

High Recoveries of Phenols from Water with the New Polymeric SPE Sorbent – strata™ X

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Phenol and substituted phenols are small polar organic molecules with low log k_w values. These chemicals have a wide range of industrial applications ranging from the production of adhesives to serving as intermediates in numerous synthetic processes. Due to their wide usage, water and soil samples are routinely monitored to detect for their presence as contaminants. The chemical nature of phenols makes their extraction from water a significant challenge in environmental analysis.

This application demonstrates a Solid Phase Extraction (SPE) method that uses strata-X to extract and concentrate phenols from water. strata-X is an innovative, patent-pending polymeric SPE sorbent developed by Phenomenex. With a surface area of $>800\text{m}^2/\text{g}$, strata-X has a higher capacity for polar solutes than silica-based C18 or C8 SPE sorbents. The functionalized styrene-divinylbenzene surface of strata-X has numerous retention mechanisms, including π - π and hydrophilic interactions that yield high recoveries for a wide range of compounds, including phenols from water. These unique surface properties give strata-X a significant advantage when compared with unmodified styrene-divinylbenzene (SDB), which is typically used in extracting organic molecules from water.¹

Instrumentation and Equipment

Solid Phase Extraction

strata-X 500mg/6mL syringe-barrel cartridges were used. Multiple SPE cartridges were processed simultaneously with a 12-position SPE vacuum manifold supplied by Phenomenex. The sample was continuously drawn through the cartridge using the apparatus shown in **Figure 1**.

Gas Chromatography

The samples were analyzed using an HP 6890N GC system (Agilent Technologies, Palo Alto, CA) equipped with the HP 5973 Mass Selective Detector (MSD). The GC column was a Phenomenex Zebron ZB-5 (30.0m x 0.25mm x 0.25mm). The data was analyzed with HP ChemStation software.

Experimental Conditions

Specimen Preparation

A 500mL water sample spiked with the target compounds (concentration range of 30-75ppm) was acidified with glacial acetic acid (pH = 3.5).

SPE Extraction Method

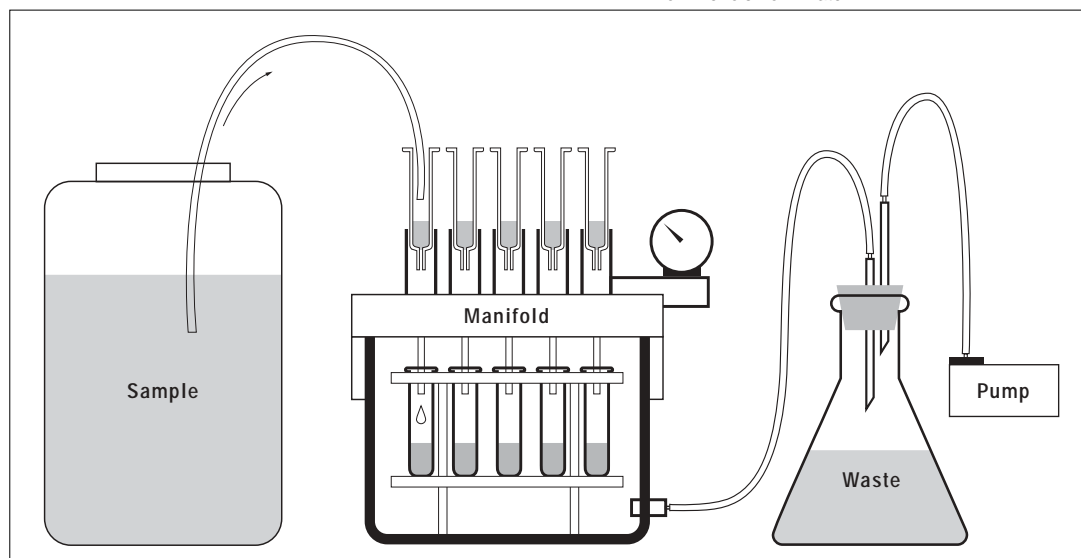
Condition: The strata-X cartridge was conditioned with 5mL methanol, followed by 5mL of DI water.

Load: The 500mL sample was continually loaded onto the column at a rate of 10mL/min using the vacuum manifold apparatus as shown in **Figure 1**.

Elution: The compounds were eluted with 5mL acetone, followed by 5mL of methylene chloride. All elution solvents were collected in a single test tube.

Figure 1.

Schematic of Apparatus used in the Extraction of Phenols from Water.



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Analysis

Extracts were dried using anhydrous sodium sulfate and concentrated to 0.5mL.

GC Experimental Conditions: 1mL of sample was injected at 250°C in 11:1 split ratio. The initial oven temperature was set at 40°C and held for 3 min. The temperature was ramped to 325°C at 9°C/min (held for 2 minutes at final temperature). The flow rate of helium was 1.2mL/min.

Conclusion

As shown in **Table 1**, strata-X successfully extracted low concentration levels (ppm) of phenols from water with recoveries of >90%. To illustrate the higher retention capacity of strata-X, percent recoveries using strata-X are compared with those using SDB. In all cases, the recoveries of these polar organic compounds are higher when strata-X was used in the extraction. In particular, the retention of phenol and 2-fluorophenol is significantly improved on the functionalized polymer. The versatility and selectivity of strata-X make it a powerful tool in the extraction and concentration of polar and nonpolar compounds from water.

¹Reference

Solid Phase Extraction Principles and Practice

by Thurman and Mills, John Wiley & Sons, 1998, pages 189-190

Ordering Information

Order Number	Description
8B-S100-TAK-AP1-X	strata-X Tubes (30mg/1mL)
8B-S100-UBJ-AP1-X	strata-X Tubes (60mg/3mL)
8B-S100-ECH-AP1-X	strata-X Tubes (100mg/6mL)
8B-S100-FCH-AP1-X	strata-X Tubes (200mg/6mL)
8B-S100-HCH-AP1-X	strata-X Tubes (500mg/6mL)
8E-S100-AGB-AP1-X	strata-X 96-Well Plate (10mg/well)
8E-S100-TGB-AP1-X	strata-X 96-Well Plate (30mg/well)
AH0-7191-AP1-X	Adapter Cap for 1, 3 and 6mL Tubes
AH0-6023-AP1-X	12-Position Vacuum Manifold
AH0-6024-AP1-X	24-Position Vacuum Manifold

Table 1. Average % recoveries of phenols from water

Compound	% Recovery using strata-X	% Recovery using SDB
Phenol	95	16
2,4,6-tribromophenol	101	79
2-fluorophenol	95	27
2-chlorophenol	97	83
2,4,6-trichlorophenol	102	93
2-nitrophenol	103	92
2,4-dinitrophenol	97	81
o-cresol	101	78