



interchim®

INTERFINE CHEMICALS

ANALYTICAL SCIENCES

BIOCHROMATOGRAPHY

LIFE SCIENCES

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Sample Preparation

Solid Phase Extraction | Disks | Cartridges

Horizon Technology, Inc. | Salem, NH USA

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Extraction Techniques

Water Sample

LLE

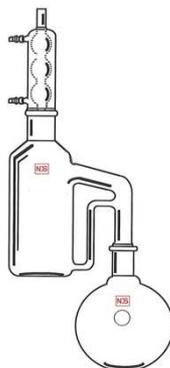
SPE

Sep funnel

Continuous

Manual

Automated



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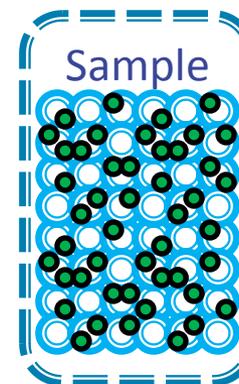


Extraction – The Basics

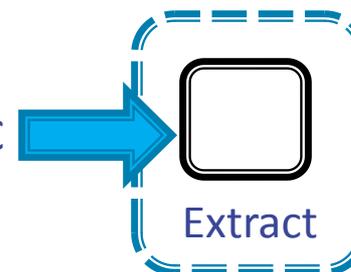
Extracting the analytes (green dots) from the matrix (blue dots)

Common types of extraction:

- Liquid Liquid Extraction
- Solid Phase Extraction
 - Cartridge
 - Disk
 - SPME
 - Stir-bar
 - Others



Analyzed by GC or LC

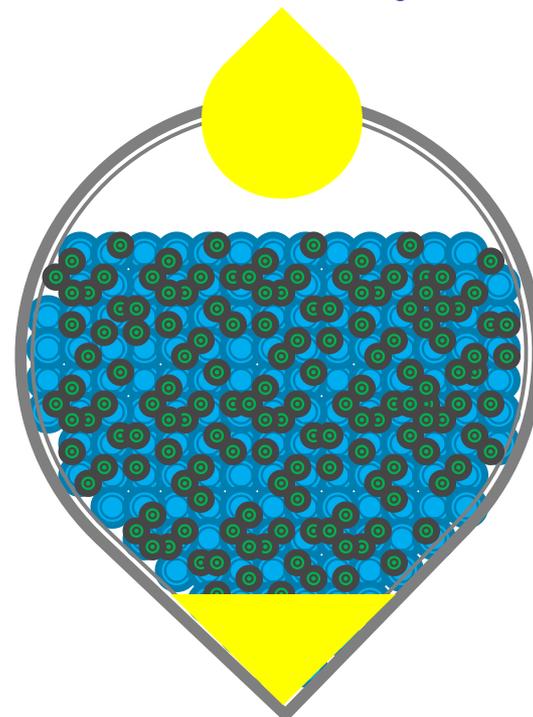


Liquid-Liquid Extractions

Separatory Funnel

Simple Process - solubility

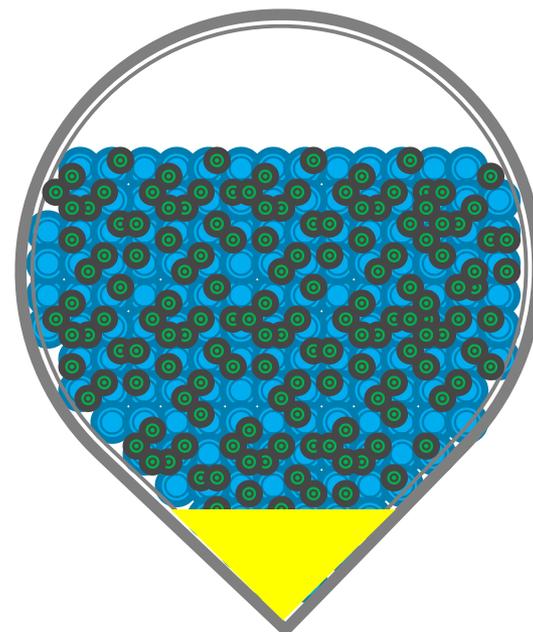
- Yellow is **Solvent**
- Blue is water - **Sample**
- Green - **Analytes** of interest
- Analytes are soluble in the **Solvent**



Liquid-Liquid Extractions

Separatory Funnel

- ▶ Shaking increases exposure of water and compounds of interest to the solvent
- ▶ Goal of extraction is to partition all of the solvent soluble material out of the water



Liquid-Liquid Extractions

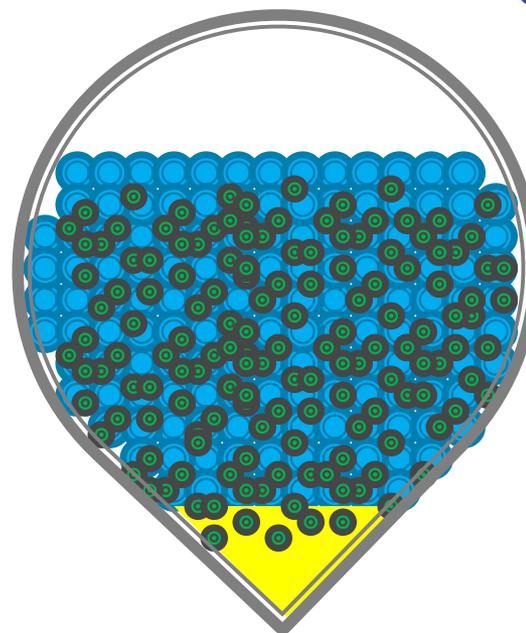
Separatory Funnel

Strengths

- Simple process
- Relatively inexpensive
- Easy & well understood

Weaknesses

- Labor intensive
 - Best case – 4 man hours to extract 20 samples
- Solvent intensive
 - Cost to buy
 - Cost to dispose of
 - Environmental impact
- Incomplete extraction in some cases
- Emulsions; low recoveries
- Safety - exposure to solvent, repetitive movements, and glassware
- Quality - subject to human error

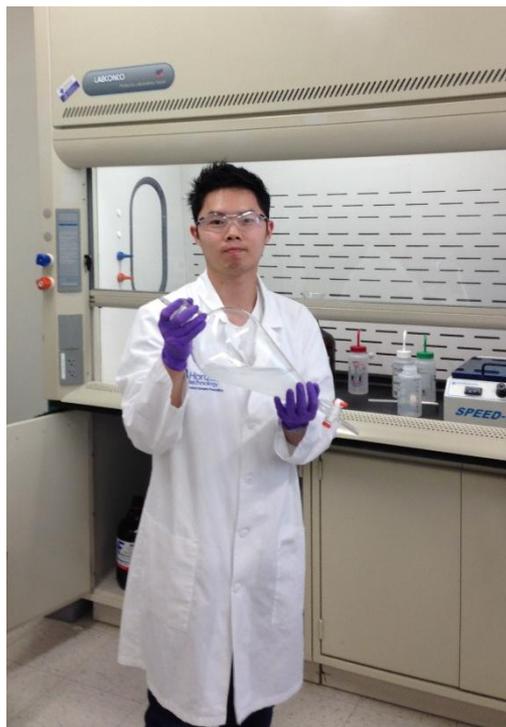


Liquid-Liquid Extractions

Separatory Funnel



(1) Adding Solvent to Separatory Funnel



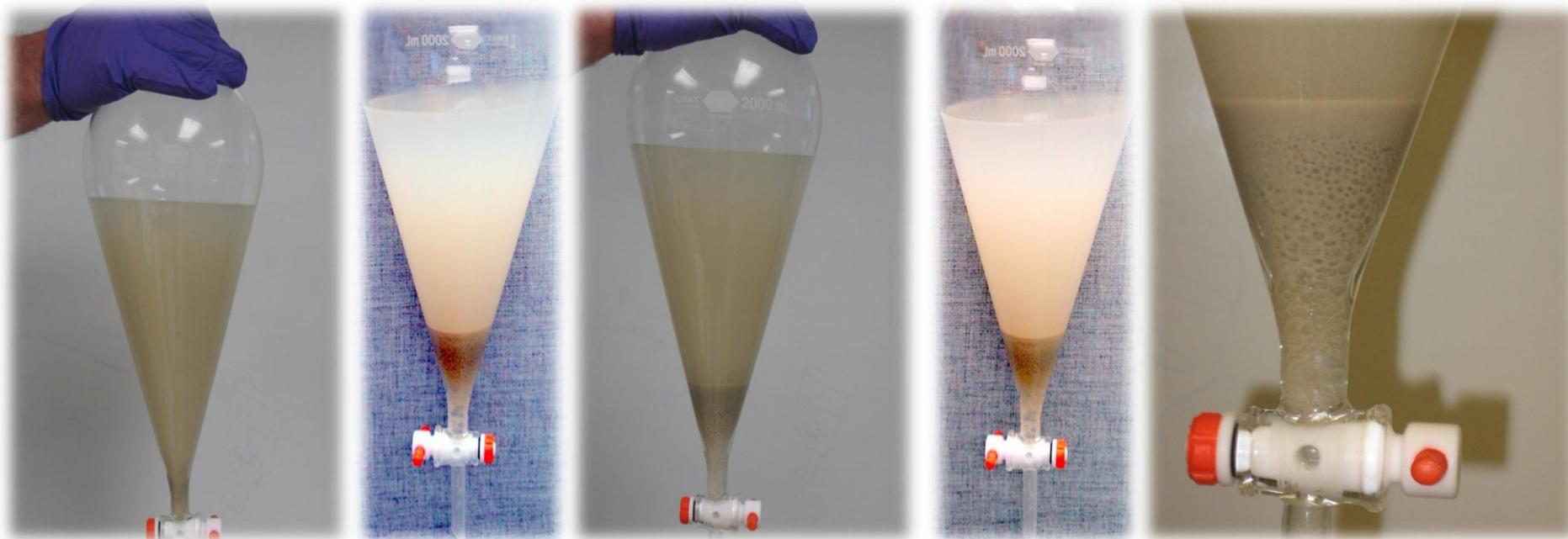
(2) Shaking Separatory Funnel



(3) Waiting for Solvent Separation and Collection

Problems with LLE

- ▶ Labor Intensive
- ▶ High Solvent Consumption
- ▶ Time Consuming
- ▶ Glassware Breakage and Washing
- ▶ Inconsistent Recoveries
- ▶ Emulsions!!!!



Solid Phase Extraction

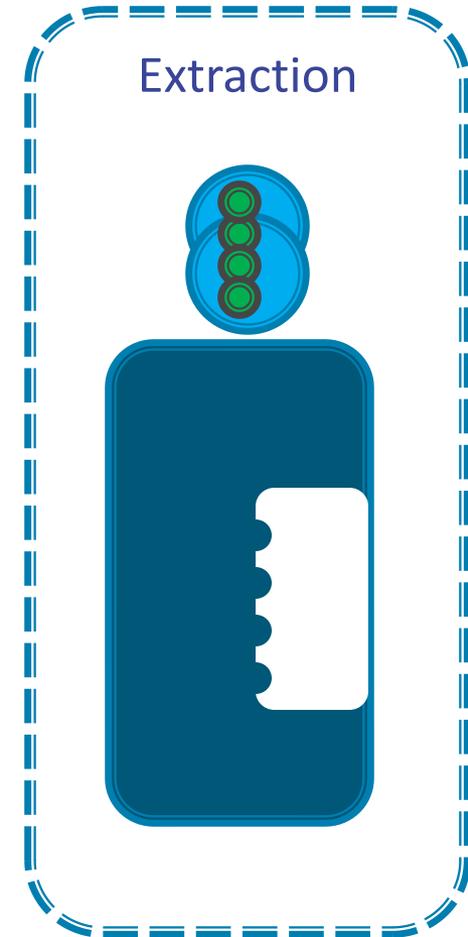
The Basics

The goal remains the same

- Separate the analytes from matrix

Process is slightly different

- Adsorb analytes from matrix onto solid sorbent material (disk, cartridge, fiber)
- Elute (extract) with small amount of solvent



Solid Phase Extraction

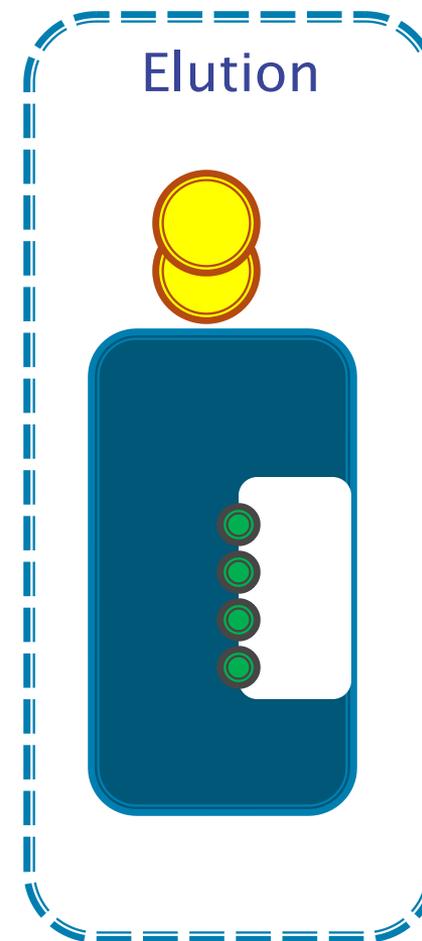
The Basics

Strengths

- Rapid
- Can be automated
- Little solvent used
- Limited exposure to solvent, glassware, repetitive movement
- Automation will remove much of the human error

Weaknesses

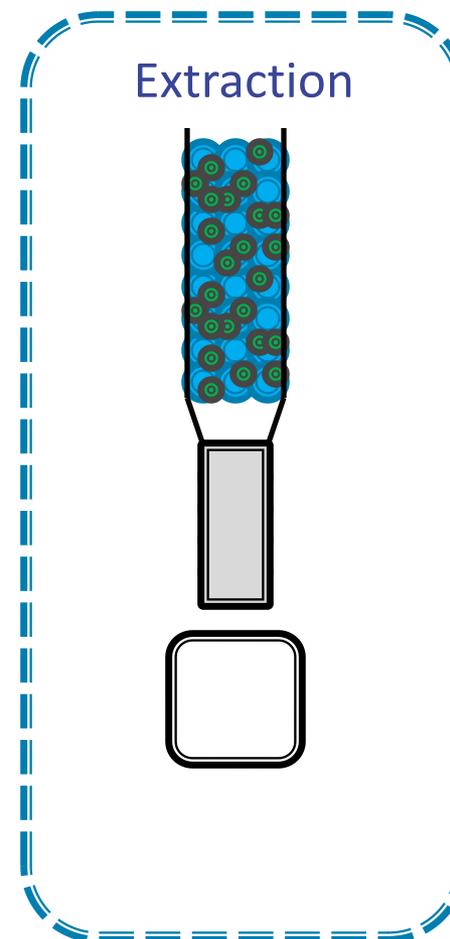
- Perceived higher costs
- Training is required
- Different – some labs fear change



Cartridge SPE

Strengths

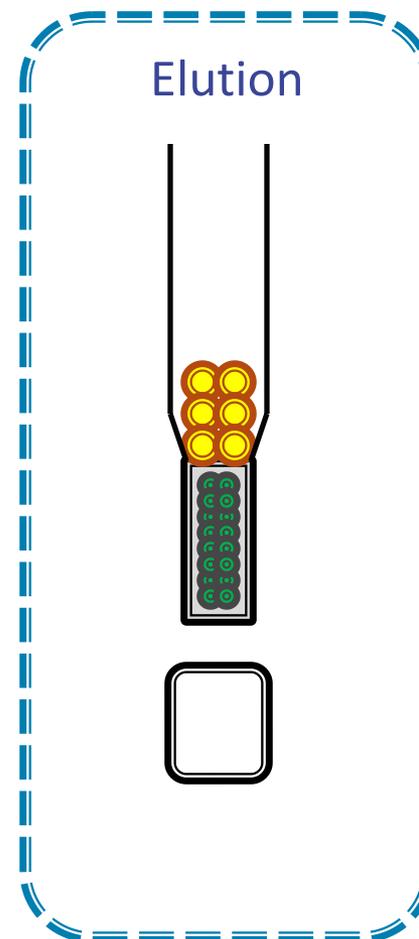
- Commonly used
- Easily automated – remove much human error
- Many consumables and accessories available
- Compact
- Very effective for small samples
- Supports parallel processing
- Little solvent used
- Limited exposure to solvent, glassware, repetitive movement



Cartridge SPE

Weaknesses

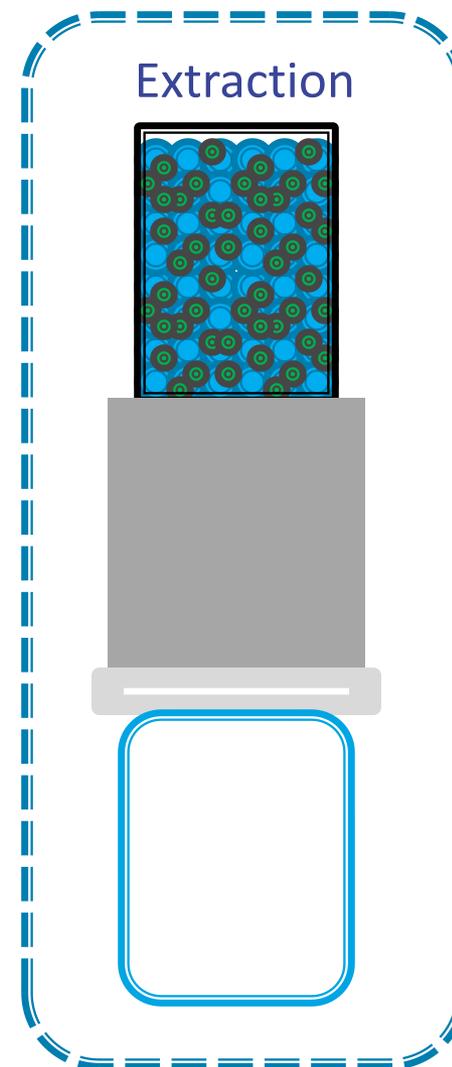
- Limited sample size
- Impossible to process particle-laden (dirty) samples
- Costs – Higher up front
- Training is required
- ‘New’ ‘Different’ – some labs fear change



Disk SPE

Strengths

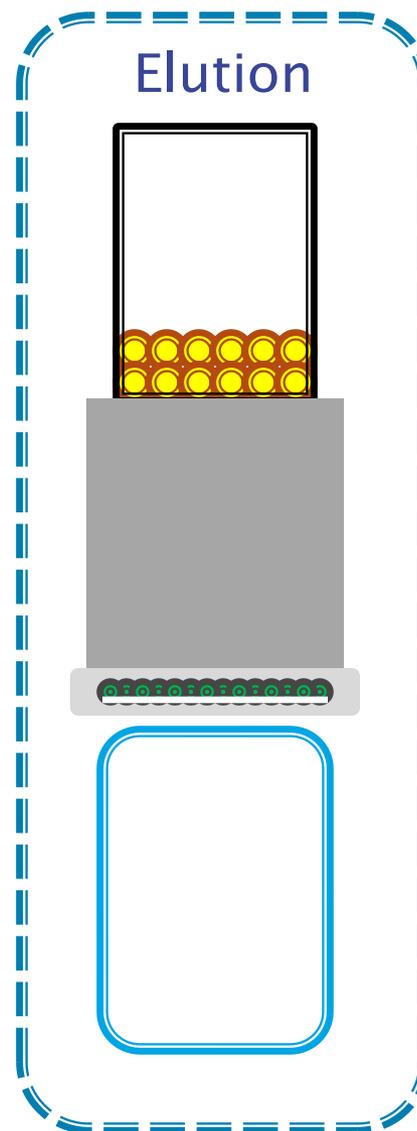
- Designed to handle large sample volumes
- Designed to completely extract all samples even those with high particulates (dirty)
- Rapid sample flow rates (> 100mL per minute)
- Easily Automated – remove human error
- Little solvent used
- Limited exposure to solvent, glassware, repetitive movement



Disk SPE

Weaknesses

- Fewer consumables and accessories are available for SPE Disks
- Costs – Higher up front
- Some training is required
- ‘New’ ‘Different’ – some labs fear change



Clean Samples (**Drinking Water**)

Disk vs. Cartridge

Environmental Water Sample

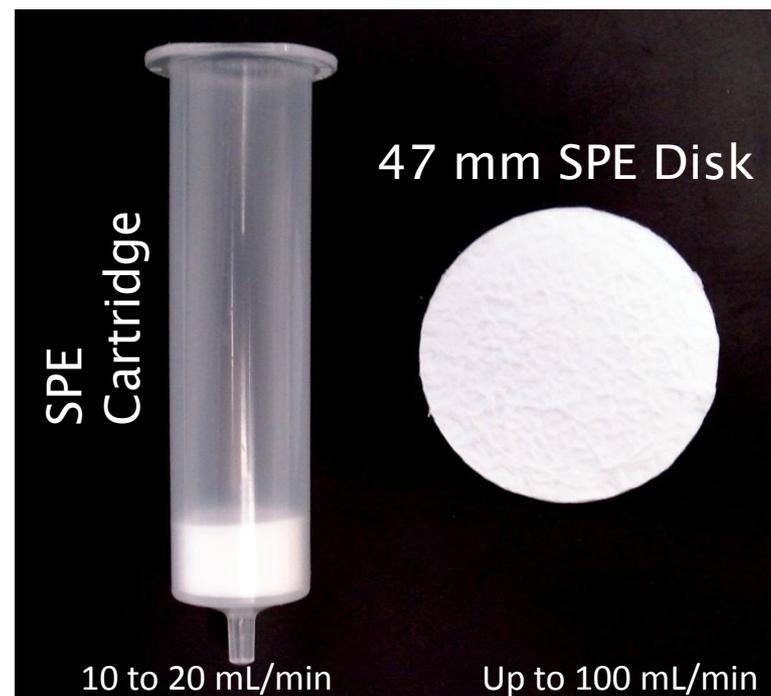
- ▶ 1 Liter water sample (**acidified** group of compounds)
- ▶ 1 Liter water sample (**basified** group of compounds)

Optimum Sample Processing Time

Cartridge: 50 min - 1 hr 40 min

Disk: **10 min**

SPE disk chosen due to faster sample processing time.



Dirty Samples (**Waste Water**)

Disk vs. Cartridge



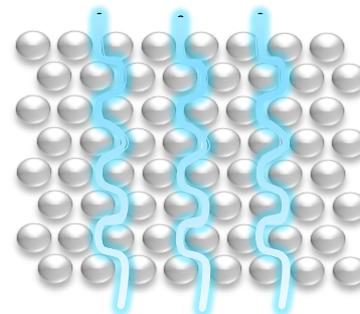
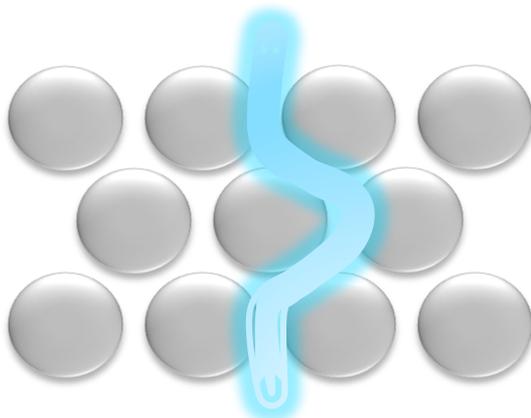
Disk Technology:

- 5 times faster sample processing of clean water samples
- The optimal technique for processing particle laden samples

Cartridges:

- Cannot process whole “dirty” samples
- Pre filtering samples has been shown to give lower recoveries
- Compounds are retained on the particles

Particle Size Cartridge vs. SPE Disk



Cartridge

Larger particles in Cartridge allows sample breakthrough if flow rates are too fast

SPE Disk

SPE Disks prevent breakthrough even with fast flow rates & no channeling

Importance of Proper Flow Rates

- ▶ Cartridges use 60 micron particles (size). This limits the flow rates to 1 – 10 mL / min. And typically reduces the sample size to 200 µL
- ▶ Low flow rates results in long sample prep times
- ▶ Higher flow rates lead to breakthrough
- ▶ Small surface area is not good for dirty samples; plugging will occur



Differences Between Cartridges & Disks

Cartridge

Flow rates must be controlled

(1 – 10 ml / min)

Low Kinetics

Breakthrough

Long time per sample

(several hours)

Limited sample volume

100 – 200 ml

Only good for clean samples



SPE Disk

Unlimited flow rates

(100 – 200 ml / min)

High Kinetics

No breakthrough

Short time per sample

(several minutes)

Large sample volume

Up to 8 liters

Can handle dirty samples



Advantages of Automated SPE



Sample preparation for most environmental labs consumes 60-80% of overall operating costs!

Automation helps to:

- ✓ Increase Productivity
- ✓ Reduce total labor costs
- ✓ Shorten sample turn-around
- ✓ Reduce the risk of sorbent drying and other common errors
- ✓ Eliminate operator variability with more consistent results
- ✓ Minimal Operator training
- ✓ Protect your analytical device investment



Commercially Available Sorbents & Packing Materials for SPE Disks



SPE Disks come in similar packing materials as SPE Cartridges for a wide range of applications:

- ✓ C8 – Octyl
- ✓ C-18 – Octadecyl
- ✓ SDB – Styrene Divinyl Benzene
- ✓ DVB – Hydrophobic
- ✓ DVB – Hydrophilic
- ✓ HLB – Hydrophilic-Lipophilic Balanced
- ✓ Oil & Grease
- ✓ Anion Exchange
- ✓ Chelating
- ✓ Activated Carbon



Atlantic® SPE Disks

Semi-Volatile Organics



5 Universal Sorbents (47 mm)

- ▶ C-18 Disks
- ▶ High Capacity C-18 Disks
- ▶ DVB
- ▶ SVOC Disk – 8270 One Pass
- ▶ HLB Disk (Hydrophillic-Lipophillic)
 - 3 Capacities Offered:



HLB-H - *High*

HLB-M - *Medium*

HLB-L - *Low*

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Why Atlantic® SPE Disks?



Prefilter on top for
dirty samples

Cross Section of Atlantic Disk
Prefilter around chemical sorbent

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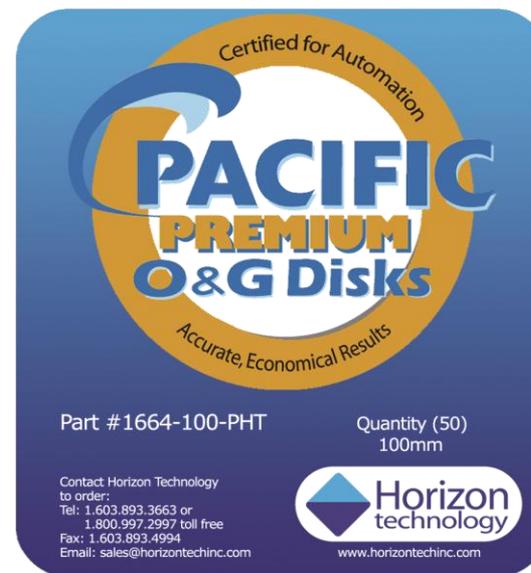


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Atlantic & Pacific Disks Certified for Automation



- ▶ Designed and tested to work with Horizon Automated SPE equipment
- ▶ Each lot is QC tested and guaranteed for quality results
 - ✓ Request for single lot orders supported
- ▶ Eliminate re-extraction and re-sampling issues



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