The Applications of Empore™ Membrane SPE for LC mobile Phase Clean-up

May 6, 2020

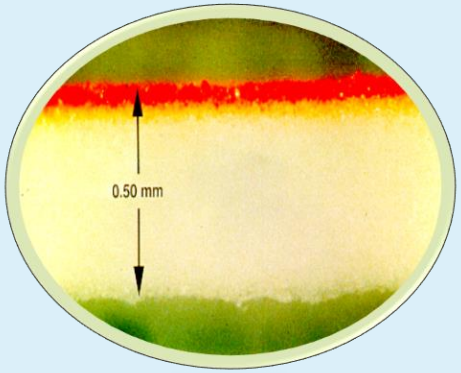
CDS Analytical

Outline

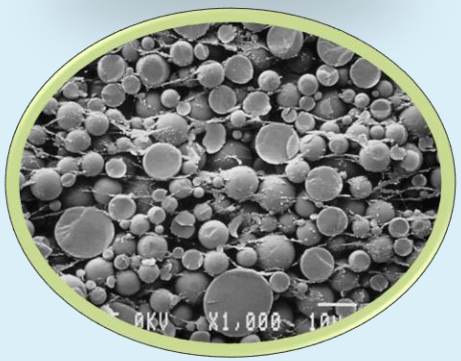
1. Empore SPE Introduction
2. Application in LC Mobile Phase Clean-up

Empore™ Technology Highlights

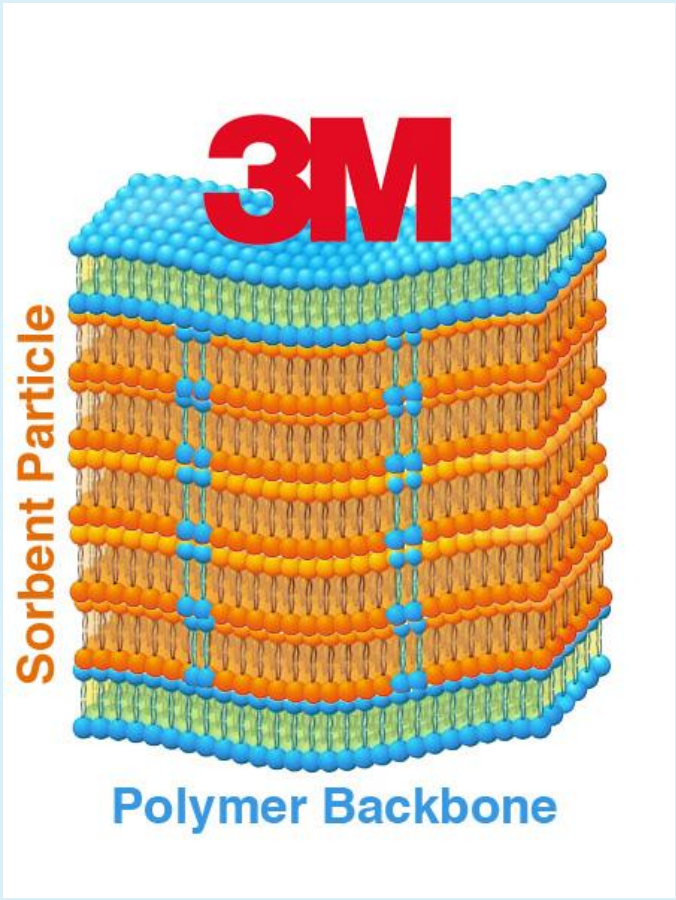
- 3M™ patented SPE particle-loaded membrane

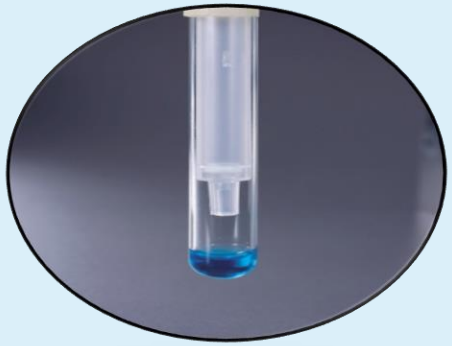


- Best Uniformity

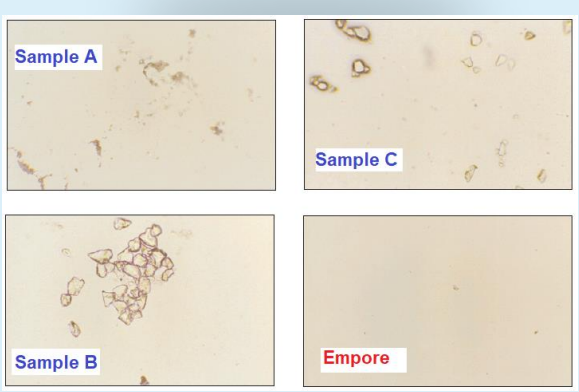


- High Density



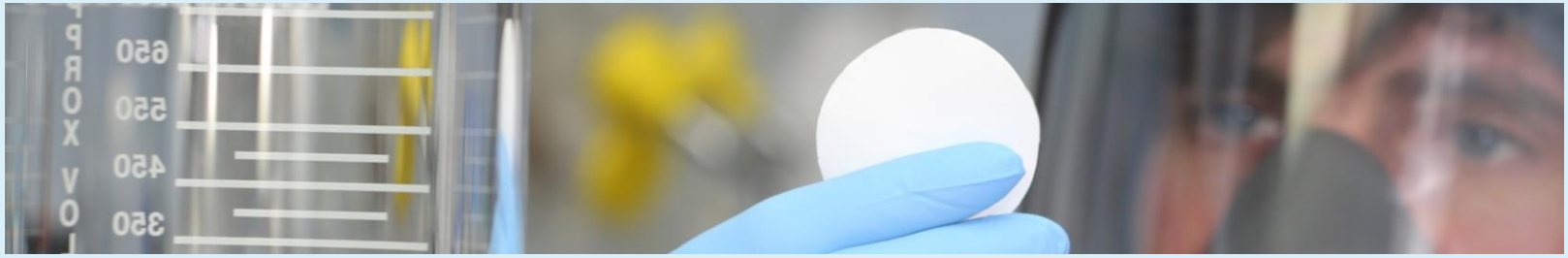


- Least Elution Volume



- Reduce Particle Fines

Empore™ Portfolio



- **Empore™ by Package Style**
  - **Disks**
  - **Cartridges**
  - **Plates**
  - **StageTips**

- **Empore™ by Sorbent Style**

Reverses Phases: C8, C18, UR, SDB-XC, Activated Carbon, Oil & Grease

Mixed Phases: MPC, UR, SDB-RPS

Ion Exchange: Cation, Anion, Chelating, SDB-RPS

Empore™ Unique Features

- **Ultra-fast flow rate up to 700ml/min – 2X faster than other leading brands**
- **Least elution volume – 1/3 of other leading brands and 1/10 of loose-packed SPE**
- **Highest consistency & reproducibility – 10-15% higher than Waters Oasis plates**
- **Least particle fines in eluates -1/10 of other leading brands to increase efficiency (reducing tube clogging & system downtime)**

Recommended in Dozens of EPA Methods:

1664 (Rev. A)	- N- Hexane Extrachable Material (HEM; Oil and Grease)
506	- Phthalate and Adipate Esters in Drinking Water
507	- Nitrogen- and Phosphorous-Containing Pesticides in Water
508.1	- Chlorinated Pesticides, Herbicides, and Organohalides in Water
512.2	- Chlorinated Acids in Water
525.3	- Organic Compounds in Drinking Water
549.1	- Diquat and Paraquat in Drinking Water
550.1	- Polycyclic Aromatic Hydrocarbons in Drinking Water
552.1	- Haloacetic Acids and Dalapon in Drinking Water
553	- Benzidines and Nitrogen-Containing Pesticides in Water
1613 (Rev. B)	- Tetra-Through Octa- Chlorinated Dioxins and Furans by Isotope Dilution e.g. in Water
SW846 method 3535	– Test Methods for TCLP Leachates
QTM	– Aqueous Phases Quick Turnaround Methods
	- PAH
	- Phenols
	- Pesticides & PCBs

Typical Customers:

- **Environmental**

- **Food and Agricultural**

- **Pharmaceutical/Clinical**

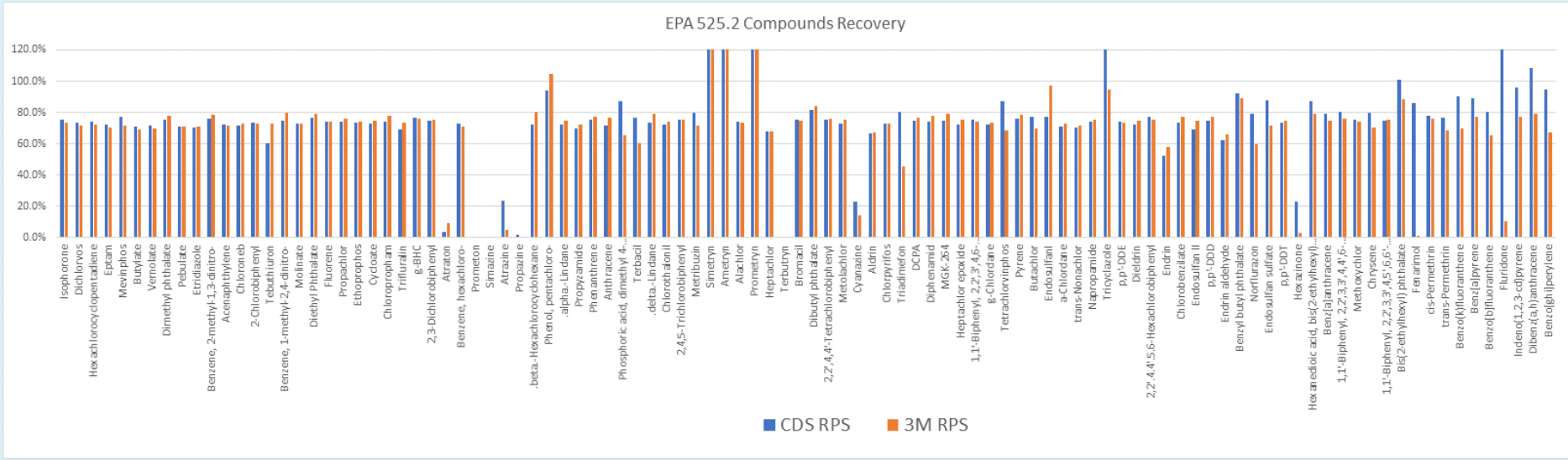
- **Research**

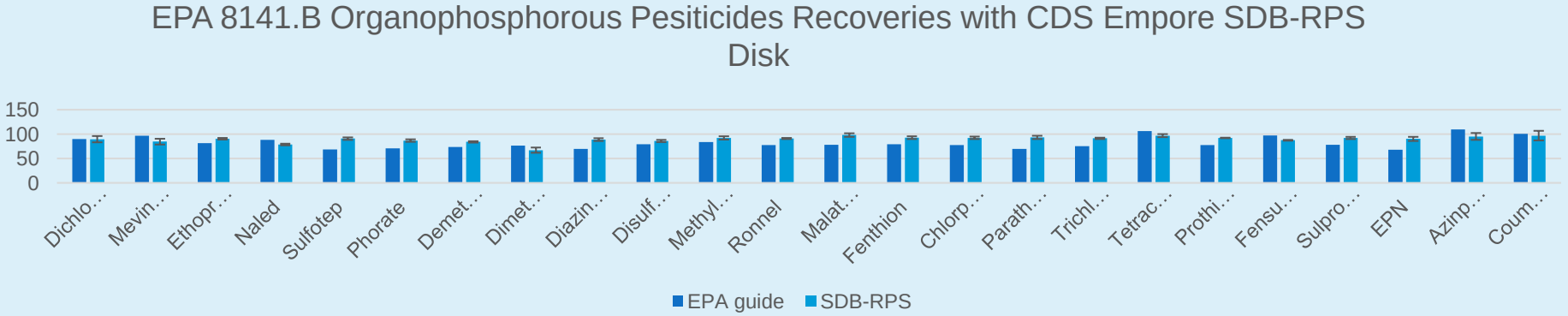
CDS has rebuilt Empore production line in a new-construct, GMP-compliant, clean room facility at Oxford, PA.

Empore production line at 3M

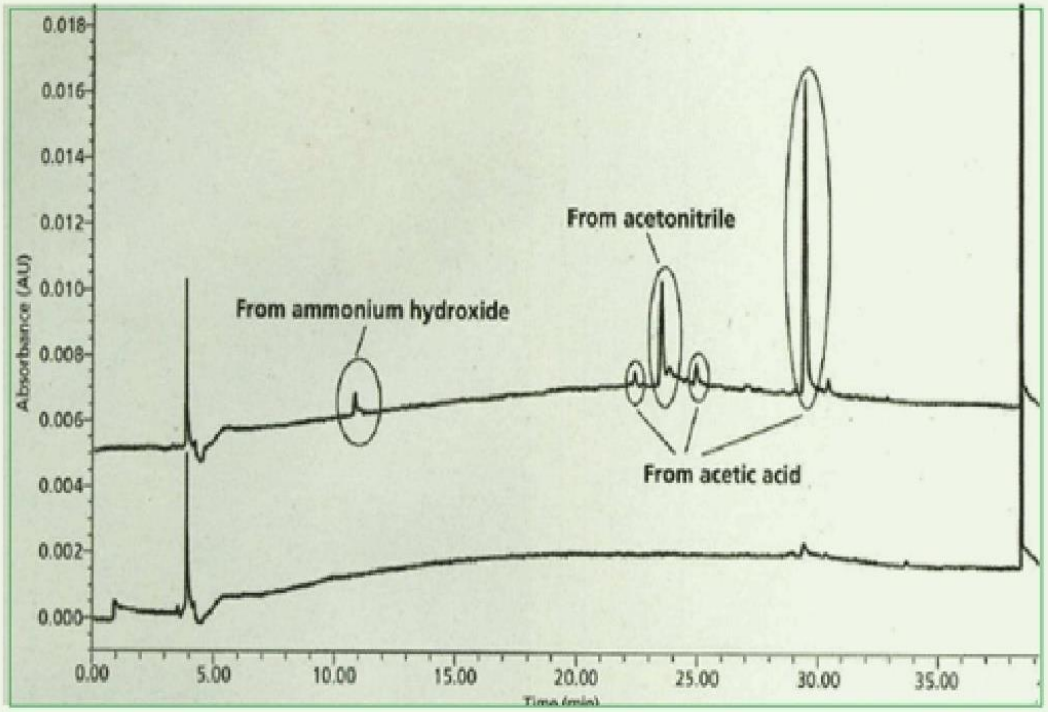
Empore new production line at CDS

Empore Disks with Improved Quality at CDS than at 3M





Part 2. Application in LC Mobile Phase Clean-up



- **Ghost peaks or contaminant peaks sources:**
- **airborne plasticizers particles, organics, colloids, ions, impure additives, dissolved gases, organic solvent impurities, accidental contamination from pH meters and laboratory glassware, plasticware, etc.**

Comparison of Different Clean-up Methods

Mobile phase treament	Advantages	Disadvantages
SPE cartridge (off-line)	remove both non-polar and polar contaminants	time-consuming, small volumes, channeling and cavitation-casued inconsistency. Subsequent contamination from airborne plasticizers, dust, and microbes
Empore disks (off-line)	fast, consistent, effectiveness	need to use combined disks to remove both polar and non-polar contaminants.
PDMS SBSE (off-line or in-line)	simple, continueously	small volume, special devices.
TFC Trap (SDB or C18, in-line)	good capacity	system contamination, inconvenient operation
DS micro-column (in-line)	compatible with HPLC and UPLC system	limited capacity, contaminant breakthrough
C18 semi-prep column (recirculating)	remove 95% contaminant. High capacity	extra system, high cost of prep columns

SBSE: Stir-Bar Sorptive Extraction; TFC: Turbulent Flow Chromatography

GSK Application Case: SDB-XC Disks for Mobile Phase Clean-up

4 Methods at Different pH Conditions

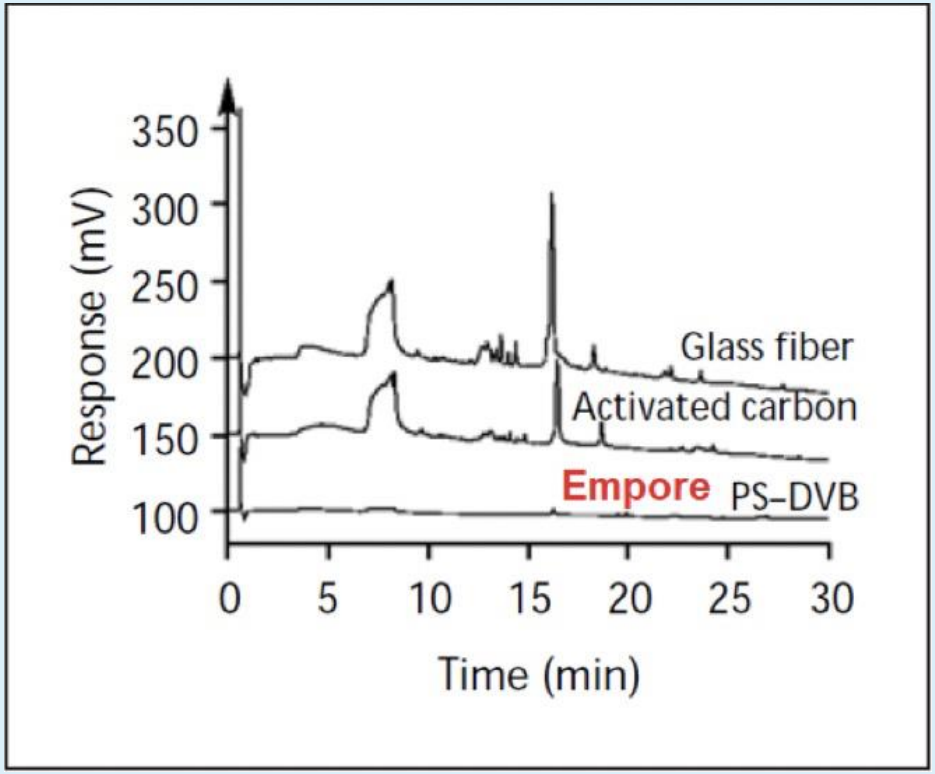
Table I: Summary of HPLC gradient methods used in investigation

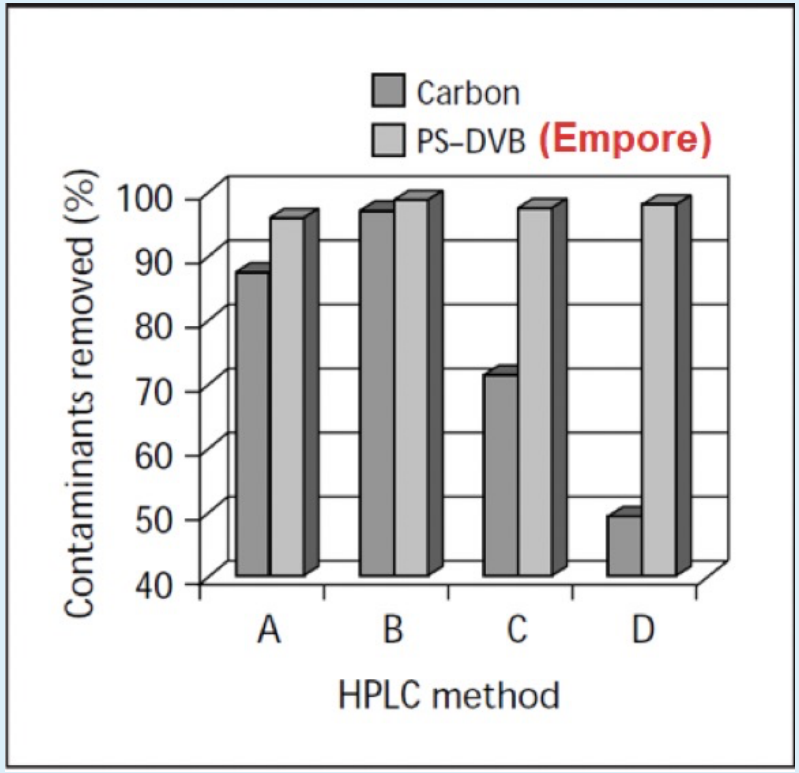
	Gradient*						
Method	Aqueous Component	Mobile Phase A (v/v Aqueous–Acetonitrile)	Mobile Phase B (v/v Aqueous–Acetonitrile)	Time (min)	% B	Column	Flow Rate (mL/min)	UV Detection Wavelength (nm)
Method A	0.044% Trifluoroacetic acid (pH 2.3)	90:10	5:95	0; 3.4; 10	10; 13; 85	100 mm × 4.6 mm, 3.5-µm d_p Waters Symmetry C18	1.5	226
Method B	0.05 M monobasic ammonium phosphate (pH 2.9)	70:30	22:78	0; 60	0; 100	250 × 4.6 mm, 5-µm d_p Inertsil ODS2	1.0	228
Method C	0.05 M monobasic potassium phosphate (pH 7.1)	98:2	78:22	0; 10; 15	0; 100; 100	100 mm × 4.6 mm, 3-µm d_p Hypersil HyPurity Elite C18	1.5	230
Method D	0.020 M ammonium acetate (pH 10.0)	95:5	5:95	0; 2; 32	0; 0; 100	100 mm × 4.6 mm, 3.5-µm d_p Waters Xterra MS C18	2.0	282

*The gradient program could include high-organic solvent flush and reequilibration steps that are not shown.

- **M. Ringo, J. Allen, and D. Mattocks, *LCGC North Am*. 21, 167–170 (2003).**

Empore SDB-XC Disk has the best performance on all 4 testing conditions than other clean-up methods

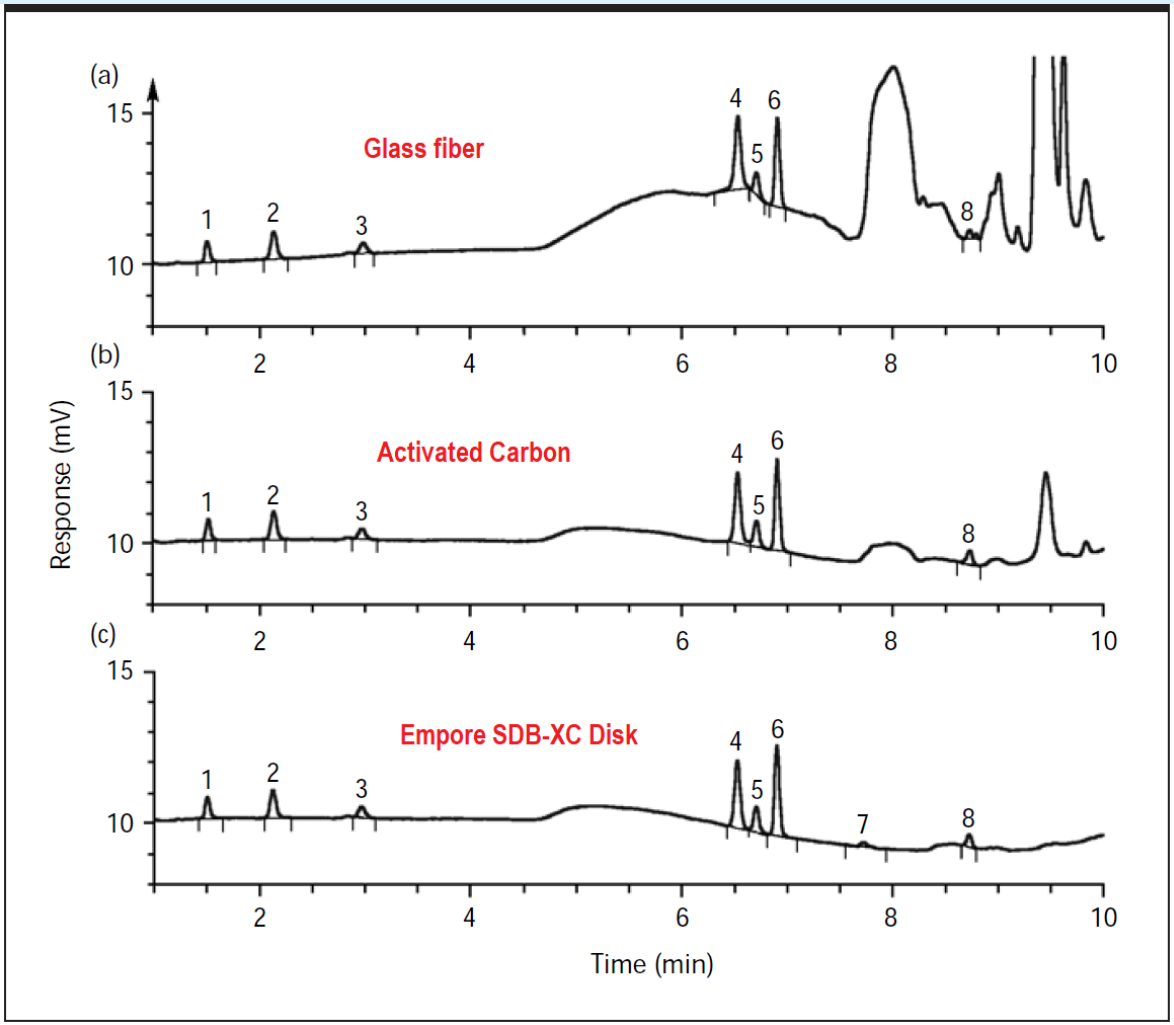




- M. Ringo, J. Allen, and D. Mattocks, *LCGC North Am*. 21, 167–170 (2003).

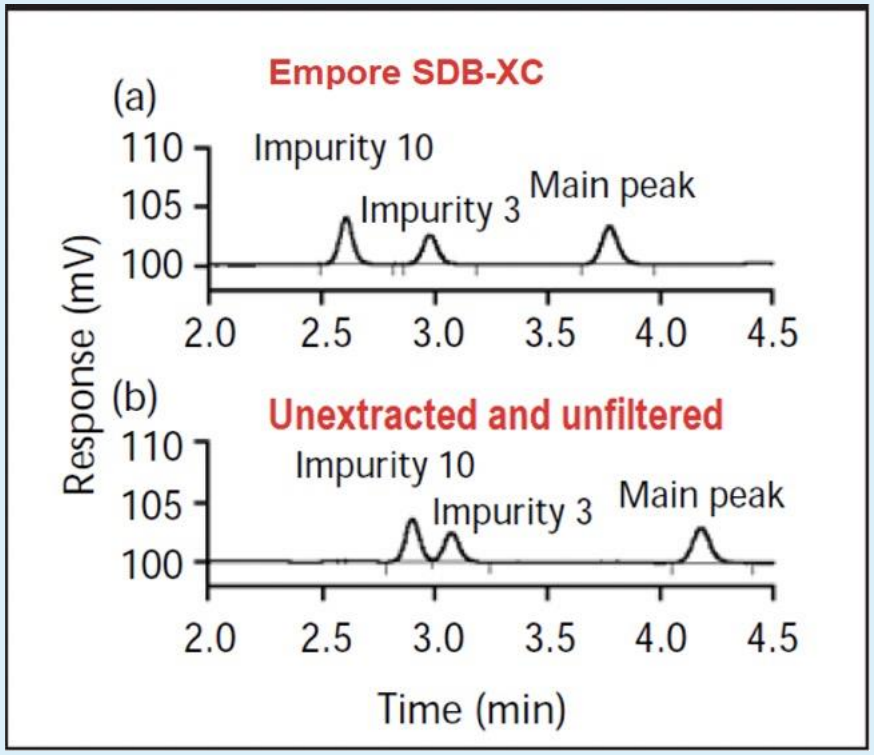
Effect on the system suitability:

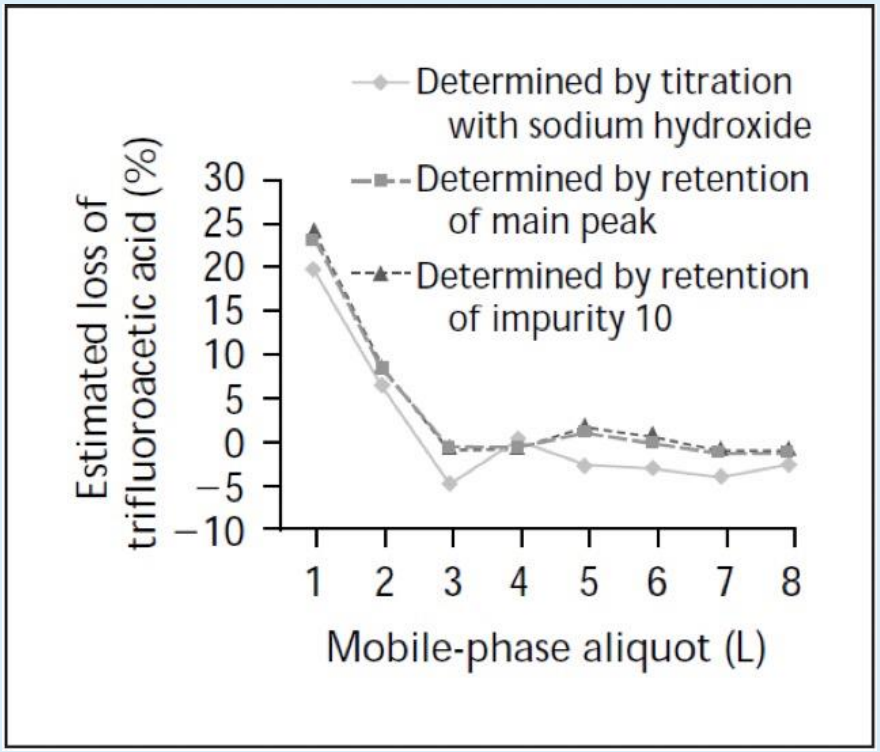
Empore disks can selectively remove typical mobile phase contaminants and don't affect the target analytes' retention times and resolutions.



- M. Ringo, J. Allen, and D. Mattocks, *LCGC North Am*. 21, 167–170 (2003).

Trifluoroacetic acid removal by Empore disks: passive adsorption. Will affect analytes' retention times and resolutions.





- M. Ringo, J. Allen, and D. Mattocks, *LCGC North Am*. 21, 167–170 (2003).

Method to Compensate TFA Removal by Empore SDB-XC Disk:

2 L of dilute trifluoroacetic acid (0.044%) might be necessary to equilibrate the SDB-XC disk before use for systems that are sensitive to trifluoroacetic acid concentration.

Biopharmaceutical Company Customers:

remdesivir

GILEAD

Empore™ C18, SDB-RPS and Carbon Disks for in-house LC-mobile phase clean-up.

Summary

Empore membrane technique is a powerful tool for LC mobile phase clean-up to improve HPLC method development efficiency.