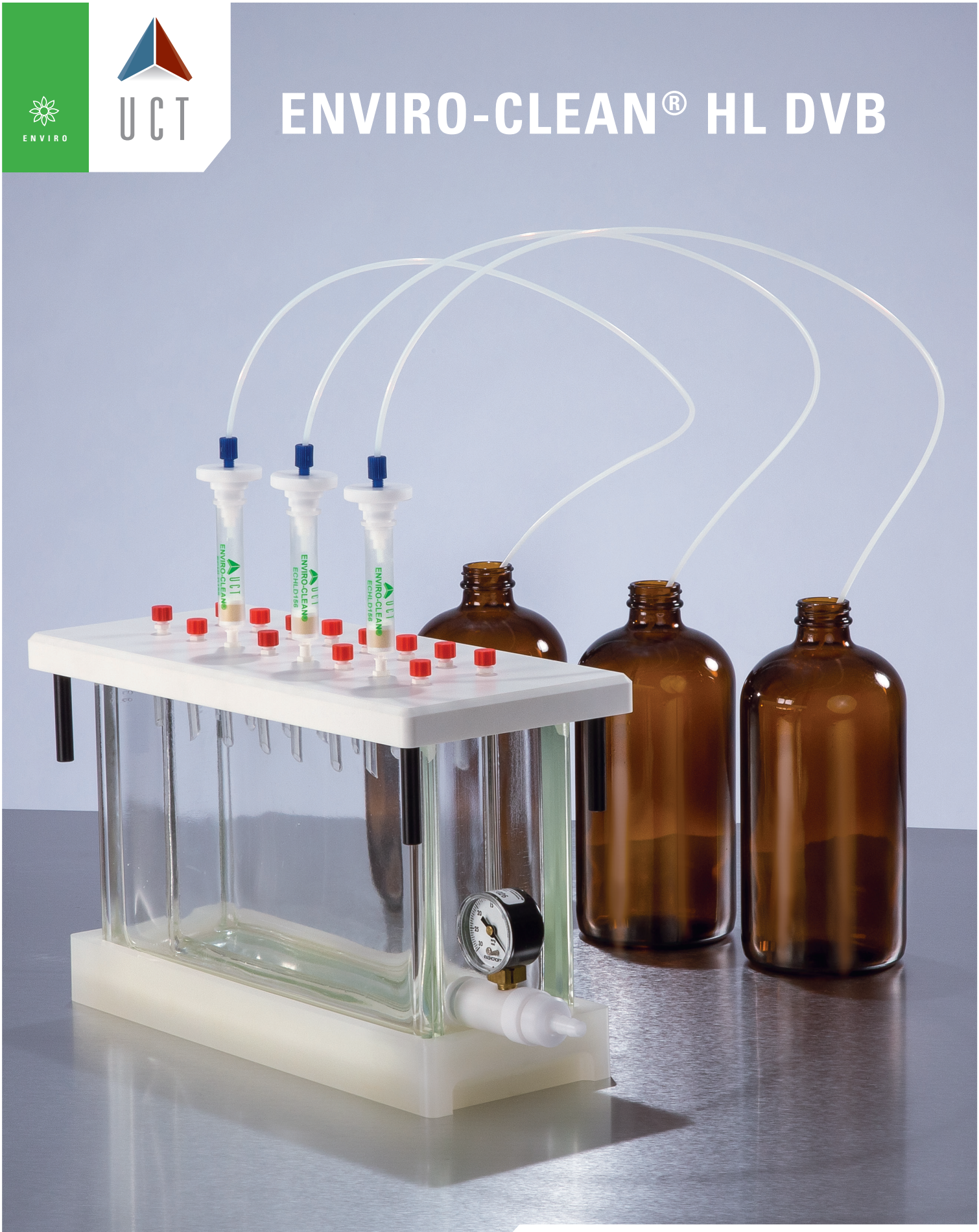
ENVIRO

UCT

ENVIRO-CLEAN® HL DVB



INNOVATION THROUGH CHEMISTRY

ENVIRO-CLEAN® HL DVB extraction columns are manufactured from an extremely clean, and highly cross-linked divinylbenzene based sorbent. The material was developed with the environmental market in mind. It has been successfully used to clean up water samples for testing a wide range of analytes. By varying the sample pH, wash and extraction solvents ENVIRO-CLEAN® HL DVB has been used to analyze for acidic, neutral (both polar & non-polar), and basic compounds.

Product		
Part Number	**Description**	**Units**
ECHLD156-P	500 mg ENVIRO-CLEAN® HL DVB in 6 mL Cartridge	30 per pack

Accessories		
Part Number	**Description**	**Units**
VMF016GL	16 Position - Glass Block Manifold	1
VMFSTFR06	Large Volume Sample Transfer Tubes	6
VMFSTFR12	Large Volume Sample Transfer Tubes	12
VMFSTFR06-PFC	Large Volume Sample Transfer Tubes - PTFE Free - For Perfluorinated Compound Analysis	6
VMFSTFR12-PFC	Large Volume Sample Transfer Tubes - PTFE Free - For Perfluorinated Compound Analysis	12
VMF02125	12 Postion Large Volume Collection Rack	1
ECSS15M6	5g ENVIRO-CLEAN® Sodium Sulfate in 6 mL Cartridge	30

Extraction of Various Organic Compounds in Water

Introduction

This application describes the use of a novel, versatile polymeric sorbent for the solid phase extraction (SPE) of a range of organic compounds. Depending on the extraction protocol used analysts are able to extract acids, bases, and neutrals including non-polar and even some mid-polar to polar compounds. Several of the compounds extracted are typically not well retained by silica-based sorbents, such as C8 and C18. The analytical performance of this new sorbent is demonstrated by selectively extracting acidic compounds (phenols), neutrals (explosives, organophosphorus pesticides, triazine herbicides, and other polar/non-polar compounds), and bases.

The SPE methods are simple and easy to use. It involves cartridge washing and conditioning, sample loading, cartridge drying and analyte elution with proper organic solvents. To ensure good extraction efficiency, the water sample must be de-chlorinated and the sample pH adjusted so that the target analytes are in their uncharged molecular forms. It is only in the neutral form that the analytes are retained by reverse phase functionality on the polymeric sorbent. For acidic compounds, sample pH should be adjusted to 2 units below the lowest pKa of the compounds to be extracted. For basic compounds, sample pH should be 2 units above the highest pKa of the compounds. For neutral compounds sample pH is not as critical as with acids or bases and can be extracted as received, unless one or more compounds to be extracted are sensitive under certain pH. Sample pH should be adjusted to the value at which any sensitive compounds are most stable to avoid low recovery caused by analyte hydrolysis or degradation. For example, captan and flumioxazin degrade much faster under alkaline conditions; therefore the sample should be adjusted to acidic conditions to avoid analyte degradation. Some compounds hydrolyze under both alkaline and acidic condition (e.g. organophosphorus esters), thus the optimum sample pH is neutral. Knowing the chemical and physical properties of the target analytes helps reduce overall method development time.

UCT created sample transfer tubes (VMFSTFR12) fit SPE cartridges of varying sizes (1, 3, 6, 15, and 25 mL). These transfer tubes allow analysts to load large sample volumes onto SPE cartridges with limited attendance. Simply connect the transfer tube to the SPE cartridge and drop the opposite end, outfitted with a SS sinker into the sample container.

Another time and effort saving option is utilized by connecting a drying cartridge (ECSS15M6) directly to the end of the SPE cartridge (ECHLD156P) using a cartridge adaptor (AD0000AS) during the elution step. This eliminates the need for an additional eluate drying step. This procedure can be used when the elution solvents are more non-polar, such as ethyl acetate or dichloromethane. Another drying option is available when eluting using more polar solvents, such as methanol or acetone. Pack 15 gm of bulk sodium sulfate (ECSS25K) into a 15-mL fritted reservoir (RFV1F15P) and place in-line at the end of the SPE cartridge. Polar solvents elute more water residue from the SPE cartridges than non-polar solvents. The use of the 15mL reservoir with 15 gm of bulk sodium sulfate ensures plenty of drying capacity.

1: Acidic compounds (EPA Method 528)

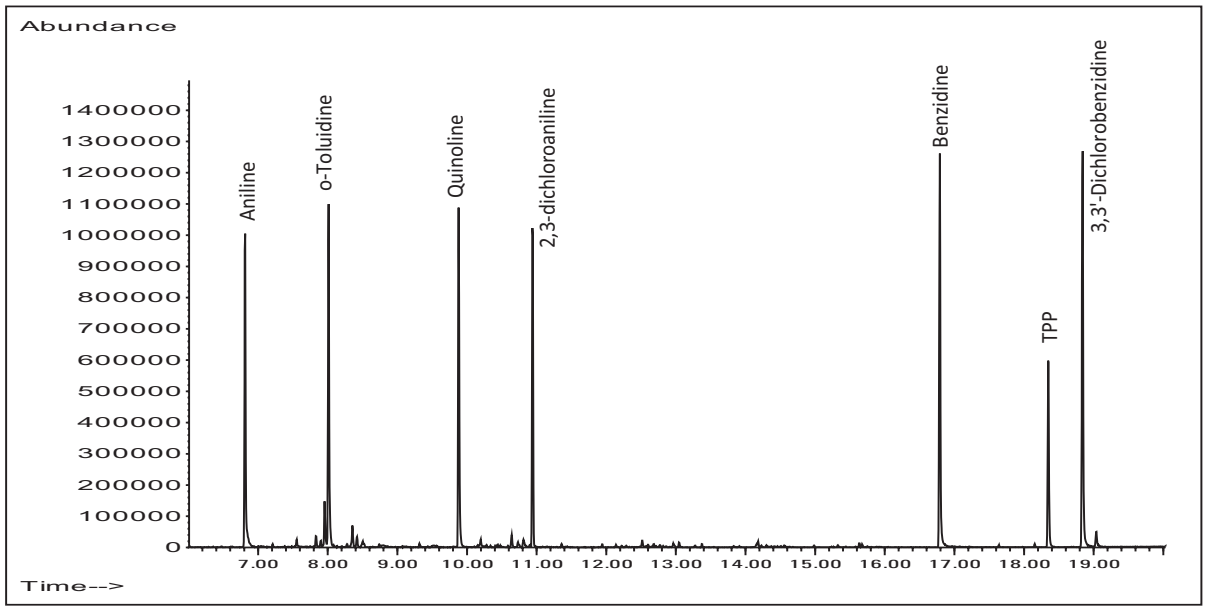
SPE procedure	
Sample pretreatment	1 L water sample, pH adjusted to < 2
Cartridge washing	3 x 3 mL dichloromethane (DCM)
Cartridge conditioning	3 x 3 mL methanol (MeOH); 4 x 3 mL 0.05 N HCl
Sample loading	15 mL/min
Cartridge drying	15 min under full vacuum
Elution with in-line drying	10 mL DCM bottle rinse; 3 mL DCM to cartridge
Eluate evaporation	Nitrogen at 40 ºC to 1 mL

Analyte	Single-lot-results		Mutiple-lot-results	
	Recovery%	RSD% (n=5)	**Recovery%**	RSD% (n=35)
Phenol	**88.2**	2.2	**86.4**	4.0
2-chlorophenol d4 (Surr)	**88.7**	1.6	**87.3**	4.7
2-chlorophenol	**87.4**	1.3	**85.3**	3.5
2-methylphenol	**88.6**	1.5	**86.8**	3.6
2-nitrophenol	**85.6**	0.8	**85.5**	3.8
2,4-dimethylphenol d3 (Surr)	**88.5**	1.4	**86.9**	6.6
2,4-dimethylphenol	**88.4**	1.1	**85.1**	6.5
2,4-dichlorophenol	**87.4**	1.3	**86.5**	3.8
4-chloro-3-methylphenol	**90.4**	1.0	**89.5**	2.9
2,4,6-trichlorophenol	**88.3**	0.6	**87.8**	3.2
2,4-dinitrophenol	**103.2**	7.6	**108.4**	5.6
4-nitrophenol	**96.5**	1.2	**97.4**	4.2
2-methyl-4,6-dinitrophenol	**92.9**	2.5	**97.9**	6.7
2,4,6-tribromophenol (Surr)	**88.7**	0.9	**89.5**	4.3
Pentachlorophenol	**94.3**	1.1	**95.8**	4.7

2: Basic compounds

SPE procedure	
Sample pretreatment	1 L water sample, pH adjusted to 12
Cartridge washing	3 x 5 mL DCM
Cartridge conditioning	3 x 5 mL MeOH; 10 mL DI water
Sample loading	25 mL/min
Cartridge drying	10 min under full vacuum
Elution with in-line drying	10 mL EtOAc and 10 mL DCM
Eluate evaporation	Nitrogen at 40 °C to 1 mL

Analyte	pKa	Recovery %	RSD% (n=5)
Aniline	4.64	**95.5**	1.4
o-Toluidine	4.48	**95.0**	1.4
Quinoline	4.50	**86.8**	1.4
2,3-dichloroaniline	2.09	**86.8**	1.6
Benzidine	3.65; 4.73	**85.9**	1.2
3,3'-Dichlorobenzidine	1.97; 2.95	**105.6**	1.1



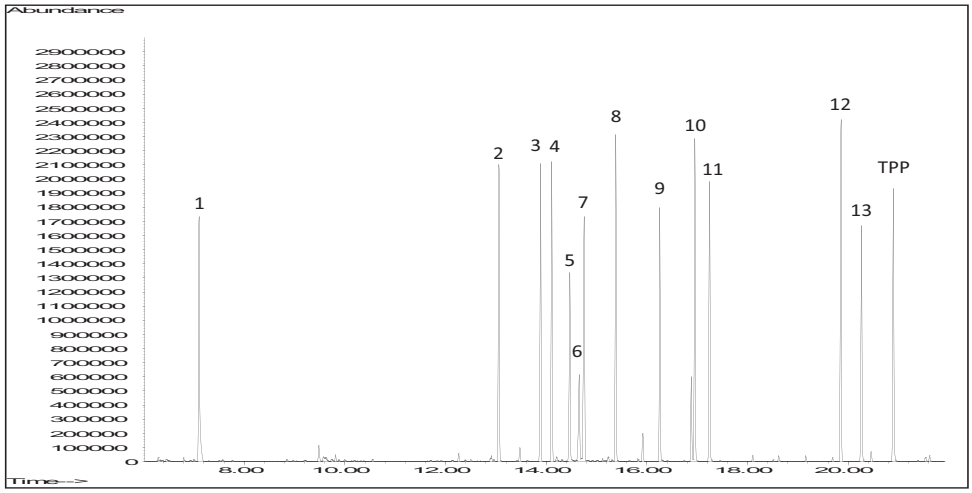
Chromatogram of a sample spiked with 20 µg/L analytes

3: Neutral compounds

3a. Organophosphorus pesticides and triazine herbicides (EPA Method 8141B)

SPE procedure	
Sample pretreatment	1 L water sample, at neutral pH
Cartridge washing	3 x 5 mL DCM
Cartridge conditioning	2 x 5 mL MeOH; 2 x 5 mL DI water
Sample loading	15 mL/min
Cartridge drying	10 min under full vacuum
Elution	5 mL acetone bottle rinse; 5 mL DCM bottle rinse; 5 mL DCM to cartridge
Eluate drying	15 g sodium sulfate in 15 mL fritted reservoir
Eluate evaporation	Concentrate to 0.5 mL under nitrogen at 40 ºC
Solvent exchange	Solvent exchange to n-hexane

Analyte	Class	Recovery %	RSD% (n=5)
o,o,o-Triethyl phosphorothioate	Organophosphorus	87.8	1.8
Thionazin	Organophosphorus	100.9	1.8
Sulfotep	Organophosphorus	96.2	0.9
Phorate	Organophosphorus	93.0	1.2
Dimethoate	Organophosphorus	108.7	7.3
Simazine	Triazine	104.2	2.1
Atrazine	Triazine	101.5	1.2
Disulfoton	Organophosphorus	85.5	1.7
Methyl parathion	Organophosphorus	112.4	1.8
Malathion	Organophosphorus	110.7	1.3
Parathion	Organophosphorus	106.8	1.3
Ethion	Organophosphorus	107.8	0.7
Famphur	Organophosphorus	120.0	1.8



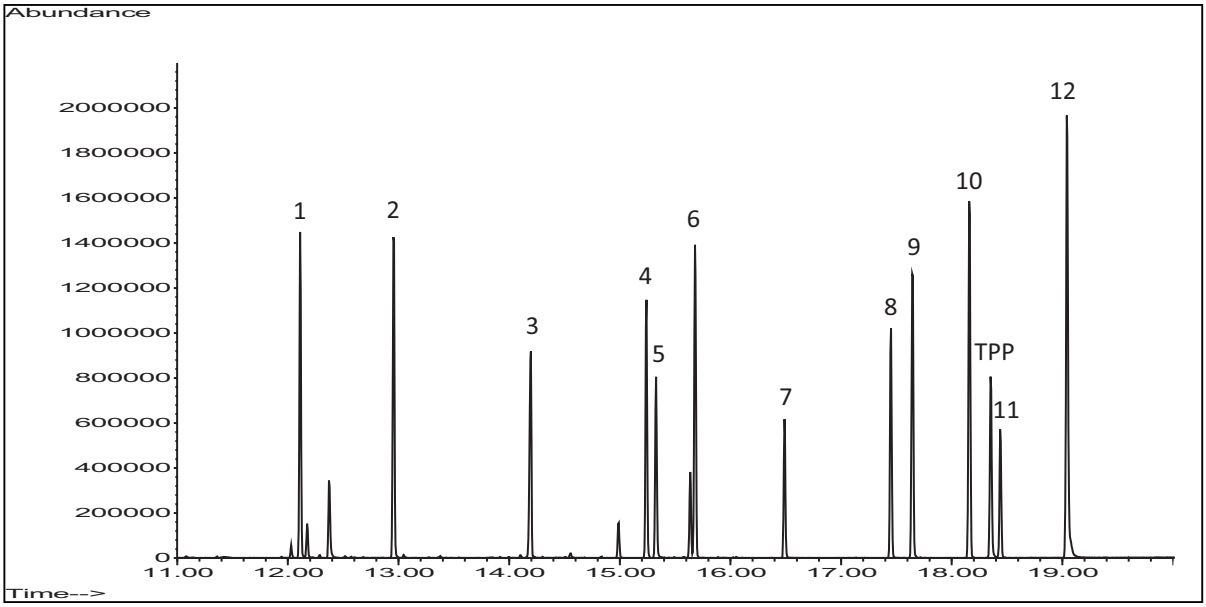
Chromatogram of a sample spiked with 10 µg/L analytes

Peak list: 1. o,o,o-Triethyl phosphorothioate; 2. Thionazin; 3. Sulfotep; 4. Phorate; 5. Dimethoate; 6. Simazine; 7. Atrazine; 8. Disulfoton; 9. Methyl parathion; 10. Malathion; 11. Parathion; 12. Ethion; 13. Famphur.

3b. Other polar and non-polar neutral compounds

SPE procedure	
Sample pretreatment	1 L water sample, pH adjusted to <5
Cartridge washing	3 x 5 mL DCM
Cartridge conditioning	3 x 5 mL MeOH; 10 mL DI water
Sample loading	30 mL/min
Cartridge drying	10 min under full vacuum
Elution with in-line drying	10 mL EtOAc and 10 mL DCM
Eluate evaporation	Concentrate to 1 mL under nitrogen at 40 ºC

Analyte	LogP	Recovery %	RSD% (n=5)
Butylated hydroxyanisole	3.06	**84.7**	1.7
Diethyl phthalate	2.42	**91.0**	2.2
Dimethipin	-1.53	**94.7**	1.9
Methyl parathion	2.80	**91.9**	2.7
Carbaryl	2.36	**107.0**	6.9
Malathion	2.36	**97.2**	2.7
Captan	2.35	**91.7**	2.6
Nitrofen	4.62	**87.9**	4.0
Ethion	3.93	**90.6**	3.5
4,4'-DDT	6.46	**88.1**	3.3
Captafol	3.95	**92.2**	4.2
Bis(2-ethylhexyl) phthalate	4.89	**92.9**	4.1



Chromatogram of a sample spiked with 20 µg/L analytes

Peak list: 1. Butylated hydroxyanisole; 2. Diethyl phthalate; 3. Dimethipin; 4. Methyl parathion; 5. Carbaryl; 6. Malathion; 7. Captan; 8. Nitrofen; 9. Ethion; 10. 4,4'-DDT; 11. Captafol; 12. Bis(2-ethylhexyl) phthalate.

3c. Explosives (EPA Method 529 and 8330)

SPE procedure	
Sample pretreatment	1 L water sample, pH as received
Cartridge washing	3 x 5 mL ethyl acetate (EtOAc)
Cartridge conditioning	3 x 5 mL MeOH; 2 x 10 mL DI water
Sample loading	15 mL/min
Cartridge drying	10 min under full vacuum
Elution with in-line drying	5 mL EtOAc bottle rinse; 5 mL EtOAc to cartridge
Eluate evaporation	Concentrate to 1 mL under nitrogen at 40 ºC

Analyte	Single-lot-results		Mutiple-lot-results	
	Recovery%	RSD% (n=5)	**Recovery%**	RSD% (n=35)
Nitrobenzene d5 Surr	**92.4**	3.5	**88.9**	4.3
Nitrobenzene	**86.8**	2.7	**88.8**	4.6
2-Nitrotoluene	**87.6**	3.6	**89.1**	4.7
3-Nitrotoluene	**86.6**	3.6	**87.7**	4.6
4-Nitrotoluene	**84.4**	3.3	**87.2**	4.9
1,3-Dinitrobenzene	**102.4**	5.3	**99.7**	4.2
2,6-Dinitrotoluene	**98.2**	5.7	**97.3**	4.8
2,4-Dinitrotoluene	**91.2**	5.3	**92.9**	4.2
1,3,5-Trinitrobenzene	**100.0**	9.1	**100.4**	5.5
2,4,6-Trinitrotoluene	**103.0**	6.3	**100.9**	5.3
RDX	**107.0**	1.7	**111.1**	5.8
4-Amino-2,6-Dinitrotoluene	**100.1**	7.5	**99.6**	5.8
3,5-Dinitroaniline	**104.3**	5.6	**103.6**	6.3
2-Amino-4,6-Dinitrotoluene	**103.3**	5.2	**105.7**	5.0
Tetryl	**102.2**	3.7	**105.4**	4.7

Conclusions

- A novel and versatile polymeric sorbent effectively retains a range of organic compounds, including acids, neutrals (polar and non-polar compounds), and bases
- Cross-linked polymeric sorbent with > 5 times greater capacity than silica-based sorbents
- Stable in samples with pH ranged from 0 to 14
- Straightforward SPE extraction protocols with excellent precision and accuracy
- Unique polymeric structure contributed to consistent analytical performance with minimum lot-to-lot variations

PRICES AND TERMS

Our prices are subject to change without notice. The price in effect when we receive your order will apply. All prices are in US Dollars and are F.O.B. Terms of payment are net 30 days.

MINIMUM ORDERS

We welcome all orders, therefore, we do not have a minimum order requirement. When ordering, please include your purchase order number, complete “Ship To” and “Bill To” address, catalog number, quantity, and description of product(s). Also include your name and a phone number where you can be reached should we have any questions concerning your order.

SHIPMENTS

Normal processing is within 24 hours after receipt of an order. Unless special shipping requests have been made, our trained staff will send all orders by UPS Ground service. The appropriate shipping charges (freight & insurance costs) will be added to the invoice, unless otherwise instructed by the customer.

SPECIAL PRICING

We offer special pricing for volume purchases and standing orders. These discounts apply to bonded phase extraction column purchases only. Please call a sales representative for more information on special pricing qualifications.

RETURN POLICY

Our Quality Manager will handle all returns. Before returning merchandise, please call to obtain a return authorization number from the quality manager. We will need to know the reason for the return, date of purchase, purchase order number and invoice number in order to issue a return authorization number. Return merchandise must be received before a credit can be issued. Returns will not be accepted after 90 days. A restocking fee of 25% of the price paid, or a minimum of $25.00 (whichever is greater) will be charged on all returns.

WARRANTY

All products manufactured by UCT are guaranteed against defects in materials and workmanship for a period of 90 days after shipment. UCT will replace any items that prove to be defective during this time period.

The exclusive remedy requires the end user to first advise UCT of the defective product by phone or in writing. Secondly, the defective product must be returned within 30 days after proper approval from our Quality Manager. All returns must indicate the purchase order number, the lot number and the shipping date. UCT’s total liability is limited to the replacement cost of UCT products.

This warranty does not apply to damage resulting from misuse.

Placing An Order

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