

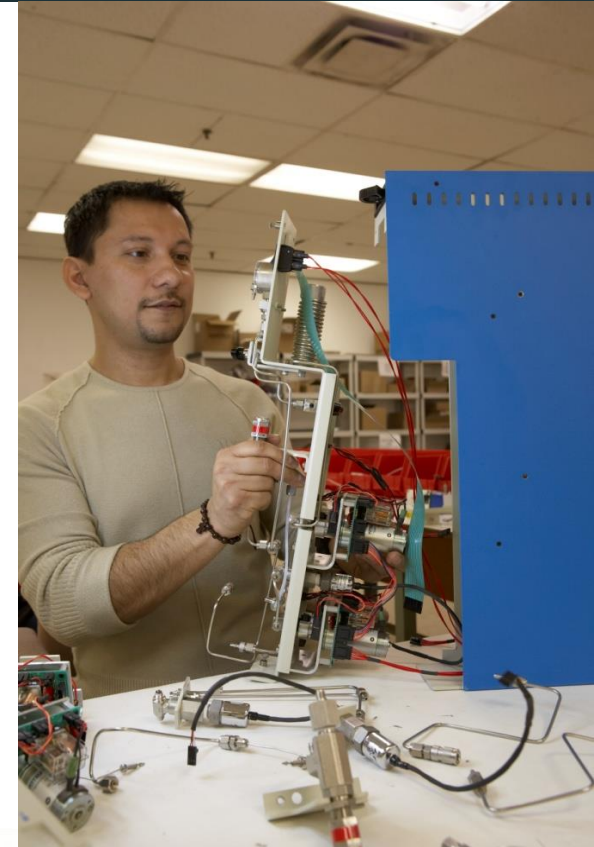
Fully Automated Solid Phase Extraction for EPA 8270 and 625 for Influent/Effluent WasteWater



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



Made in the USA



Made in the USA



Made in the USA

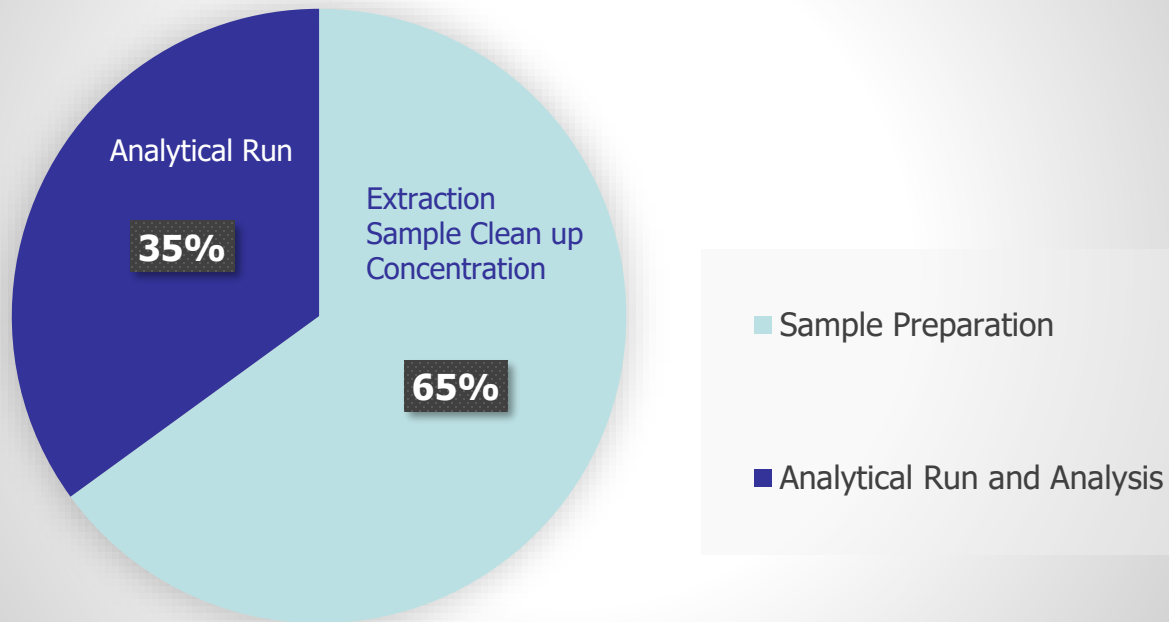


Class 1000 Cleanroom for Consumables Manufacturing



Laboratory Workflow Breakdown

Sample Prep versus Analytical in Time



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

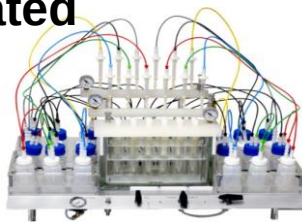


Direct to Vial

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



Concentration



SuperVap®
Concentration and
Evaporation



Direct to Vial

Sample Cleanup

Automated



PowerPrep® NG
Dioxin & PCB
Sample Cleanup



EconoPrep®
Dioxin & PCB Sample
Cleanup



EP110®
Zero DCM Dioxin
& PCB Sample
Prep



Concentration



SuperVap®
Concentration and
Evaporation



Direct to Vial

Semi-Automated



Ezprep 123®
Dioxin & PCB
Analysis

Overview

- **Development of a fully automated extraction system for EPA 8270/625**
 - Full Validation package available reviewed by the US EPA
- **Establishment of an extraction procedure capable of implementation of various aqueous matrices**
 - Implementation of platform across other EPA methodologies
- **Participation in ILI SPE Demonstration project for method suitability**
- **Performed Independent Validation Study of Many Waste Water Matrices**



Matrices

- **DI and Tap**
- **ASTM 5909 synthetic Wastewater**
- **TCLP Fluid**
- **Pond, River and Reservoir surface water**
- **Real world industrial effluents and influents**
- **Groundwater**



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 uses a lot of power

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

FMS TurboTrace[®] ABN

Touch Screen Control

SD Card for Storing and Transferring
Methods

Six Elution and Wash Solvents

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

Sample Size 2 ml to unlimited

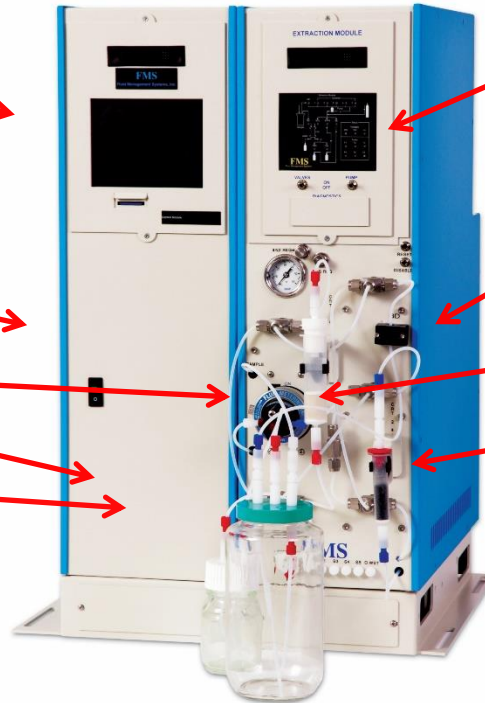
Automatic Bottle Rinse

Real Time Graphical Display of
Extraction Steps

Automatic Liquid Level Sensor

ABN Cartridge

Carbon Cartridge



TurboTrace ABN

- **Fully automates all processes, not manual steps**
- **Capable of delivering up to 3 independent fractions (or combine as 1)**
- **Can elute direct to FMS SuperVap evaporator**
- **Automated organic solvent rinse of sample bottle**
- **Can elute either cartridge independently or in parallel**
- **Modular and Expandable**
- **Direct to GC Vial extracts**

Automated Fast Flow Sample Processing



Sample Sizes Unlimited



SPE Cartridges



Drying Cartridges



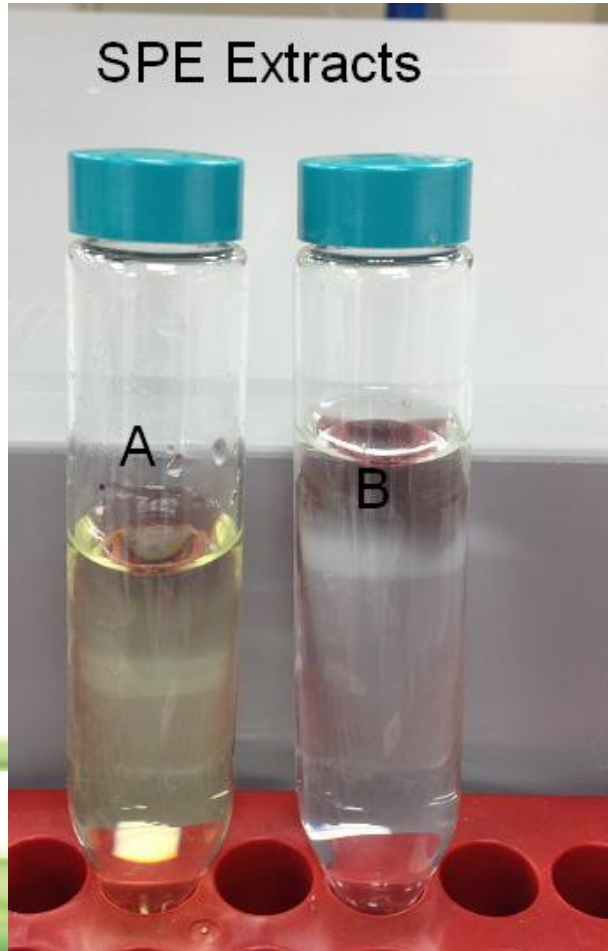
Vacuum and Nitrogen Drying



No Formation of Emulsions



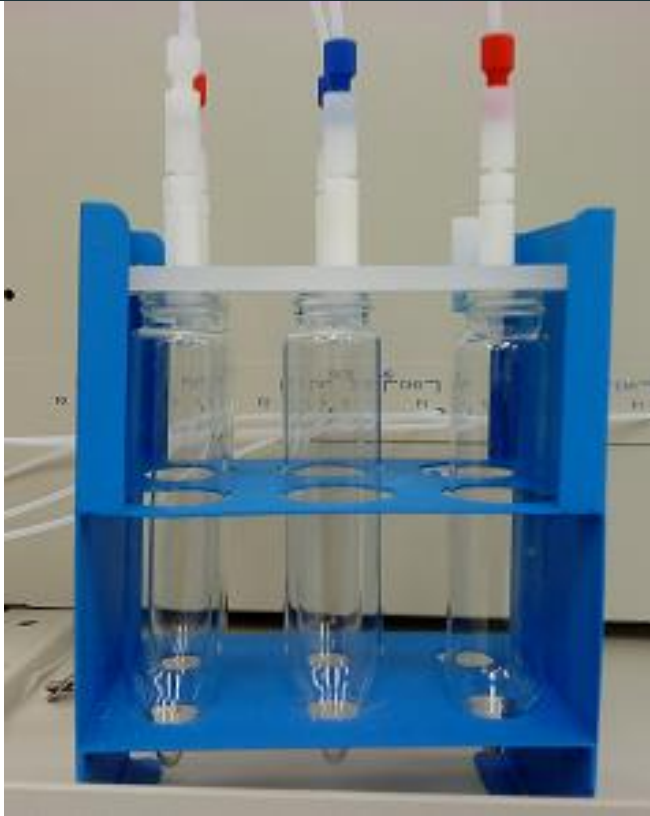
No subsequent Emulsions in Extracts to deal with



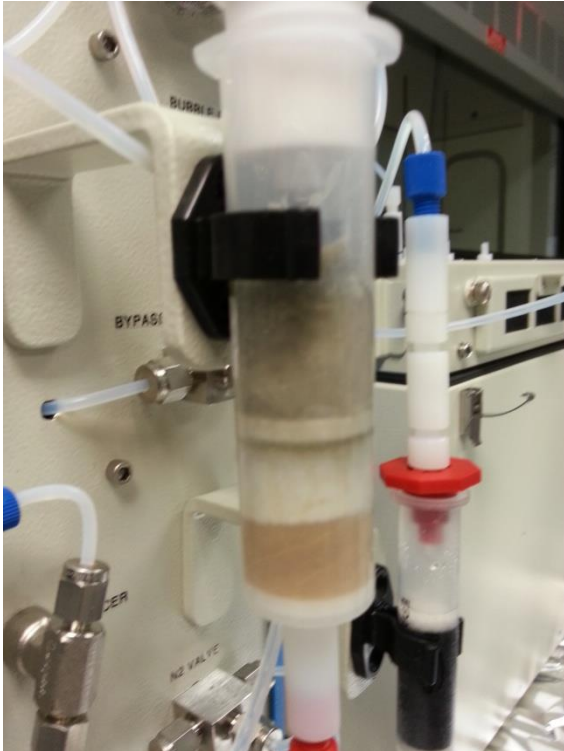
Reduced Solvent Usage



Reduced Exposure to Laboratory Background



Dual SPE Cartridge Extraction



Direct to Vial
Concentration

Direct to Vial Concentration



SuperVap Concentrator

- 12 position
- 50ml vessel



SuperVap Features

- **6 (250ml) and 12 (50ml) position models for extractions.**
- **Dry bath heating element**
- **Independent secondary heater for extract nipple (Can be disabled).**
- **Sensor controlled**
- **Savable temperature log capability.**



Procedure (1)

- **1 L water samples, pH < 2, spike with standards**
- **Condition with DCM, MeOH, water**
- **Cartridges: mixed bed and coconut charcoal**
- **Load samples across cartridges under vacuum and dry**
- **Bottle rinse, elute DCM across mixed bed and collect (Fraction # 1)**
- **Recondition mixed bed (MeOH); 1% NaOH across both cartridges**

Procedure (2)

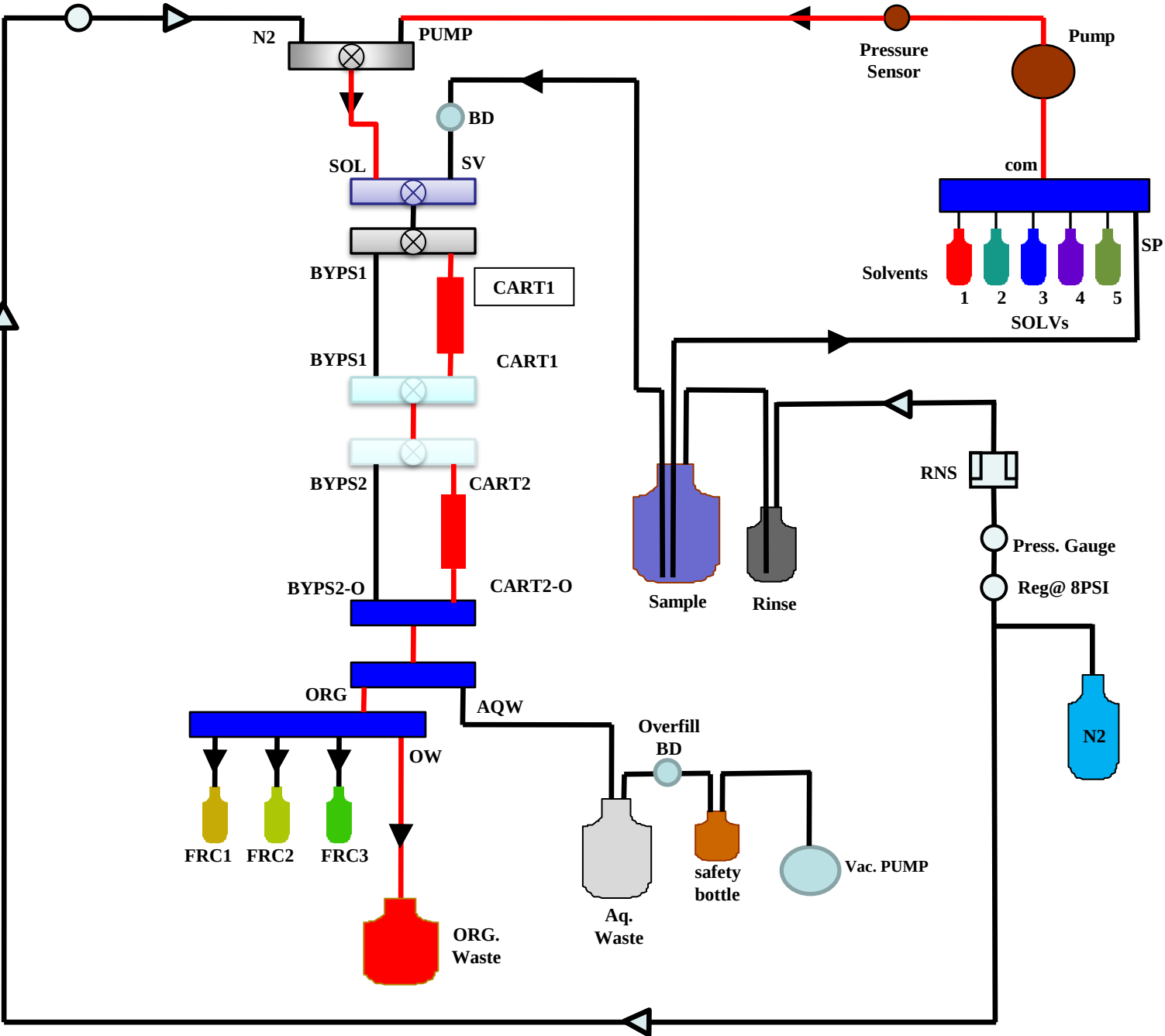
- **Dry, elute both cartridges sequentially with DCM (Fraction # 2)**
- **Purge system with nitrogen to collect any analytes**
- **Dry Fraction with sodium sulfate**
- **Evaporation and low res GC/MS**



TurboTrace ABN
Plumbing Diagram

Reg @ 20PSI

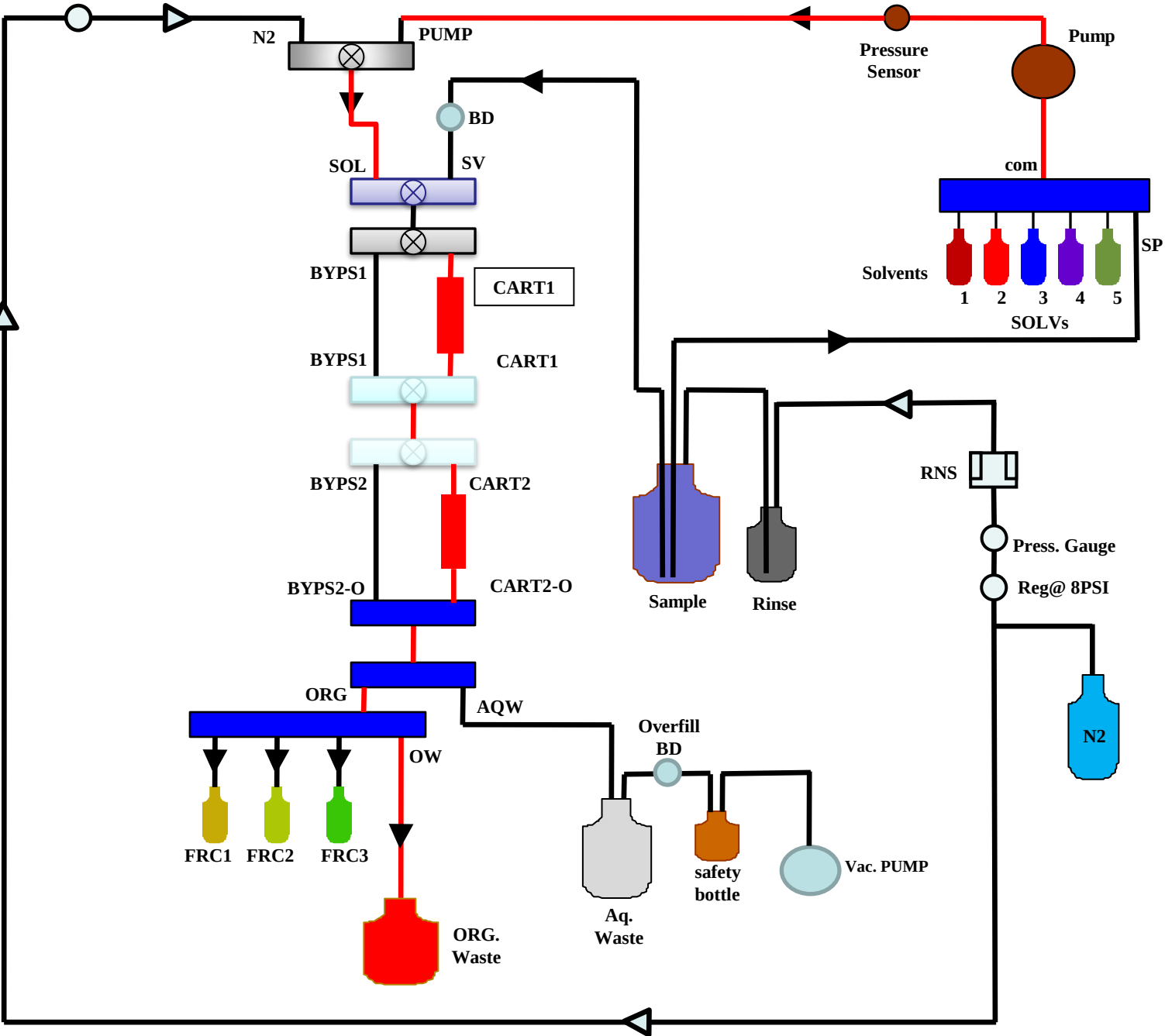
DCM
Conditioning



TurboTrace ABN
Plumbing Diagram

Reg @ 20PSI

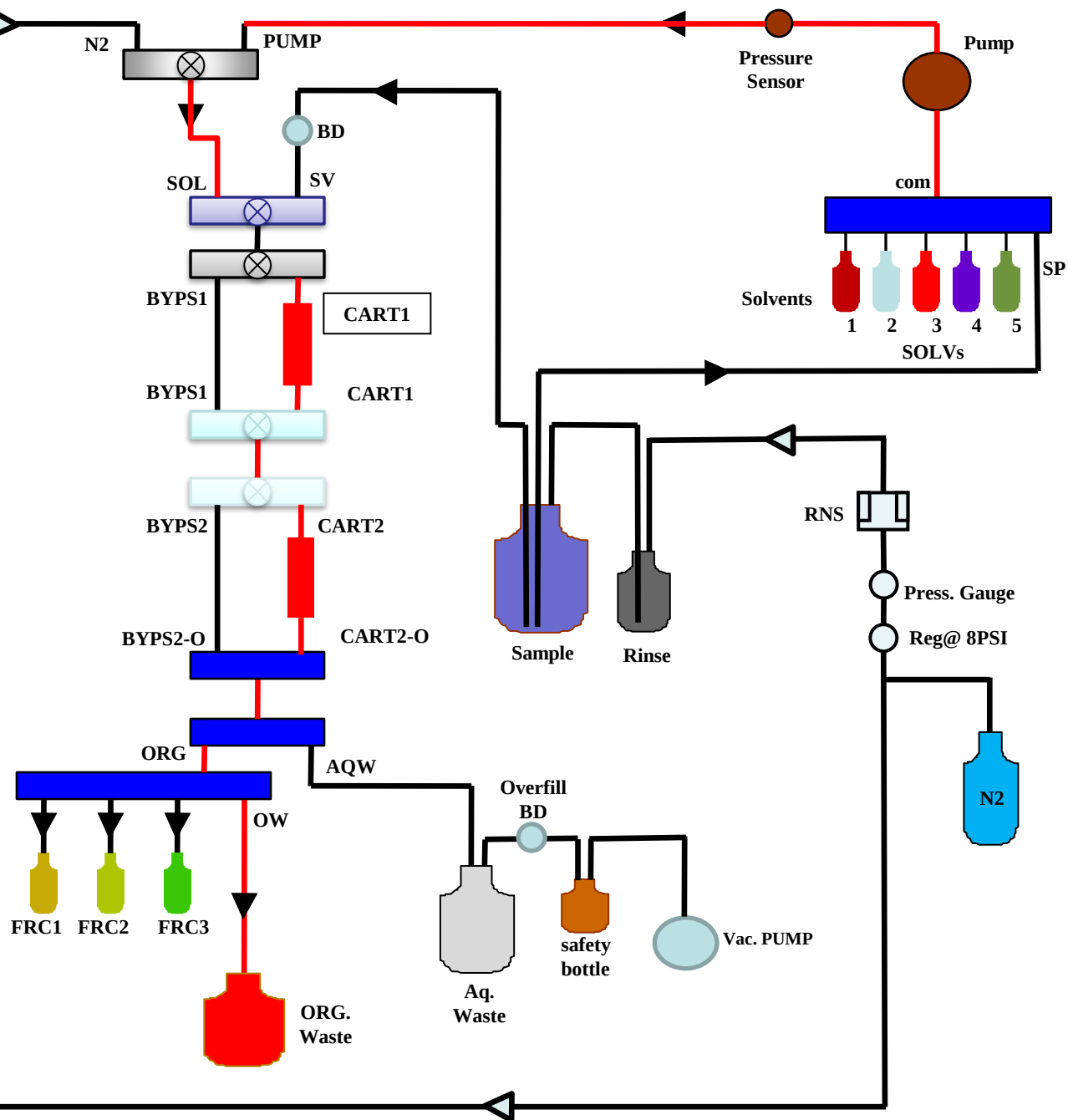
MeOH
Conditioning



TurboTrace ABN Plumbing Diagram

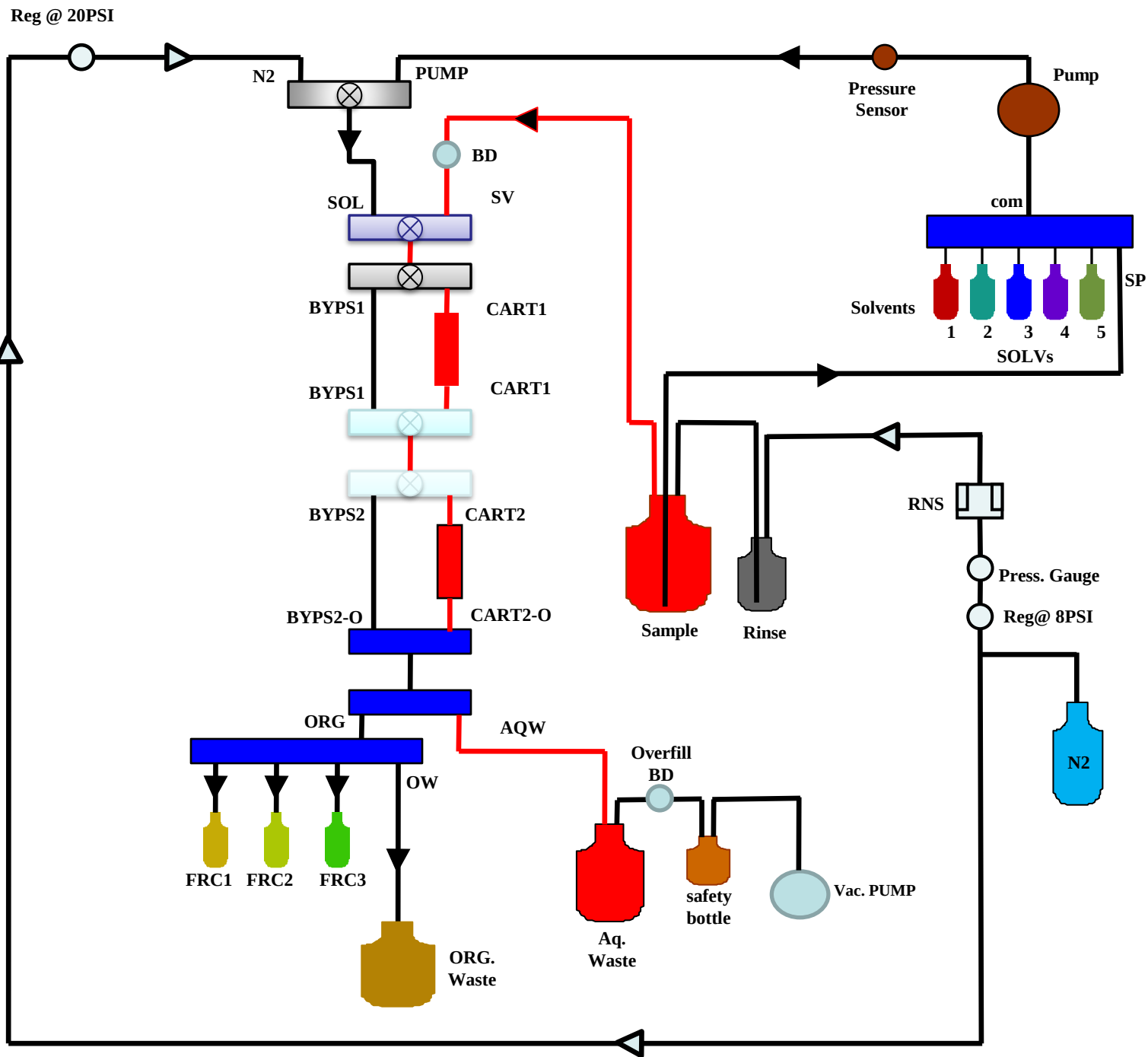
Reg @ 20PSI

H₂O
Conditioning



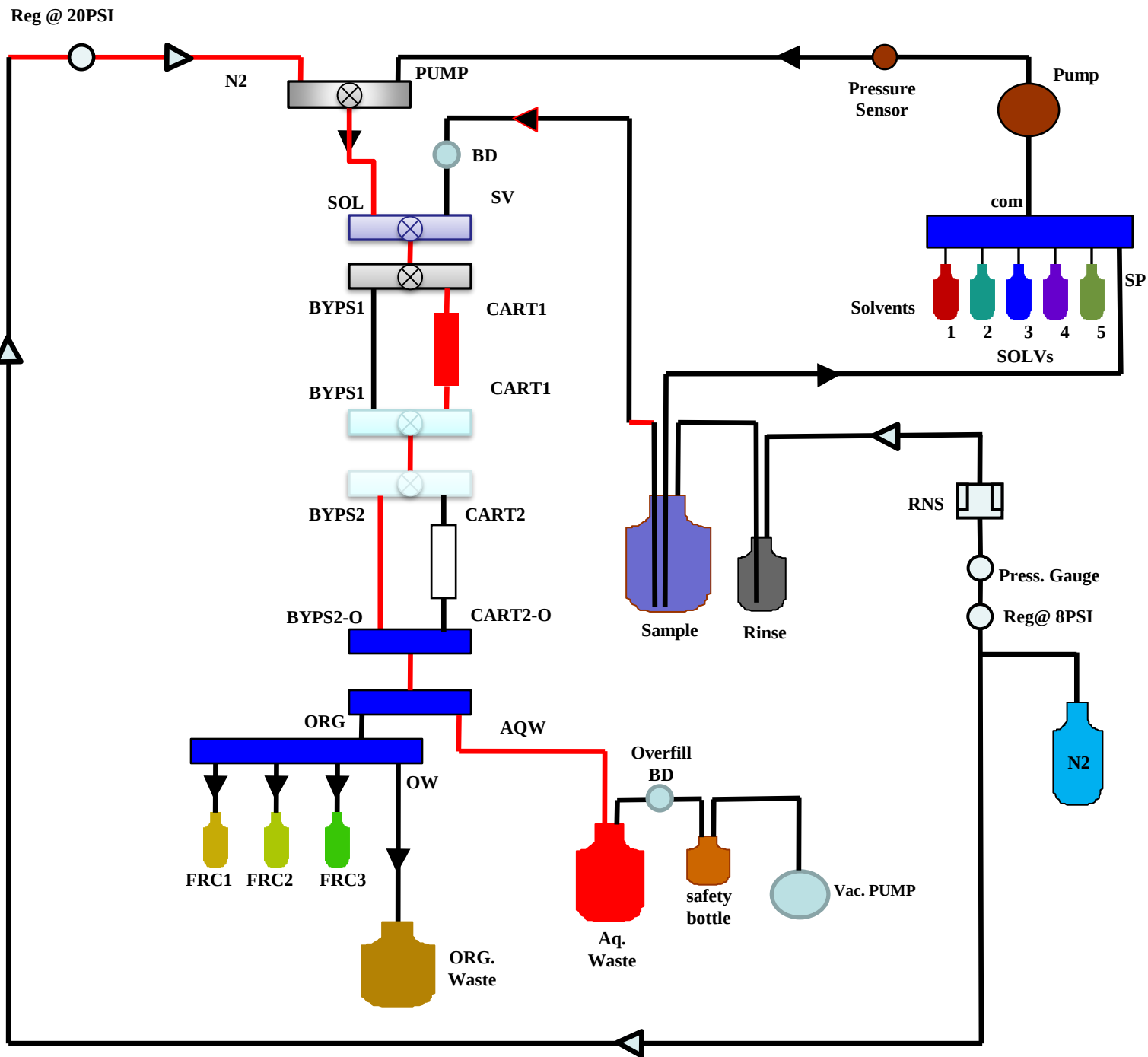
TurboTrace ABN Plumbing Diagram

Load
Sample

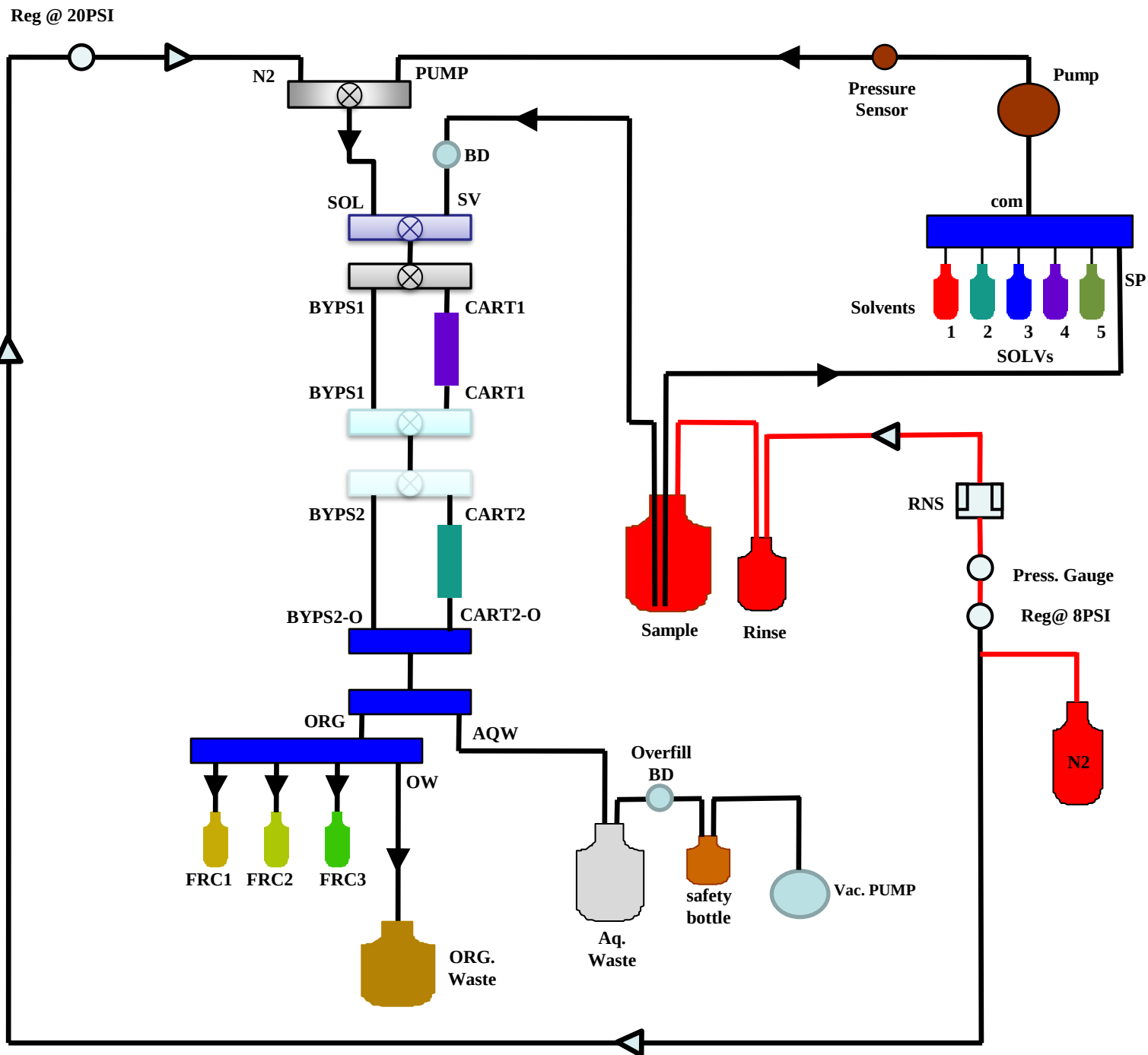


TurboTrace ABN Plumbing Diagram

N2 Dry
Cartridge



TurboTrace ABN Plumbing Diagram



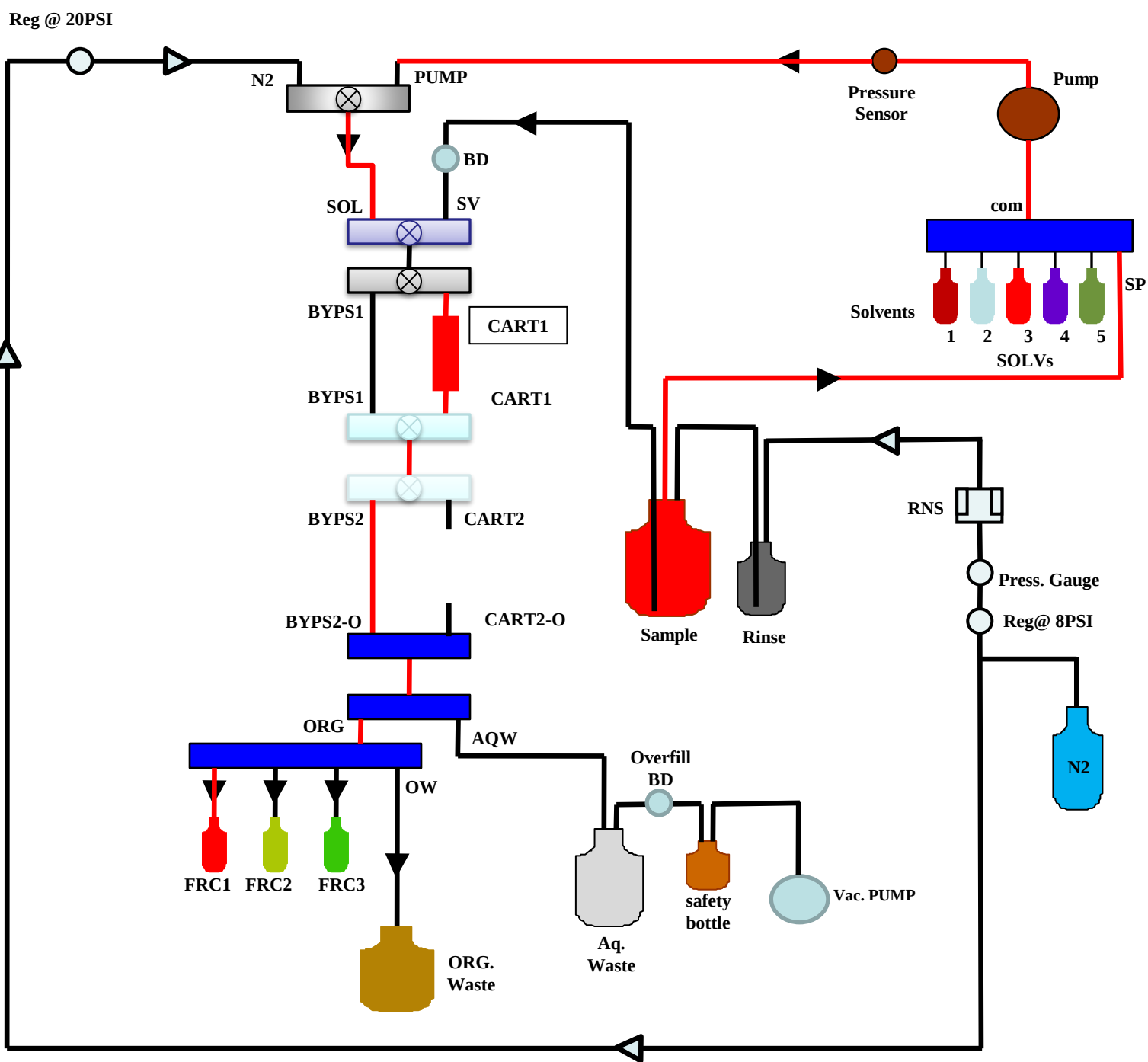
Rinse
Bottle
DCM

**TurboTrace ABN
Plumbing Diagram**

**Load
Bottle
Rinse and
Elute**

Cartridge 1

Fraction 1

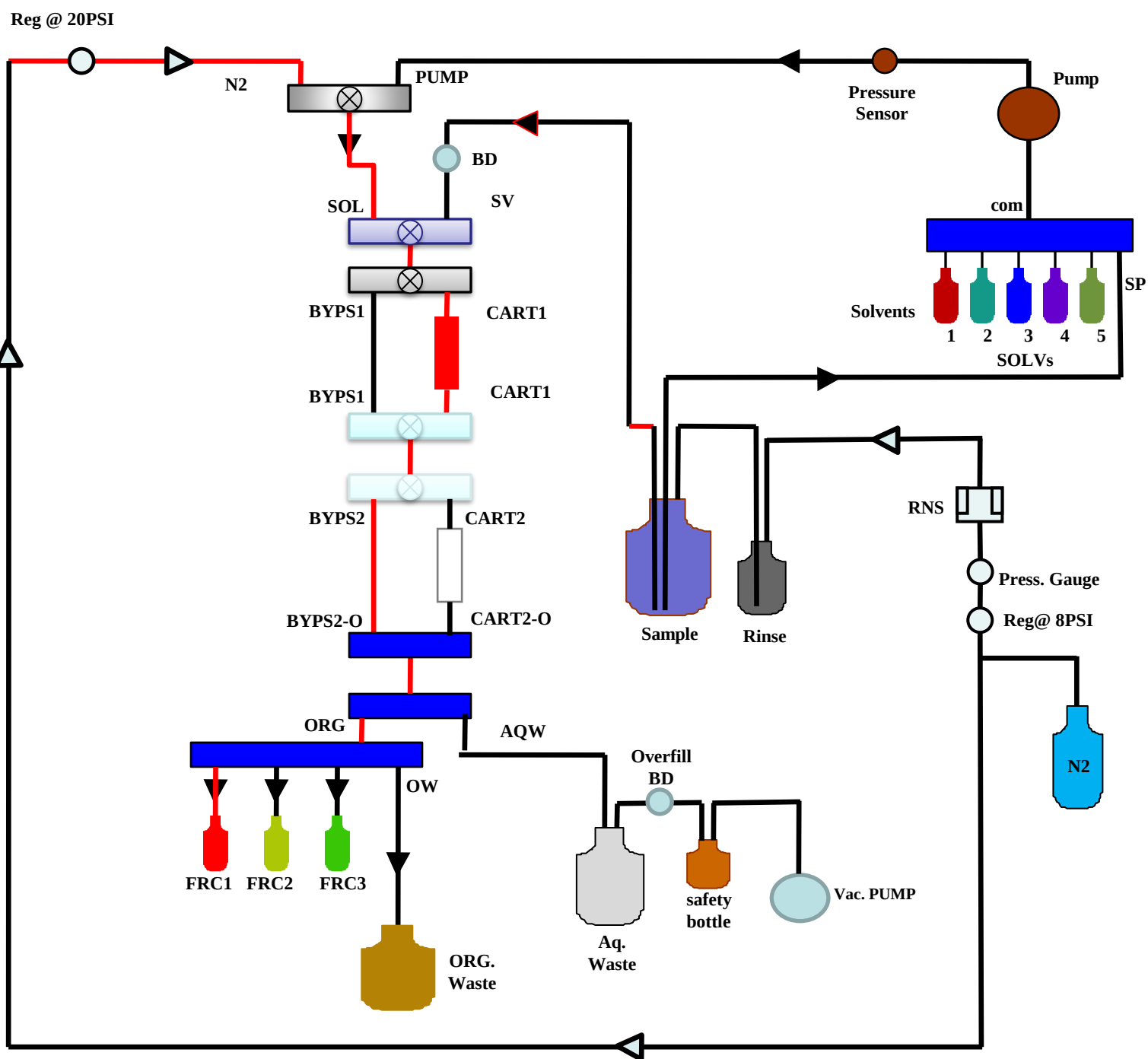


**TurboTrace ABN
Plumbing Diagram**

**N2 Push
Elute**

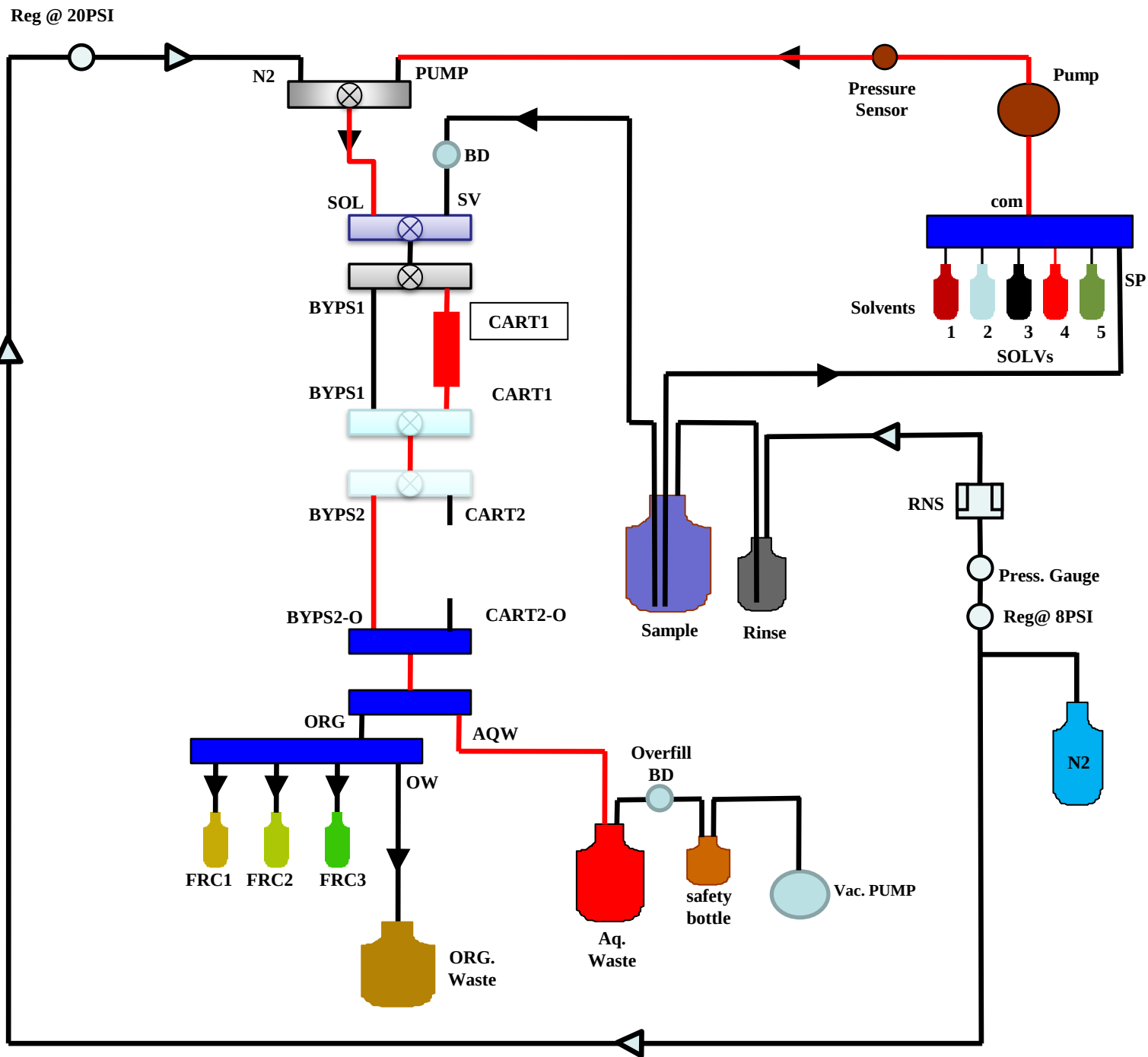
**ABN
Cartridge**

Fraction 1



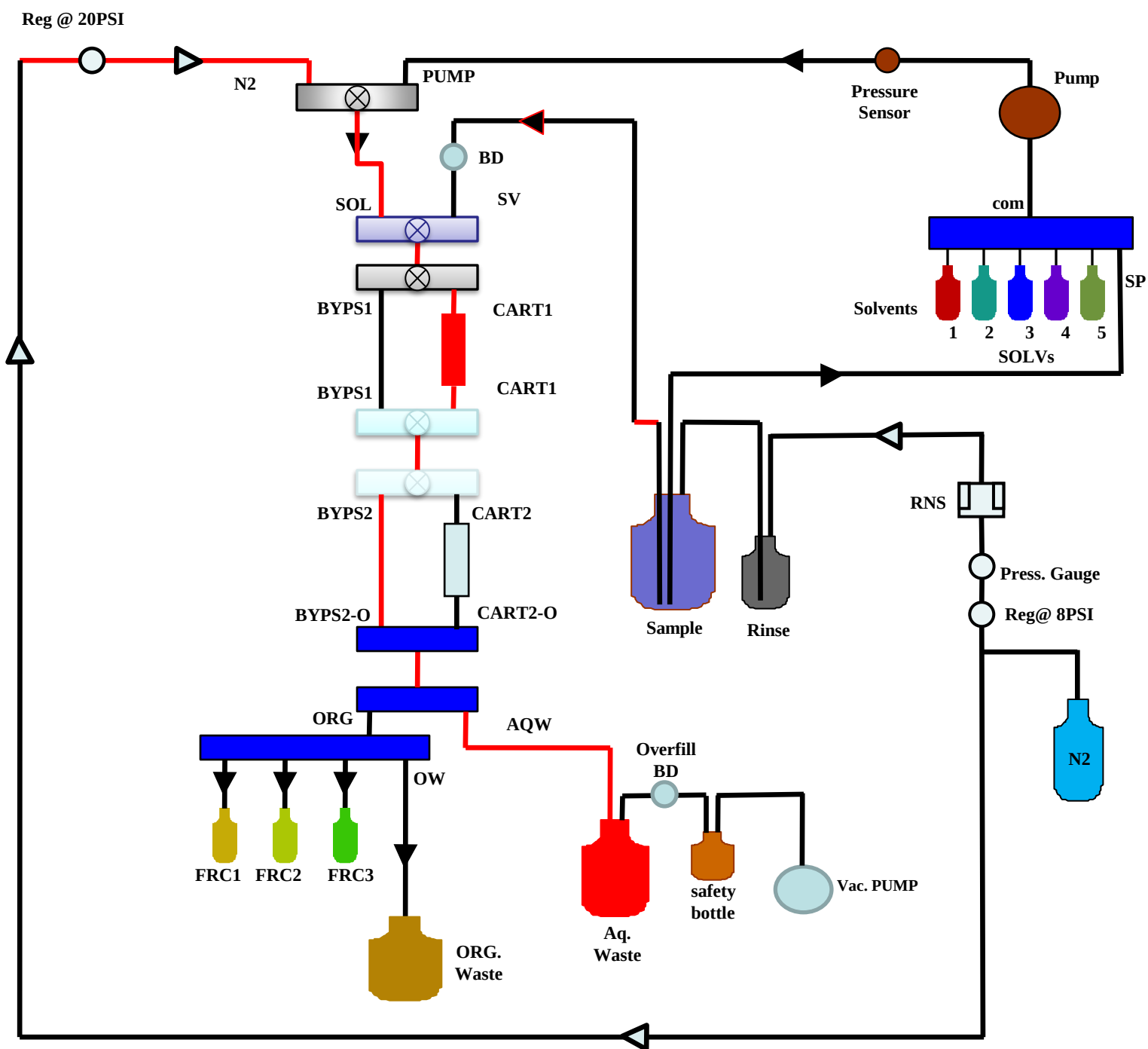
**TurboTrace ABN
Plumbing Diagram**

**NaOH
Exchange**



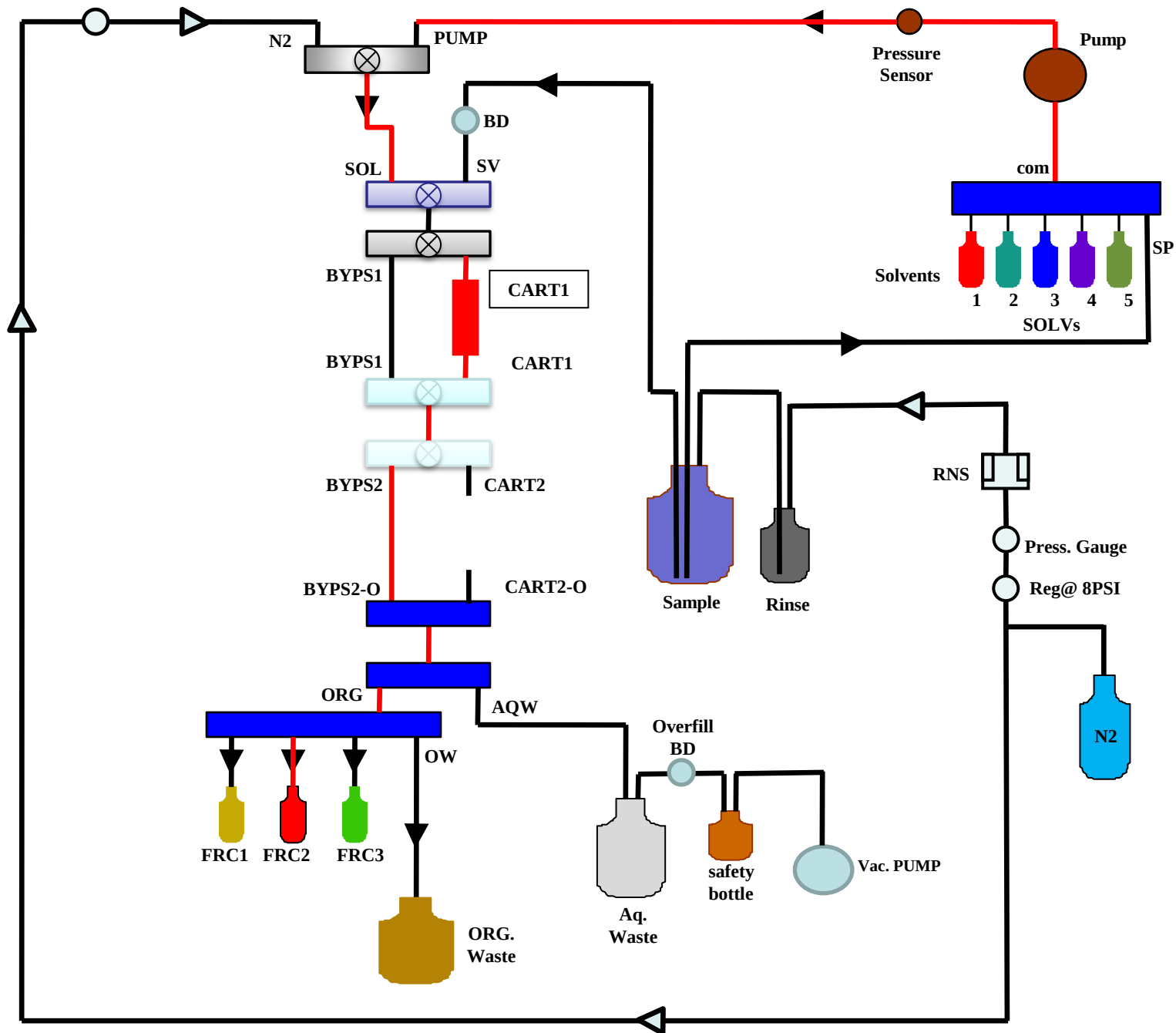
**TurboTrace ABN
Plumbing Diagram**

**N2 Dry
ABN
Cartridge**



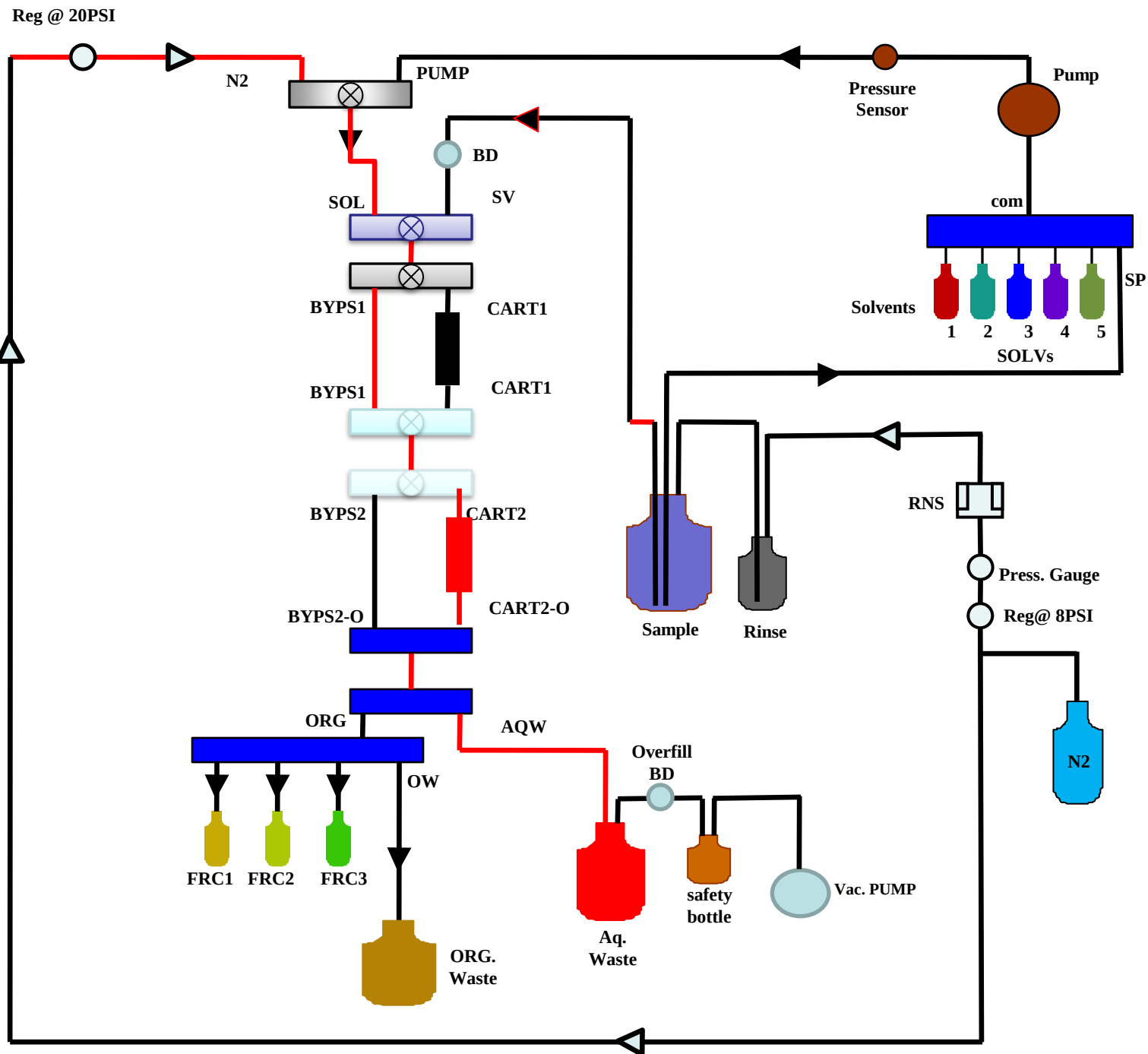
Reg @ 20PSI

ABN Cartridge Fraction 2



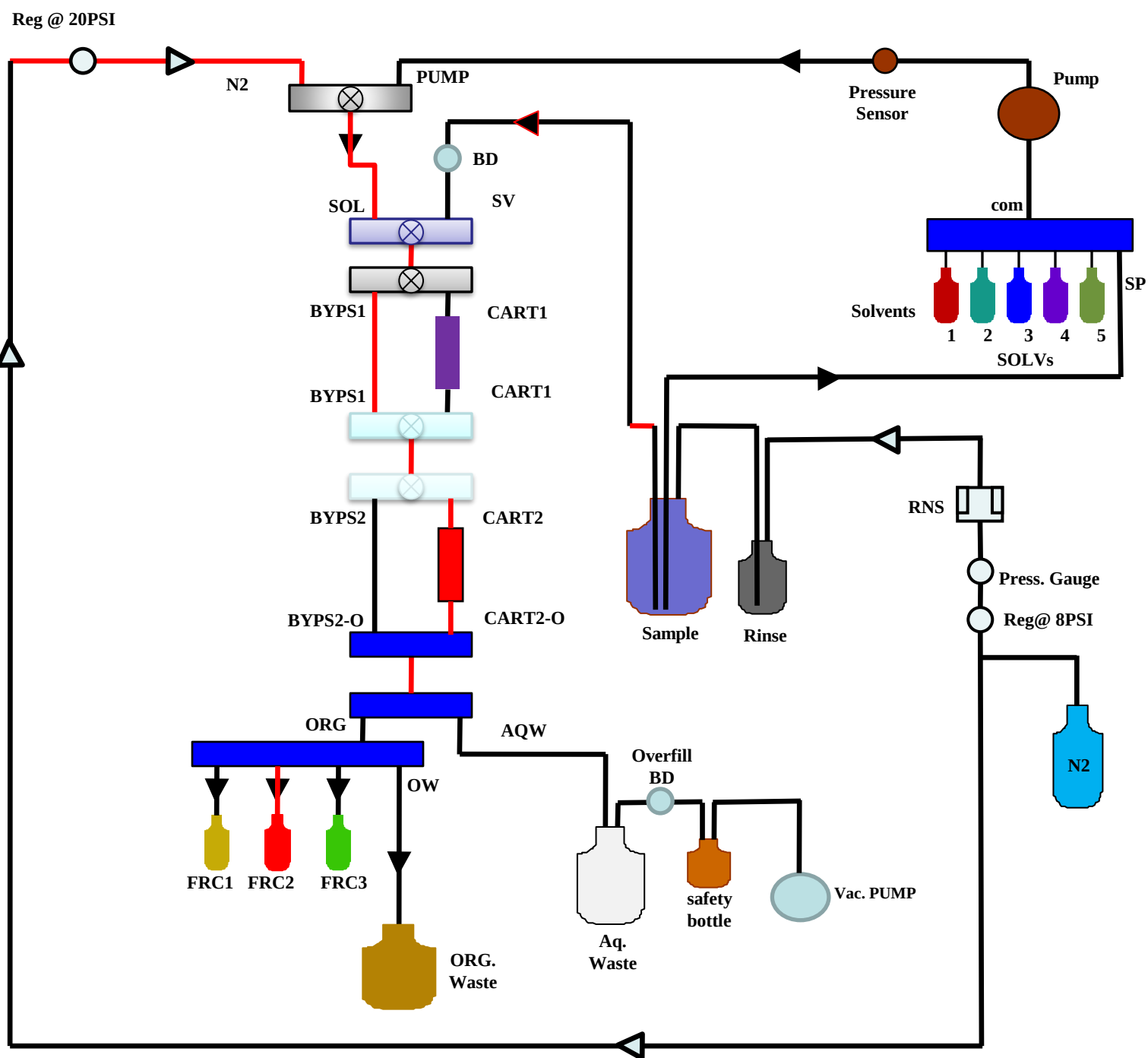
**TurboTrace ABN
Plumbing Diagram**

**N2 Dry
Coconut
Charcoal
Cartridge**



**TurboTrace ABN
Plumbing Diagram**

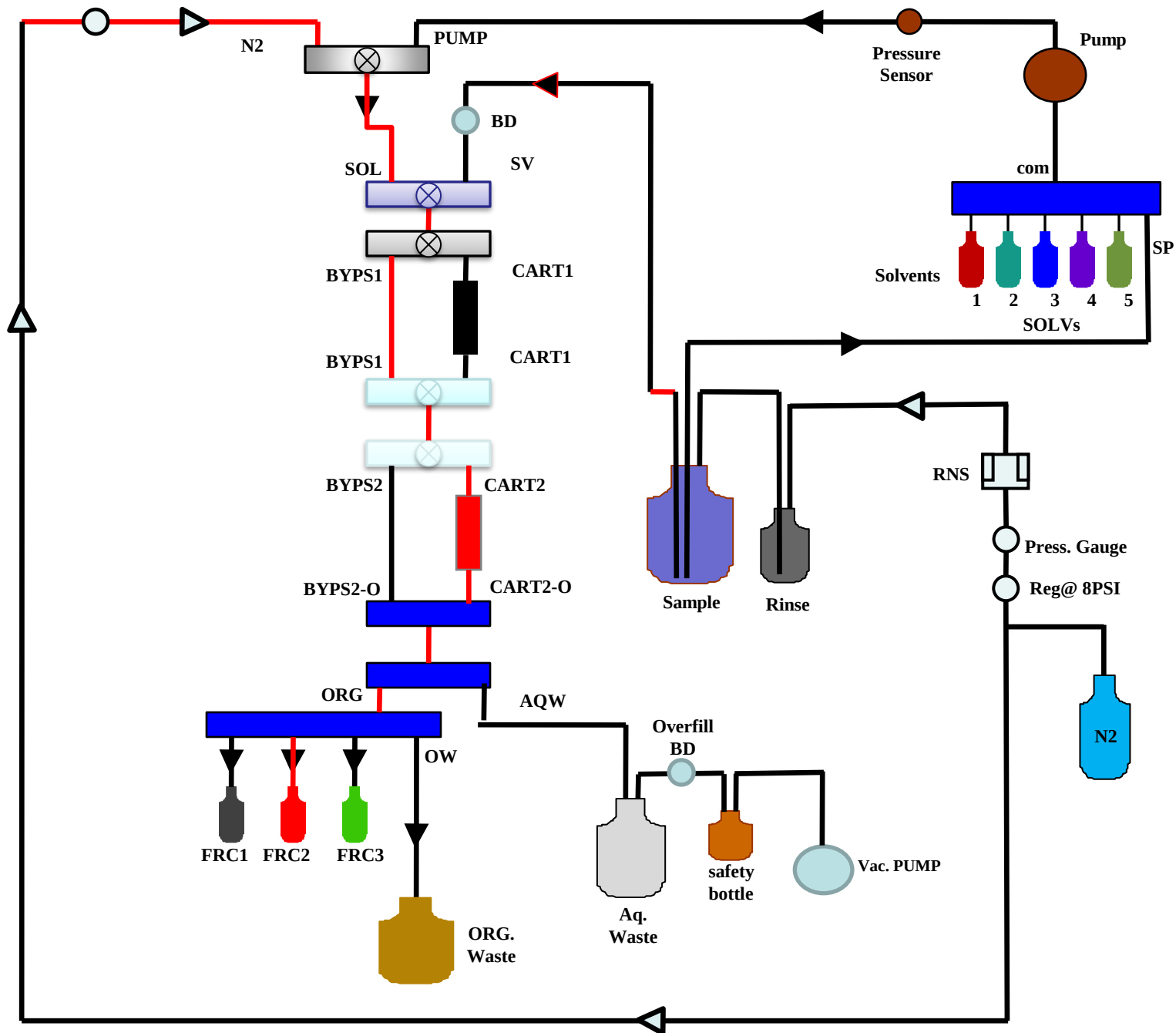
**Elute
Coconut
Charcoal
Cartridge
DCM
Fraction 2**



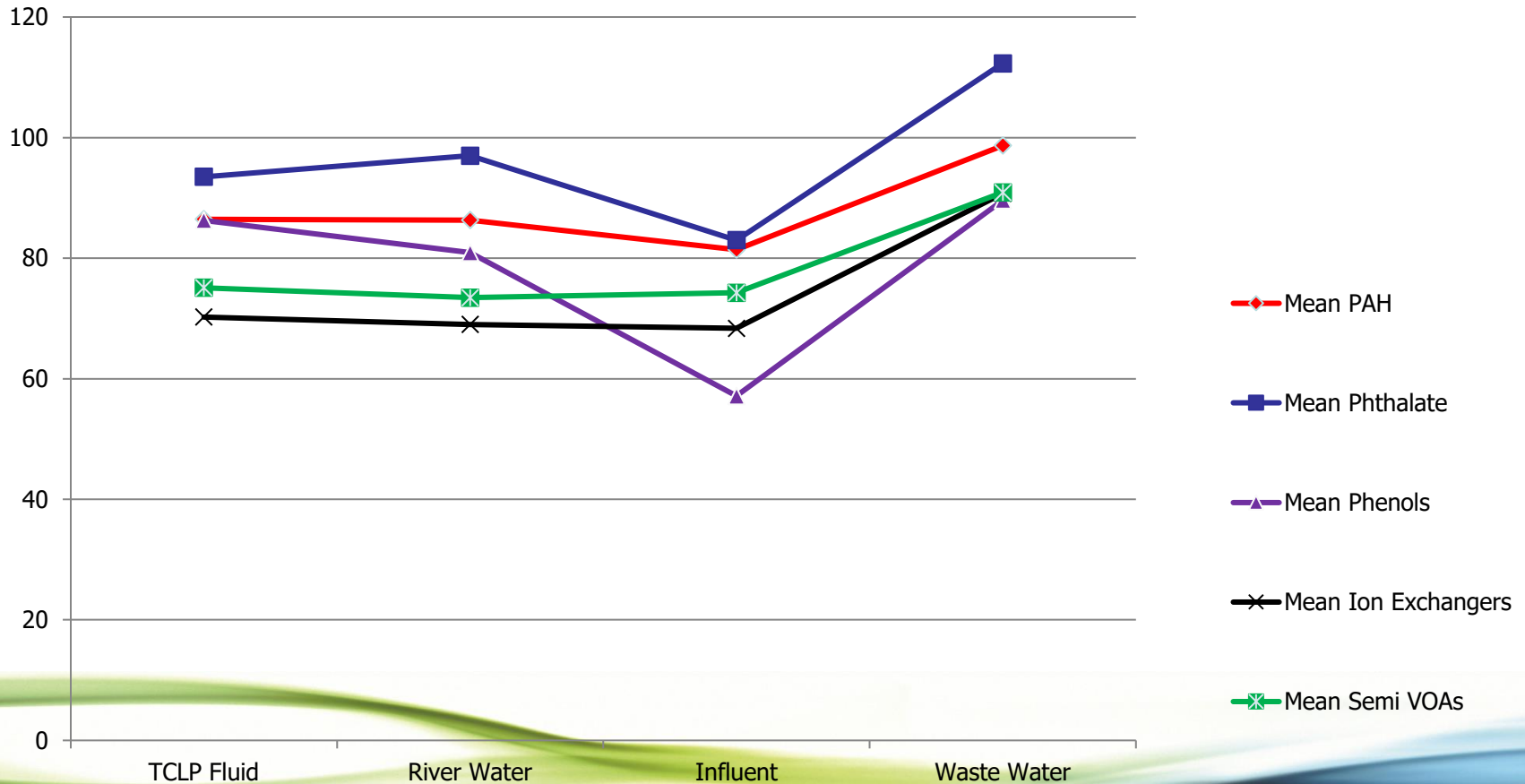
Reg @ 20PSI

Coconut Charcoal Cartridge

Fraction 2



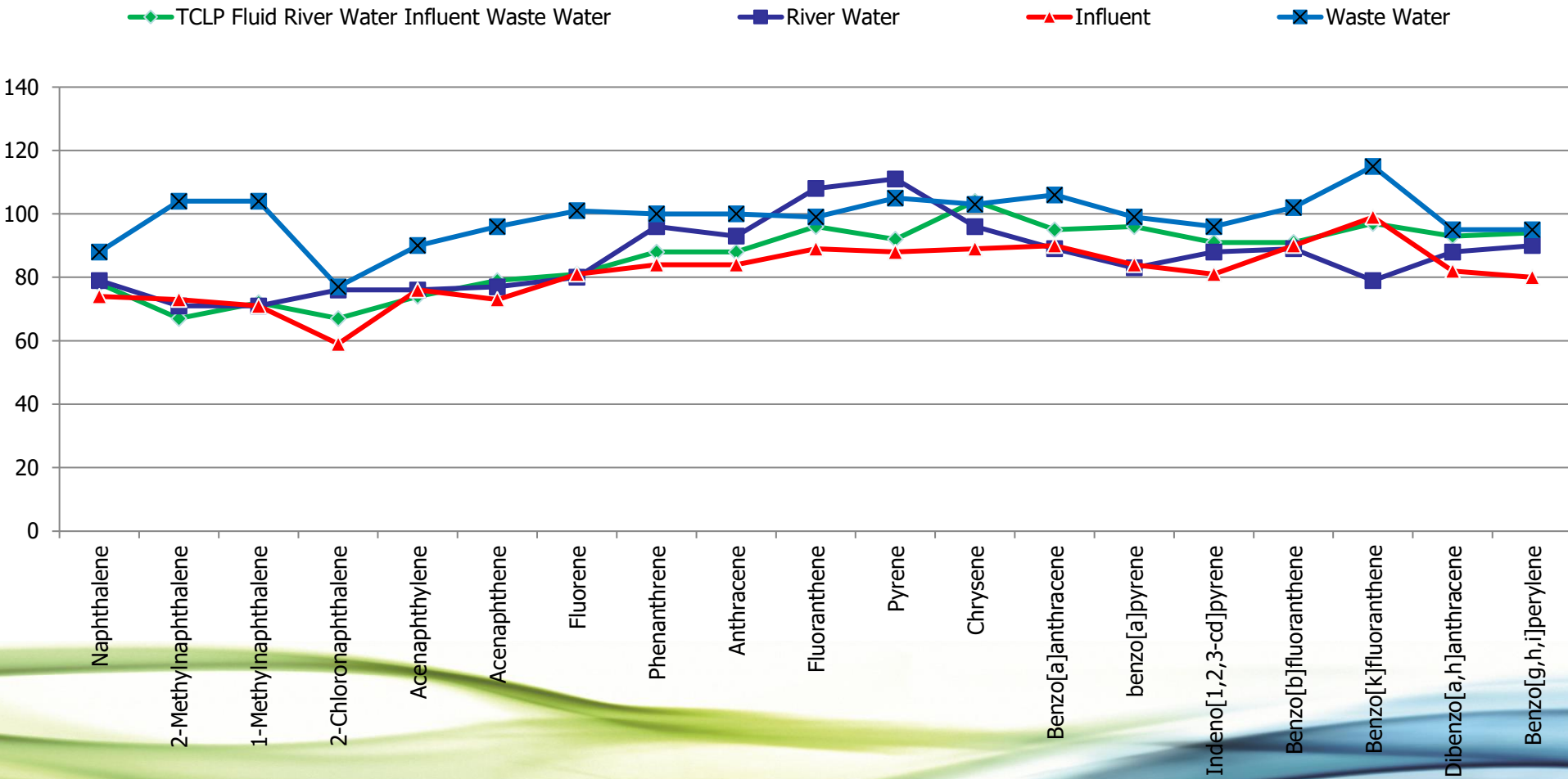
Recoveries by Analyte Class



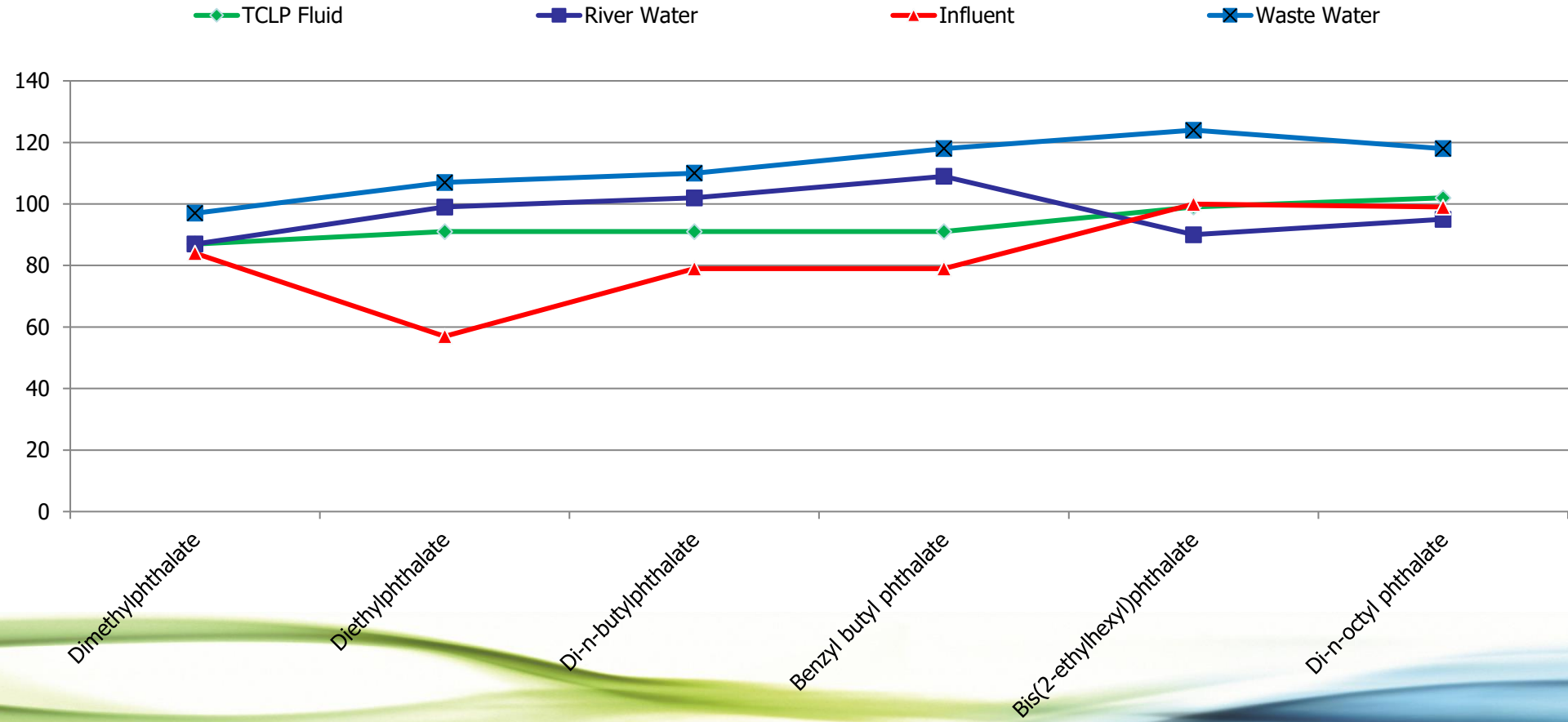
Recoveries for Individual Compounds with specific Analyte Classes



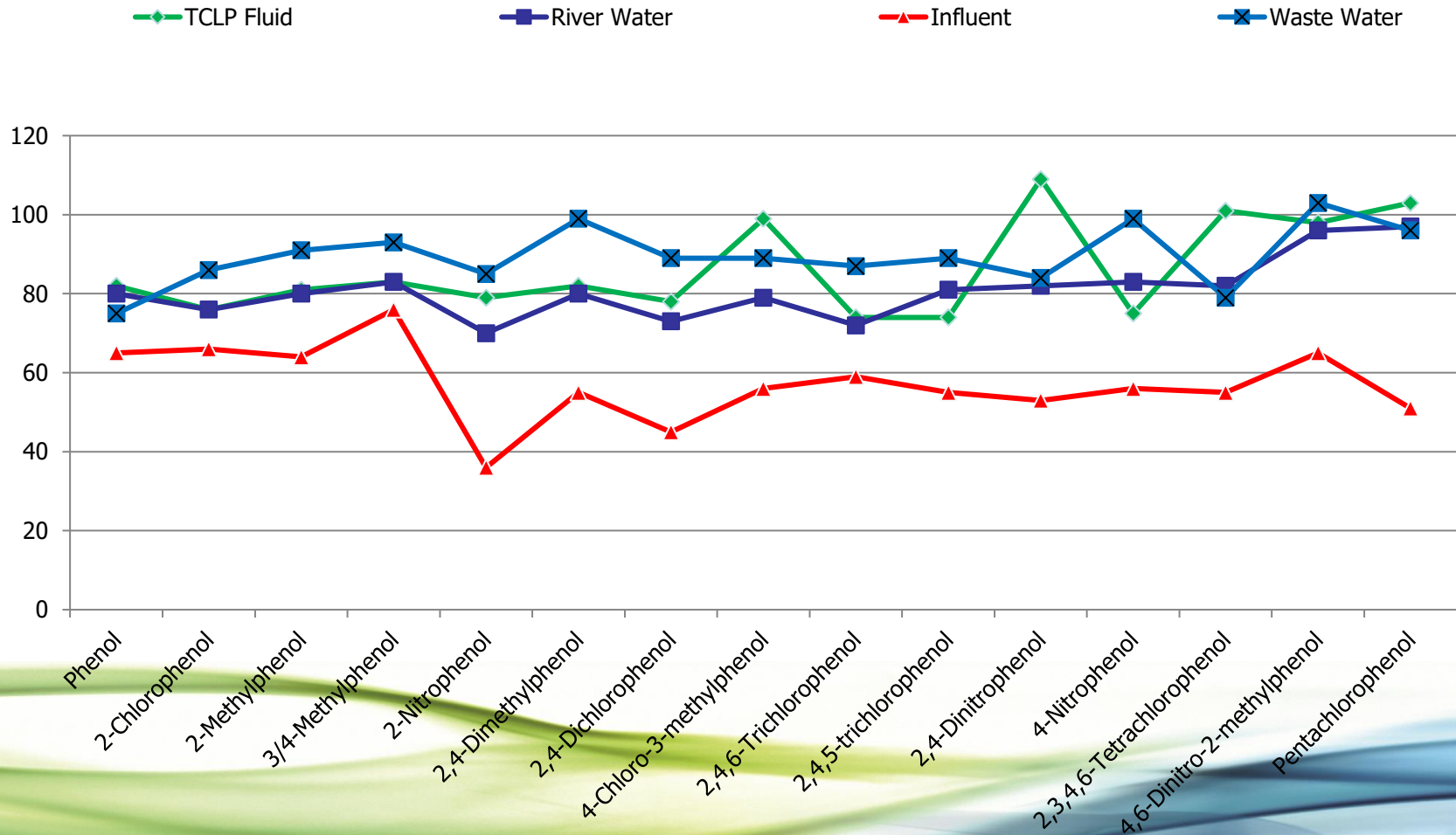
PAHs



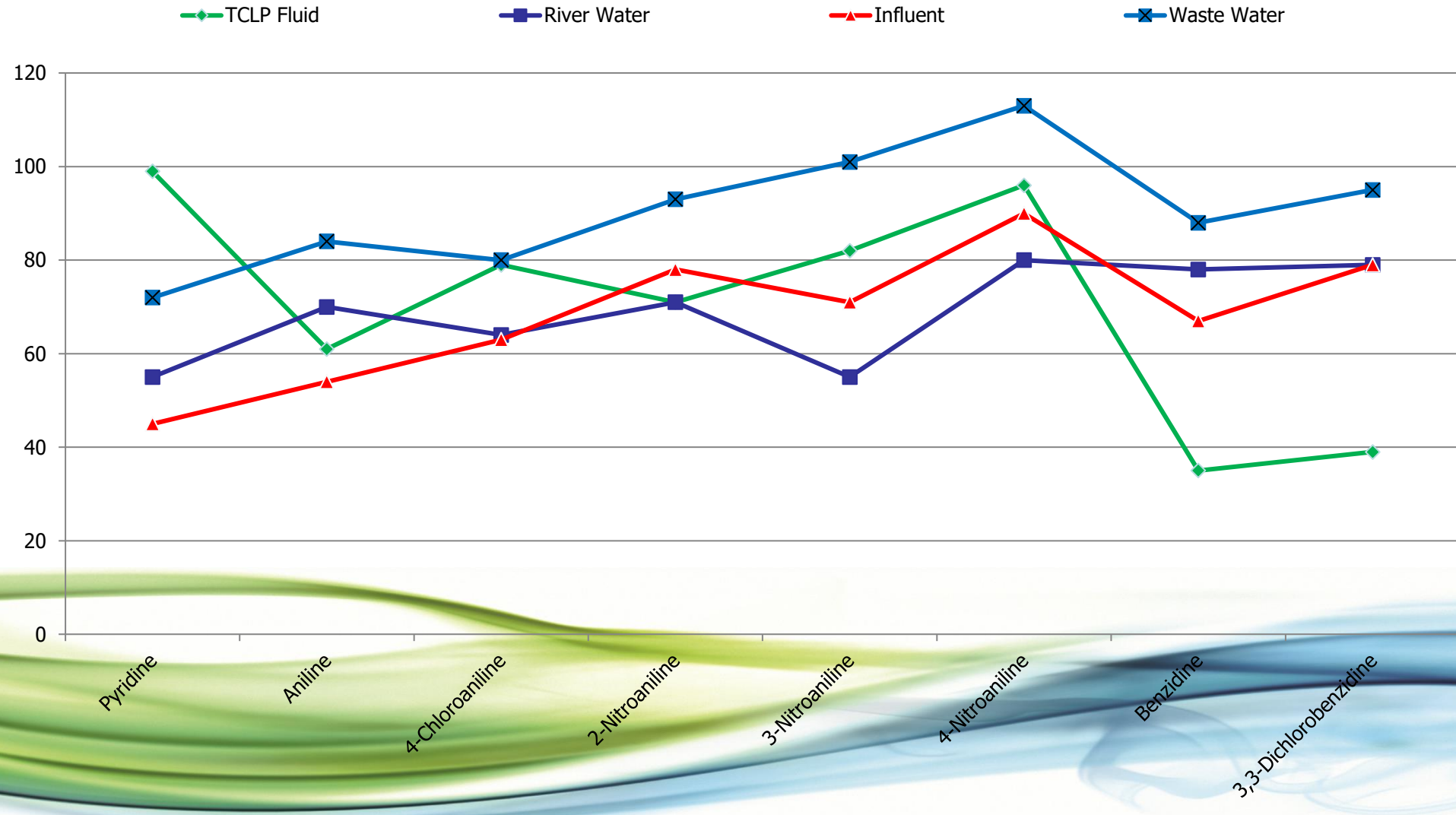
Phthalates



Phenols

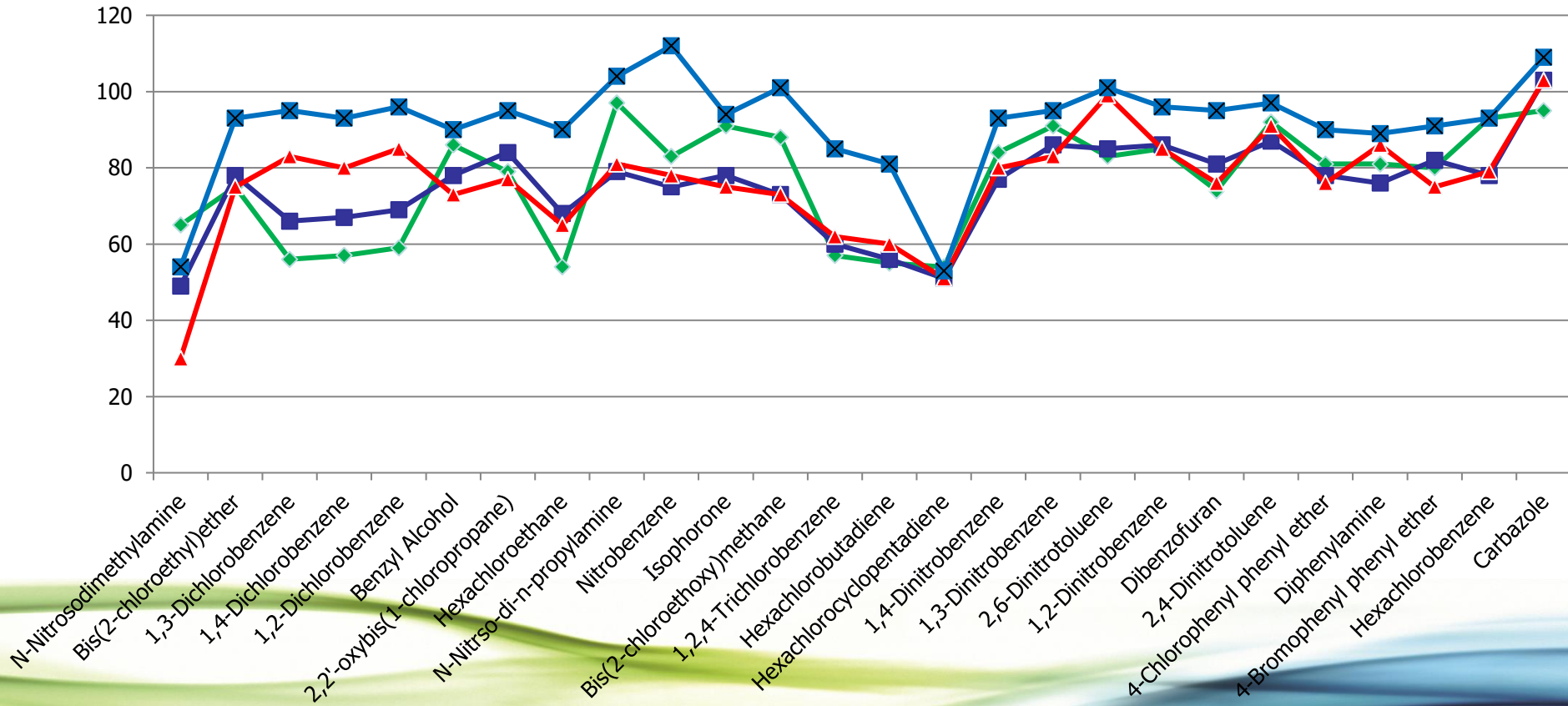


Ion Exchangers



Semi-Volatiles

◆ TCLP Fluid
 ■ River Water
 ▲ Influent
 ✕ Waste Water

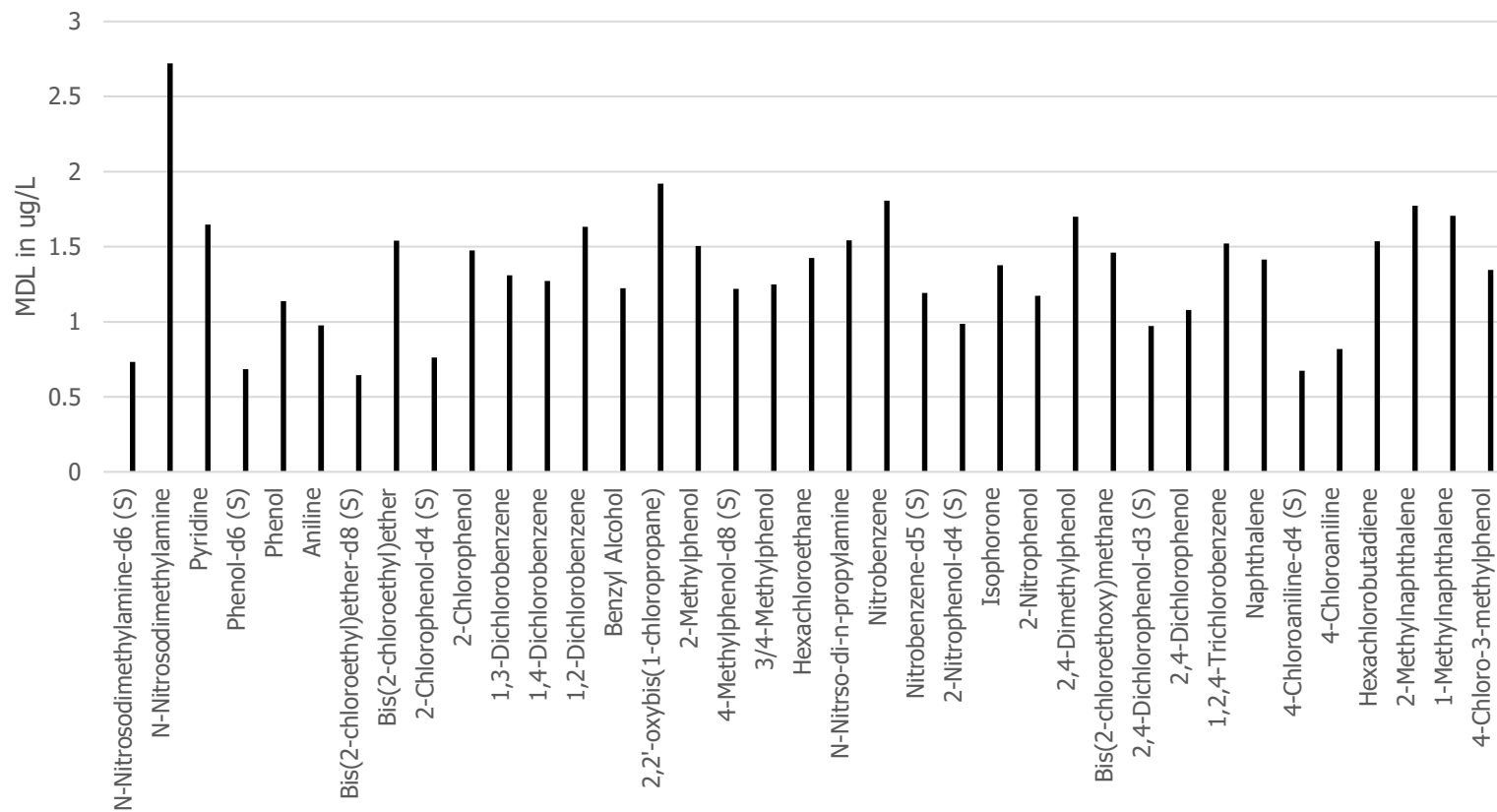


Method Validation

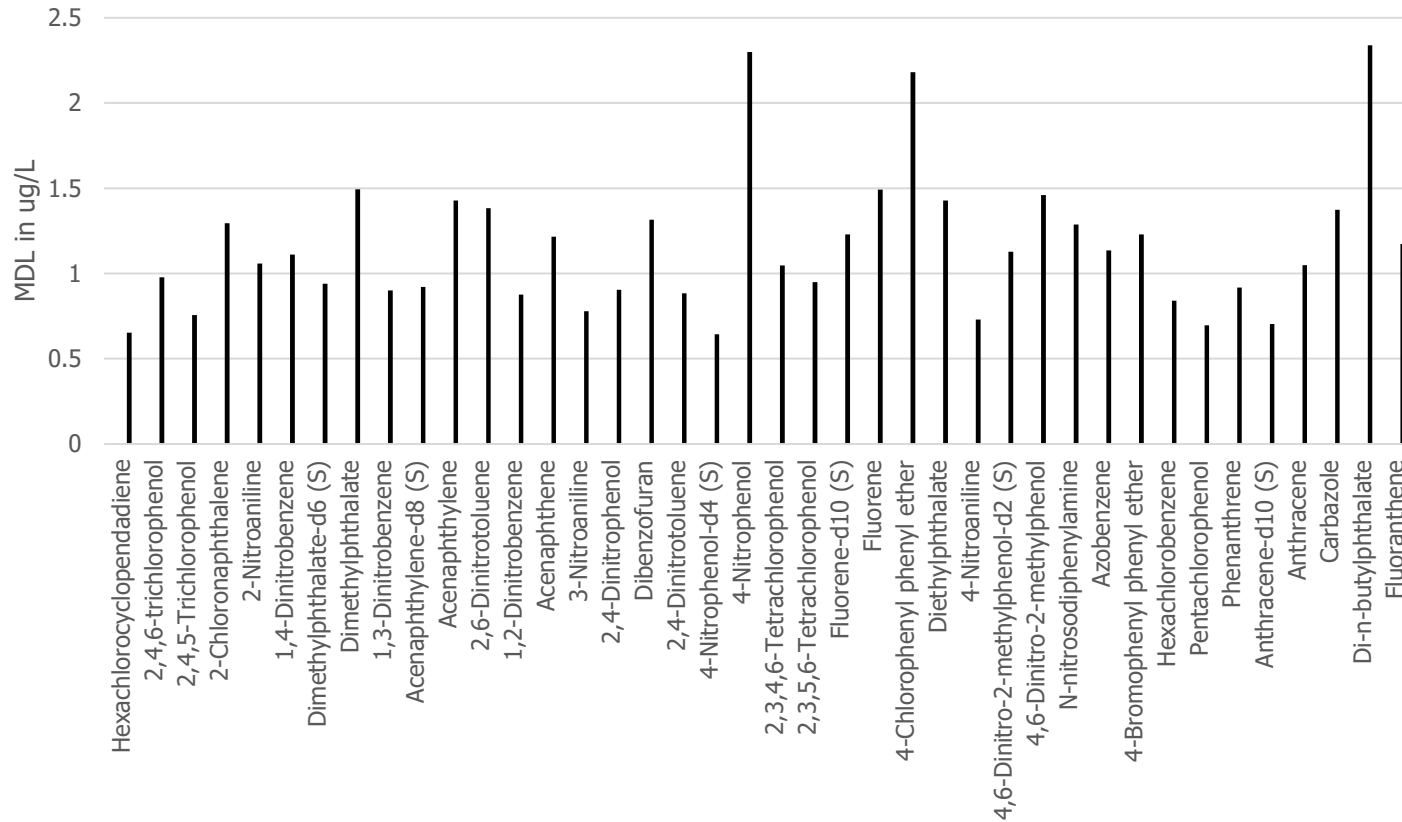
Method Detection Limit



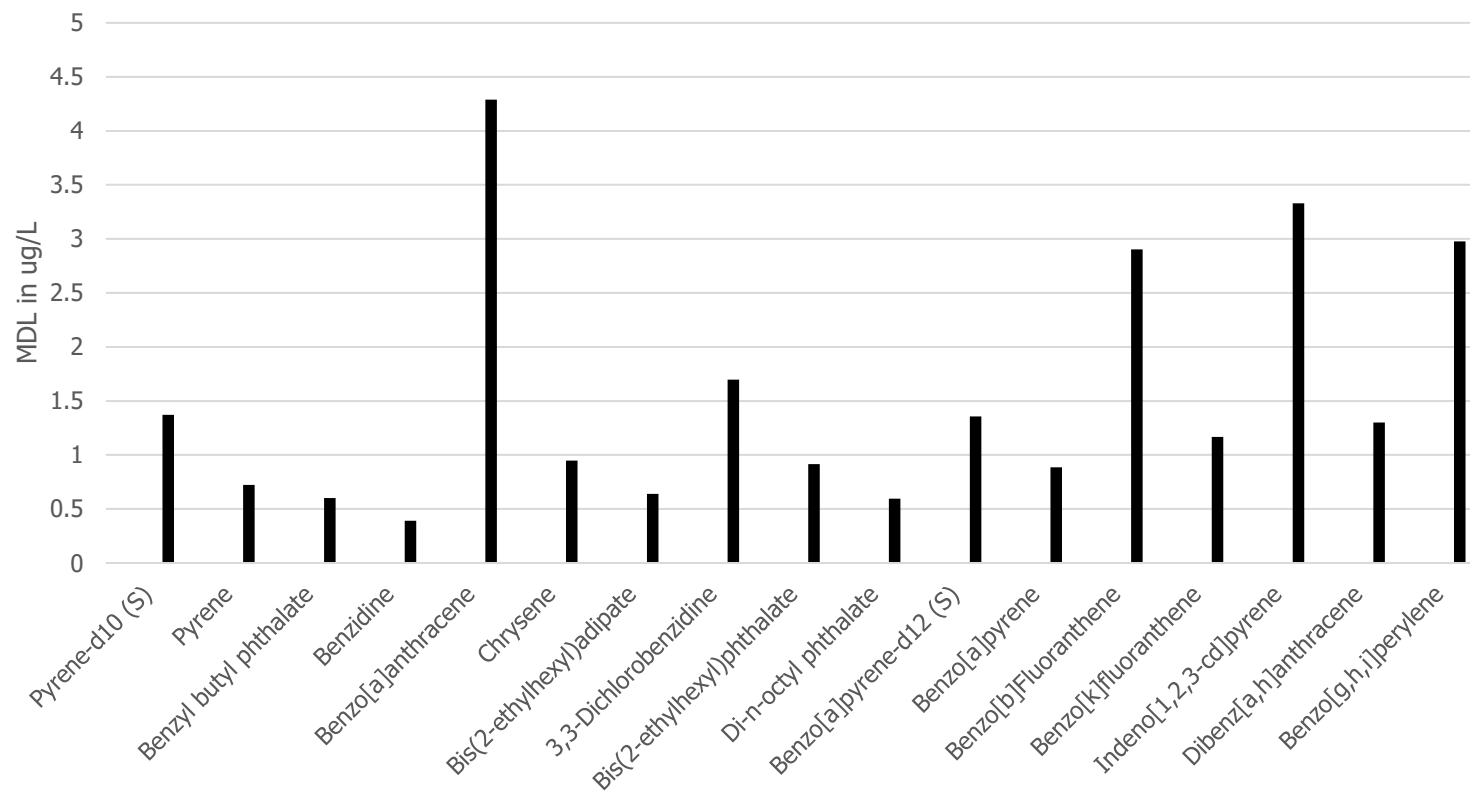
MDL (1)



MDL (2)



MDL (3)



Sample Analysis Work Flow

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

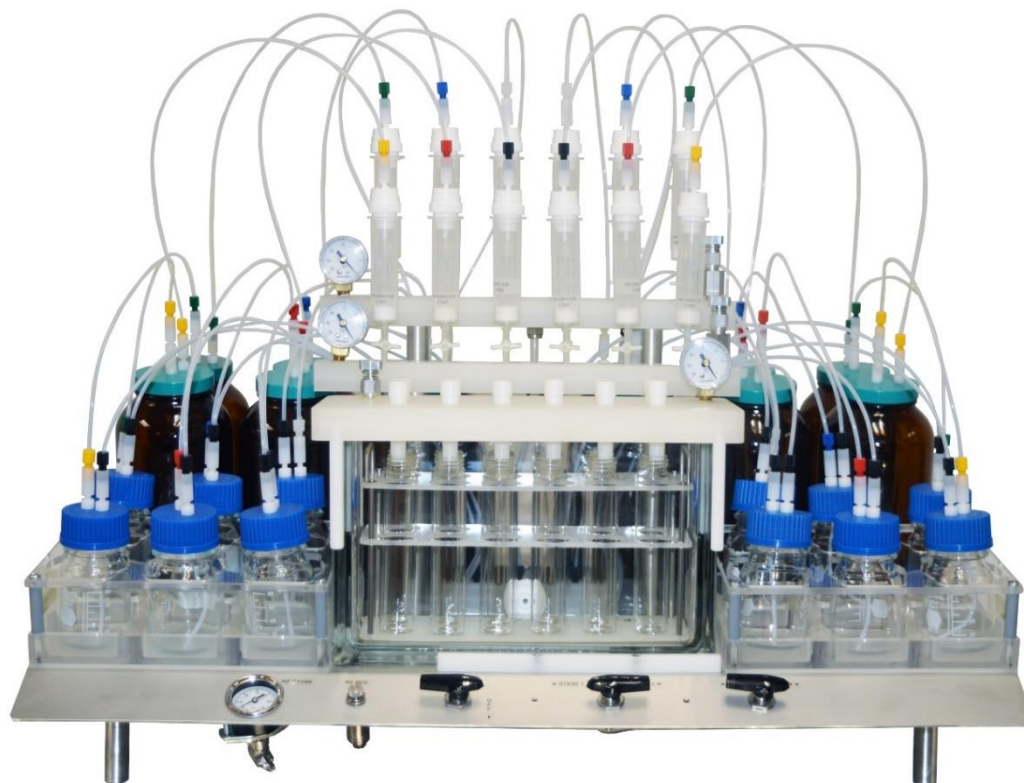
- **Efficient**

- 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**

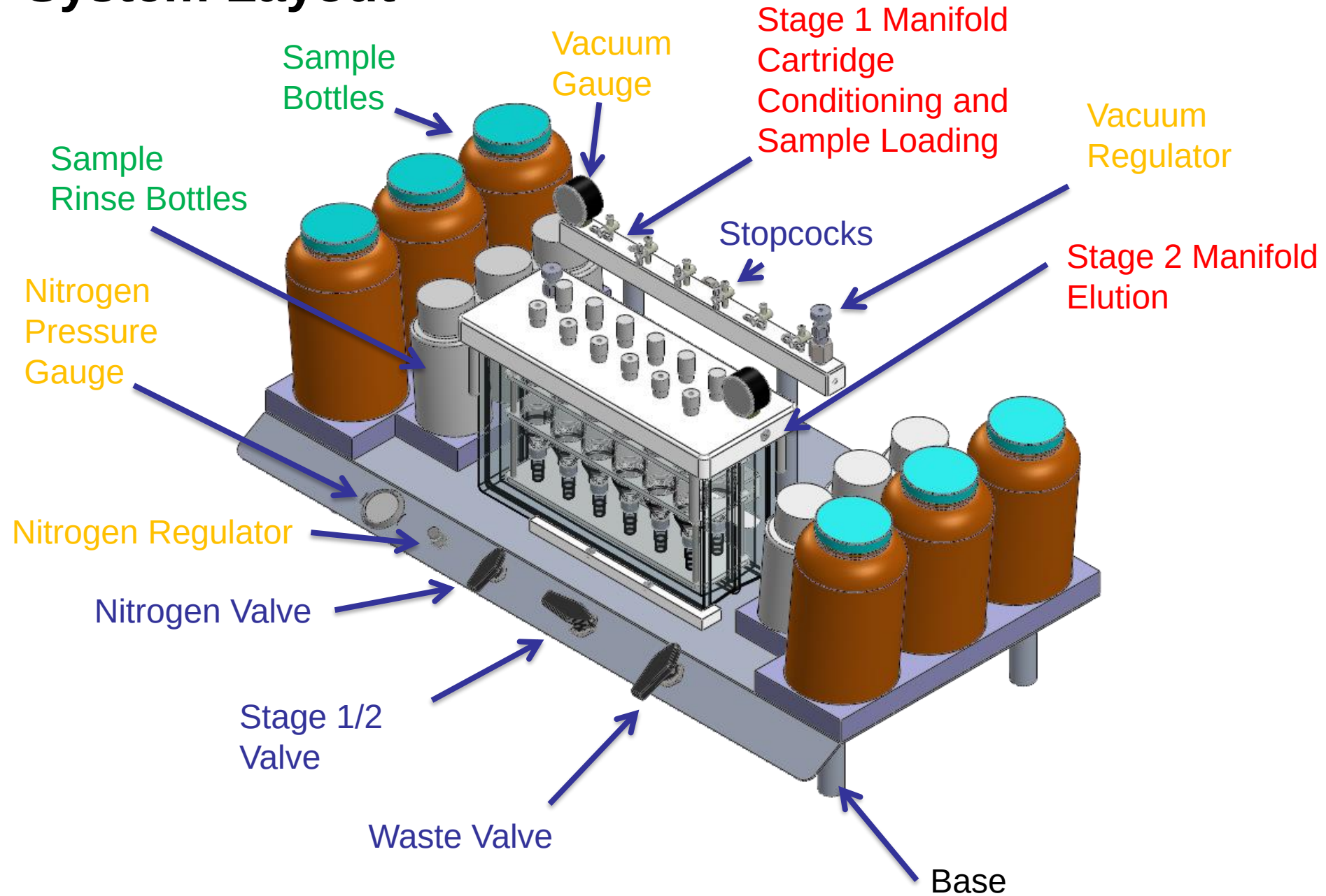
- Purchase an FMS Cartridge Contract
- receive an EZSpe at No Charge

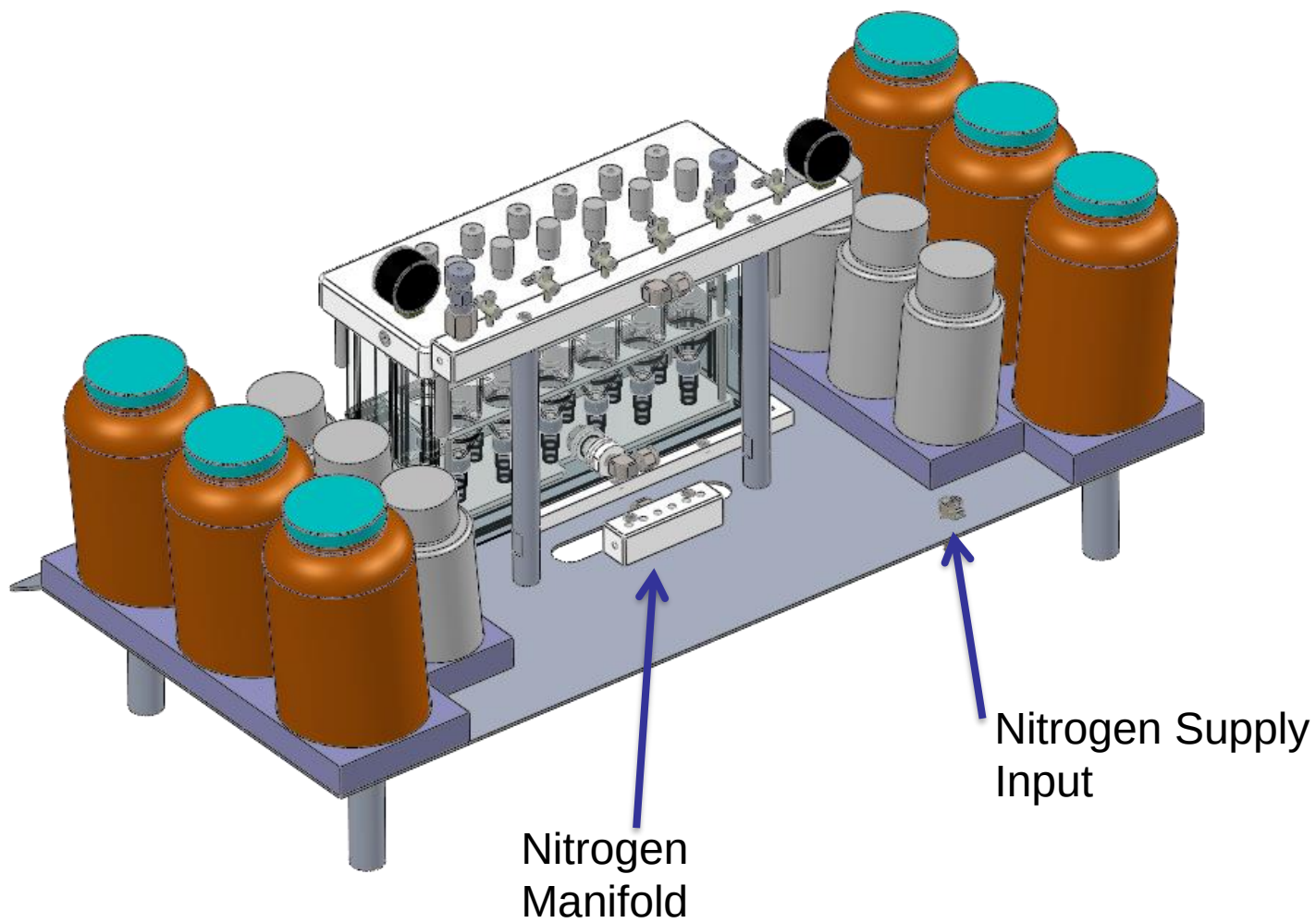




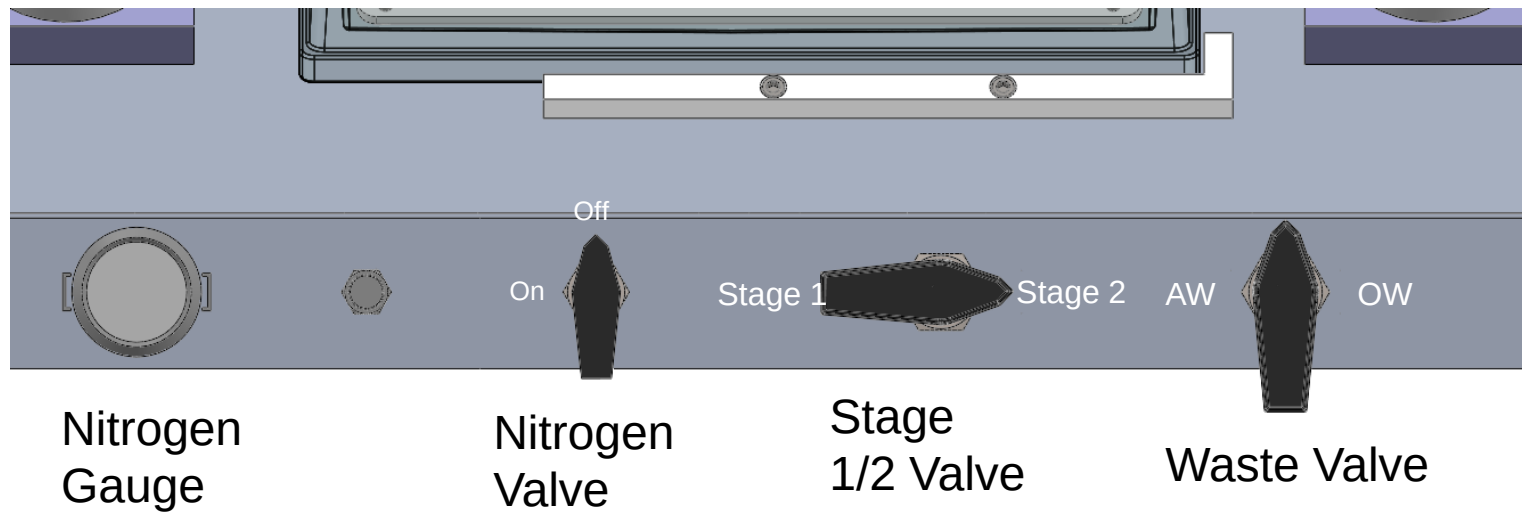
EZSpe 12 sample

System Layout

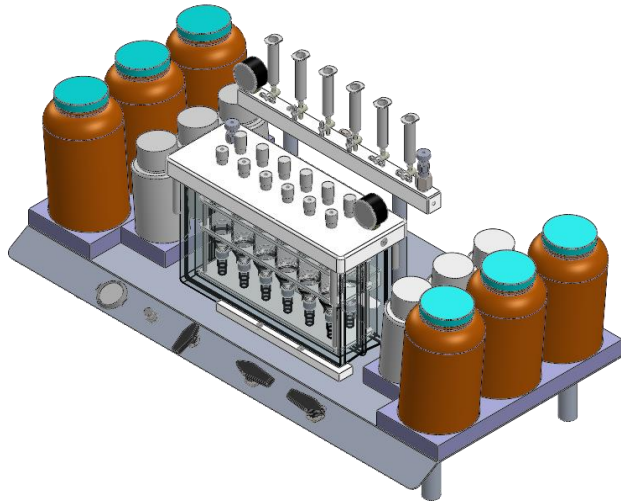




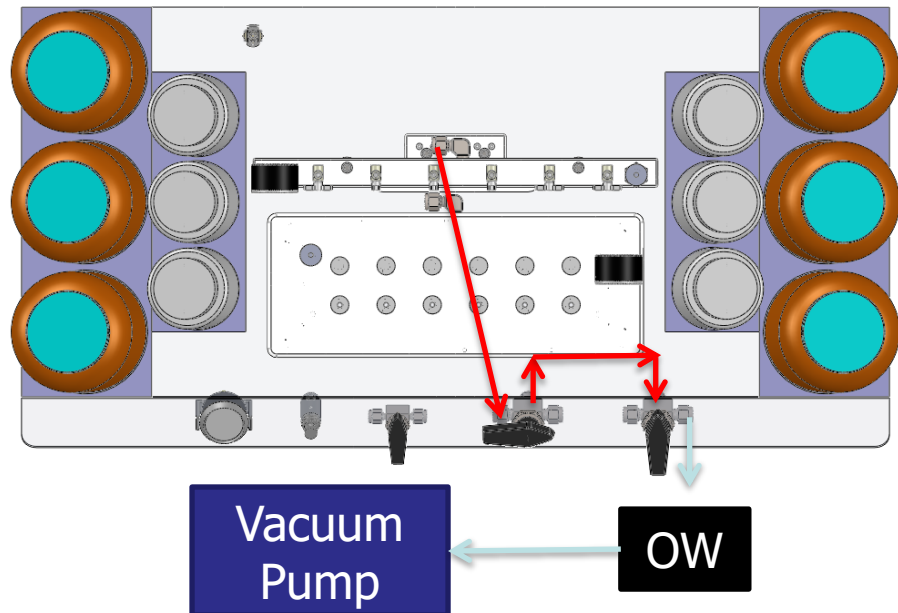
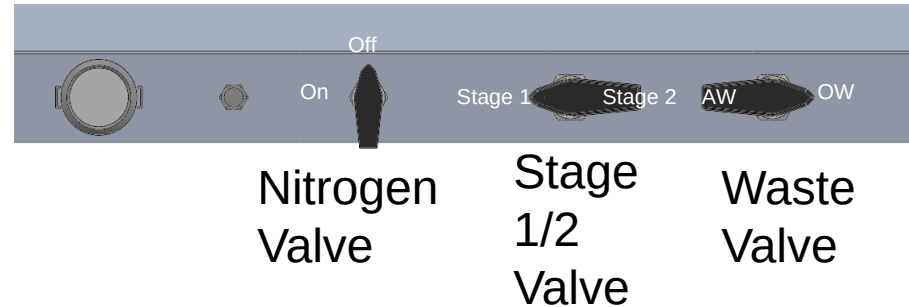
Control Valve Layout



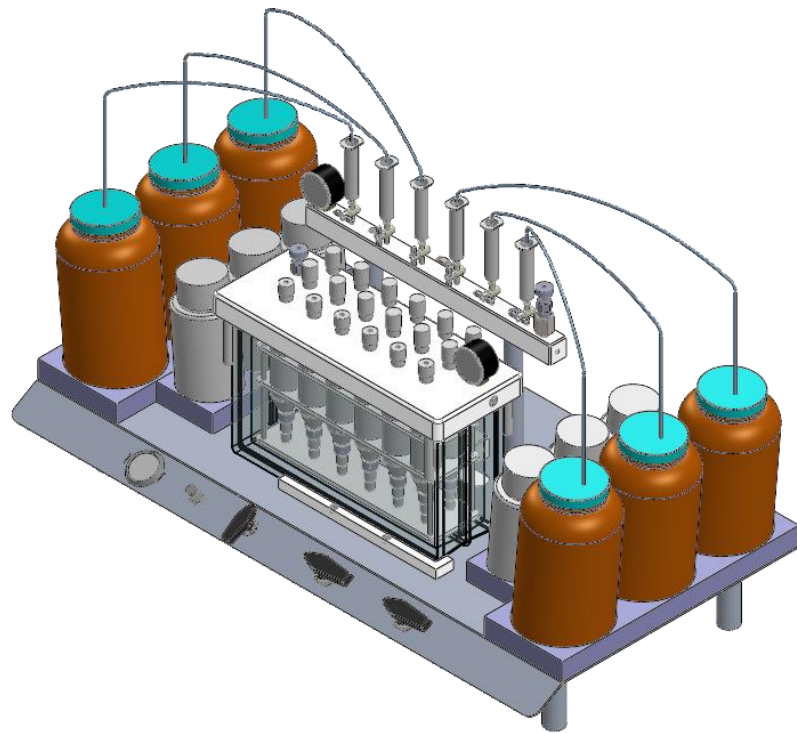
Cartridge Conditioning (Stage 1, Organic Waste)



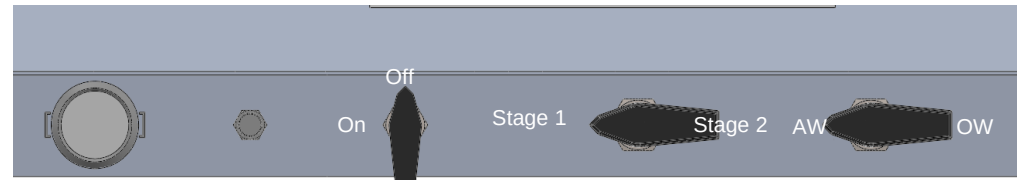
Flow
Path



Sample Loading (Stage 1, Aqueous Waste)



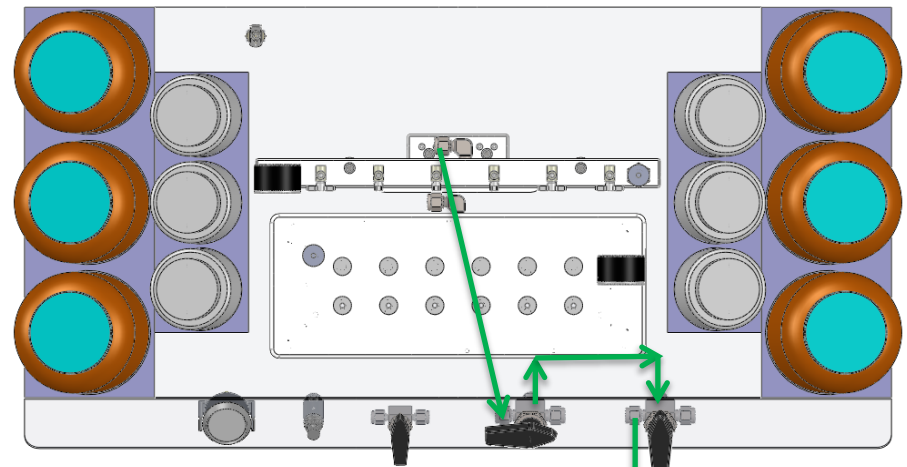
Flow
Path



Nitrogen
Valve

Stage
1/2
Valve

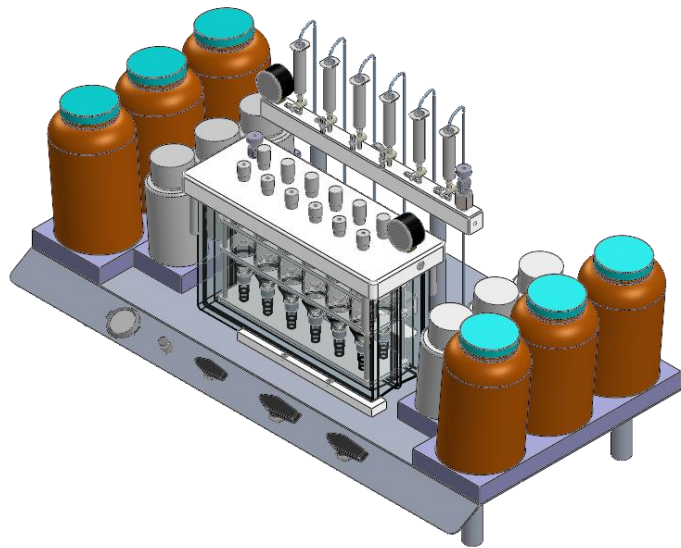
Waste
Valve



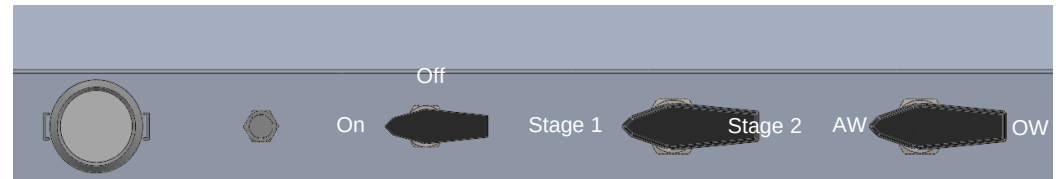
Vacuum
Pump

AW

Cartridge Drying- Nitrogen/Vacuum



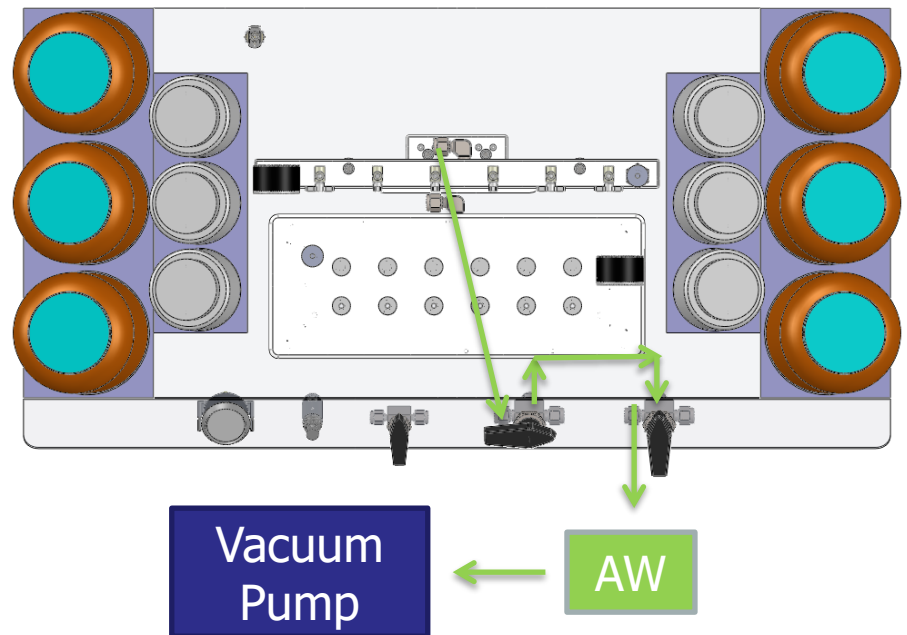
Flow
Path



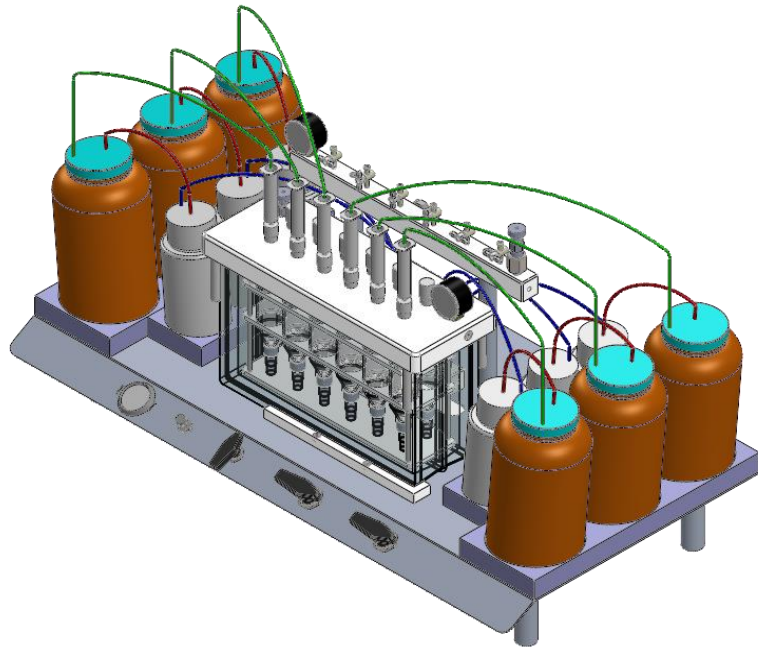
Nitrogen
Valve

Stage
1/2
Valve

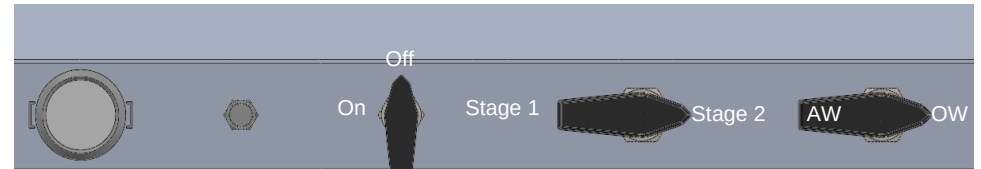
Waste
Valve



Sample Elution (Stage 2)



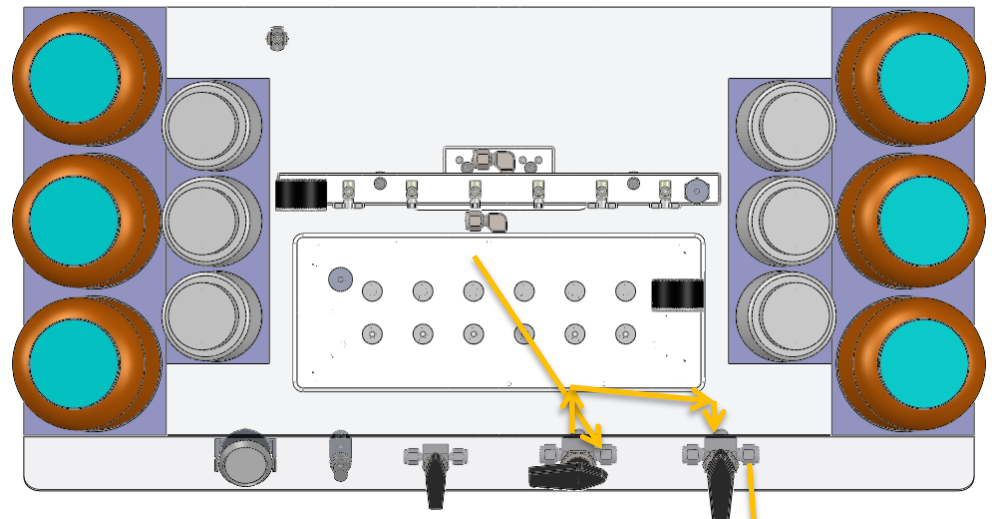
Flow
Path



Nitrogen
Valve

Stage
1/2
Valve

Waste
Valve



Vacuum
Pump

OW

Summary

- **Fully Automated Semi-Volatile extractions for various compound classes**
- **Excellent recoveries**
- **Method validated (five year US-based study), can be used internationally**
- **Can use many brands of cartridges**
- **Excellent MDL results**

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**



- **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**



Questions?

