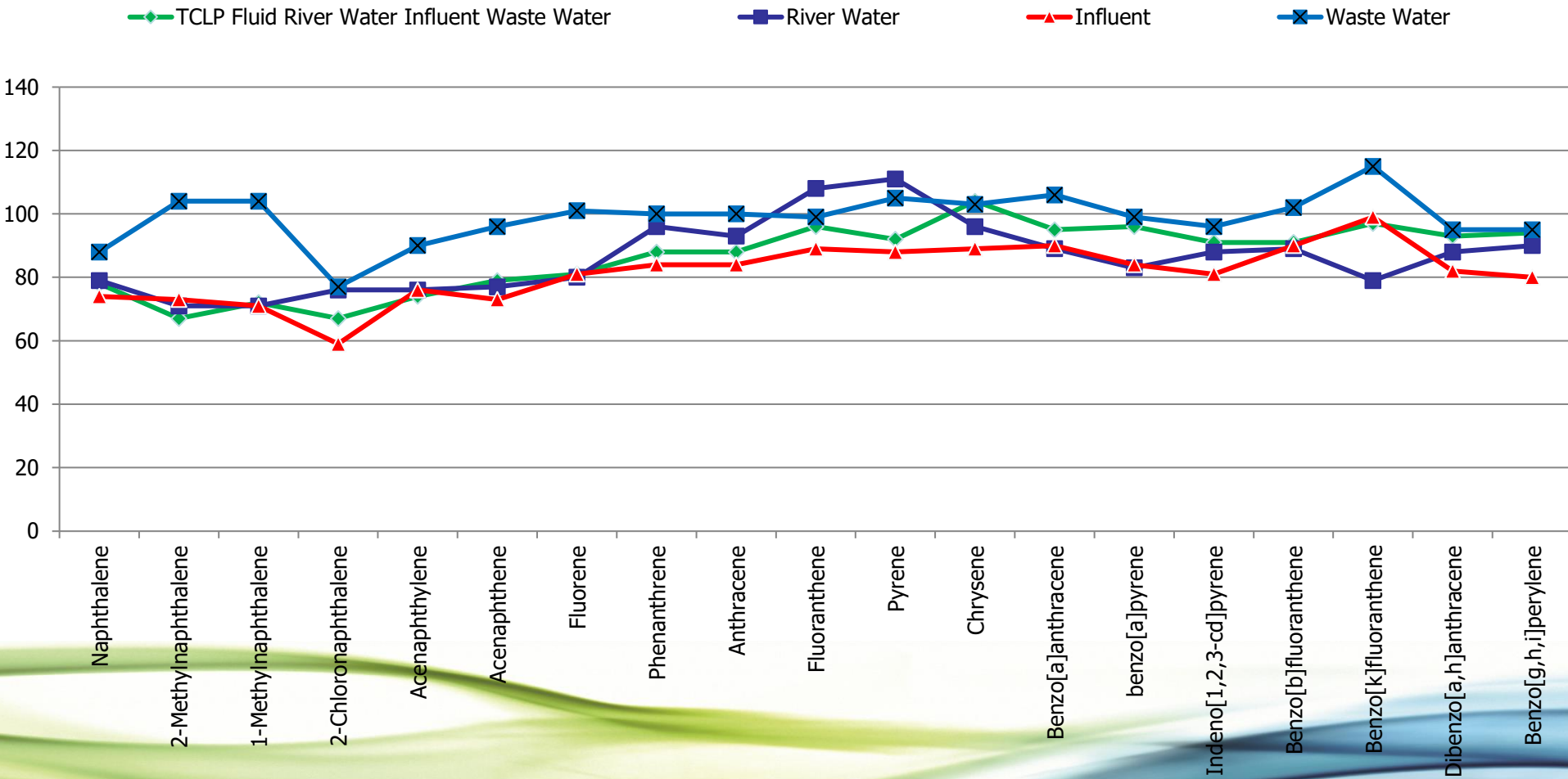
PAHs in Water using TurboTrace

PAHs recoveries TurboTrace



Average
recoveries, n=6, 5
ug PAH/L

PAHs by EPA 625



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 for transfer to GC or LC.**
- **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**



Automated SPE in Summary

- **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**

Sample Prep 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

Objective for Semi Automation

- **Use as many features from the FMS Automated systems and implement them into a Semi automated platform**
- **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**

Goal

- **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 Optional Direct to GC Vial Concentration
- **Fast**
 - The fastest sample processing available for SPE
 - Run up to six samples simultaneously
 - Vacuum for fast loading of large volume samples
 - Unattended Sample loading walkaway time
- **Closed system**
 - Eliminate potential outside contamination

Goal

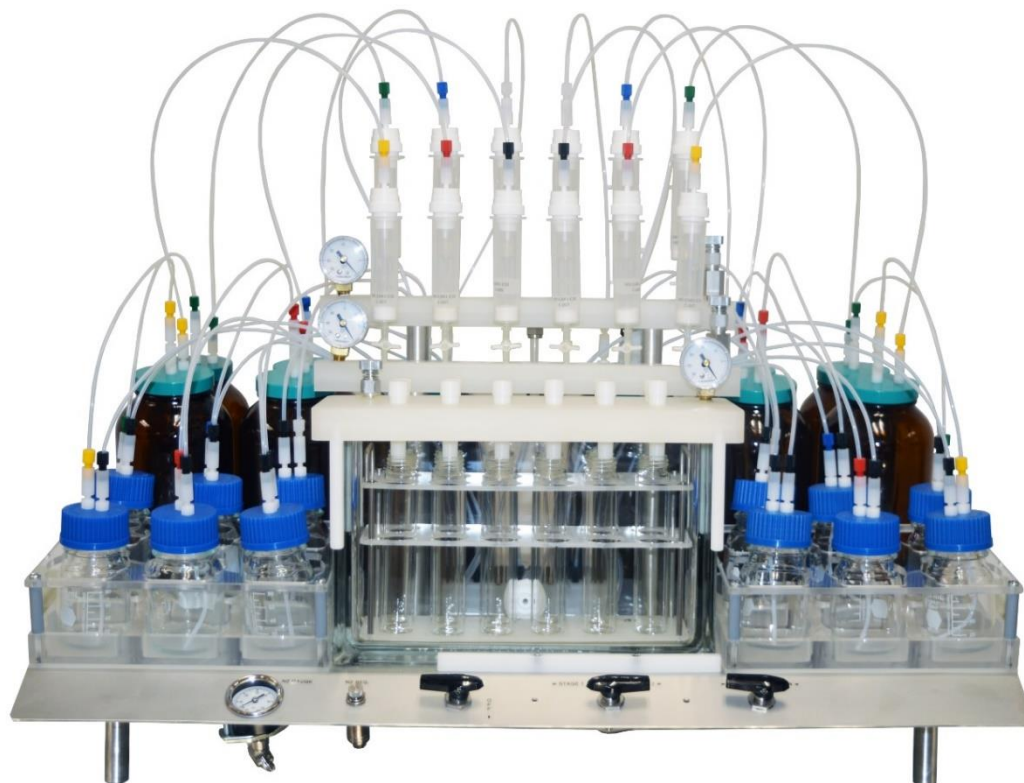
- **Efficient**

- 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

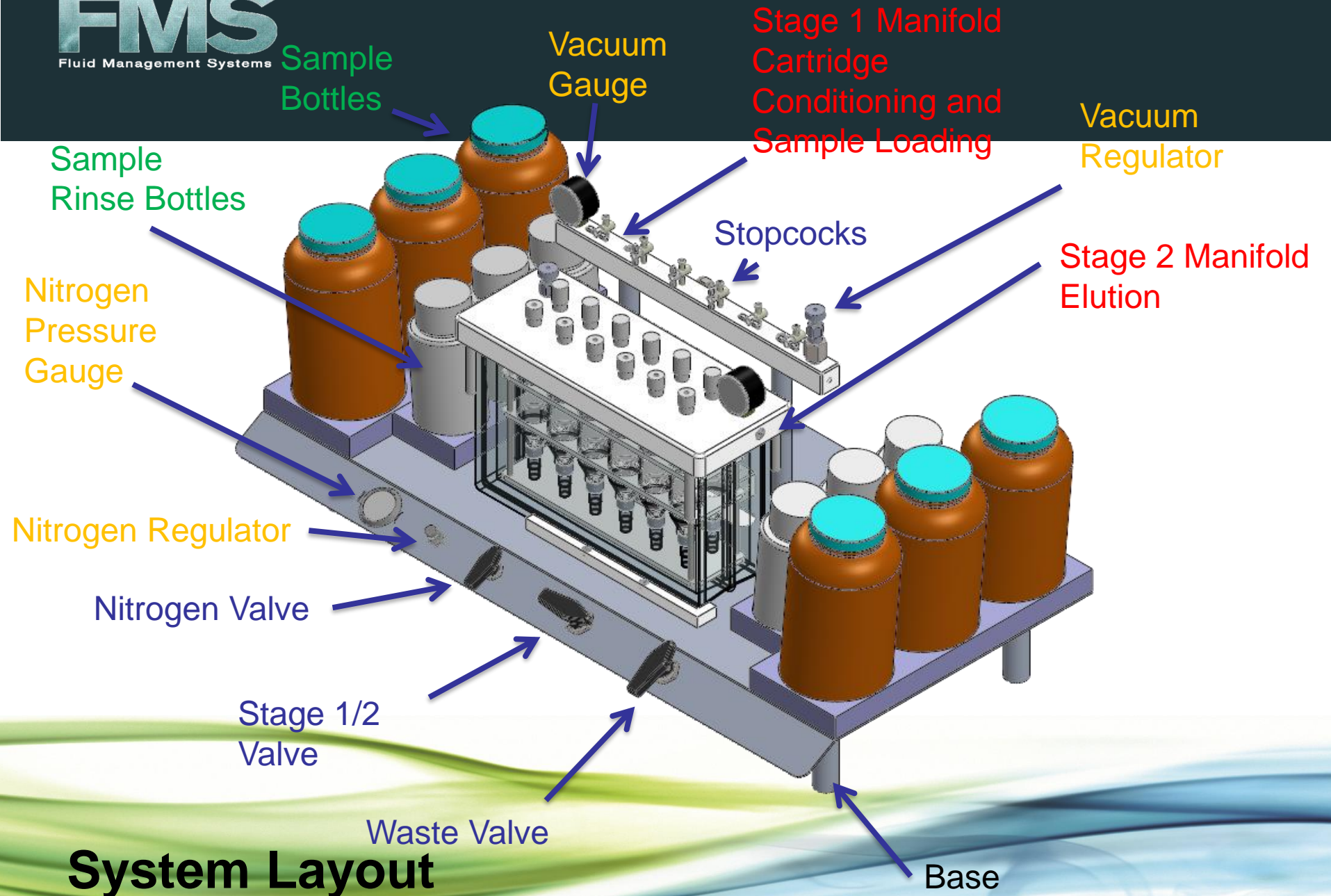
- **Low to No Capital Expense**

- Purchase an FMS Cartridge Contract
- Receive an EZSpe at No Charge

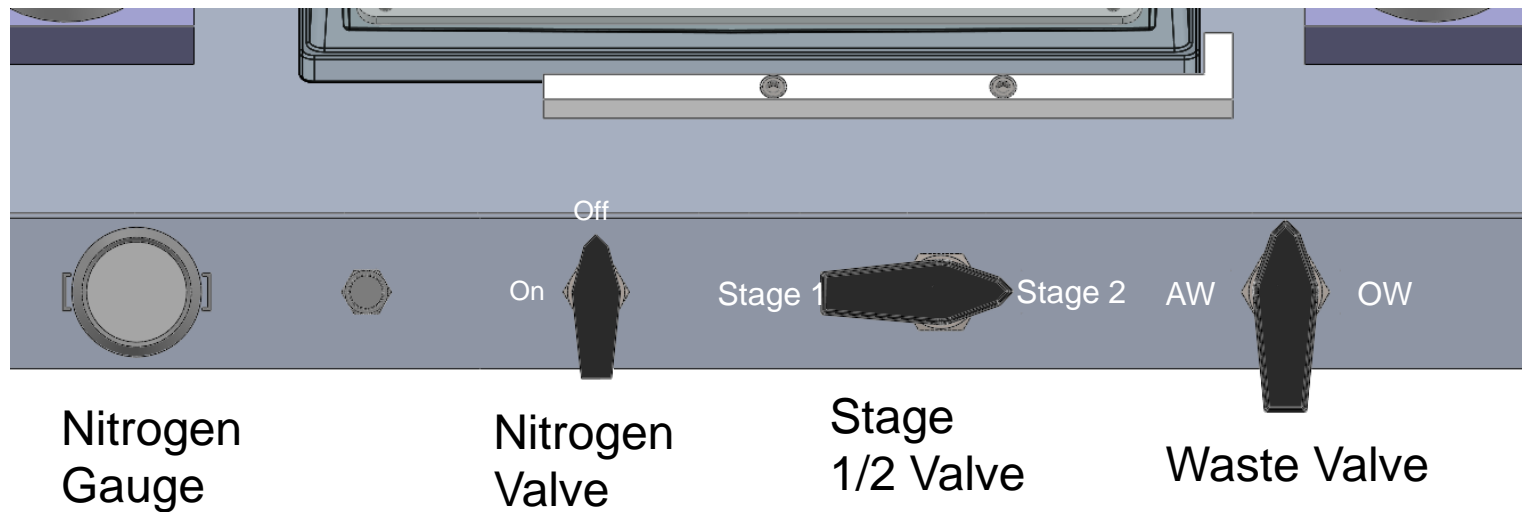




EZSpe 12 sample



Control Valve Layout



- **EZSpe and SuperVap systems are easy to use and install**
 - Complete Water Sample Prep Workflow
- **Low cost, High throughput, Low maintenance solution**
- **EZSpe Extractions and Concentration is a very green technique**
 - Reduces Solvent Use
 - Reduces Solvent Disposal Costs
 - Reduces Solvent emissions



Semi-Automated Summary

- **FMS semi-automated SPE and SuperVap systems deliver consistent, reproducible results**
- **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**



Summary

- **Solid Phase Extraction is a well accepted technology**
- **New Solid Phase Extraction Chemistries and Sorbents are being developed**
- **Drinking Water and Waste Water Extractions**
 - 625/8270
 - 608
 - Validation data package is available
- **Capable of performing in line extract drying and/or Cartridge extract clean-ups**
- **Reduce Solvent, Labor and Time**



Questions?

