Solid phase extraction

Contents

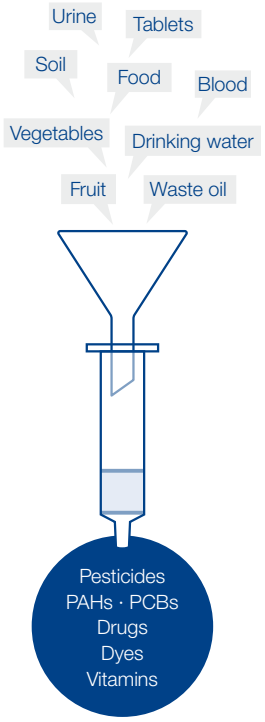
Basics

Solid phase extraction (SPE) is a powerful method for sample preparation and is used by most chromatographers today.

About 25 years ago MACHEREY-NAGEL designed and introduced CHROMABOND® SPE cartridges containing silica-based adsorbents. Since then we have developed the widest range of phases and products for SPE based on silica and polymeric materials.

SPE has capabilities in a broad range of applications

- Environmental analysis
- Pharmaceutical and biochemical analysis
- Organic chemistry
- Food analysis



SPE is a form of digital (step-wise) chromatography designed to extract, partition, and / or adsorb one or more components from a liquid phase (sample) onto a stationary phase (adsorbent or resin). An adsorbed substance can be removed from the adsorbent by stepwise increase of elution strength of the eluent (step gradient technique). SPE extends a chromatographic system's lifetime, improves qualitative and quantitative analysis, and the demand placed on an analytical instrument is considerably lessened.

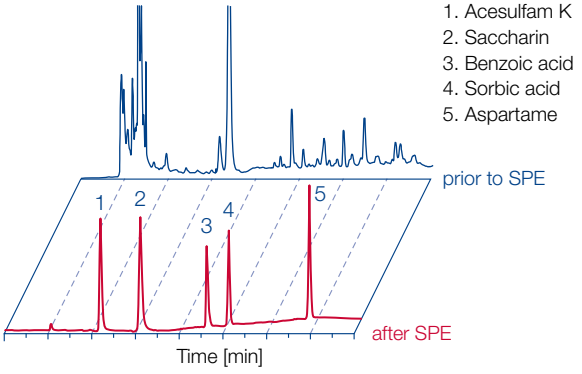
In general, SPE is used for three important purposes in state-of-the-art analysis

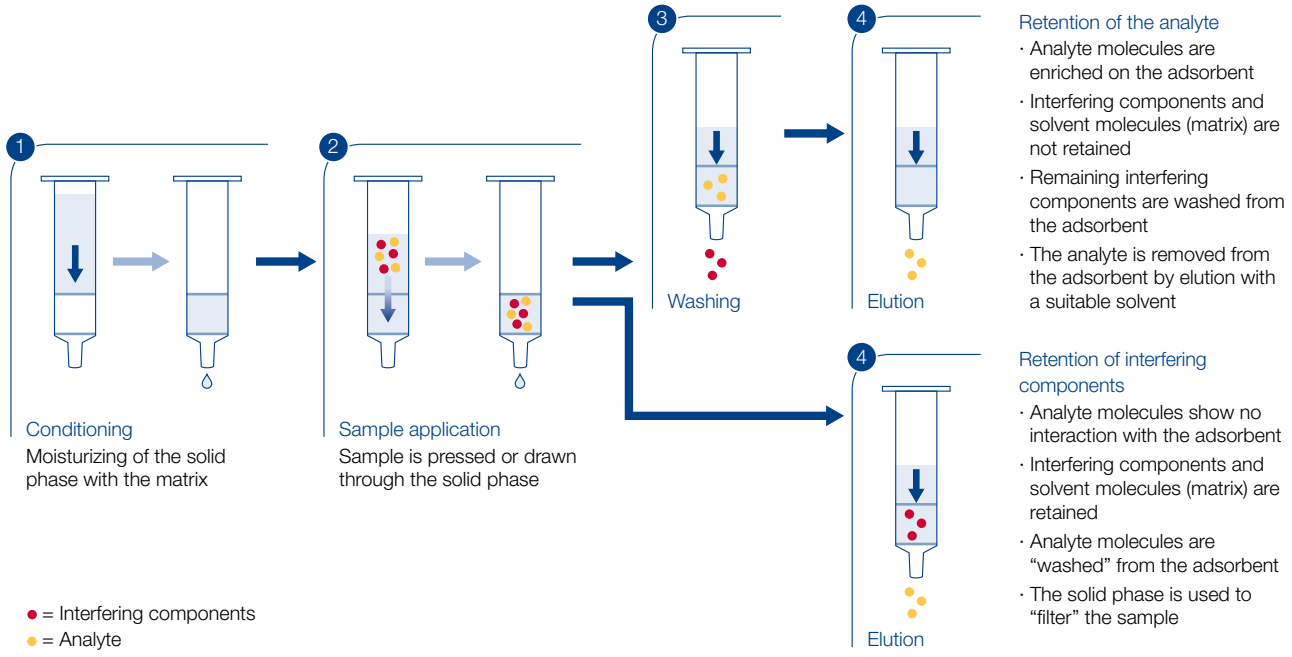
- Concentration of the analyte – up to factor 10.000 - increase of chromatographic sensibility and improved limits of detection
- Removal of interfering compounds – protection of subsequent analysis like HPLC, GC, TLC, UV or IR spectroscopy, …
- Changing an analyte's environment to a simpler matrix more suitable for subsequent analysis

Advantages of SPE compared to classical liquid-liquid extraction

- Lower consumption of solvents
- Faster – enormous time savings
- Lower costs per sample
- Potential for automation
- High consistency in individual sample handling
- More specific selectivity because of the broad range of adsorbents and different retention mechanisms
- Optimization of extraction by the variation or adjusting of the solid phase and chromatographic conditions

Separation of food additives





Since analytes can either be adsorbed on the SPE packing material or directly flown through while the interfering substances are retained, two general separation procedures are possible – both cases are shown in the figure above.

Main steps of the SPE procedure

① Conditioning of the adsorbent

Conditioning of the adsorbent is necessary in order to ensure reproducible interaction with the analyte. Conditioning, also called solvation, results in a wetting of the adsorbent and thus produces an environment, which is suitable for adsorption of the analyte. Nonpolar adsorbents are usually conditioned with 2–3 column volumes of a solvent, which is miscible with water (methanol, THF, 2-propanol etc.), followed by the solvent in which the analyte is dissolved (pure matrix, e.g., water, buffer). Polar adsorbents are conditioned with nonpolar solvents.

After the conditioning step the adsorbent bed must not run dry, because otherwise solvation is destroyed (deconditioning).

② Sample application (adsorption)

Sample application can be performed with positive or negative pressure with a flow rate of ~3 mL/min. Sample volumes vary from a few mL up to liters.

③ Washing of the adsorbent

Washing of the adsorbent is usually achieved with a special wash solution; however, in some cases it may not be necessary. If the polarity difference between wash solution and eluent is very large, or if both are not miscible, drying of the adsorbent bed after washing is recommended to improve elution and recovery.

④ Elution

Elution with a suitable eluent should not be too fast. The elution speed depends on the column or cartridge dimension and the quantity of adsorbent (about 1 mL/min).

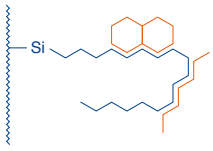
Molecular interactions in SPE

SPE adsorbents are most commonly categorized by the nature of their primary interaction mechanism with the analyte of interest. The three most common extraction mechanisms used in SPE are reversed phase (RP), normal phase (NP) and ion exchange.

Typical extraction mechanisms

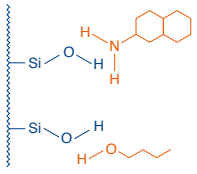
· Reversed phase	extraction of hydrophobic or polar organic analytes from aqueous matrix
· Normal phase	extraction of polar analytes from nonpolar organic solvents
· Ion exchange	extraction of charged analytes from aqueous or nonpolar organic samples

Types of retention mechanisms



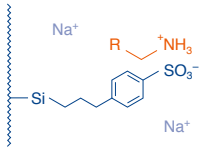
Nonpolar interactions

Silica-based:	C_{18} ec, C_{18}, C_{18} Hydra, C_8
Polymer-based:	HR-X, HR-P, Easy, PS-RP
Interactions:	hydrophobic
Sample:	mostly aqueous
Elution:	solvents with lower polarity (compared to water) CH_3OH, CH_2Cl_2, $CHCl_3$, hexane



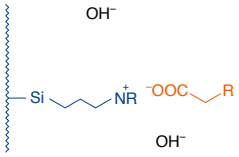
Polar interactions

Silica-based:	SiOH, CN, NH_2, OH (diol), C_6H_5
Other:	Alox, Florisil®
Interactions:	hydrogen bonds, dipole-dipole and π-π interactions
Sample:	mostly organic
Elution:	polar solvents (compared to sample solvent), e.g., (nonprotic) ethers, ketones (MTBE, THF, acetone), CH_2Cl_2, $CHCl_3$



Cation exchangers

Silica-based:	SA (SCX), PCA (WCX), PSA
Polymer-based:	HR-XC, HR-XCW, PS-H^+
Interaction:	between charged analytes and functional group of cation exchanger
Sample:	aqueous (pH 3–5)
Elution:	acidic: pH 2 (e.g., HCl, or 20 % AcOH in CH_3OH – CH_3CN) basic: pH 8–9 (e.g., 5 % NH_3 in CH_3OH – CH_3CN) solvents or buffers with higher ionic strength and counter ions with high selectivity (e.g., Ca^{2+})



Anion exchangers

Silica-based:	SB (SAX), NH_2
Polymer-based:	HR-XA, HR-XAW, PS-OH^-
Interaction:	between charged analytes and functional group of anion exchanger
Sample:	aqueous (pH 8–9)
Elution:	basic: pH 10 (e.g., 20 % NH_3 in CH_3OH – CH_3CN) acidic: pH 4–5 (e.g., HCl, or 5 % AcOH in CH_3OH – CH_3CN) solvents or buffers with higher ionic strength and counter ions with high selectivity (e.g., citrate)

It should be noted, that in SPE the interactions described on page 12 are not found in pure form, but in combination. For example, modified silicas, unless they have been subjected to endcapping (silanization of residual silanol groups with short-chain silanes), still possess free silanol groups, which can enter into secondary interactions.

Sample pretreatment

For direct extraction with adsorbents the sample matrix (sample environment) has to fulfill three conditions:

- The matrix has to be liquid, if possible with low viscosity
- Solids should be removed from the liquid matrix
- The matrix (sample environment) should be suitable for retention of the analyte

For solid samples there are different methods to convert the sample into a suitable matrix:

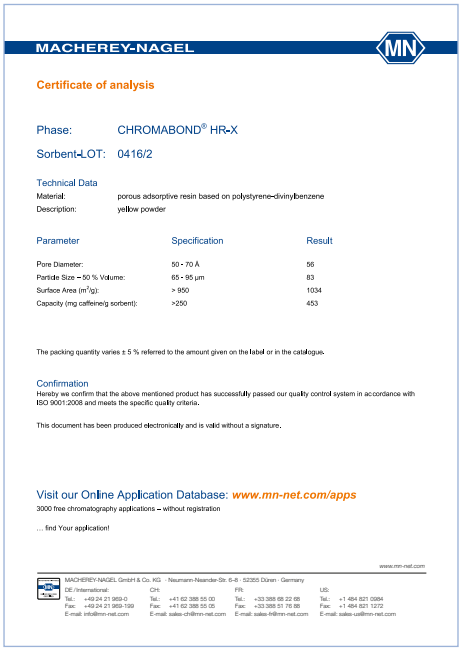
- Dissolution of the solid sample in a suitable solvent
- Lyophilization of the sample and dissolution in a suitable solvent
- Extraction of the solid sample with a suitable solvent
- Homogenization of the sample in a suitable solvent

In order to find the suitable solvent, one has to consider all desired sample components. Also, the suitable solvent should enhance retention of the analyte. For example, samples with large contents of solids are often homogenized in nonpolar solvents like hexane, while for samples with high water content dissolution in acids, bases, buffers or very polar solvents such as methanol is recommended.

Additionally, SPE allows to alter the properties of the sample matrix. If, for example, natural products are extracted with methanol or acetone, the polarity of the extracts can be increased by dilution with water, in order to enhance nonpolar solid phase extraction on the C_{18} material.

Our CHROMABOND® QC policy

- Highest production standard – our facilities are EN ISO 9001:2008 certified
- All products are individually tested to meet our strict quality specifications, ensuring our outstanding product reproducibility, reliability and performance
- Perfect reproducibility from lot-to-lot and within every single batch:
  - → Careful attention to particle size distribution and pore diameters assures consistent column flow
  - → Chemical reproducibility is guaranteed by strict quality control throughout manufacturing
- Each product is supplied with a certificate of analysis stating the results of internal examinations and quality control



MACHEREY-NAGEL

Certificate of analysis

Phase: CHROMABOND® HR-X

Sorbent-LOT: 0416/2

Technical Data

Material: porous adsorptive resin based on polystyrene-divinylbenzene

Description: yellow powder

Parameter	Specification	Result
Pore Diameter:	50 - 70 Å	56
Particle Size – 50 % Volume:	65 - 95 µm	83
Surface Area (m^2/g):	> 950	1034
Capacity (mg caffeine/g sorbent):	>250	453

The packing quantity varies ± 5 % referred to the amount given on the label or in the catalogue.

Confirmation

Hereby we confirm that the above mentioned product has successfully passed our quality control system in accordance with ISO 9001:2008 and meets the specific quality criteria.

This document has been produced electronically and is valid without a signature.

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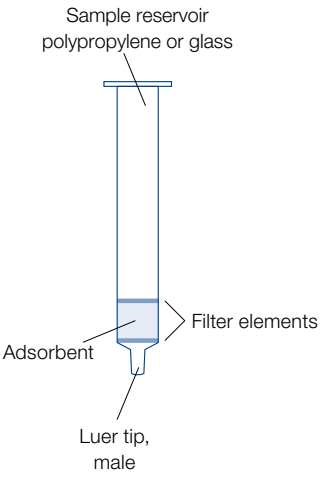
CHROMABOND® hardware

Design of columns, cartridges and 96-well plates

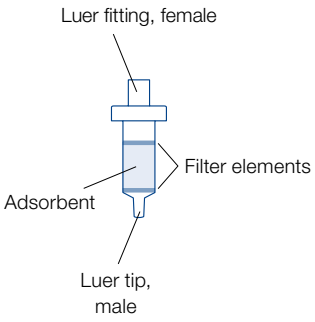
All CHROMABOND® columns, cartridges and 96-well plates are manufactured from polypropylene (PP) with lowest content of extractables (plasticizers, stabilizers, …) offering blank value free results when using most common solvents.

The high quality CHROMABOND® adsorbents are kept in place by chemically very inert polyethylene filter elements.

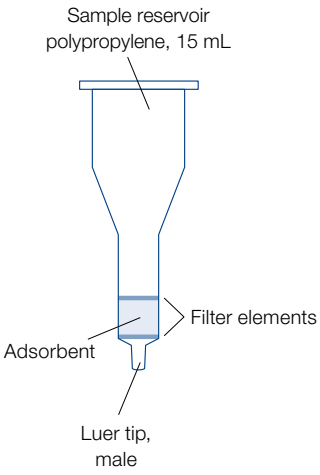
CHROMABOND®



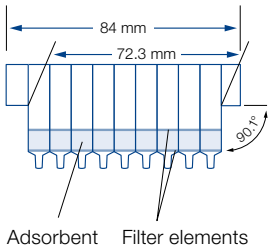
CHROMAFIX®



CHROMABOND® LV



CHROMABOND® MULTI 96



CHROMABOND® polypropylene columns

- PP columns with PE filter elements
- Different sizes from 1, 3, 6 up to 150 mL
- Adsorbent weights from 20 mg to 50 g
- Male Luer tip as exit
- Compatible with most robots (e.g., Gilson® ASPEC™, Caliper AutoTrace®)

CHROMABOND® glass columns

- Glass columns with chemically very inert glass fiber filter elements (nominal pore size 1 µm)
- Two different sizes: 3 and 6 mL
- Available with all CHROMABOND® phases
- Excludes any influence from the column material (e.g., plasticizers)

CHROMAFIX® cartridges

- PP cartridges with PE filter elements
- Three different sizes with different adsorbent weights: Small (0.4 mL), Medium (0.8 mL), Large (1.8 mL)
- Female Luer fitting at the inlet, male Luer tip as exit
- Offers alternative way of handling using positive pressure by syringes or peristaltic pumps
- Especially suited for convenient solid phase extraction of small sample volumes

CHROMABOND® LV columns

- Large volume PP columns with PE filter elements
- Three different adsorbent weights (100, 200 and 500 mg)
- Funnel-shaped reservoir with 15 mL volume
- Especially for clinical samples - the whole sample (e.g., urine, serum, blood) can be applied to the column in one step
- Can be directly used in the Zymate® lab robots of Zymark

CHROMABOND® MULTI 96 · SPE in 96-well format

- 96-well PP plates with PE filter elements
- Cavity volume 1.5 mL
- Adsorbent weights 10, 25, 50 and 100 mg
- Supplied with any CHROMABOND® SPE adsorbents
- For the simultaneous preparation of 96 samples
- Easy method transfer from CHROMABOND® columns or CHROMAFIX® cartridges to CHROMABOND® MULTI 96
- Readily adaptable to all common automated / robotic handling systems (for details see page 69)

On-line SPE (see page 68)

- Online columns and cartridges
- SPE columns with caps and needles for the Gerstel MultiPurposeSampler (MPS)
- Columns for Gilson® ASPEC™ systems (ASP)

CHROMABOND® SPE columns from page 23 onwards

CHROMABOND® Multi 96 page 14 and 69

CHROMABOND® Flash RS page 75

CHROMABOND® Flash BT page 76

CHROMABOND® Flash DL page 76

CHROMABOND® Flash FM page 77

CHROMABOND® summary of MN phases

CHROMABOND® Phase	Matrix	Modification / Application	Similar phases*	Page
Reversed phases				
HR-X	PS/DVB		ENVI-Chrom P · Strata™-X · Oasis® HLB · Nexus	23
Easy	PS/DVB	polar, bifunctional	Strata™-X · Oasis® HLB · Porapak™ RDX · Nexus, Bond Elut® PPL, Focus™ · Styre Screen® DVB Bakerbond™ H_2O-philic DVB · Isolute® ENV+	29
HR-P	PS/DVB		Strata™ SDB-L · Bond Elut® ENV, Bond Elut® LMS · DSC-PS/DVB, ENV PS-DVB · Bakerbond™ H_2O-phobic DVB · Isolute® 101 · LiChrolut® EN	30
PS-RP	PS/DVB	removal of organic components	like HR-P	31
C_{18} ec	silica	octadecyl, endcapped	Strata™ C18-E · Sep-Pak® tC18 · Bond Elut® C18 · DSC-18(Lt), ENVI-18, LC-18 · CLEAN-UP® C18, Bakerbond® Octadecyl · Isolute® C18(EC), LiChrolut® RP-18 E	32
C_{18} ec f	silica	as above, fast flow		32
C_{18}	silica	octadecyl, not endcapped	Strata™ C18-U · AccuBond® C18 · Bakerbond™ PolarPlus · Isolute® C18 · LiChrolut® RP-18	33
C_{18} f	silica	as above, fast flow		33
C_{18} Hydra	silica	octadecyl, not endcapped, for polar analytes		34
C_8	silica	octyl	Strata™ C8 · Sep-Pak® C8 · Bond Elut® C8 · DSC-8, ENVI-8, LC-8 · CLEAN-UP® C8 · AccuBond® C8 · Bakerbond™ Octyl · Isolute® C8(EC)	35
C_4	silica	butyl		36
C_2	silica	dimethyl	Bond Elut® C2	36
C_6H_{11} ec	silica	cyclohexyl, endcapped	Bond Elut® CH	37
C_6H_5	silica	phenyl	Strata™ PH · Bond Elut® PH · DSC-Ph · CLEAN-UP® Phenyl · AccuBond® Phenyl · Bakerbond™ Phenyl · Isolute PH(EC)	38
Normal phases				
SiOH	silica	unmodified	Strata™ Si-1 · Bond Elut® silica · DSC-Si, LC-Si · CLEAN-UP® silica · AccuBond® silica, Bakerbond™ silica gel · Isolute® silica · LiChrolut® Si	39
NH_2	silica	aminopropyl	Strata™ NH_2 · Sep-Pak® NH_2 · Bond Elut® NH_2 · DSC-NH_2, LC-NH_2 · CLEAN-UP® aminopropyl · AccuBond® NH_2 · Bakerbond™ amino · Isolute® NH_2 · LiChrolut® NH_2	40
OH (Diol)	silica	diol	DSC-Diol, LC-Diol · AccuBond® Diol (OH)	41
CN	silica	cyano	Strata™ CN · Sep-Pak® CN · Bond Elut® CN-U · DSC-CN, LC-CN · CLEAN-UP® CN · AccuBond® CN · Bakerbond™ cyano · Isolute® CN · LiChrolut® CN	41
HILIC	silica	zwitterionic ammonium-sulfonic acid modification	ZIC® HILIC	42
Alox A	aluminum oxide	acidic	LC-Alumina-A · AccuBond® Aluminiumoxid A	43
Alox N	aluminum oxide	neutral	LC-Alumina-N · AccuBond® Aluminiumoxid N	43
Alox B	aluminum oxide	basic	LC-Alumina-B · AccuBond® Aluminiumoxid B	43
Florisil®	magnesium silicate		Strata™ FL-PR · Sep-Pak® Florisil® · Bond Elut® Florisil® · ENVI-Florisil® · LC-Florisil® · CLEAN-UP® Florisil® · AccuBond® Florisil® · Bakerbond™ Florisil® · Isolute® FL · LiChrolut® Florisil®	44
PA	polyamide 6		DPA-6S	44
Ion exchangers				
SA	silica	benzenesulfonic acid cation exchanger (SCX)	Strata™ SCX · Bond Elut® SCX · DSC-SCX, LC-SCX · CLEAN-UP® Benzenesulfonic Acid · AccuBond® SCX · Bakerbond™ Aromatic Sulfonic Acid · Isolute® SCX · LiChrolut® SCX	45
SB	silica	quaternary ammonium anion exchanger (SAX)	Strata™ SAX, Sep-Pak® SAX, Bond Elut® SAX · DSC-SAX, LC-SAX · CLEAN-UP® Quaternary Amine · AccuBond® SAX · Bakerbond™ Quaternary Amine · Isolute® SAX · LiChrolut® SAX	46
PCA	silica	propylcarboxylic acid cation exchanger (WCX)	Strata™ WCX · Bond Elut® CBA · DSC-WCX, LC-WCX · CLEAN-UP® Carboxylic Acid · Bakerbond™ Carboxylic Acid · Isolute® CBA	47
PSA**	silica	propylsulfonic acid cation exchanger	Isolute® SCX-2 · Bond Elut® PRS	47

CHROMABOND® summary of MN phases

CHROMABOND® Phase	Matrix	Modification / Application	Similar phases*	Page
HR-XC	PS/DVB	strong mixed mode cation exchanger for basic analytes (MCX)	Oasis® MCX · Strata™-X-C · HyperSep™ Retain™-CX · Styre Screen® DBX	25
HR-XA	PS/DVB	strong mixed mode anion exchanger for acidic analytes (MAX)	Oasis® MAX · Strata™-X-A · HyperSep™ Retain™-AX · Styre Screen® QAX	26
HR-XCW	PS/DVB	weak mixed mode cation exchanger for basic analytes (WCX)	Oasis® WCX · Strata™-X-CW	27
HR-XAW	PS/DVB	weak mixed mode anion exchanger for acidic analytes (WAX)	Oasis® WAX · Strata™-X-AW	28
PS-OH^-	PS/DVB	strong anion exchanger in OH^- form		31
PS-H^+	PS/DVB	strong cation exchanger in H^+ form		31
PS-Mix	PS/DVB	mixture of PS-OH^- and PS-H^+		31
PS-Ag^+	PS/DVB	strong cation exchanger in Ag^+ form		31
PS-Ba^{2+}	PS/DVB	strong cation exchanger in Ba^{2+} form		31
Phases for special applications				
Drug	silica	bifunctional C_8/SA, for enrichment of drugs from urine	Strata™ Screen-C · Bond Elut® Certify I · DSC-MCAX · Clean Screen® DAU · AccuBond® Evidex · Bakerbond™ Narc-2 · Isolute® HCX · LiChrolut® TSC · HyperSep™ Verify CX	48
Drug II	silica	bifunctional C_8/SB, for extraction of THC and derivatives and of acidic analytes from biological fluids	Strata™ Screen-A · Bond Elut® Certify II · Clean Screen® THC · Bakerbond™ Narc-1 · Isolute® HAX · HyperSep™ Verify AX	49
Tetracycline	silica	special octadecyl phase, for enrichment of tetracyclines		50
HR-P-AOX	PS/DVB	for extraction of AOX from water (DIN 38409 – H22)		51
C_{18} PAH	silica	special octadecyl phase, for enrichment of PAHs from water	Bakerbond™ Octadecyl Lightload	51
NH_2/C_{18}	silica	combination phase for enrichment of PAHs from water		52
CN/SiOH	silica	combination phase for enrichment of PAHs from soil		52
Na_2SO_4/Florisil®		combination phase for extraction of hydrocarbons from water (DIN H-53 / ISO DIS 9377-4)		53
NAN	silica / $AgNO_3$ + Na_2SO_4	combination phase for enrichment of PCBs from sludge		54
SA/SiOH	silica	combination phase for enrichment of PCBs from waste oil	Bakerbond™ PCB-N	55
SiOH-H_2SO_4/SA	silica	combination phase, used together with SiOH for enrichment of PCB from oil		56
QuEChERS / Diamino	silica	primary and secondary amine functions (PSA), for determination of pesticides in food samples (QuEChERS method)	Supelclean™ PSA · Bond Elut® PSA	57
ABC18	silica	octadecyl, with ion exchange functions, for acrylamide analysis	Isolute® M-M (multimode)	60
Carbon A	activated carbon	determination of acrylamide from water according to DIN 38413-6	Bakerbond™ Carbon · BEKOlut® Carbon SAC	60
PL		specially developed SPE phase for the preparation of bioanalytical samples	Ostro™ · Phree™ · HybridSPE®-Phospholipid	61
Dry	Na_2SO_4	for drying organic samples		61
PTL/PTS	special membrane	phase separation		62
XTR	kieselguhr	liquid-liquid extraction	EXtrelut® · Chem Elut™ · Hydromatrix™ · Isolute® SLE+	63

* Phases which provide a similar selectivity based on chemical or physical properties (list not complete)

** For primary and secondary amine functions see QuEChERS / Diamino

Method development kits

For the development kits as well as for all individual CHROMABOND®, CHROMABOND® LV and CHROMAFIX® types columns are sealed in units of five columns each to prevent adsorption of contaminants from the environment, e.g., laboratory air.

Designation	Contents of the kit	REF
Investigating the best separation mechanism for a clean-up procedure		
CHROMABOND® HR-*Xpert* development kit I	columns with 3 mL, 60 mg (particle size 45 µm): 10 columns with HR-X; 5 columns each with HR-XC, HR-XA, HR-XCW, HR-XAW	730723
CHROMABOND® HR-*Xpert* development kit II	columns with 3 mL, 200 mg (particle size 85 µm): 10 columns with HR-X; 5 columns each with HR-XC, HR-XA, HR-XCW, HR-XAW	730726
CHROMABOND® polymer development kit	5 columns each with 3 mL, 200 mg: HR-X, HR-XC (MCX), HR-XA (MAX), HR-P, Easy, PS-H^+, PS-OH-	730288
CHROMABOND® standard development kit	5 columns each with 3 mL, 500 mg: C_{18}, C_{18} ec, C_8, C_6H_5, NH_2, DMA, OH (Diol), CN, SiOH, SA (SCX), SB (SAX)	730496
Selecting the optimum RP phase for a clean-up procedure		
CHROMABOND® RP development kit I	10 columns each with 3 mL, 500 mg: C_{18}, C_{18} ec, C_8, C_4 and 10 columns each with 3 mL, 200 mg HR-P, HR-X	730197
CHROMABOND® RP development kit II	10 columns each with 1 mL, 100 mg: C_{18}, C_{18} ec, C_8, C_4, HR-P, HR-X	730207
CHROMAFIX® RP development kit I	10 cartridges each CHROMAFIX® S: C_{18}, C_{18} ec, C_8, C_4, HR-P, HR-X	731883
CHROMABOND® RP development kit III	10 columns each with 3 mL, 500 mg: C_{18}, C_{18} ec, C_{18} Hydra, C_8 and 10 columns each with 3 mL, 200 mg HR-P, HR-X	730490
CHROMABOND® RP development kit IV	10 columns each with 1 mL, 100 mg: C_{18}, C_{18} ec, C_{18} Hydra, C_8, HR-P, HR-X	730491
CHROMAFIX® RP development kit II	10 cartridges each CHROMAFIX® S: C_{18}, C_{18} ec, C_{18} Hydra, C_8, HR-P, HR-X	731886
Selecting the optimum polar phase for a clean-up procedure		
CHROMABOND® polar development kit I	10 columns each with 3 mL, 500 mg: SiOH, Florisil®, NH_2, CN, OH (Diol)	730199
CHROMABOND® polar development kit II	10 columns each with 1 mL, 100 mg: SiOH, Florisil®, NH_2, CN, OH (Diol)	730208
CHROMAFIX® polar development kit	10 cartridges each CHROMAFIX® S: SiOH, Florisil®, NH_2, CN, OH (Diol)	731884
Selecting the optimum ion exchanger for a clean-up procedure		
CHROMABOND® ion exchange development kit I	10 columns each with 3 mL, 500 mg: SA (SCX), SB (SAX), HR-XC (MCX), HR-XA (MAX), PS-OH^-, PS-H^+, DMA	730206
CHROMABOND® ion exchange development kit II	10 columns each with 1 mL, 100 mg: SA (SCX), SB (SAX), HR-XC (MCX), HR-XA (MAX), PS-OH^-, PS-H^+, DMA	730209
CHROMAFIX® ion exchange development kit I	10 cartridges each CHROMAFIX® S: SA (SCX), SB (SAX), HR-XC (MCX), HR-XA (MAX), PS-OH^-, PS-H^+, DMA	731885
CHROMABOND® cation exchange development kit I	10 columns each with 3 mL, 500 mg: SA (SCX), PSA, PCA, HR-XC (MCX), HR-XCW (WCX), PS-H^+	730494
CHROMAFIX® cation exchange development kit	10 cartridges each CHROMAFIX® S: SA (SCX), PSA, PCA, HR-XC (MCX), HR-XCW (WCX), PS-H^+	731888
Phase selection for clean-up procedures for environmental samples		
CHROMABOND® kit I environmental sample preparation	10 columns each with 3 mL, 200 mg HR-P; 6 mL, 1000 mg C_{18} ec; 6 mL, 2000 mg C_{18} PAH; 6 mL, 500/1000 mg CN/SiOH; 3 mL, 500/500 mg SA/SiOH	730205
CHROMABOND® kit II environmental sample preparation	5 columns each with 3 mL, 500/500 mg SiOH-H_2SO_4/SA; 3 mL, 500 mg SiOH; 6 mL, 1000 mg Florisil®; 3 mL, 500/500 mg SA/SiOH; 6 mL, 700/2000/700 mg NAN	730349

The professional concept of innovative SPE phases

The CHROMABOND® HR-*Xpert* family comprises 5 polymer-based RP and mixed-mode ion exchange phases:

- CHROMABOND® HR-X — hydrophobic PS/DVB copolymer
- CHROMABOND® HR-XC — strong mixed-mode cation exchanger
- CHROMABOND® HR-XA — strong mixed-mode anion exchanger
- CHROMABOND® HR-XCW — weak mixed-mode cation exchanger
- CHROMABOND® HR-XAW — weak mixed-mode anion exchanger

State-of-the-art spherical polymer

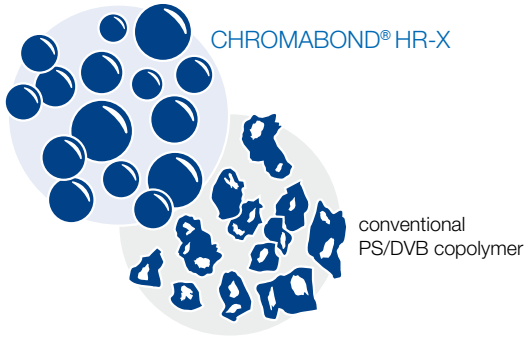
- Two particle sizes (45 µm and 85 µm) adequate for different sample volumes and matrices
- Broad spectrum of application with special suitability for the enrichment of pharmaceuticals from biological matrices
- Ideal flow properties due to low content of particulate matter

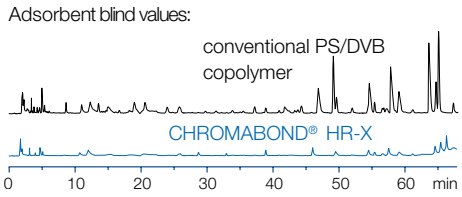
Optimized pore structure and high specific surface

- High loadability and outstanding elution properties
- Low solvent consumption
- Rapid, economical analysis

High-purity adsorber material

- Allows highest reproducibility with extremely low blind values
- Reliable analysis at ultra trace level
- No method adaptation for new batches necessary





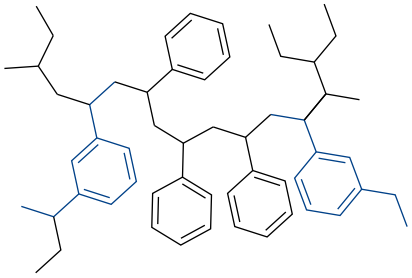
The HR-*Xpert* concept guarantees

- RP and mixed-mode SPE phases with distinct ion exchange and reversed phase properties: excellent enrichment of neutral, acidic and basic compounds
- Modern, spherical support polymer with optimized pore structure and high surface: good reproducibility, reliable and cost-efficient analysis
- Possibility for more aggressive washing procedures for matrix removal: cleaner samples and protection of your HPLC and GC instruments
- Quantification of analytes also from heavily contaminated samples: lower limits of detection also for critical matrices

CHROMABOND® HR-*Xpert* is the perfect combination for all tasks in sample preparation.

Chemical structures of the phases

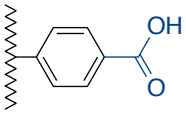
CHROMABOND® HR-X



hydrophobic polystyrene-divinylbenzene copolymer

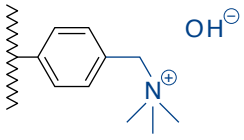
spherical base material for efficient enrichment and ideal flow behavior

CHROMABOND® HR-XCW



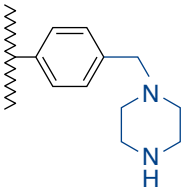
weak acidic cation exchanger

CHROMABOND® HR-XA



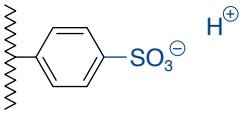
strong basic anion exchanger

CHROMABOND® HR-XAW



weak basic anion exchanger

CHROMABOND® HR-XC



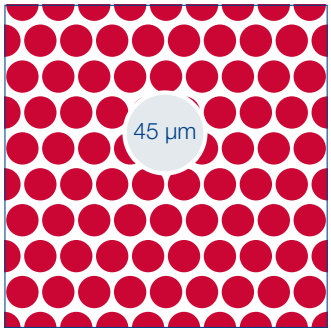
strong acidic cation exchanger

Similar phases

CHROMABOND® HR-X:	Oasis® HLB, Strata™-X, Nexus, ENVI-Chrom P
CHROMABOND® HR-XC:	Oasis® MCX, Strata™-X-C, HyperSep™ Retain™-CX, StyreScreen® DBX
CHROMABOND® HR-XA:	Oasis® MAX, Strata™-X-A, HyperSep™ Retain™-AX, StyreScreen® QAX
CHROMABOND® HR-XCW:	Oasis® WCX, Strata™-X-CW
CHROMABOND® HR-XAW:	Oasis® WAX, Strata™-X-AW

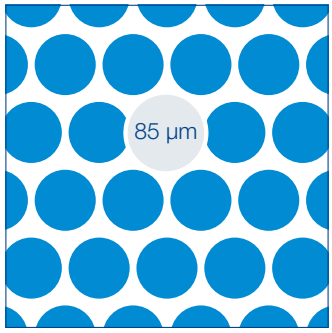
2 particle sizes - 1 goal: HR-X*pert* for optimized sample preparation

For different application requirements the particle sizes complement each other perfectly.



Ideal for:

- Smaller sample volumes
- Smaller adsorbent weights
- Lower elution volumes



Recommended for:

- Large volume or viscous samples, heavy matrix load
- Operation without vacuum possible (e.g., for volatile analytes)
- Higher adsorbent weight without increase in back pressure

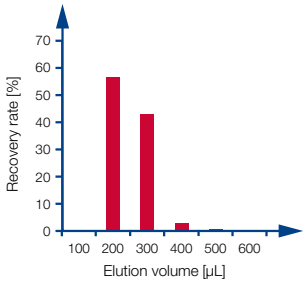
Features of 45 µm particles

- About half the radius results in 8-fold particle number per volume for approx. equal adsorbent weight
- Same specific surface for both particle sizes: considerably larger freely accessible external surface for 45 µm particles
- Denser adsorbent packing: enhanced interaction of the analyte with the adsorbent, better extraction results

Ideal elution characteristics

Method: 1 mL column with 30 mg CHROMABOND® HR-X, 1 mL standard solution (1 mg/mL hexobarbital), drying, elution in portions of 100 µL with methanol (see application 305490 at *www.mn-net.com/apps*)

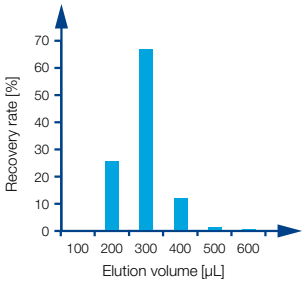
Recovery rates 45 µm



Advantages of 45 µm particles:

- Faster elution
- Lower elution volumes required

Recovery rates 85 µm



Breakthrough behavior in enrichment

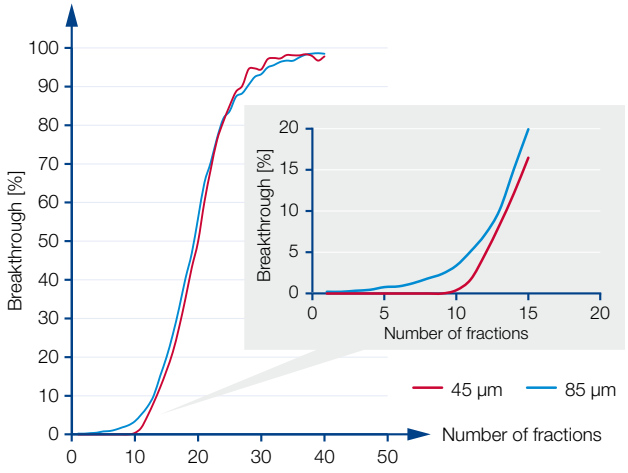
Method: 1 mL column with 15 mg CHROMABOND® HR-X, apply portions of 1 mL standard solution (250 µg/mL hexobarbital in water), collect eluates (see application 305480 at *www.mn-net.com*)

45 µm (red) The analyte is completely retained up to fraction 10.

85 µm (blue) Small amounts even break through with fraction 4.

45 µm particles provide better enrichment and breakthrough behavior for small adsorbent weights. When using larger adsorbent weights this effect is less pronounced, since then analytes have sufficient contact with the 85 µm adsorbent particles as well.

45 µm particles are ideal for small sample and elution volumes, while for large amounts of sample and adsorbent 85 µm particles show advantages due to better flow properties.

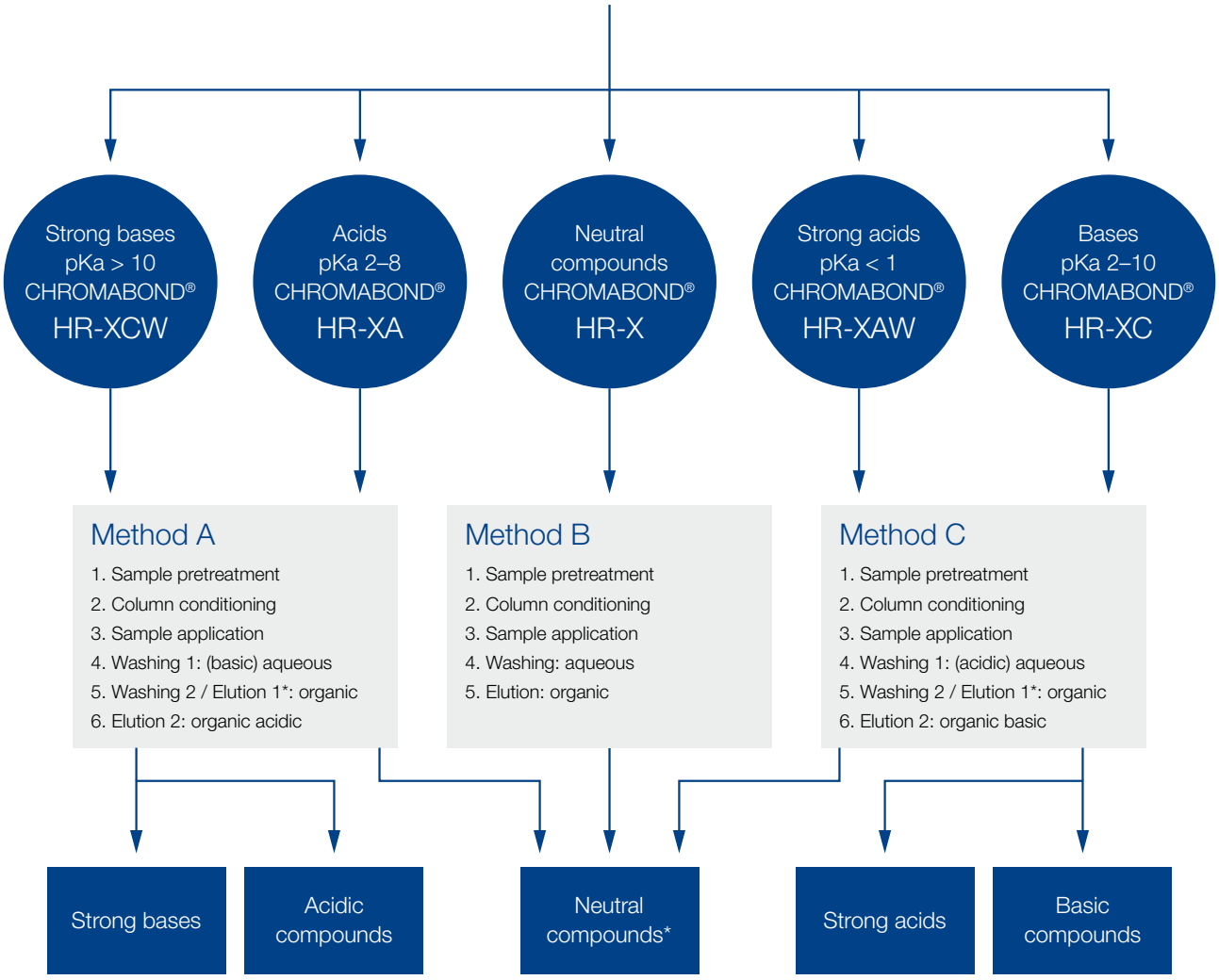


CHROMABOND® HR-*Xpert*

The CHROMABOND® HR-*Xpert* concept for neutral, acidic and basic analytes

3 paths - 1 goal: cleaner samples

Depending on the character of the analytes HR-*Xpert* offers suitable adsorbents and optimal methods for sample preparation, cleaning and concentration.



* Under organic washing and elution conditions the following compounds will be also eluted

HR-X:	polar compounds such as organic acids and bases
HR-XC, HR- XCW:	acidic components and impurities
HR-XA, HR- XAW:	basic components and impurities

CHROMABOND® HR-X HR-X spherical, hydrophobic polystyrene-divinylbenzene adsorbent resin

Key features

- High-purity material with highest reproducibility and lowest blank values due to an optimized manufacturing process
- Excellent recovery rates especially for the enrichment of pharmaceuticals and active ingredients due to the spherical structure of the particles, very homogeneous surface and optimized pore structure

Technical characteristics

- Hydrophobic polystyrene-divinylbenzene copolymer, pH stability 1–14
- Spherical particles, size 45 µm and 85 µm (standard), pore size 55–60 Å, very high surface 1000 m^2/g, capacity 390 mg/g (caffeine in water)

Recommended application

- Pharmaceuticals / active ingredients from tablets, creams and water / waste water
- Drugs and pharmaceuticals from urine, blood, serum and plasma
- Trace analysis of pesticides, herbicides, phenols, PAHs and PCBs from water

Drugs from water

MN Appl. No. 304240

Column type:
CHROMABOND® HR-X, 3 mL, 200 mg
REF 730931

Sample: 1 µg/mL each in water

Column conditioning: 5 mL methanol, 5 mL dist. water

Sample application:
slowly aspirate 500 mL water (pH 3) through the column

Column washing: 5 mL water

Elution: after drying 3 x 2 mL acetonitrile

Further analysis: HPLC on NUCLEODUR® C_{18} Gravity, 5 µm; see MN Appl. No. 121690

Recovery rates [%]

Compound	HR-X	Strata™ X
Ketoprofen	98	92
Ibuprofen	91	93
Pentobarbital	99	95
Meclofenamic acid	92	93
Protriptyline	63	45
Nortriptyline	53	39

Pesticides from water

MN Appl. No. 304250 / 304260

Column type:
CHROMABOND® HR-X, 3 mL, 200 mg
REF 730931

Sample pretreatment: samples are spiked with 500 ng of each pesticide in 1000 mL water, adjusted to pH 2 with HCl or pH 7

Column conditioning:
10 mL methanol, 10 mL dist. water

Sample application:
slowly pass 1000 mL spiked water sample through the column with the aid of a tubing adapter (REF 730243)

Elution: after drying 5 mL methanol – THF (1:1, v/v)

Further analysis: HPLC

Recovery rates [%]

Compound	HR-X pH 2	Compound	HR-X pH 7
Metamitron	86	Desisopropylatrazine	90
Quinmerac	90	2,4-Dichlorobenzamide	95
Chloridazon	93	Desethylatrazine	89
Picloram	83	Hexazinone	95
Metribuzin	84	Bromacil	103
Cyanazine	83	Simazine	91
Metabenzthiazuron	94	Desethylterbuthylazine	89
Chlortoluron	91	Atrazine	88
Isoproturon	89	Metalaxyl	97
Diuron	91	Metazachlor	93
Dimethenamid-P	89	Propazine	88
Linuron	94	Terbuthylazine	86
Epoxyconazole	85	Metolachlor	97
Penconazole	90		
Alachlor	93		
Propiconazole-1	89		
Flufenacet	91		
Diflufenicam	58		
Triallate	42		

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® HR-Xpert

Standard protocol for CHROMABOND® HR-X

MN Appl. No. 304310

Column type:
CHROMABOND® HR-X, 3 mL, 200 mg
REF 730931

Sample pretreatment: if necessary, adjust pH value
Column conditioning: 5 mL methanol
Equilibration: 5 mL water
Sample application: slowly aspirate the sample through the column
Column washing: 5 mL water – methanol (95:5, v/v)
Elution: after drying 3 x 2 mL methanol

Further analysis: if necessary, evaporate and redissolve in a suitable solvent; HPLC or GC

Highest reproducibility
Barbiturates from serum

MN Appl. No. 304290

Column type:
CHROMABOND® HR-X, 3 mL, 200 mg
REF 730931

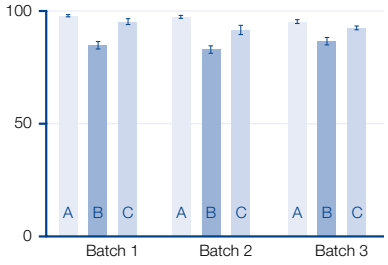
Sample: 100 ng/mL each in serum
Column conditioning: 5 mL methanol, 5 mL dist. water
Sample application: 1 mL spiked serum
Column washing: 5 mL water
Elution: after drying 3 x 2 mL methanol

Further analysis: HPLC on NUCLEODUR® 100-5 C_{18} ec, see MN Appl. No. 117820

· Within each batch
· From batch to batch

Compounds:

A phenobarbital
B pentobarbital
C hexobarbital



Ordering information

	Volume	Adsorbent weight → 30 mg	60 mg	100 mg	200 mg	500 mg	1 g	Pack of
	CHROMABOND® HR-X polypropylene columns (85 µm)							
	1 mL	730934		730935				30
	3 mL		730936		730931	730937		30
	6 mL				730938	730939		30
	15 mL					730940	730941	20
	CHROMABOND® HR-X polypropylene columns (85 µm) · BIGpacks							
	3 mL				730931.250			250
	6 mL				730938.250	730939.250		250
	CHROMABOND® HR-X polypropylene columns (45 µm)							
	1 mL	730934P45		730935P45				30
	3 mL		730936P45		730931P45			30
	CHROMABOND® LV-HR-X (85 µm)							
	15 mL	732130	732131		732132			30

		96 x 10 mg (45 µm)	96 x 25 mg (45 µm)	96 x 50 mg (85 µm)	96 x 100 mg (85 µm)	Pack of
	CHROMABOND® MULTI 96 HR-X					
		738530.010M	738530.025M	738530.050M	738530.100M	1

Glass columns, LV columns and MULTI 96 on request.

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® HR-XC strong cation exchanger

Key features

- High purity material, highest reproducibility and lowest blank values due to an optimized production process
- Outstanding recovery rates especially for the enrichment of basic analytes

Technical characteristics

- Strong acidic benzenesulfonic acid cation exchanger, exchange capacity 1.0 meq/g, base material polystyrene-divinylbenzene copolymer, pH stability 1–14
- Spherical particles, size 45 µm and 85 µm (standard), pore size 65–75 Å, very large specific surface 800 m^2/g, pore volume 1.4 cm^3/g, RP capacity 300 mg/g (caffeine in water)

Recommended application

- Basic active ingredients from heavily matrix-contaminated samples like, e.g., urine, plasma, serum
- Fungicides from food
- Basic analytes like, e.g., amines
- Bases with pKa 2–10

Standard protocol for CHROMABOND® HR-XC

MN Appl. No. 304790

Column type:
CHROMABOND® HR-XC, 3 mL, 200 mg
REF 730952

Sample pretreatment: adjust pH value if necessary

Column conditioning: 5 mL methanol

Equilibration: 5 mL water

Sample application: slowly aspirate sample through the column

Column washing 1: 2 mL 0.1 mol/L HCl in Wasser

Column washing 2 / Elution 1: 2 mL methanol (neutral and acidic compounds); if necessary, further washing steps

Elution 2: after drying 5 mL methanol – 5 % NH_3 (basic compounds)

Further analysis: if necessary, evaporate and redissolve in a suitable solvent; HPLC or GC

Fractionation of acidic, neutral and basic analytes from serum

MN Appl. No. 304780

Column type:
CHROMABOND® HR-XC, 3 mL, 200 mg
REF 730952

Sample: 1 mL spiked matrix, acidified with 200 µL 2 % H_3PO_4

Column conditioning: 5 mL methanol, then 5 mL water

Sample application: slowly aspirate sample through the column

Column washing: 2 mL 0.1 mol/L HCl

Elution: 2.5 mL methanol (fraction A: neutral and acidic analytes); then 5 mL methanol – NH_3 90:10, v/v (fraction B: basic analytes)

Further analysis:

for fraction A:
HPLC, e.g., on NUCLEODUR® C_{18} Gravity, see MN Appl. No. 122230;

for fraction B:
HPLC on NUCLEODUR® C_8 Gravity, see MN Appl. No. 118520

Recovery rates [%]

Fraction A: neutral and acidic analytes		Fraction B: basic analytes			
Compound	HR-XC	Compound	HR-XC	Oasis® MCX	Strata™ X-C
Suprofen	108	Doxepin	101	68	82
Naproxen	85	Imipramine	95	71	85
Tolmetin	73	Amitriptyline	94	72	78
Phenobarbital	108	Trimipramine	92	70	81
Indomethacin	33				
Hexobarbital	80				

Ordering information

Volume	Adsorbent weight → 30 mg	60 mg	100 mg	150 mg	200 mg	500 mg	Pack of
CHROMABOND® HR-XC polypropylene columns (85 µm)							
1 mL	730969		730049				30
3 mL		730956			730952	730953	30
6 mL				730957		730955	30
CHROMABOND® HR-XC polypropylene columns (45 µm)							
1 mL	730969P45		730049P45				30
3 mL		730956P45			730952P45		30

Size →	S	M	L	
Minimum adsorbent weight →	50 mg	140 mg	400 mg	Pack of
CHROMAFIX® HR-XC cartridges (85 µm)				
	731755	731756	731757	50

Glass columns, LV columns and MULTI 96 on request.

CHROMABOND® HR-Xpert

CHROMABOND® HR-XA strong anion exchanger

Key features

- High purity material with highest reproducibility and lowest blank values due to an optimized production process
- Outstanding recovery rates especially for the enrichment of acidic analytes

Technical characteristics

- Strong basic quaternary ammonium anion exchanger, exchange capacity 0.25 meq/g, pKa ~ 18, base material polystyrene-divinylbenzene copolymer, pH stability 1–14
- Spherical particles, size 45 µm and 85 µm (standard), pore size 55–65 Å, very large specific surface 850 m^2/g, pore volume 1.4 cm^3/g, RP capacity 350 mg/g (caffeine in water)

Recommended application

- Acidic active ingredients from heavily matrix-contaminated samples like, e.g., urine, plasma, serum
- Phenolic acids
- Acidic herbicides
- Weak / medium-strength acids with pKa 2–8

Standard protocol for CHROMABOND® HR-XA

MN Appl. No. 304970

Column type:
CHROMABOND® HR-XA, 3 mL, 200 mg
REF 730951

Sample pretreatment:
individual sample preparation with reference to analytes and matrix

Column conditioning: 5 mL methanol

Equilibration: 5 mL water

Sample application: slowly aspirate sample through the column

Column washing 1: 2 mL 0.1 mol/L NaOH in water

Column washing 2 / Elution 1: 2 mL methanol (neutral and basic compounds), if necessary, further washing steps

Elution 2: after drying 5 mL methanol – 1 to 10 % formic acid (acidic compounds)

Further analysis: if necessary, evaporate and redissolve in a suitable solvent; HPLC or GC MN Appl. No. 304970

Ordering information

	Volume	Adsorbent weight → 30 mg	60 mg	100 mg	150 mg	200 mg	500 mg	Pack of
	CHROMABOND® HR-XA polypropylene columns (85 µm)							
	1 mL	730968		730727				30
	3 mL		730950			730951	730954	30
	6 mL				730958		730966	30
	CHROMABOND® HR-XA polypropylene columns (45 µm)							
	1 mL	730968P45		730727P45				30
	3 mL		730950P45			730951P45		30
	Size →	S		M		L		
	Minimum adsorbent weight →	70 mg		180 mg		510 mg		Pack of
	CHROMAFIX® HR-XA cartridges (85 µm)							
		731768		731769		731770		50

Glass columns, LV columns and MULTI 96 on request.

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® HR-XCW weak cation exchanger

Key features

- High purity material, highest reproducibility and lowest blank values due to an optimized production process
- Outstanding recovery rates especially for enrichment of strongly basic analytes

Technical characteristics

- Weak acidic carboxylic acid cation exchanger, exchange capacity >0.7 meq/g, pKa ~ 5, base material spherical PS/DVB copolymer, pH stability 1–14
- Spherical particles, size 45 µm and 85 µm (standard), pore size 50–60 Å very large specific surface 850 m^2/g, pore volume 1.2–1.4 cm^3/g, RP capacity 350 mg/g (caffeine in water)

Recommended application

- Basic compounds like quaternary amines
- Active ingredients from heavily matrix-contaminated samples like, e.g., urine, plasma, serum
- Strong bases with pKa > 10

Standard protocol for CHROMABOND® HR-XCW

MN Appl. No. 305300

Column type:
CHROMABOND® HR-XCW, 3 mL, 200 mg
REF 730739

Sample pretreatment:
individual sample preparation with reference to analytes and matrix

Column conditioning: 5 mL methanol, 5 mL water

Sample application:
slowly aspirate sample through the column

Column washing 1: 2 mL acidified water

Column washing 2 / Elution 1: 2 mL methanol (neutral and acidic compounds), further washing steps if necessary

Elution 2: after drying 2 x 2 mL methanol – 1 to 5 % formic acid (strongly basic compounds)

Further analysis: if necessary, evaporate and redissolve in a suitable solvent; HPLC or GC

Ordering information

Volume	Adsorbent weight → 30 mg	60 mg	100 mg	150 mg	200 mg	500 mg	Pack of
CHROMABOND® HR-XCW polypropylene columns (85 µm)							
1 mL	730731		730733				30
3 mL		730735			730739	730741	30
6 mL				730737		730743	30
CHROMABOND® HR-XCW polypropylene columns (45 µm)							
1 mL	730731P45		730733P45				30
3 mL		730735P45			730739P45		30

Size →	S	M	L	
Minimum adsorbent weight →	60 mg	160 mg	450 mg	Pack of
CHROMAFIX® HR-XCW cartridges (85 µm)				
	731774	731775	731776	50

Glass columns, LV columns and MULTI 96 on request.

CHROMABOND® HR-XAW weak anion exchanger

Key features

- High purity material with highest reproducibility and lowest blank values due to an optimized production process
- Outstanding recovery rates especially for enrichment of acidic analytes

Technical characteristics

- Weak basic secondary and tertiary ammonium anion exchanger, exchange capacity >0.5 meq/g, pKa ~ 6, base material spherical PS/DVB copolymer, pH stability 1–14
- Spherical particles, size 45 µm and 85 µm (standard), pore size 55–65 Å very large specific surface 850 m^2/g, pore volume 1.2–1.4 cm^3/g, RP capacity 350 mg/g (caffeine in water)

Recommended application

- Perfluorinated surfactants
- Acidic compounds like sulfonates
- Active ingredients from heavily matrix-contaminated samples like, e.g., urine, plasma, serum
- Strong acids with pKa < 1

Standard protocol for CHROMABOND® HR-XAW

MN Appl. No. 305200

Column type:
CHROMABOND® HR-XAW, 3 mL, 200 mg
REF 730748

Sample pretreatment:
individual sample preparation with reference to analytes and matrix

Column conditioning: 5 mL methanol

Equilibration: 5 mL water

Sample application:
slowly aspirate sample through the column

Column washing 1: 25 mmol/L ammonium acetate

Column washing 2 / Elution 1: 2 mL methanol (neutral and basic compounds), if necessary, further washing steps

Elution 2: after drying 2 x 2 mL methanol – 1 to 5 % ammonia (strongly acidic compounds)

Further analysis: if necessary, evaporate and redissolve in a suitable solvent; HPLC or GC

Analysis of perfluorinated surfactants from water

MN Appl. No. 305140

Application in accordance with DIN 38407-42

Column type:
CHROMABOND® HR-XAW, 3 mL, 60 mg
REF 730747

Sample: 500 mL water, spiked with 1 mL standard solution (20 µg/L of each compound

Column conditioning:
2 mL methanol + 5 % ammonia, then 2 mL methanol, finally 2 mL water

Sample application:
slowly aspirate sample through the column

Column washing: 2 mL water, then 2 mL acetone – acetonitrile – formic acid (50:50:1, v/v/v), finally 2 mL methanol

Elution: 2 mL methanol with 5 % ammonia

Further analysis: evaporate to dryness in a stream of nitrogen under slight heating, and redissolve in a suitable solvent for HPLC

Recovery rates [%]

Compound	Recovery
Perfluoropropionic acid (PFPrA)	103
Perfluoropentanoic acid (PFPeA)	94
Perfluorohexanoic acid (PFHxA)	94
Perfluorooctanoic acid (PFOA)	95
Perfluorooctane sulfonate K salt (PFOS)	81
Perfluorododecanoic acid (PFDoDA)	82

Ordering information

	Volume	Adsorbent weight → 30 mg	60 mg	100 mg	150 mg	200 mg	500 mg	Pack of
	CHROMABOND® HR-XAW polypropylene columns (85 µm)							
	1 mL	730728		730729				30
	3 mL		730747			730748	730744	30
	6 mL				730749		730745	30
	CHROMABOND® HR-XAW polypropylene columns (45 µm)							
	1 mL	730728P45		730729P45				30
	3 mL		730747P45			730748P45		30
	Size →	S		M		L		
	Minimum adsorbent weight →	50 mg		120 mg		360 mg		Pack of
	CHROMAFIX® HR-XAW cartridges (85 µm)							
		731771		731772		731773		50

Glass columns, LV columns and MULTI 96 on request.

CHROMABOND® Easy polar, bifunctionally modified polystyrene-divinylbenzene copolymer

Key features

The Easy effect:

- Without preconditioning
- Due to bifunctional modification much more hydrophilic than conventional polystyrene-divinylbenzene polymers
- Easily wettable with water

Technical characteristics

- Polar modified polystyrene-divinylbenzene copolymer with a weak anion exchanger, specific surface 650–700 m^2/g, particle size 80 µm, pore size 50 Å, pH stability 1–14

Recommended application

- Polar herbicides and pesticides from water (acidic, neutral, basic), polar phenols from water, polyaromatic compounds, polychlorinated biphenyls
- Drug analysis from urine, blood, serum, plasma
- Pharmaceuticals and active ingredients from tablets, creams

Recovery of pesticides

MN Appl. No. 303220

Private communication Mr. Kühn, GUB, Waldshut Tiengen, Germany

Column type:
CHROMABOND® Easy, 3 mL, 200 mg
REF 730754

Column conditioning:
1 mL water, 3 mL methanol, 1 mL water

Sample application:
aspirate the sample through the column

Elution:
3 x 1 mL acetone

Further analysis: HPLC with NUCLEOSIL® 120-5 C_{18}

Recovery rates [%]

Compound	Recovery	Compound	Recovery
Desisopropylatrazine	90	Metalaxyl	96
2,6-Dichlorobenzamide	93	Isoproturon	94
Desethylatrazine	93	Diuron	94
Hexazinone	69	Metazachlor	97
Terbacil	65	Propazine	95
Simazine	81	Terbuthylazine	93
Cyanazine	93	Linuron	96
Desethylterbuthylazine	91	Metolachlor	97
Methabenzthiazuron	94	Triallate	61
Chlortoluron	91	Standard	64
Atrazine	92		

Ordering information

Volume	Adsorbent weight → 30 mg	60 mg	100 mg	200 mg	500 mg	1 g	Pack of
CHROMABOND® Easy polypropylene columns							
1 mL	730751		730752				30
3 mL		730753		730754	730759		30
6 mL				730755	730756		30
15 mL					730757	730758	20
CHROMABOND® Easy polypropylene columns · BIGpacks							
3 mL				730754.250			250
6 mL				730755.250			250
CHROMABOND® LV-Easy							
15 mL				732472			30

	96 x 25 mg	96 x 50 mg	96 x 100 mg	Pack of
CHROMABOND® MULTI 96 Easy				
	738520.025M	738520.050M	738520.100M	1

CHROMABOND® Easy adsorbent				
			730661	20 g

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® HR-P polystyrene-divinylbenzene adsorbent resin

Key features
- Very high binding capacity, up to 30 % of adsorbent weight (for comparison: silica adsorbents about 3 %)

Technical characteristics
- Highly porous polystyrene-divinylbenzene copolymer, specific surface 1200 m^2/g, particle size 50–100 µm

Recommended application
- Aromatic compounds, phenols from water, nitroaromatics from water, pesticides from water, PAHs from oil

Aromatic amines from water samples

MN Appl. No. 301810

Private communication M. Leß, T.C. Schmidt, Department of Chemistry, University Marburg, 1997

Compounds investigated: aromatic amines

Column type:
CHROMABOND® HR-P, 3 mL, 200 mg
REF 730108

Sample pretreatment: adjust to pH 9 using 10 mol/L NaOH

Column conditioning: 2 mL each of methanol, acetonitrile and 10^{-5} mol/L aqueous sodium hydroxide solution

Sample application: aspirate sample through the column with about 10 mL/min

Column washing: wash with 2 mL dist. water, dry 5 min under vacuum

Elution: 3 x 1 mL methanol – acetonitrile (1:1, v/v)

For recovery rates of numerous aromatic amines please see application 301810 at *www.mn-net.com/apps*

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	Pack of
CHROMABOND® HR-P polypropylene columns					
1 mL	730280				30
3 mL		730108	730117		30
6 mL		730119	730111	730118	30
CHROMABOND® HR-P polypropylene columns · BIGpack					
3 mL		730108.250			250
CHROMABOND® HR-P glass columns					
3 mL		730108G			30
6 mL			730111G	730118G	30
CHROMABOND® LV-HR-P					
15 mL		732108			30

	Size →	S	M	L	
	Minimum adsorbent weight →	50 mg	130 mg	380 mg	Pack of
CHROMAFIX® HR-P cartridges					
		731839	731840	731841	50

	96 x 100 mg	Pack of
CHROMABOND® MULTI 96 HR-P		
	738111.100M	1
CHROMABOND® HR-P adsorbent		
	730615	20 g

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® PS-RP / PS-OH⁻ / PS-H⁺ / PS-Mix / PS-Ag⁺ / PS-Ba²⁺

phases for RP and ion chromatography

Key features

- Very low degree of swelling, thus very well suited for chromatography, reliable function over the whole pH range from 0–14

Technical characteristics

- Base material high purity polystyrene-divinylbenzene copolymers (PS/DVB), pore size 100 Å, particle size 100 µm
- Different modifications for different applications from the elimination of nonpolar compounds up to the removal of specific polar components

Recommended application

- Removal of interfering compounds
- Improves chromatographic separation, if the interfering components overlap with the analyte in the chromatogram
- Improves lifetime of the chromatographic column, since interfering components can irreversibly block the column packing
- Enrichment of the analytes

Properties of the individual modifications

PS-RP	hydrophobic PS/DVB copolymer	removal of organic interfering components from water
PS-OH⁻	strong PS/DVB anion exchanger, OH⁻ form capacity 0.6 meq/g	removal or concentration of anions from water increasing the pH value in acidic samples
PS-H⁺	strong PS/DVB cation exchanger, H⁺ form capacity 2.9 meq/g	removal or concentration of cations from water decreasing the pH value of basic samples
PS-Mix	mixture of PS-OH⁻ and PS-H⁺	desalting of water
PS-Ag⁺	strong PS/DVB cation exchanger, Ag⁺ form	removal of halide ions from water
PS-Ba²⁺	strong PS/DVB cation exchanger, Ba²⁺ form	removal of sulfate ions from water

Removal of halides from aqueous samples shown for the trace analysis of nitrate besides an excess of chloride or bromide

MN Appl. No. 301930 / 302750

Compounds investigated:
20 ppm nitrate besides 2500 ppm chloride or 500 ppm bromide

Column type:
CHROMAFIX® PS-Ag⁺ (M) 0.8 mL, min. 250 mg
REF 731865

Column conditioning: 1 mL dist. water

Sample application and Elution:
apply 4 x 1 mL sample fractions to the cartridge, discard 1st mL, collect 2nd, 3rd and 4th mL separately

Further analysis: HPLC with column 250 x 4 mm NUCLEOSIL® Anion II; eluent 2 mmol/L potassium hydrogen phthalate pH 6, 2 mL/min; detection: indirect UV, 280 nm (see applications 110440 and 110450 at *www.mn-net.com/apps*)

Ordering information

Phases	Adsorbent weight → 3 mL / 200 mg	3 mL / 500 mg	6mL / 500 mg	6 mL / 900 mg			Pack of
CHROMABOND® PS polypropylene columns							
PS-RP	730765	730692	730693				30
PS-OH⁻	730396	730344	730378				30
PS-H⁺	730690	730376	730377				30
PS-Mix		730394		730310			30

Phases	Size S	Minimum adsorbent weight →	Size M	Minimum adsorbent weight →	Size L	Minimum adsorbent weight →	Pack of
CHROMAFIX® PS cartridges							
PS-RP	731877	60 mg	731875	160 mg			50
PS-OH⁻	731868	70 mg	731860	180 mg	731862	510 mg	50
PS-H⁺	731867	90 mg	731861	220 mg	731863	620 mg	50
PS-Mix	731909	70 mg					50
PS-Ag⁺	731866	100 mg	731865	250 mg			50
PS-Ba²⁺	731871	100 mg	731870	250 mg			50

CHROMABOND® reversed phases

CHROMABOND® C_{18} ec / C_{18} ec f (f = fast flow) octadecyl silica, endcapped

Key features

- Very nonpolar, hydrophobic interactions with a wide variety of organic compounds
- Advantageous for the clean-up of samples with large structural variations (polarity differences)

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm for C_{18} ec, 100 µm for C_{18} ec f (for fast flow), specific surface 500 m^2/g, pH stability 2–8
- Octadecyl phases, endcapped, carbon content 14 %

Recommended application

- Nonpolar compounds aflatoxins, amphetamines, antibiotics, antiepileptics, barbiturates, caffeine, drugs, preservatives, fatty acids, nicotine, PAHs, pesticides, PCBs, heavy metals, vitamins
- Very well suited for desalting of samples
- C_{18} ec f for viscous samples

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	2 g	5 g	10 g	Pack of
CHROMABOND® C_{18} ec polypropylene columns								
1 mL	730011							100
3 mL		730012	730013					50
6 mL			730014	730015	730141			30
15 mL					730404			20
45 mL						730405		20
70 mL							730259	10
CHROMABOND® C_{18} ec polypropylene columns · BIGpacks								
3 mL			730013.250					250
6 mL			730014.250	730015.250				250
CHROMABOND® C_{18} ec glass columns								
3 mL		730012G	730013G					50
6 mL			730014G	730015G				30
CHROMABOND® LV-C_{18} ec								
15 mL		732012	732013					30

	Size → Minimum adsorbent weight → S 90 mg	M 230 mg	L 630 mg	Pack of
CHROMAFIX® C_{18} ec cartridges				
	731804	731805	731806	50
	96 x 25 mg	96 x 50 mg	96 x 100 mg	Pack of
CHROMABOND® MULTI 96 C_{18} ec				
	738011.025M	738011.050M	738011.100M	1
CHROMABOND® C_{18} ec adsorbent				
			730611	100 g

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	2 g	5 g	10 g	Pack of
CHROMABOND® C_{18} ec f polypropylene columns (fast flow)								
3 mL		730269	730018					50
6 mL			730016	730010				30
CHROMABOND® C_{18} ec f adsorbent (fast flow)								
							730613	100 g

CHROMABOND® C_{18} / C_{18} f (f = fast flow) octadecyl silica

Key features

- Similar to C_{18} ec, however possesses more free silanols (SiOH), which allow secondary interactions with polar groups of the analytes

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm for C_{18}, 100 µm for C_{18} f (for fast flow), specific surface 500 m^2/g, pH stability 2–8
- Octadecyl phases, not endcapped, carbon content 14 %

Recommended application

- Nonpolar compounds, pesticides
- C_{18} f for viscous samples

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	2 g	5 g	10 g	Pack of
CHROMABOND® C_{18} polypropylene columns								
1 mL	730001							100
3 mL		730002	730003					50
6 mL			730004	730005	730130			30
15 mL					730028			20
45 mL						730400		20
70 mL							730261	10
CHROMABOND® C_{18} polypropylene columns · BIGpacks								
3 mL			730003.250					250
6 mL			730004.250	730005.250				250
CHROMABOND® C_{18} glass columns								
3 mL			730003G					50
6 mL			730004G	730005G				30
CHROMABOND® LV-C_{18}								
15 mL		732002						30

	Size → / Minimum adsorbent weight →	S 90 mg	M 200 mg	L 560 mg	Pack of
CHROMAFIX® C_{18} cartridges					
		731801	731802	731803	50

	96 x 25 mg	96 x 100 mg	Pack of
CHROMABOND® MULTI 96 C_{18}			
	738001.025M	738001.100M	1

		Pack of
CHROMABOND® C_{18} adsorbent		
	730602	100 g

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	2 g	5 g	10 g	Pack of
CHROMABOND® C_{18} f polypropylene columns (fast flow)								
3 mL		730402	730008					50
6 mL			730403	730009				30
CHROMABOND® C_{18} f adsorbent (fast flow)								
							730612	100 g

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® reversed phases

CHROMABOND® C_{18} Hydra octadecyl silica for polar analytes

Key features
- Special octadecyl phase for polar analytes, not endcapped, carbon content 15 %

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8

Recommended application
- Polar compounds like pesticides and their polar degradation products, phenols, phenoxycarboxylic acids

Pesticides from water

MN Appl. No. 302060

Compounds investigated: triazines and carboxylic amides

Column type:
CHROMABOND® C_{18} Hydra, 6 mL, 2 g
REF 730301

Sample pretreatment: adjust 1000 mL water to pH 7–8 with diluted NH_3 and add 100 µL of the internal standards (1 µg/L).

Column conditioning: 2 x 5 mL methanol, then 2 x 5 mL dist. water

Sample application: force or aspirate the sample through the column. Then dry for 2 h with 2 bar N_2.

Elution: slowly aspirate 10 mL methanol through the column. Evaporate the eluate to dryness in a tapered flask with a rotation evaporator at 30 °C and store in a refrigerator for ~15 min. Redissolve the residue in 200 µL cold, fresh *n*-hexane and transfer the solution to a conic HPLC vial (e.g., REF 702891). Store the solution in a refrigerator until chromatography.

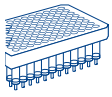
Recovery rates: between 95 and 100 %

Further analysis: GC with OPTIMA® δ-3 or OPTIMA® δ-6 (e.g., application 250420) or HPLC in accordance with EN ISO 11369: 1997 on NUCLEOSIL® 120-3 C_{18} (application 110880)

Ordering information

	Volume	Adsorbent weight → 50 mg	100 mg	200 mg	500 mg	1 g	2 g	3 g	Pack of
	**CHROMABOND® C_{18} Hydra polypropylene columns**								
	1 mL	730294	730295						100
	3 mL			730296	730297	730298			50
	6 mL				730299	730300	730301	730302	30
	CHROMABOND® C_{18} Hydra glass columns								
	3 mL			730296G	730297G	730298G			50
	6 mL				730299G	730300G			30
	**CHROMABOND® LV-C_{18} Hydra**								
	15 mL			732295					30

	Size →	S	M	L	Pack of
	Minimum adsorbent weight →	90 mg	230 mg	640 mg	
	CHROMAFIX® C_{18} Hydra cartridges				
		731730	731731	731732	50

		96 x 100 mg	Pack of
	**CHROMABOND® MULTI 96 C_{18} Hydra**		
		738294.100M	1
	**CHROMABOND® C_{18} adsorbent**		
		730628	100 g

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® C_8 octyl silica

Key features
- Similar to C_{18}, however slightly more polar
- Secondary interactions with polar compounds are more pronounced due to shorter alkyl chains

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Octyl phase, not endcapped, carbon content 8 %

Recommended application
- Pesticides, PCBs

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	Pack of
CHROMABOND® C_8 polypropylene columns					
1 mL	730021				100
3 mL		730022	730023		50
6 mL			730024	730134	30
CHROMABOND® C_8 glass columns					
6 mL			730024G		30
CHROMABOND® LV-C_8					
15 mL			732023		30

Size → Minimum adsorbent weight →	M 210 mg	96 x 100 mg	Pack of
CHROMAFIX® C_8 cartridges			
	731808		50
		96 x 100 mg	Pack of
CHROMABOND® MULTI 96 C_8			
		738021.100M	1
CHROMABOND® C_8 adsorbent			
		730601	100 g

CHROMABOND® reversed phases

CHROMABOND® C_4 butyl silica

Key features
- Slightly more polar than C_{18} or C_8, due to shorter alkyl chains the silica surface is not completely shielded

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Butyl phase, not endcapped, carbon content 7 %

Recommended application
- Compounds, which are too strongly retained on C_{18} or C_8 e.g., analgetics from blood

Ordering information

	Volume	Adsorbent weight →	100 mg	500 mg	Pack of
	**CHROMABOND® C_4 polypropylene columns**				
	1 mL		730225		100
	3 mL			730227	50
		Size →	S	M	
		Minimum adsorbent weight →	80 mg	200 mg	Pack of
	CHROMAFIX® C_4 cartridges				
			731740	731741	50
	**CHROMABOND® C_4 adsorbent**				
				730651	100 g

Glass columns, LV columns and MULTI 96 on request.

CHROMABOND® C_2 dimethyl silica

Key features
- Similar to C_4

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Dimethyl phase, not endcapped, carbon content 4 %

Recommended application
- e.g., antiepileptics from plasma

Ordering information

	Volume	Adsorbent weight → 100 mg	500 mg	1 g	Pack of
	**CHROMABOND® C_2 polypropylene columns**				
	1 mL	730169			100
	3 mL		730221		50
	6 mL		730409	730410	30
	**CHROMABOND® C_2 adsorbent**				
				730652	100 g

Glass columns, LV columns, CHROMAFIX® cartridges and MULTI 96 on request.

CHROMABOND® C_6H_{11} ec cyclohexyl silica, endcapped

Key features

- Alternative phase for the midpolar range

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Cyclohexyl phase, endcapped, carbon content 9 %

Recommended application

- Phenols from water
- Chloroanilines from waste water
- Anthelmintics from tissue

Comparison of different phases for phenol analysis

MN Appl. No. 302150

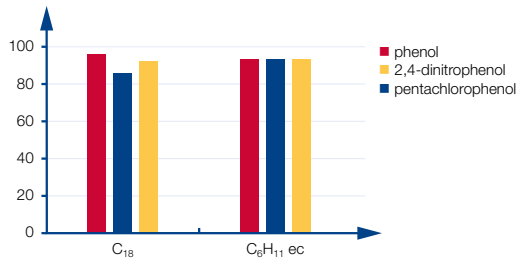
Compounds investigated: phenol, 2,4-dinitrophenol, pentachlorophenol

Column types:
CHROMABOND® C_{18}, 6 mL, 2000 mg
REF 730130
CHROMABOND® C_6H_{11} ec, 6 mL, 2000 mg
REF 730469

Column conditioning: 10 mL acetone, 10 mL methanol, and 10 mL dist. water (pH 2)

Sample application: aspirate the sample through the column.

Elution: 10 mL methanol



Ordering information

	Volume	Adsorbent weight → 500 mg	1 g	Pack of
	CHROMABOND® C_6H_{11} ec polypropylene columns			
	3 mL	730442		50
	6 mL	730443	730444	30
	CHROMABOND® C_6H_{11} ec adsorbent			
			730631	100 g

Glass columns, LV columns, CHROMAFIX® cartridges and MULTI 96 on request.

CHROMABOND® reversed phases

CHROMABOND® C_6H_5 phenyl silica

Key features

- Polarity similar to C_8
- In addition to hydrophobic interactions more selective adsorption is possible by π-π interactions due to the electron density of the phenyl ring.

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Phenyl phase, carbon content 8 %

Recommended application

- Aflatoxins, caffeine, phenols

Flavor compounds from brandy

MN Appl. No. 300170

Compounds investigated: asarone, quinine, coumarin, quassin

Column type:
CHROMABOND® C_6H_5, 6 mL, 1000 mg
REF 730412

Sample pretreatment: mix 10 mL sample with 90 mL water and 10 g sodium chloride and adjust to pH 7 with 0.1 mol/L sodium hydroxide solution

Column conditioning: 10 mL methanol, then 10 mL dist. water

Sample application: slowly force or aspirate the sample through the column

Column washing: 2.5 mL water, then 2.5 mL pentane

Elution: 1) 2 x 2.5 mL pentane – diethyl ether (7:3, v/v): asarone, coumarin
2) 10 mL 1 mol/L basic methanol – diethyl ether (9:1, v/v): quinine
3) 5 mL chloroform: quassin

Ordering information

	Volume	Adsorbent weight → 100 mg	200 mg	500 mg	Pack of
	**CHROMABOND® C_6H_5 polypropylene columns**				
	1 mL	730083			100
	3 mL		730411	730084	50
	**CHROMABOND® C_6H_5 adsorbent**				
				730606	100 g

Glass columns, LV columns, CHROMAFIX® cartridges and MULTI 96 on request.

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® SiOH unmodified silica

Key features

- Very polar
- Adsorbs humidity from air, for this reason it should be kept well closed and if necessary dried before use
- Due to its high affinity for polar compounds it should not be conditioned with polar (e.g., methanol) or water-containing solvents.

Technical characteristics

- Unmodified, weakly acidic silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8

Recommended application

- Aflatoxins, chloramphenicol, pesticides, steroids, vitamins

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	2 g	5 g	10 g	50 g	Pack of
CHROMABOND® SiOH polypropylene columns									
1 mL	730071								100
3 mL		730214	730073						50
6 mL			730070	730075	730107				30
15 mL					730217				20
45 mL						730406			20
70 mL							730072		10
150 mL								730473	10
CHROMABOND® SiOH polypropylene columns · BIGpacks									
3 mL			730073.250						250
6 mL				730075.250	730107.250				250
CHROMABOND® SiOH glass columns									
3 mL		730214G	730073G						50
6 mL			730070G	730075G	730107G				30
CHROMABOND® LV-SiOH									
15 mL		732072	732073						30

	Size →	S	M	L	
	Minimum adsorbent weight →	60 mg	190 mg	490 mg	Pack of
CHROMAFIX® SiOH cartridges					
		731828	731829	731830	50

	96 x 100 mg	Pack of
CHROMABOND® MULTI 96 SiOH		
	738071.100M	1

			Pack of
CHROMABOND® SiOH adsorbent			
	730608		100 g

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® normal phases

CHROMABOND® NH_2 aminopropyl silica

Key features
- Polar, weak anion exchanger

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Aminopropyl phase, carbon content 3.5 %

Recommended application
- Trace elements, lipids

Metals: trace elements from water

MN Appl. No. 301910

Compounds investigated: Al, Be, Cu, Cr(VI), Mo(VI), V(V))

Column type:
CHROMABOND® NH_2, 3 mL, 500 mg
REF 730033

Sample pretreatment:
mix 100 mL water sample with 5 mL 0.001 % alizarinsulfonic acid solution and adjust to pH 5.5 with acetic acid or sodium acetate

Column conditioning: 2 column volumes 1 mol/L nitric acid, then 2 column volumes dist. water

Sample application: force or aspirate sample through the column with 3–4 mL/min

Column washing: 2 mL dist. water; dry column under vacuum for 4 min

Elution: 2 column volumes 2 mol/L nitric acid

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	Pack of
CHROMABOND® NH_2 polypropylene columns					
1 mL	730031				100
3 mL		730413	730033		50
6 mL			730180	730626	30
CHROMABOND® NH_2 polypropylene columns · BIGpack					
3 mL			730033.250		250
CHROMABOND® NH_2 glass columns					
3 mL			730033G		50
6 mL			730180G	730626G	30
CHROMABOND® LV-NH_2					
15 mL			732033		30

	Size → S Minimum adsorbent weight → 70 mg			Pack of
CHROMAFIX® NH_2 cartridges				
	731813			50

	96 x 100 mg	Pack of
CHROMABOND® MULTI 96 NH_2		
	738031.100M	1
CHROMABOND® NH_2 adsorbent		
	730603	100 g

CHROMABOND® OH (Diol) diol silica

Key features
- Polar, properties similar to SiOH

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Diol phase, carbon content 5.5 %

Recommended application
- Antibiotics, prostaglandins

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	Pack of
CHROMABOND® OH (Diol) polypropylene columns				
1 mL	730051			100
3 mL		730417	730053	50
6 mL			730418	30
CHROMABOND® OH (Diol) adsorbent				
			730605	100 g

Glass columns, LV columns, CHROMAFIX® cartridges and MULTI 96 on request.

CHROMABOND® CN cyanopropyl silica

Key features
- In addition to weak hydrophobic interactions selective interactions are possible due to the high electron density of the CN group.
- Polar to midpolar

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Cyanopropyl phase, carbon content 5.5 %

Recommended application
- Cyclosporins, carbohydrates

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	Pack of
CHROMABOND® CN polypropylene columns				
1 mL	730061			100
3 mL		730420	730063	50
6 mL			730421	30
CHROMABOND® CN adsorbent				
			730607	100 g

Glass columns, LV columns, CHROMAFIX® cartridges and MULTI 96 on request.

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® normal phases

CHROMABOND® HILIC zwitterionic polar phase with ammonium sulfonic acid modification

Technical characteristics

- Basic material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8

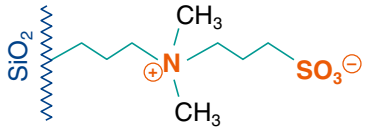
Recommended application

- Polar organic acids and bases, polar natural compounds, nucleosides, oligonucleotides, amino acids, peptides, water-soluble vitamins

Hydrophilic interaction liquid chromatography

A water-rich layer is formed on the surface of the adsorbent, which enables stronger interactions for polar than for nonpolar analytes. Thus polar analytes are more strongly retained than nonpolar compounds. This behavior is inverse (orthogonal) to RP materials like, e.g., CHROMABOND® C_{18} ec.

In HILIC-HPLC (e.g., NUCLEODUR® HILIC) increase of the portion of water in the eluent results in reduction of the retention times – consequently enrichment in SPE is the more difficult, the higher the portion of water in the sample matrix. Elution of the analytes is achieved with water.



Standard protocol

MN Appl. No. 305580

Column type:
CHROMABOND® HILIC, 3 mL, 500 mg
REF 730593

Sample pretreatment: A high part of acetonitrile in the sample is recommended. Aqueous samples must be diluted with acetonitrile (recommendable: water – acetonitrile (1:3, v/v). Dioxane or THF can be used instead of acetonitrile.

Column conditioning: 1 mL water (Do not let run the column dry!)

Equilibration: 6 mL acetonitrile or the organic solvent, dilute the sample

Sample application: prepared sample is passed dropwise through the column

Column washing: if necessary 0.5–2 mL acetonitrile or the organic solvent, dilute the sample

Elution: 1–2 mL water (dependent on analyte)

Further analysis: if necessary, evaporate and redissolve in a suitable solvent; HPLC or GC

Creatinine and creatine from water: variation of the organic solvent

MN Appl. No. 305590

Column type:
CHROMABOND® HILIC, 3 mL, 500 mg
REF 730593

Sample pretreatment: 250 µL of aqueous sample are diluted with 750 µL tetrahydrofurane, 1,4-dioxane or acetonitrile

Column conditioning: 1 mL water (Do not let run the column dry!)

Equilibration: 5 mL tetrahydrofurane, 1,4-dioxane or acetonitrile

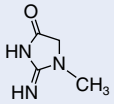
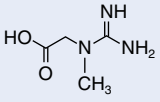
Sample application: prepared sample is passed dropwise through the column

Column washing: 3 x 1 mL tetrahydrofurane, 1,4-dioxane or acetonitrile

Elution: 1 mL water

Further analysis: HPLC with NUCLEODUR® HILIC according to MN Appl. No. 122990 (injection volume: 5 µL)

Recovery rates [%]

Compound		
	Creatinine	Creatine
Tetrahydrofurane	105 %	101 %
1,4-dioxane	83 %	95 %
Acetonitrile	0 %	97 %

Ordering information

	Volume	Adsorbent weight → 500 mg	1 g	Pack of
	CHROMABOND® HILIC polypropylene columns			
	3 mL	730593		50
	6 mL	730594	730596	30
	CHROMABOND® HILIC adsorbent			
			730643	100 g

CHROMABOND® Alox A / Alox N / Alox B aluminum oxide, acidic, neutral, basic

Key features

- Alox A: aluminum oxide, acidic pH value 4 ± 0.5
- Alox N: aluminum oxide, neutral pH value 7 ± 0.5
- Alox B: aluminumoxide, basic pH value 9.5 ± 0.5

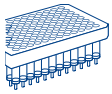
Technical characteristics

- Aluminum oxide, high purity, pore volume 0.90 mL/g, particle size 60–150 µm, specific surface 150 m^2/g

Ordering information

	Phases	Volume	Adsorbent weight → 500 mg	1 g	4 g	Pack of
	**CHROMABOND® Alox polypropylene columns**					
	Alox A	3 mL	730452			50
	Alox A	6 mL	730453	730017		30
	Alox A	45 mL			730455	20
	Alox N	3 mL	730446			50
	Alox N	6 mL	730447	730139		30
	Alox N	45 mL			730250	20
	Alox B	3 mL	730429			50
	Alox B	6 mL	730466	730020		30
	Alox B	45 mL			730467	20
	CHROMABOND® Alox glass columns					
	Alox N	6 mL		730139G		30
	Alox B	6 mL		730020G		30
	**CHROMABOND® LV-Alox**					
	Alox A	15 mL		732210		30
	Alox N	15 mL		732091		30
	Alox B	15 mL		732205		30

	Phase	Size → Minimum adsorbent weight →	M 450 mg	L 1200 mg		Pack of
	CHROMAFIX® Alox cartridges					
	Alox N		731844	731845		50

	Phases				96 x 100 mg	Pack of
	CHROMABOND® MULTI 96 Alox					
	Alox A				738253.100M	1
	Alox N				738251.100M	1
	Alox B				738252.100M	1

	**CHROMABOND® Alox adsorbents**					
	Alox A				730642	100 g
	Alox N				730641	100 g
	Alox B				730640	100 g

CHROMABOND® normal phases

CHROMABOND® Florisil® magnesium silicate

Technical characteristics

- Matrix magnesium silicate (MgO - SiOH 15:85), high purity, particle size 150–250 µm

Recommended application

- Organic tin compounds, aliphatic carboxylic acids, PCBs, PAHs

Ordering information

Volume	Adsorbent weight → 200 mg	500 mg	1 g	2 g	Pack of
CHROMABOND® Florisil® polypropylene columns					
3 mL	730457	730081			50
6 mL		730238	730082	730239	30
CHROMABOND® Florisil® polypropylene columns · BIGpack					
6 mL			730082.250		250
CHROMABOND® Florisil® glass columns					
6 mL		730238G	730082G	730239G	30

	Size → L Minimum adsorbent weight → 700 mg	Pack of
CHROMAFIX® Florisil® cartridges		
	731848	50

CHROMABOND® Florisil® adsorbent		
730622		100 g

LV columns and MULTI 96 on request.

CHROMABOND® PA polyamide 6

Technical characteristics

- Matrix polyamide 6, unmodified, high purity, particle size 40–80 µm

Recommended application

- Flavonoids, PAHs

Ordering information

Volume	Adsorbent weight → 200 mg	500 mg	1 g	Pack of
CHROMABOND® PA polypropylene columns				
3 mL	730384	730126		50
6 mL		730007	730127	30

	Size → S Minimum adsorbent weight → 30 mg	L 260 mg	Pack of
CHROMAFIX® PA cartridges			
	731849	731851	50

CHROMABOND® PA adsorbent		
730660		100 g

Glass columns, LV columns and MULTI 96 on request.

CHROMABOND® SA benzenesulfonic acid cation exchanger based on silica (SCX)

Key features

- Adsorbent with hydrophobic and π-π interactions (benzene ring)
- Ion exchange of organic compounds from aqueous matrix
- Elution of interesting compounds with solvent systems, which compensate the ionic and nonpolar interactions, e.g., methanolic HCl

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8, benzenesulfonic acid modified silica, strongly acidic cation exchanger (capacity ~ 0.5 meq/g)

Recommended application

- Amino acids, amines, chlorophyll, PCBs

Sulfonamides in meat and kidney

MN Appl. No. 302710

B. Pacciarelli et al., Mitt. Gebiete Lebensm. Hyg. 82 (1991) 45–55

Compounds investigated:
sulfaguanidine, sulfanilamide, sulfadiazine, sulfathiazole, sulfapyridine, sulfamerazine, sulfamethizole, sulfadimidine, sulfamethoxypyridazine, sulfachlorpyridazine, sulfadoxine, sulfadimethoxine

Column type:
CHROMABOND® SA (≡ SCX), 3 mL, 500 mg
REF 730077

Sample pretreatment: homogenize 10 g sample and 60 mL dichloromethane – acetone (1:1, v/v) for 30 s with a Polytron. Centrifuge the homogenate for 10 min at 2500 rpm. Filter the organic phase and wash the filter residue with a little dichloromethane – acetone. Add 5 mL glacial acetic acid to the filtered extract.

Column conditioning: apply 6 mL hexane and suck air until the column is dry (10 min). Then apply 6 mL dichloromethane – acetone – glacial acetic acid (10:10:1, v/v/v). Now the column must not run dry.

Sample application:
1/10 of the extract volume, flow rate about 2 mL/min; the column must not run dry

Column washing: 5 mL water, then 5 mL methanol; dry for 10 min under vacuum. Now suck NH_3 gas through the column until the acid is neutralized. To control the neutralization process, press air through the column: a wet pH paper should indicate a neutral or basic pH value.

Elution: 3 mL methanol (1–2 mL/min); carefully concentrate the eluate on a rotation evaporator (40 °C/100 mbar), dissolve the residue in 0.5 mL of 5.5 % acetonitrile in buffer (1.641 g sodium acetate in 1 L water, adjusted to pH 5 with glacial acetic acid) and centrifuge.

Further analysis: HPLC

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	Pack of
CHROMABOND® SA polypropylene columns					
1 mL	730076				100
3 mL		730275	730077		50
6 mL			730425	730212	30
CHROMABOND® SA polypropylene columns · BIGpack					
3 mL			730077.250		250
CHROMABOND® LV-SA					
15 mL			732083		30

	Size → S	M	L	
Minimum adsorbent weight →	80 mg	200 mg	580 mg	Pack of
CHROMAFIX® SA cartridges				
	731831	731832	731833	50

	96 x 100 mg	Pack of
CHROMABOND® MULTI 96 SA		
	738141.100M	1
CHROMABOND® SA adsorbent		
	730609	100 g

Glass columns on request.

CHROMABOND® ion exchangers

CHROMABOND® SB quaternary ammonium anion exchanger based on silica (SAX)

Key features

- Not suited for very strong anions such as sulfonic acids because these are difficult to elute

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8, silica modified with quaternary amine, strongly basic anion exchanger (capacity ~ 0.3 meq/g)

Recommended application

- Organic acids, caffeine, saccharin

Vitamins: folic acid from food (e.g., wheat germs)

MN Appl. No. 300650

Column type:
CHROMABOND® SB (≡ SAX), 3 mL, 500 mg
REF 730079

Sample pretreatment: homogenize 10 g food sample in 100 mL 0.01 mol/L phosphate buffer pH 7.4 and filter
Column conditioning: 2 column volumes *n*-hexane, then 2 column volumes methanol, finally 2 column volumes dist. water
Sample application: force or aspirate 10 mL of the filtrate through the column
Column washing: 2 column volumes dist. water
Elution: 5 mL 10 % sodium chloride in 0.1 mol/L sodium acetate buffer

Ordering information

Volume	Adsorbent weight → 100 mg	200 mg	500 mg	1 g	Pack of
CHROMABOND® SB polypropylene columns					
1 mL	730078				100
3 mL		730322	730079		50
6 mL			730426	730323	30
CHROMABOND® SB polypropylene columns · BIGpack					
3 mL			730079.250		250
CHROMABOND® LV-SB					
15 mL			732088		30

	Size → S	Size → M	Size → L	
Minimum adsorbent weight →	80 mg	180 mg	500 mg	Pack of
CHROMAFIX® SB cartridges				
	731834	731835	731836	50

	96 x 100 mg	Pack of
CHROMABOND® MULTI 96 SB		
	738101.100M	1
CHROMABOND® SB adsorbent		
	730610	100 g

Glass columns on request.

CHROMABOND® PCA propylcarboxylic acid cation exchanger based on silica (WCX)

Key features
- Weakly acidic cation exchanger (WCX)

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Propylcarboxylic acid modified silica

Recommended application
- Strong cations

Ordering information

Volume	Adsorbent weight → 500 mg	1 g	Pack of
CHROMABOND® PCA polypropylene columns			
3 mL	730482		50
6 mL	730483	730484	30
CHROMABOND® LV-PCA			
15 mL	732482		30
CHROMABOND® PCA adsorbent			
		730629	100 g

Glass columns, LV columns, CHROMAFIX® cartridges and MULTI 96 on request.

CHROMABOND® PSA propylsulfonic acid cation exchanger based on silica

Key features
- In contrast to the SA phase no π-π interactions

Technical characteristics
- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Propylsulfonic acid modified silica, very strong cation exchanger (capacity ~ 0.7 meq/g)

Recommended application
- Weak cations

Ordering information

Volume	Adsorbent weight → 100 mg	500 mg	1 g	Pack of
CHROMABOND® PSA polypropylene columns				
1 mL	730460			100
3 mL		730462		50
6 mL			730464	30
CHROMABOND® PSA adsorbent				
			730630	100 g

Glass columns, LV columns, CHROMAFIX® cartridges and MULTI 96 on request.

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® Drug special silica phase for drug analysis

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm, specific, surface 500 m^2/g, pH stability 2–8
- Special bifunctional modification - C_8: RP interaction SA: strong cation exchanger / benzenesulfonic acid

Recommended application

- Enrichment of acidic, neutral and basic drugs from urine or plasma

Drugs from blood serum

MN Appl. No. 302020

W. Weinmann, M. Renz, C. Pelz, P. Brauchle, S. Vogt, S. Pollak, Blutalkohol 35 (1998), 1–9

Compounds investigated: benzoylecgonine, amphetamine, codeine, morphine

Column type:
CHROMABOND® Drug, 3 mL, 200 mg
REF 730168

Sample pretreatment: 0.1 mL blood serum are mixed with 1.4 mL of a 0.1 mol/L KH_2PO_4 buffer (pH 6) and centrifuged

Column conditioning: 2 mL methanol, then 2 mL 0.1 mol/L KH_2PO_4 buffer (pH 6)

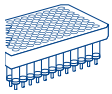
Sample application: slowly force or aspirate the supernatant from the sample pretreatment through the column

Column washing: 2 mL 0.1 mol/L KH_2PO_4 buffer (pH 6), then 1 mL 0.1 mol/L acetic acid, then 2 mL methanol; finally dry the column first by centrifugation (2 min, 4000 U/min), then under vacuum for 10 min

Elution: 1.5 mL dichloromethane – 2-propanol – 25 % ammonia solution (80:20:2, v/v/v)

Further analysis: HPLC with NUCLEOSIL® 100-5 C_{18} AB (application 110240) or GC/MS after derivatization with perfluoropropanoic acid pentafluoropropanol, e.g., with column OPTIMA® 5 MS, 0.25 µm film, 30 m x 0.25 mm ID, (REF 726220.30)

Ordering information

	Volume	Adsorbent weight → 100 mg	200 mg	500 mg	Pack of
	**CHROMABOND® Drug polypropylene columns**				
	1 mL	730681			100
	3 mL		730168	730684	50
	6 mL			730682	30
	CHROMABOND® Drug polypropylene columns · BIGpack				
	3 mL		730168.250		250
	**CHROMABOND® LV-Drug**				
	15 mL		732168		30
				96 x 100 mg	Pack of
	CHROMABOND® MULTI 96 Drug				
				738161.100M	1

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® Drug II extraction of THC and derivatives, acidic analytes from biological fluids (urine, blood, etc.)

Key features

- Two primary retention mechanisms facilitate use of very strong interferant-eluting solvents, resulting in very pure extracts

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2-8
- Special bifunctional modification - C_8: RP interaction
  SB: strong anion exchanger/quaternary amine $–NR_3^+$

Recommended application

- Extraction of THC and derivatives from urine, blood, serum, plasma
- Acidic analytes from biological fluids

11-nor-Δ^9-THC-carboxylic acid from urine

MN Appl. No. 303880

Compounds investigated: tetrahydrocannabinol, 11-nor-Δ^9-THC-carboxylic acid

Column type:
CHROMABOND® Drug II, 3 mL, 200 mg
REF 730680

Sample pretreatment:
add 300 µL 10 mol/L potassium hydroxide solution and internal standard (for GC/MS deuterium labeled 11-nor-Δ^9-THC-carboxylic acid) to 5 mL urine. Vortex the sample and then hydrolyze at 60 °C for 15 min. Cool sample and add 200 µL glacial acetic acid and 2 mL 50 mmol/L ammonium acetate solution. If necessary, adjust sample pH to 6–7.

Column conditioning:
2 mL methanol, 2 mL dist. water; equilibrate column with 2 mL 50 mmol/L ammonium acetate buffer

Sample application: slowly force or aspirate the sample through the column (1–2 mL/min)

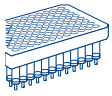
Column washing: elute interferants with 10 mL methanol – water (1:1, v/v); dry the column for 10 min at high vacuum; further wash the column with 2 mL acetonitrile and dry for another 2 min

Elution: elute THC metabolites with 3 mL hexane – ethyl acetate – glacial acetic acid (75:25:1, v/v/v)

Recovery rates: 70–80 %

Further analysis: we recommend GC/MS on an OPTIMA® 5 MS column after derivatization with 50 µL SILYL-991 (REF 701480; BSTFA – TMCS 99:1) at 70 °C for 20 min; inject 1–2 µL onto the GC column.

Ordering information

	Volume	Adsorbent weight → 100 mg	200 mg	500 mg	Pack of
	**CHROMABOND® Drug II polypropylene columns**				
	1 mL	730685			100
	3 mL		730680	730686	50
	6 mL			730683	30
	**CHROMABOND® LV-Drug II**				
	15 mL		732681		30
				96 x 100 mg	Pack of
	CHROMABOND® MULTI 96 Drug II				
				738680.100M	1

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® Tetracycline special phase for enrichment of tetracyclines

Key features

- Silica phase with special C_{18} modification, tested for tetracyclines
- Constant recovery rates for the title compounds (every batch individually tested)

Recommended application

- Tetracyclines from biological samples

Tetracyclines from musculature

MN Appl. No. 302030

Private communication of Mr. Lippold, Chemisches Landesuntersuchungsamt (Chem. Research Agency) Freiburg, Germany

Compounds investigated: tetracycline, oxytetracycline, chlorotetracycline (100–500 mg/kg)

Column type:
CHROMABOND® Tetracycline, 6 mL, 500 mg
REF 730315

Sample pretreatment: see detailed description in appl. 302030 at *www.mn-net.com/apps*

Column conditioning: 1 column volume methanol, 1 column volume dist. water, then 1 column volume EDTA – succinate buffer

CAUTION: DO NOT LET THE COLUMN RUN DRY!

Sample application: force or aspirate 50 mL of the eluate from the sample pretreatment through the CHROMABOND® column

Column washing: 2 mL dist. water (removal of Cu ions), 2 mL *n*-hexane

Elution: 7.5 mL methanol into a 25-mL tapered flask. Add 1 mL of an ethylene glycol – methanol mixture (22 g ethylene glycol filled up to 100 mL with methanol) and evaporate to dryness with a rotation evaporator (max. 40 °C). Fill up the residue to 400 mL with 0.1 mol/L McIlvain-EDTA buffer (52.5 g citric acid · H_2O, 44.5 g Na_2HPO_4 · H_2O and 93 g Titriplex III dissolved in 2.5 L dist. water, adjusted to pH 4 with NaOH).

Recovery rates: tetracycline, chlorotetracycline ~50–70 %, oxytetracycline ~60–80 %

Further analysis: HPLC with column 250 x 4 mm NUCLEOSIL® 100-5 C_{18} HD (application 110710))

Ordering information

	Volume	Adsorbent weight → 500 mg	Pack of
	CHROMABOND® Tetracycline polypropylene columns		
	6 mL	730315	30

Product for research purposes only (see page 395)

CHROMABOND® HR-P-AOX AOX from waters with high salt loads (DIN 38409 – H22)

Technical characteristics

- Special PS/DVB phase

Recommended application

- Extraction of AOX (adsorbable organically bonded halogens) from waters containing high salt loads or organic pollutants in accordance with DIN 38409 – H22

AOX from water (DIN 38409 – H22)

MN Appl. No. 302080

Column type:
CHROMABOND® HR-P-AOX, 6 mL, 500 mg
REF 730111.AOX

Column conditioning: 5 mL methanol, 10 mL dist. water
Do not let the column run dry!

Sample application: force or aspirate 100 mL original or diluted sample (pH 1) through the column (3–5 mL/min). Do not let the column run dry!

Column washing: 50 mL nitrate rinsing solution (dissolve 17 g $NaNO_3$ in 100 mL dist. water, add 1.4 mL HNO_3 10 mol/L, fill up to 1000 mL; take 50 mL and fill to 1000 mL with dist. water). Discard the flowthrough.

Elution: slowly aspirate 1 x 1 mL, then 1 x 4 mL methanol and 10 mL dist. water through the column.
Collect eluates in 100 mL volumetric flask and fill to 100 mL with dist. water.

Ordering information

Volume	Adsorbent weight → 200 mg	500 mg	Pack of
CHROMABOND® HR-P-AOX polypropylene columns			
6 mL	730119.AOX	730111.AOX	30

CHROMABOND® C_{18} PAH octadecyl silica for PAH analysis

Technical characteristics

- Base material silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Special octadecyl modification for the enrichment of PAHs, not endcapped, carbon content 14 %

Recommended application

- PAHs from water

PAHs from water

MN Appl. No. 301250

Column type:
CHROMABOND® C_{18} PAH, 6 mL, 2 g
REF 730166

Sample pretreatment: mix 1000 mL water sample with 10 mL methanol

Column conditioning: 1 column volume methanol, then 1 column volume dist. water

Sample application: aspirate 1000 mL water sample through the column (~ 15–20 mL/min), then dry column (stream of nitrogen or 24 h in a desiccator over P_2O_5)

Elution: elute with 4 mL acetonitrile – benzene (3:1, v/v) and then evaporate or fill up to the volume required

Recovery rates (50 ng/L per component): Naphthaline 87 %, Acenaphthylene 89 %, Acenaphthene 90 %, Fluorene 82 %, Phenanthrene 85 %, Anthracene 90 %, Fluoranthene 89 %, Pyrene 89 %, Benz[*a*]anthracene 87 %, Chrysene 95 %, Benzo[*b*]fluoranthene 91 %, Benzo[*k*]fluoranthene 89 %, Benzo[*a*]pyrene 90 %, Dibenz[*ah*]anthracene 97 %, Benzo[*ghi*]perylene 91 %, Indeno[1,2,3-*cd*]pyrene 96 %

Ordering information

Volume	Adsorbent weight → 2 g	Pack of
CHROMABOND® C_{18} PAH polypropylene columns		
6 mL	730166	30
CHROMABOND® C_{18} PAH glass columns		
6 mL	730166G	30
CHROMABOND® C_{18} PAH adsorbent		
	730616	100 g

CHROMABOND® NH_2/C_{18} combination phase for PAH analysis

Key features

- Special combination phase:
  Aminopropyl phase for removal of interfering humic acids
  octadecyl phase for the enrichment of PAHs

Recommended application

- PAHs from water containing humic acids

PAHs from water containing humic acids

MN Appl. No. 301260

Column type:
CHROMABOND® NH_2/C_{18}, 6 mL, 500 mg/1 g glass column
REF 730620G

Sample pretreatment: mix 500 mL water sample with 25 mL 2-propanol

Column conditioning: 10 mL dichloromethane, 10 mL methanol, then 10 mL dist. water – 2-propanol (9:1, v/v)

Sample application: aspirate 500 mL prepared water sample through the column (~ 5 mL/min)

Column washing: 2 mL dist. water – 2-propanol (9:1, v/v), then dry column (about 20 min, vacuum)

Elution: 4 x 0.5 mL CH_2Cl_2 (let percolate first 0.5 mL into the column packing without vacuum, then apply light vacuum), if necessary evaporate in a stream of N_2 and fill up with a suitable solvent

Ordering information

Volume	Adsorbent weight → 500/500 mg	500 mg / 1 g	Pack of
CHROMABOND® NH_2/C_{18} polypropylene columns			
6 mL	730618	730620	30
CHROMABOND® NH_2/C_{18} glass columns			
6 mL	730618G	730620G	30

CHROMABOND® CN/SiOH combination phase for PAH analysis

Key features

- Cyanopropyl phase for selective adsorption of polycyclic aromatics via π-π interactions
- Unmodified silica phase for removal of polar compounds

Recommended application

- Extraction of the 16 PAHs according to EPA from soil samples

PAHs from soil

MN Appl. No. 301310

Column type:
CHROMABOND® CN/SiOH, 6 mL, 500/1000 mg
REF 730135

Sample pretreatment: dry 30 g soil with sodium sulfate and reflux 4 h with 250 mL petroleum ether in a Soxhlet extractor. For low PAH contents (colorless or weakly colored extracts) concentrate extract to 1/10 of its volume in a rotation evaporator.

Column conditioning: 4 mL petroleum ether

Sample application: aspirate 20 mL of the extract through the column

Column washing: 2 mL petroleum ether

Elution: 2 x 2 mL acetonitrile – toluene (3:1, v/v), then evaporate or fill to the volume required

Further analysis: HPLC, e.g., with column 100 x 4 mm NUCLEODUR® C_{18} PAH, 3 µm, REF 760783.40 according to application 123820 (see page 227)

For recovery rates see application 301310 at *www.mn-net.com/apps*

Ordering information

Volume	Adsorbent weight → 500 mg / 1 g	Pack of
CHROMABOND® CN/SiOH polypropylene columns		
3 mL	730112	50
6 mL	730135	30
CHROMABOND® CN/SiOH glass columns		
6 mL	730135.250	250
CHROMABOND® CN/SiOH glass columns · BIGpack		
6 mL	730135G	30

CHROMABOND® Na_2SO_4/Florisil® hydrocarbons from water in accordance with DIN H-53 / ISO DIS 9377-4

Key features

· Special combination phase of sodium sulfate and Florisil®

Recommended application

· Hydrocarbons from drinking, surface and waste waters

Hydrocarbons from water

MN Appl. No. 302090

Column type:
CHROMABOND® Na_2SO_4/Florisil®, 6 mL, 2 g/2 g glass column
REF 730249G

Internal standard solution: dissolve 20 mg *n*-tetracontane ($C_{40}H_{82}$) in petroleum ether, add 20 mL *n*-decane ($C_{10}H_{22}$) and fill up to one liter with petroleum ether. For the preparation of the extraction solution dilute standard solution 1:10 with petroleum ether.

Sample pretreatment: adjust 900 mL water (10 °C) with HCl (12 mol/L) to pH 2 and add 80 g $MgSO_4$. Add 50 mL of the extraction solution, close the bottle and stir the suspension intensely for 30 min. Add enough dist. water to separate the organic from the aqueous phase.

Column conditioning: 5 mL petroleum ether

Sample application: slowly aspirate or force the sample through the column

Elution: wash with 10 mL petroleum ether. Evaporate the combined solution from sample application and elution to 1 mL at about 75 °C. If necessary, fill up to 1 mL again. (If the hydrocarbon content is high, evaporation to 1 mL may not be necessary.)

Recovery rates: must be > 80 % for *n*-tetracontane

Ordering information

Volume	Adsorbent weight → 2 g / 2 g	Pack of
CHROMABOND® Na_2SO_4/Florisil® polypropylene columns		
6 mL	730249	30
CHROMABOND® Na_2SO_4/Florisil® glass columns		
6 mL	730249G	30
CHROMABOND® Na_2SO_4/Florisil® glass columns · BIGpack		
6 mL	730249G.250	250

CHROMABOND® NAN special phase for PCB analysis

Key features

- N: sodium sulfate for removal of trace water
- A: SiOH/$AgNO_3$ phase for removal of sulfur, sulfur-containing and polar compounds

Recommended application

- Extraction of PCBs from sludge

PCB from sludge

MN Appl. No. 301400

Compounds investigated: polychlorinated biphenyls (PCB)
This method can also be used for soil samples.

Column type:
CHROMABOND® NAN, 6 mL, 700/2000/700 mg
REF 730149

Sample pretreatment:
extract 2 g lyophilized sludge with 70 mL *n*-hexane, evaporate extract and fill to 10 mL with *n*-hexane

Column conditioning: 10 mL *n*-hexane

Sample application: aspirate 2 mL extract into the column

Elution: slowly aspirate 40 mL *n*-hexane through the column with light vacuum, then evaporate and fill to 5 mL with *n*-hexane

Recovery rates: PCB-28 104 %, PCB-52 100 %, PCB-101 99 %, PCB-138 98 %, PCB-153 101 %, PCB-180 98 %, PCB-209 104 %

Ordering information

	Volume	Adsorbent weight → 400/1400/400 mg	700/2000/700 mg	Pack of
	**CHROMABOND® NAN polypropylene columns**			
	3 mL	730109		50
	6 mL		730149	30
	CHROMABOND® NAN polypropylene columns · BIGpack			
	6 mL		730149.250	250
	CHROMABOND® NAN glass columns			
	6 mL		730149G	30
	**CHROMABOND® NAN adsorbent***			
		730619		100 g

* This product contains harmful substances which must be specially labeled as hazardous. For detailed information please see SDS.

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® SA/SiOH combination phase for PCB analysis

Key features

- SA: strongly acidic cation exchanger based on silica with benzenesulfonic acid modification
- SiOH: unmodified silica for removal of polar compounds

Recommended application

- Extraction of PCBs from waste oil (hexane extract)

PCB from waste oil

MN Appl. No. 301390

Column type:
CHROMABOND® SA/SiOH, 3 mL, 500/500 mg
REF 730132

Column conditioning: 1 mL *n*-hexane

Sample application: apply 250 µL waste oil sample to the column and aspirate or force it into the adsorbent with 2 x 1 mL *n*-hexane

Elution: aspirate or force another 2 x 500 µL *n*-hexane through the column; collect all *n*-hexane fractions and if necessary adjust concentration for subsequent analysis by either evaporating *n*-hexane in a stream of nitrogen or by dilution with *n*-hexane

Recovery rates: PCB-28 97 %, PCB-52 96 %, PCB-101 95 %, PCB-138 90 %, PCB-153 95 %, PCB-180 96 %, PCB-209 100 %

Ordering information

Volume	Adsorbent weight → 500/500 mg	Pack of
CHROMABOND® SA/SiOH polypropylene columns		
3 mL	730132	50
6 mL	730235	30
CHROMABOND® SA/SiOH polypropylene columns · BIGpack		
3 mL	730132.250	250

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

PCBs can be separated successfully with e.g., OPTIMA® XLB (see page 317).

CHROMABOND® SiOH-H_2SO_4/SA combination phase for PCB analysis

Key features

- SiOH-H_2SO_4: H_2SO_4-impregnated silica phase for oxidation of accompanying compounds to ionic and/or polar compounds
- SA: strongly acidic cation exchanger based on silica with benzenesulfonic acid modification for removal of ionic and sulfur-containing compounds
- This combination column is used together with a SiOH column. Both columns together are available as Kombi-Kit PCB.

Recommended application

- Extraction of PCBs from oil with reference to German industrial standard DIN 51527, part 1

PCB in oil samples

MN Appl. No. 301380

determination with reference to German industrial standard DIN 51527

Column type:
CHROMABOND® SiOH-H_2SO_4/SA, 3 mL, 500/500 mg and
CHROMABOND® SiOH, 3 mL, 500 mg
REF 730085 and 730073
or Kombi-Kit PCB, REF 730125

Sample pretreatment: extract oil-contaminated solids with *n*-hexane. Homogenize other oil samples and dissolve 1.5 to 2.0 g in 50 mL *n*-hexane. Water which may cause turbidity can be removed with sodium sulfate.

Column conditioning: let 1 mL *n*-hexane flow through the CHROMABOND® SiOH-H_2SO_4/SA column

Sample application: aspirate or force 500 µL sample through the CHROMABOND® SiOH-H_2SO_4/SA column. This phase offers better removal of interfering substances due to sulfonation. Place CHROMABOND® SiOH-H_2SO_4/SA column on top of the SiOH column with the aid of an adapter and after at least 30 s flush sample into the SiOH column with 2 x 1 mL *n*-hexane.

Elution: elute SiOH column with 3 x 0.5 mL *n*-hexane; adjust to a suitable concentration for subsequent GC analysis by evaporation of *n*-hexane in a stream of nitrogen or by dilution with *n*-hexane

Recovery rates: PCB-28 99 %, PCB-52 95 %, PCB-101 99 %, PCB-138 94 %, PCB-153 99 %, PCB-180 96 %, PCB-209 101 %

Ordering information

Volume	Adsorbent weight → 500/500 mg	Pack of
CHROMABOND® SiOH-H_2SO_4/SA polypropylene columns		
3 mL	730085	50
CHROMABOND® SiOH-H_2SO_4/SA polypropylene columns · BIGpack		
3 mL	730085.250	250
CHROMABOND® SiOH-H_2SO_4/SA glass columns		
3 mL	730085G	50
Kombi-Kit for extraction of PCB from oil with reference to DIN 51527, part 1		
25 columns each of CHROMABOND® SiOH-H_2SO_4/SA and CHROMABOND® SiOH	730125	1

CHROMABOND® QuEChERS special silica phase for determination of pesticides in food samples

Key features

- Reliable CHROMABOND® adsorbents
- Different packaging with mixes for all established methods
- Convenient to use - pre-weighed and mixed
- Saves time and money
- Increases efficiency in the laboratory
- Individual combination of mixes on request

Recommended application

- Special SPE phase for quick and cheap determination of pesticides in strongly matrix-contaminated samples by GC or HPLC
- QuEChERS methode = Quick Easy Cheap Effective Rugged Safe

CHROMABOND® Diamino special silica phase for determination of pesticides in food samples

Key features

- Base material silica, pore size 60 Å
- Removes polar compounds (e.g., organic acids, pigments, sugars) from matrices like fruit or vegetables

Technical characteristics

- Particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8
- Primary and Secondary Amine functions (PSA), 5 % C

Similar phases

- Supelclean™ PSA, Bond Elut® PSA

Food analysis

QuEChERS methods and ready-mixes

Within a few years after its development by Anastassiades et al. [1] the QuEChERS method has gained a leading position for determination of pesticide residues in food samples by GC-MS or LC-MS, allowing rapid and cheap clean-up of strongly matrix-contaminated samples.

Advantages of QuEChERS in comparison with classical clean-up methods:

- High through-put, due to easy handling and time-saving procedure
- Low consumption of solvents
- No need for chlorinated solvents
- Suitable for a variety of pesticides
- Rugged method with high and safe recovery rates
- Broad applications for various foods

To optimize the extraction of pH-dependent compounds, to minimize decomposition of sensitive substances, and to broaden the matrix spectrum, different modifications of the QuEChERS method have been elaborated. These mixes differ in the type of buffer agent used and in this way the resulting pH value of the aqueous sample during the extraction vary.

Today three methods are used:

- Original (non-buffered) [1]
- AOAC Standard 2007.1 (acetate buffered) [2]
- EN 15662 (citrate buffered) [3]

In particular the buffered versions are commonly used.

All methods require two proceeding steps:

- Extraction: pesticides are transferred from the aqueous to the organic layer (often acetonitrile)
- Clean-up: Interfering substances (like e.g., lipids, pigments), which were also extracted with the organic layer, are removed by special adsorbents

Analysis: Sample is analyzed by GC-MS or LC-MS/MS

The QuEChERS procedure is described in the following in accordance with EN 15662:2008. An extraction mix and a clean-up mix is required.

Step 1 – Extraction and salting-out

1. Homogenize sample (e.g., with dry ice in a blender)
2. Weigh 10 g of the sample into a centrifuge tube
3. Add 10 mL of acetonitrile and internal standard
4. Shake vigorously for 1 minute
5. Add extraction mix to centrifuge tube

   Optional: check pH and adjust pH to 5.0–5.5 with 5 mol/L aqueous NaOH.
6. Shake vigorously for 1 minute
7. Centrifuge for 5 minutes at > 3000 g. For the determination of pesticides with acidic groups, the raw extract should be analyzed directly (preferably by LC/MS ESI neg.)

Step 2 – Clean-up

1. Transfer an aliquot of the supernatant to a centrifuge tube containing a clean-up mix
2. Shake for 30 seconds
3. Centrifuge for 5 minutes at > 3000 g

Analysis

Transfer supernatant to vial, acidify with 5 % formic acid in acetonitrile (10 µL/mL extract) and analyze the sample by LC-MS or GC-MS. MACHEREY-NAGEL offers a variety of pre-weighed and mixed extraction and clean-up mixes, which are in accordance with the above mentioned standardized methods, specially adapted to the different sample matrices. These matrices differ in their characteristics e.g., low or high fat content or different amounts of pigments.

If you require an individual mix, which differs in the composition from the below mentioned mixes, please contact us.

Additional MACHEREY-NAGEL offers the reliable adsorbent CHROMABOND® Diamino (PSA) as bulk material.

The following table provides guidance for the choice of different QuEChERS mixes:

Step 1 – Extraction and salting-out

Method	Sample weight	Solvent	Content of mix	Mix
EN 15662:2008, citrate-buffered [2]	10 g	10 mL acetonitrile	4 g $MgSO_4$, 1 g NaCl, 0.5 g Na_2H citrat · 1.5 H_2O, 1 g Na_3 citrat · 2 H_2O	Mix I
AOAC 2007.01, acetate-buffered [3]	15 g	15 mL 1 % acetic acid in acetonitrile	6 g $MgSO_4$, 1.5 g NaOAc	Mix II
Original non-buffered [1]	10 g	10 mL acetonitrile	4 g $MgSO_4$, 1 g NaCl	Mix XII

Step 2 – Clean-up

Sample property	Content of mix	EN 15662	AOAC 2007.01
Low fat content e.g., apple, asparagus, broccoli, pear, pineapple, strawberry	$MgSO_4$ Diamino (PSA)	Mix III	Mix XX
Moderate content of chlorophyll and carotinoids e.g., carrot, lettuce	$MgSO_4$ Diamino (PSA) Carbon	Mix IV	Mix XVII
Higher content of chlorophyll and carotinoids e.g., pepper, spinach, blackberry, raspberry	$MgSO_4$ Diamino (PSA) Carbon	Mix V	–
Higher fat content e.g., avocado, cereals, nuts, beef, chicken, pork, dairy products, soil, oils, baby food	$MgSO_4$ Diamino (PSA) C_{18} ec	Mix VI	Mix XIX

Adsorbents and what they are used for

$MgSO_4$	removes excess of water
NaCl	for phase separation
CHROMABOND® Diamino (PSA) (Primary Secondary Amine)	removes organic and fatty acids, sugars and anthocyanin pigments
CHROMABOND® C_{18} ec (reversed phase modified silica)	traps nonpolar compounds, e.g., lipids
CHROMABOND® Carbon (GCB) (Graphitized Carbon Black)	removes pigments and sterols (please note: planar pesticides are also removed)

Further information can be found online at *www.mn-net.com* or *www.quechers.com*

Ordering information

	Volume	Adsorbent weight → 200 mg	500 mg	Pack of
	CHROMABOND® Diamino polypropylene columns			
	3 mL	730561		50
	6 mL		730562	30
	CHROMABOND® Diamino adsorbent			
		730653.20		20 g
		730653		100 g

Ordering information

Method	Mix	Volume	Content	Pack of	REF
Extraction mix 15 mL centrifuge tubes with screw cap					
EN 15662	Mix I	15 mL	4 g $MgSO_4$, 1 g NaCl, 0.5 g Na_2H Citrate · 1.5 H_2O, 1 g Na_3 Citrate · 2 H_2O	50	730970
AOAC 2007.01	Mix II	15 mL	6 g $MgSO_4$, 1.5 g NaOAc	50	730971
Original	Mix XII	15 mL	4 g $MgSO_4$, 1 g NaCl	50	730648
Clean-up-Mix 15 mL and 2 mL centrifuge tubes with screw cap					
EN 15662	Mix III	15 mL	0.90 g $MgSO_4$, 0.15 g CHROMABOND® Diamino	50	730972
EN 15662	Mix IV	15 mL	0.90 g $MgSO_4$, 0.15 g CHROMABOND® Diamino, 15 mg CHROMABOND® Carbon	50	730973
EN 15662	Mix V	15 mL	0.90 g $MgSO_4$, 0.15 g CHROMABOND® Diamino, 45 mg CHROMABOND® Carbon	50	730975
EN 15662	Mix VI	15 mL	0.90 g $MgSO_4$, 0.15 g CHROMABOND® Diamino, 150 mg CHROMABOND® C_{18} ec	50	730974
AOAC 2007.01	Mix XVII	2 mL	0.15 g $MgSO_4$, 50 mg CHROMABOND® Diamino, 50 mg CHROMABOND® Carbon	50	730996.2
AOAC 2007.01	Mix XIX	15 mL	0.15 g $MgSO_4$, 50 mg CHROMABOND® Diamino, 50 mg CHROMABOND® C_{18} ec	50	730657
AOAC 2007.01	Mix XX	15 mL	1.20 g $MgSO_4$, 0.40 g CHROMABOND® Diamino	50	730658

Further information can be found online at *www.mn-net.com* or *www.quechers.com*

Special phases · food analysis

CHROMABOND® ABC18 special phase for analysis of acrylamide in food

Key features

- Octadecyl silica phase with ion exchange functions for acrylamide analysis

Recommended application

- Clean-up of acrylamide from ultra-heated starch-containing food, such as potato chips and other snacks, french fries, crispbread, cereals etc.

Ordering information

	Volume	Adsorbent weight → 500 mg	Pack of
	CHROMABOND® ABC18 polypropylene columns		
	6 mL	730533	30

Important notes

- For “Determination of Acrylamide in Foods, SPE Clean-up Procedure for LC-MS/MS” please see application 303580 at *www.mn-net.com/apps*
- Acrylamide is created at temperatures above 100 °C from sugar and proteins, e.g., from potatoes or grain during the process of frying, baking, roasting or grilling. The formation depends on temperature, starting at 120 °C and increasing with more elevated temperatures. In cooked food, no acrylamide is found.
- Minimum concentration of acrylamide should be 70 µg/kg.
- The procedure includes no concentration step.
- Acrylamide and the isotopically labeled form, is carcinogenic, mutagenic and neurotoxic.

CHROMABOND® Carbon A

Technical characteristics

- Base material activated carbon, highly porous, spherical particles, specific surface >1000 m^2/g

Recommended application

- Acrylamide from water according to DIN 38413-6 (e.g., application 306140)

Enrichment of acrylamide from water acc. to DIN 38413

MN Appl. No. 306140

Column type:
CHROMABOND® Carbon A, 6 mL, 1000 mg
REF 730167

Sample pretreatment: A drinking water sample was taken according to DIN 38402. The sample was treated with 100 mg/L sodium thiosulfate pentahydrate to reduce oxidizing species. 40 mg/L sodium azide was then added to avoid microbiological degradation. An aliqout of 500 mL pretreated water sample was spiked with 50 ng acrylamide.

Column conditioning: 8 mL methanol and 8 mL water

Sample application: sample was aspirated at a flow of 20 mL/min

Column washing: 1 mL water

Drying: 15 min nitrogen or air flow

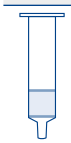
Elution: 5 x 2 mL methanol

Concentration: eluate was concentrated to 1 mL by heating at 40 °C under a slight nitrogen stream

Recovery rates: 81 % (SD: 5 % [n=6])

Further analysis: HPLC-MS/MS in reference to appl. no. 127530

Ordering information

	Volume	Adsorbent weight → 500 mg	1 g	Pack of
	CHROMABOND® Carbon A polypropylene columns			
	6 mL	730165	730167	30

CHROMABOND® PL special phase for removal of phospholipids

Key features

- CHROMABOND® PL products are designed for internal protein precipitation. External protein precipitation could be necessary in order to prevent upper frit adsorbent bed clogging.

Recommended application

- Removal of phospholipids
- Standard protocol see application 306110

Standard protocol for removal of phospholipids with internal protein precipitation

MN Appl. No. 306110

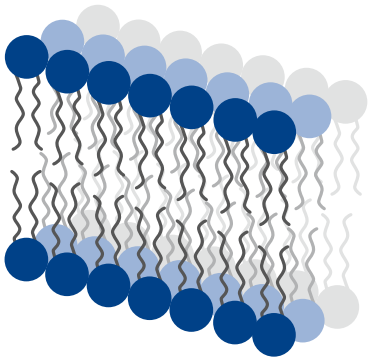
Column type:
CHROMABOND® PL, 1 mL, 30 mg, REF 730703 or
CHROMABOND® Multi 96 PL, 96 x 30 mg, REF 738702.030M

Column conditioning: none

Sample application: add up to 100 µL sample onto column / into well
Protein precipitation (internal): add protein precipitation reagent (e.g., final ratio of 3:1 to 4:1 of 1 % formic acid in acetonitrile : sample)

Mixing: mix thoroughly, avoiding cross contamination

Sample collection: slowly elute using vacuum or positive pressure



Ordering information

	Volume	Adsorbent weight → 30 mg	Pack of
	CHROMABOND® PL polypropylene columns		
	1 mL	730703	100
		96 x 30 mg	
	CHROMABOND® MULTI 96 PL		
		738702.030M	1

CHROMABOND® Dry (Na_2SO_4) special phase for drying of organic samples

Key features

- Anhydrous high-purity sodium sulfate which forms Glauber's salt with traces of water

Recommended application

- Removal of traces of water from organic solutions.
- For removal of larger quantities of water several cartridges can be combined in series.

Ordering information

	Size →	S	M	L	
	Minimum adsorbent weight →	360 mg	760 mg	2000 mg	Pack of
	CHROMAFIX® Dry cartridges				
		731852	731853	731854	50

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

Special phases · others

CHROMABOND® PTS and PTL PTS and PTL columns for phase separation

Key features

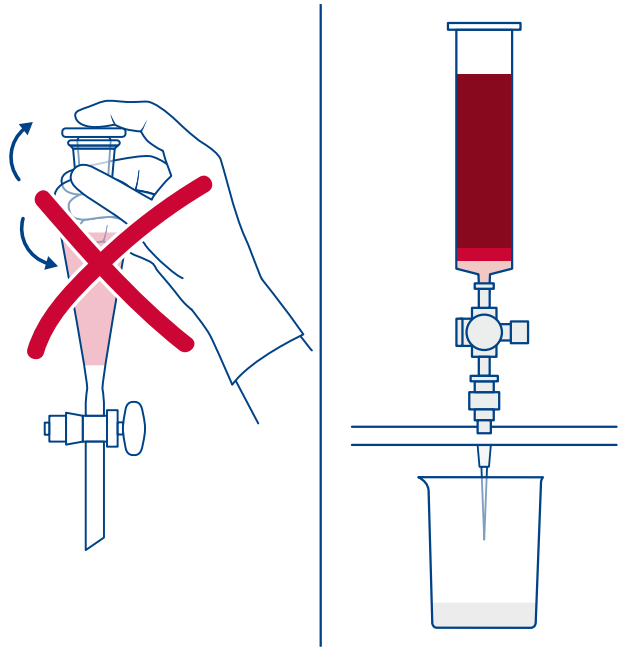
- Automatic separation of a two-phase mixture without separation funnel
- Two-phase mixtures are completely applied to the column and the phase boundary is determined without further work. The special membrane automatically stops the flow when the lower phase has passed. The upper phase remains in the column, thus both phases are available for further analysis.
- Columns must not be run with vacuum or pressure

Recommended application

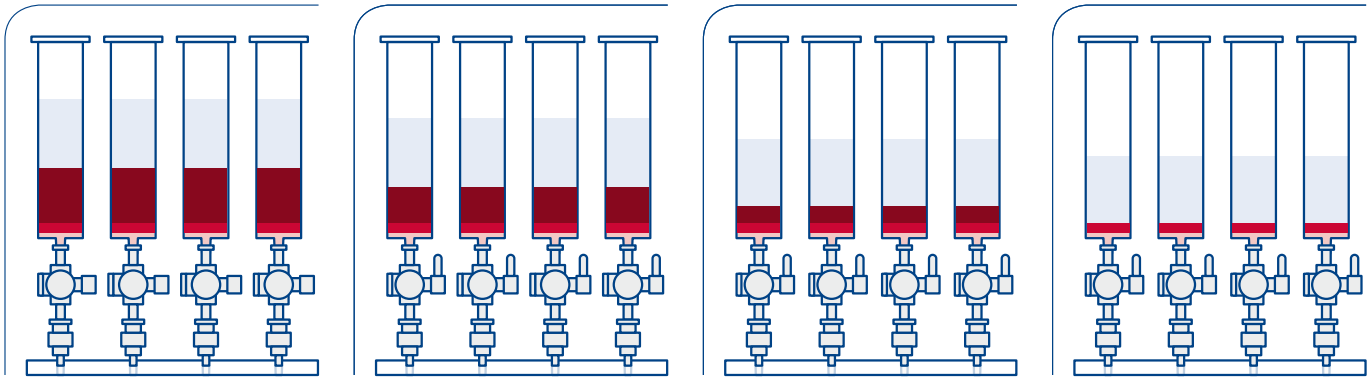
- PTS: for solvents heavier than water, e.g., trichloromethane, dichloromethane maximum size 150 mL
- PTL: for solvents lighter than water, e.g., diethyl ether, hexane maximum size 70 mL

Ordering information

Column volume	Pack of [columns]	REF
CHROMABOND® PTS for solvents heavier than water		
1 mL	100	730710
3 mL	100	730712
6 mL	100	730714
15 mL	100	730716
30 mL	100	730718
45 mL	50	730720
70 mL	50	730722
150 mL	20	730724
CHROMABOND® PTL for solvents lighter than water		
1 mL	100	730730
3 mL	100	730732
6 mL	100	730734
15 mL	100	730736
30 mL	100	730738
45 mL	50	730740
70 mL	50	730742



Ideal tool for breaking emulsions



CHROMABOND® PTL in action: organic upper phase (colorless), aqueous lower phase (red)

CHROMABOND® XTR for liquid-liquid extraction

Key features

- Base material coarse-grained kieselguhr (also known as diatomaceous earth, hydromatrix, celite), large pore size, high pore volume, constantly high batch-to-batch quality, pH working range 1–13
- Advantages:
  - Fast, reproducible and economical
  - Simultaneous preparation of several samples
  - No problems with phase separation
  - No formation of emulsions
  - High recovery rates
  - Saving of time and solvents
  - Organic solutions need not to be dried after separation

Recommended application

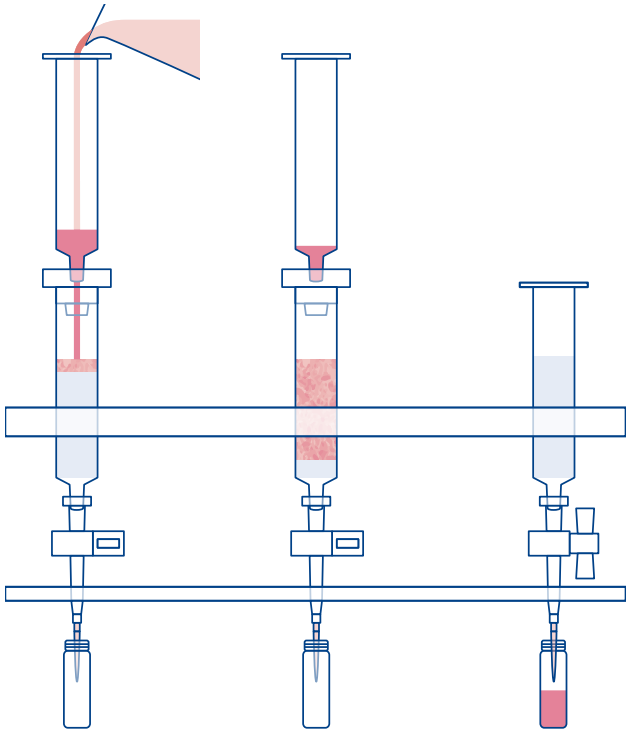
- Liquid-liquid extraction of highly viscous aqueous solutions such as physiological fluids (blood, plasma, and serum) in clinical chemistry, dyes in textiles, environmental and food analysis without use of a separation funnel
- High water loadability without breakthrough of water during elution with organic solvents also suited for removing small amounts of water from solvents which are not miscible with water

Solvents applicable for elution

- Diethyl ether
- *tert* butyl methyl ether
- Ethyl acetate
- *n*-hexane
- Cyclohexane
- Toluene
- Dichloromethane (methylene chloride)
- Trichloromethane (chloroform)
- Trichloromethane – methanol (90:10, v/v)
- Trichloromethane – methanol (85:15, v/v)
- Diethyl ether – ethanol (90:10, v/v)
- Diethyl ether – ethanol (80:20, v/v)
- Dichloromethane – 2-propanol (90:10, v/v)
- Dichloromethane – 2-propanol (85:15, v/v)

Eluents with too high alcohol contents cause an increase in volume of the aqueous phase on the CHROMABOND® XTR. Here the column could be overloaded and the aqueous phase displaced from the column. In this case, a greater capacity column should be used.

Depending on the concentration of the analytes eluates can be analyzed immediately, or the organic solvent is evaporated. The pH value of the aqueous solution can be altered on the column, which enables elution of different compounds of a sample under optimized conditions. Under certain circumstances, acidic, neutral, and basic compounds can be fractionated in this way.



Sample application | Adsorption of the sample | Sample elution

General column parameters

Volume	Adsorbent weight	Max. volume capacity of aq. solution	Waiting period before elution	Elution volume
CHROMABOND® XTR				
1 mL	250 mg	0.25 mL	5 min	3 mL
3 mL	500 mg	0.5 mL	5 min	6 mL
6 mL	1 g	1 mL	5–10 min	8 mL
15 mL	3 g	3 mL	5–10 min	12 mL
30 mL	4.5 g	5 mL	5–10 min	16 mL
45 mL	8.3 g	10 mL	10–15 min	24 mL
70 mL	14.5 g	20 mL	10–15 min	40 mL
150 mL	37.5 g	50 mL	10–15 min	90 mL

Special phases · others

Determination of azo dyes and aromatic amines in colored textile materials
with reference to § 64 LFGB (formerly § 35 LMBG)

MN Appl. No. 302100

Column type:
CHROMABOND® XTR, 70 mL, 14.5 g, for max. 20 mL aqueous solution
REF 730507

Sample pretreatment: Weigh about 1 g cut-up textile sample (colored textiles about 0.1 g) in a 100 mL threaded vial. (Degrease leather samples before processing: cover sample with technical purity *n*-hexane and put the vial in an ultrasonic bath for 20 min. After decanting the *n*-hexane rinse with little *n*-hexane and dry sample by gentle heating and blowing with air or N_2).

Add 250 µL internal standard (IS: 1.2 mg/mL tetramethylbenzidine in methanol – ethyl acetate (1:1, v/v)), 17.0 mL citrate buffer (pH 6) (25.05 g citric acid and 12.64 g NaOH, fill up with deionized water to 2 L) and heat 30 min at 70 °C.

Then add 3 mL of a freshly prepared solution of 0.2 g/mL sodium dithionite in water and heat for exactly 30 min to 70 °C while shaking occasionally.

Sample application: Cool the solution immediately (put vial in water – stopping of reductive cleavage). After 5–10 min pour it onto the CHROMABOND® XTR column (squeeze textile remains).

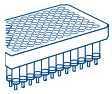
Elution: Allow solution to be soaked up by the adsorbent for 15 min. Then elute four times with 20 mL each of diethyl ether or diethyl ether – ethanol (90:10, v/v) (depending on recovery rates), using the first 40 mL to rinse the sample remains.

Evaporate eluates to 3 mL with a rotation evaporator and transfer the solution into a 10 mL measuring flask using a pasteur pipette and rinsing with methanol. Fill up to the marking with methanol, shake, and pipette about 1 mL into a vial.

Further analysis:

Fast GC on OPTIMA® δ-3, 10 m, 0.1 mm ID, 0.1 µm film, REF 726410.10 (application 210820) or HPLC on NUCLEOSIL® 100-5 C_{18} HD (application 110500 at *www.mn-net.com/apps*)

Ordering information

	Column volume	1 mL	3 mL	6 mL	15 mL	30 mL	45 mL	70 mL	150 mL
	Adsorbent weight	250 mg	500 mg	1 g	3 g	4.5 g	8.3 g	14.5 g	37.5 g
	Max. volume capacity of aqueous solution	0.25 mL	0.5 mL	1 mL	3 mL	5 mL	10 mL	20 mL	50 mL
	Pack of →	100	50	30	30	30	30	30	10
	**CHROMABOND® XTR polypropylene columns** (glass columns on request)								
		730501	730502	730487	730489	730505	730506	730507	730509
	CHROMABOND® XTR polypropylene columns · BIGpacks								
				730487.250	(250 col.)			730507.100	(100 col.)
	**CHROMABOND® MULTI 96 XTR**								
	96-well plates 96 x 150 mg, packs of 1 plate, for max. 96 x 0.2 mL aqueous solution								
				738131.150M					
	**CHROMABOND® XTR adsorbent**								
	50 bags of 14.5 g, (for max. 20 mL aqueous solution each)								
	for 70 mL PP columns with 100 PE filter elements	for NT20 with 50 PE filter elements (10 mm dia.)							
					500 g	1 kg	5 kg		
	730585	730586			730595.500	730595.1000	730595.5000		
	Accessories for liquid-liquid extraction with CHROMABOND® XTR								
	variable polypropylene rack for 24 positions, incl. 24 PP stopcocks and 24 PP needles								730508

For parallel processing of up to 24 CHROMABOND® XTR columns 1–150 mL we recommend the polypropylene rack REF 730508 consisting of: two side walls, middle part including stopcocks and needles, bottom part, top part for stabilizing 45 mL and 70 mL CHROMABOND® XTR columns.
This rack can be adjusted to various heights depending on the CHROMABOND® XTR columns and the collection vials used.

Each position of the middle part is equipped with a polypropylene stopcock on the top (REF 730185) and a polypropylene needle on the bottom (REF 730154).

For collection of the sample, vessels such as vials, test tubes, round bottom or tapered flasks, can be used. For our program of sample vials, please see the chapter “Vials and accessories” from page 97.

For further applications on CHROMABOND® phases visit our online application database at *www.mn-net.com/apps*

CHROMABOND® Vacuum manifold

Key features

- For the simultaneous preparation of up to 12, 16 or 24 samples
- Replacement parts and accessories for special applications

Vacuum manifold for 12 columns

① Rectangular glass cabinet; 2 sizes available: small for up to 12 CHROMABOND® columns or CHROMAFIX® cartridges; large for up to 16 CHROMABOND® LV columns or up to 24 CHROMABOND® columns or CHROMAFIX® cartridges (depending on lid)

② Polypropylene lid

③ Vacuum gauge for pressure reading

④ Control valve for adjustment of vacuum

⑤ Replaceable valves for vacuum control of individual SPE columns

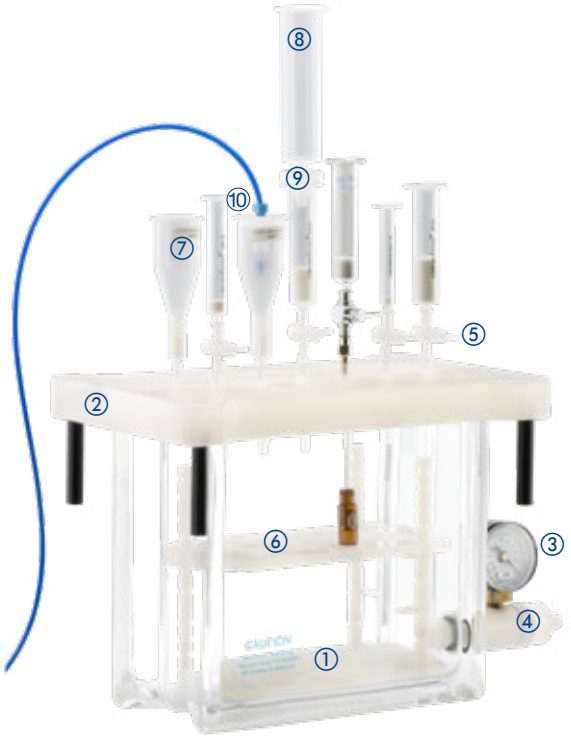
⑥ Variable rack with exchangeable partitions, which accept a wide variety of vessels like test tubes, measuring flasks, scintillation vials, autosampler vials, plastic vials etc.

⑦ CHROMABOND® LV columns with 15 mL sample reservoir for medium size samples

⑧ Polypropylene sample reservoirs (30 or 70 mL)*

⑨ Adapter for sample reservoirs*

⑩ CHROMABOND® tubing adapters



Full description and manual can be downloaded at *www.mn-net.com*

Ordering information

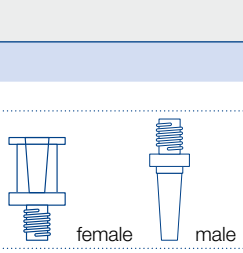
Description	Pack of	REF
Vacuum manifold complete		
consists of glass cabinet with lid and lid gasket, removable needles on lower side of lid, vacuum gauge, control valve, valves and caps, variable rack:		
for up to 12 columns or cartridges (including PP tank)	1	730150
for up to 16 LV columns	1	730360
for up to 24 columns or cartridges	1	730151
Glass cabinets without accessories ①		
for 12 columns	1	730173
for 16 LV or 24 columns (large)	1	730174
Lids with gaskets ②		
for 12 columns (including Luer fittings and valves ⑤)	1	730175
for 16 LV columns (including Luer fittings and valves ⑤)	1	730365
for 24 columns (including Luer fittings and valves ⑤)	1	730176
Gaskets for lid, for 12 columns	2	730177
Gaskets for lid, for 16 or 24 columns	2	730178

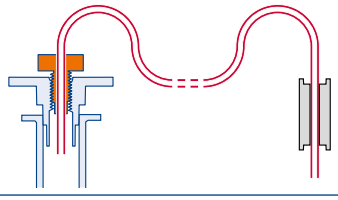
* Ordering information see on page 67.

SPE vacuum manifolds and accessories

Ordering information

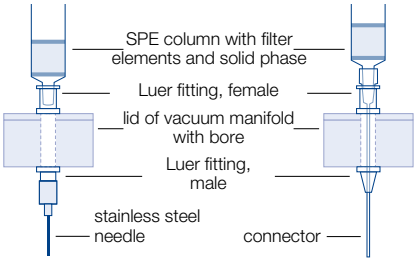
Description	Pack of	REF
General accessories for vacuum manifolds		
Luer stoppers for vacuum manifold, blue	12	730194
Luer fittings for lid, female	12	730183.12
Luer fittings for lid, male	12	730184.12
Valves, plastic ⑤	12	730185
Stainless steel needles	12	730152
Polypropylene needles	12	730154
PP tanks for vacuum manifold for 12 columns (not available for 16- or 24-position manifold)	2	730233
Vacuum gauge, complete with accessories ③ + ④	1	730179
Drying attachment and collecting racks		
for evaporation of eluates (application see below)		
Drying attachment, with 12 positions ⑪	1	730187
Drying attachment, with 16 positions	1	730990
Drying attachment, with 24 positions	1	730188
Collecting rack for 12 columns ⑥	1	730157
Collecting rack for 16 LV columns	1	730366
Collecting rack for 24 columns	1	730153
Products for protection from cross contamination		
Valve, brass, tarnished	1	730189.1
Valves, as above	12	730189.12
Stainless steel connectors	12	730106
PTFE connectors	12	730564
Tubing adapters for application of large sample volumes ⑩		
for 3 and 6 mL glass columns	4	730387
for 1, 3 and 6 mL polypropylene columns	4	730243
for 15, 45 and 70 mL polypropylene columns (material: PTFE tube length approx. 1 m)	4	730386





Protection from cross contamination

For special applications which require maximum protection from cross contamination we supply chrome-plated brass valves and stainless steel or PTFE connectors. Their application is shown on the right side. These special connectors are fitted through the lid; thus the sample only has contact with the inert connector and can flow directly into the receptacle.



Drying attachment

If the eluate has to be evaporated, this can be performed with the so-called drying attachment ⑪. This special lid has a gas connector ⑫ on one side, from which the gas is fed simultaneously to the 12, 16, or 24 stations ⑬. Thus 12, 16, or 24 eluates can be evaporated simultaneously by just changing the lid and applying a stream of inert gas, e.g., nitrogen.

For individual packing of SPE columns with CHROMABOND® adsorbents

Ordering information

Description		Pack of	REF
Empty polypropylene columns with 2 PE filter elements, 1 mL	one filter element is already inserted in the polypropylene column	100	730159
Empty polypropylene columns with 2 PE filter elements, 3 mL		50	730160
Empty polypropylene columns with 2 PE filter elements, 6 mL		30	730161
Empty polypropylene columns with 2 PE filter elements, 15 mL		20	730230
Empty polypropylene columns with 2 PE filter elements, 30 mL		20	730380
Empty polypropylene columns with 2 PE filter elements, 45 mL		20	730355
Empty polypropylene columns with 2 PE filter elements, 70 mL		20	730158
Empty polypropylene columns with 2 PE filter elements, 150 mL		20	730474
PE filter elements for polypropylene columns 1 mL		250	730164
PE filter elements for polypropylene columns 3 mL		250	730162
PE filter elements for polypropylene columns 6 mL		250	730163
PE filter elements for polypropylene columns 15 mL		250	730351
PE filter elements for polypropylene columns 30 mL		250	730034
PE filter elements for polypropylene columns 45 mL		250	730356
PE filter elements for polypropylene columns 70 mL		250	730026
PE filter elements for polypropylene columns 150 mL		250	730475
Empty glass columns with 2 glass fiber filter elements, 3 mL	one filter element is already inserted in the polypropylene column	50	730171
Empty glass columns with 2 glass fiber filter elements, 6 mL		30	730172
Glass fiber filter elements for glass columns 3 mL		250	730191
Glass fiber filter elements for glass columns 6 mL		250	730192
Empty LV polypropylene columns with PE filter elements, 15 mL, for 100 mg adsorbent weight		50	732500
Empty LV polypropylene columns with PE filter elements, 15 mL, for 200/500 mg adsorbent weight		50	732501
PE filter elements for LV polypropylene columns 15 mL for 100 mg adsorbent weight		250	732019
PE filter elements for LV polypropylene columns 15 mL for 200/500 mg adsorbent weight		250	732020
Adapters (PVDF) for glass columns		4	730104.4
Adapters as above		10	730105
Adapters (PP) for polypropylene columns (1, 3 and 6 mL)		4	730100.4
Adapters as above		10	730101
Adapters (PE) for polypropylene columns (15, 45, 70 mL)		4	730350.4
Adapters as above		10	730385
Adapter (PE) for polypropylene columns (30 and 70 mL)		1	730566
Reservoir columns for application of medium-size samples ⑧ + ⑨			
Reservoir column 30 mL, polypropylene, with one adapter for 1, 3, 6 mL CHROMABOND® polypropylene columns		1	730102
10 Reservoir columns 30 mL, polypropylene, with one adapter for 1, 3, 6 mL CHROMABOND® polypropylene columns		1 kit	730103
Reservoir column 70 mL, polypropylene, with one adapter for 1, 3, 6 mL CHROMABOND® polypropylene columns		1	730381
10 Reservoir columns 70 mL, polypropylene, with one adapter for 1, 3, 6 mL CHROMABOND® polypropylene columns		1 kit	730382
Reservoir column 70 mL, polypropylene, with one adapter for 15, 45, 70 mL CHROMABOND® polypropylene columns		1	730388
10 Reservoir columns 70 mL, polypropylene, with one adapter for 15, 45, 70 mL CHROMABOND® polypropylene columns		1 kit	730389

High throughput SPE

Automated and on-line SPE

Performing Solid Phase Extraction (SPE) manually can be time consuming and nerve-racking, especially when recovery and reproducibility are lacking due to sample variability. If SPE can be reliably automated it becomes a much more efficient and reproducible process.

On-line SPE is a powerful method in automated sample preparation where the SPE hardware is technically integrated into a HPLC system. Crude samples are placed in an autosampler and processed fully automatically prior to injection into a GC (MS) or LC (MS) system.

MN offers different on-line column configurations designed to fit your on-line SPE needs and filled with a choice of different adsorbents, modifications and particle sizes:

- Ready-to-use EC columns or ChromCart® cartridges for on-line SPE (standard dimensions 20 x 2 mm or 20 x 4 mm, resp.), filled with CHROMABOND® HR-X*pert* phases (15 µm particles) or with NUCLEODUR® C_{18} ec, C_8 ec, CN (20 µm particles)

EC column

CC-cartridges

- Columns for Gilson® ASPEC™ systems are ready to use assembled with caps. In addition to the columns and phases listed below, all 1, 3 and 6 mL CHROMABOND® polypropylene columns from our program can be supplied assembled with ASP caps.

Columns for the Gilson® ASPEC™

Ordering information Gilson® ASPEC™ columns

Volume	Adsorbent weight	Pack of [columns]	REF
CHROMABOND® SiOH			
1 mL	100 mg	100	730071ASP
3 mL	500 mg	100	730073ASP
6 mL	1000 mg	100	730075ASP
CHROMABOND® C_{18} ec			
1 mL	100 mg	100	730011ASP
3 mL	500 mg	100	730013ASP
6 mL	1000 mg	100	730015ASP

- SPE columns equipped with caps and needles to be used in the SPE unit of the Gerstel MultiPurposeSampler (MPS)

SPE cartridges for Gerstel MPS system

Gerstel MPS system

Ordering information Gerstel MPS columns

Volume	Adsorbent weight	Pack of [columns]	REF
CHROMABOND® SiOH			
3 mL	200 mg	50	730214MPS
3 mL	500 mg	50	730073MPS
6 mL	1000 mg	30	730075MPS
CHROMABOND® C_{18} ec			
1 mL	100 mg	100	730011MPS
3 mL	200 mg	50	730012MPS
3 mL	500 mg	50	730013MPS
CHROMABOND® HR-X			
1 mL	100 mg	30	730935MPS
3 mL	200 mg	30	730931MPS
6 mL	500 mg	30	730939MPS

Other dimensions and adsorbents on request.

CHROMABOND® MULTI 96 for robot systems

Alternatively CHROMABOND® MULTI 96 plates provide a means of high throughput sample preparation by processing 96 samples in a standard 8 x 12 microcolumn plate format compatible with standard 96-well plate liquid handling technologies and injection systems. MULTI 96 plates are available for solid phase extraction (SPE) and for filtration (see page 95)

CHROMABOND® MULTI 96

- 96-well PP microtiter plates with PE filter elements
- Cavity volume 1.5 mL
- Adsorbent weights 10, 25, 50, 100 mg per microcolumn
- Supplied with any CHROMABOND® SPE adsorbents
- For the simultaneous preparation of 96 samples
- Easy method transfer from CHROMABOND® columns or CHROMAFIX® cartridges to CHROMABOND® MULTI 96

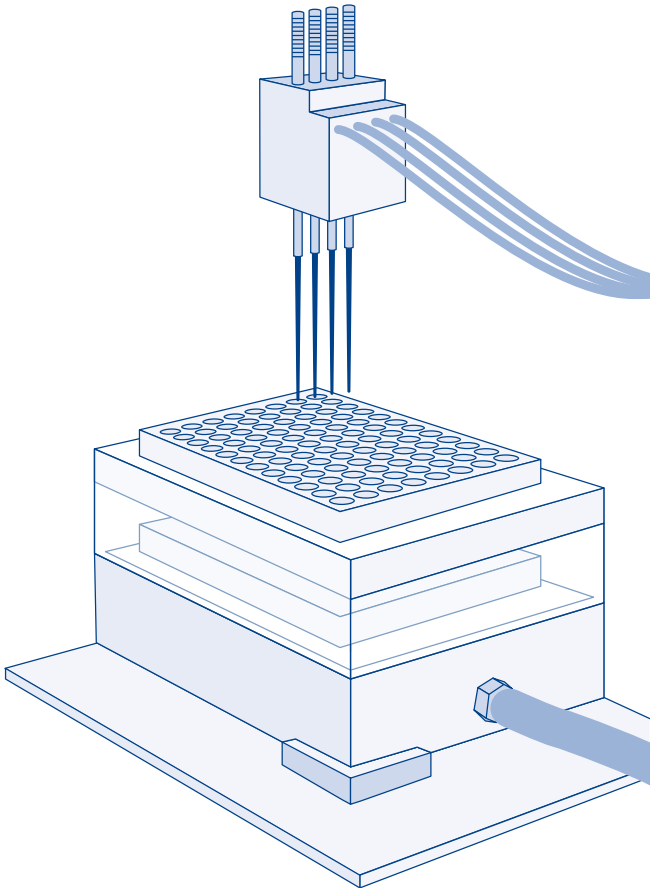
Advantages of this high-throughput system

- Simultaneous preparation of 96 samples; this means a 4-fold increase over traditional 24-position SPE processors
- Economical by saving time and solvent
- Use of multi-channel pipettors facilitates liquid transfer steps
- Readily adaptable to all common automated and robotic handling systems
- Minimized dead volume (≤ 40 µL)

Instrument compatibility

CHROMABOND® MULTI 96 SPE microtiter plates as well as CHROMAFIL® MULTI 96 filtration plates are compatible with, e.g., the following liquid handling and SPE automation systems:

- Perkin Elmer MultiProbe® II
- Tomtec Quadra 3® and Quadra 3® SPE
- Hamilton Microlab® SPE Workstation
- Beckman Coulter Biomek® 2000
- Caliper Life Science RapidTrace®
- Gilson® ASPEC™ XL4 and ASPEC™ XL
- Gilson® 215 SPE Liquid Handler
- Tecan Genesis™ FE500
- Eppendorf ep*Motion*®



CHROMABOND® MULTI 96 vacuum manifold

For handling of CHROMABOND® MULTI 96 SPE plates for up to 96 samples

CHROMABOND® MULTI 96 is designed for use in common robotic workstations or commercially available liquid handling systems. Alternatively, use of multichannel pipettors facilitates a manual liquid transfer. Extraction is carried out using the CHROMABOND® MULTI 96 vacuum manifold.

With the help of the control valve the vacuum of the manifold can be adjusted leading to an optimum flow rate through the CHROMABOND® MULTI 96 SPE plate.

A reservoir tank and 96-well collection plates (96 x 0.5 or 96 x 2 mL) made of polypropylene can be supplied as accessories.

An interesting alternative for collection of the eluates is a collection rack, which can be fitted with twelve 8-well strips of polypropylene tubes (each 1 mL).

If you have to work on less than 96 samples, you can seal individual rows of the 96-well plate with a PTFE-covered rubber pad.

738639.M

738638

738637

Ordering information

Description	Pack of	REF
CHROMABOND® MULTI 96 accessories		
CHROMABOND® MULTI 96 vacuum manifold with reservoir tank, vacuum gauge, and control valve	1	738630.M
96-well microtiter plates (polypropylene) 96 x 0.25 mL	10	738651
96-deep-well collecting plate (polypropylene) 96 x 2 mL	5	738650.5
Collection racks with polypropylene tube strips (twelve 8-well strips) 96 x 1.0 mL	5	738637
Polypropylene tube strips (twelve 8-well strips) 96 x 1.0 mL	10	738652
8-well strip sealing caps for PP tube strips (REF 738652)	30	738638
Reservoir tanks (polypropylene)	2	738639.M
Butyl rubber pad, PTFE covered for sealing of individual rows of the 96-well plate, 125 x 85 mm	1	738645

For CHROMAFIL® MULTI 96 filter plates see page 95. The ordering information of 96-well plates packed with individual CHROMABOND® adsorbents is listed with the respective phases.

MN Flash adsorbents a unique variety of phases

Key features

- Flash columns and cartridges from MACHEREY-NAGEL are available with all CHROMABOND® SPE / Flash packings (more than 40 phases, e.g., C_{18}, C_8, OH, Alox). Additionally you can choose from our range of POLYGOPREP silica packings in particle sizes from 20 to 130 µm and pore sizes from 60 to 4000 Å.
- For high performance Flash separations spherical silica featuring very high separation efficiency can be requested

Technical characteristics

- Specification of modified and plain silica, acid-washed irregular silica, pore size 60 Å, particle size 45 µm, specific surface 500 m^2/g, pH stability 2–8

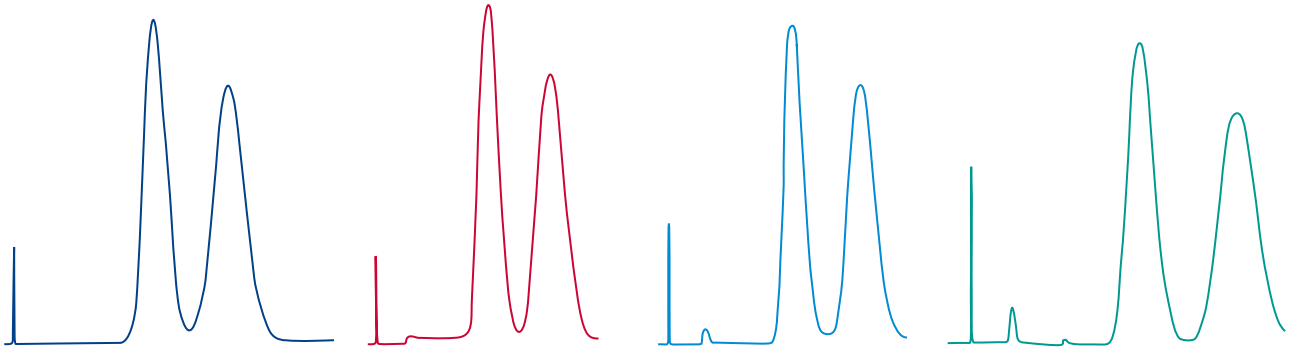
Comparison of separation efficiency and price of irregular versus spherical silica

Separation efficiency and reproducibility

Our optimized automatic packing process leads to an excellent packing quality, irrespective of the phase or particle size distribution (normal phase or reversed phase, spherical or irregular particles). MACHEREY-NAGEL, as a manufacturer of silicas, has decades of experience in the production of first class separation phases and columns. This leads to highest separation efficiencies of the columns, a constant back pressure (via controlled narrow particle size distribution) and good reproducibilities from cartridge to cartridge.

The separation efficiency is in the first place not influenced by the dimension or the geometry of the Flash RS cartridges. The chromatograms below show an identical resolution and peak form for different column dimensions, when flow and sample amount is adjusted correctly. This is advantageous for optimization and upscaling experiments.

Resolution and peak shape for different column dimensions



4 g SiOH: 0.25 mL sample, 10 mL/min

15 g SiOH: 1 mL sample, 40 mL/min

25 g SiOH: 1 mL sample, 80 mL/min

40 g SiOH: 1 mL sample, 160 mL/min

Flash chromatography

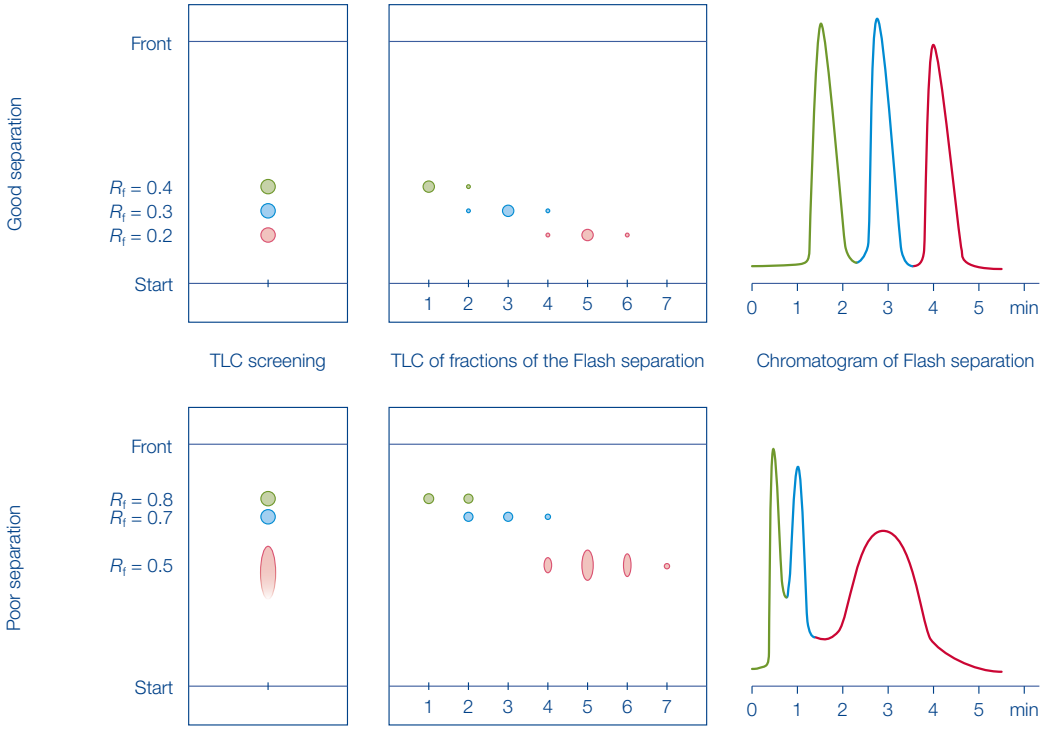
MN TLC and Flash products

- Same selectivity and easy upscaling from TLC to Flash separations
- Saving time and money, because expensive optimizations are not required

TLC is often used for the development of a selective and reproducible method in Flash chromatography, because it is often necessary to test a large number of eluent and / or adsorbent combinations. MN TLC plates and sheets are coated with the same base silica, which is used in our CHROMABOND® Flash cartridges. This is an important prerequisite for the reproducible transfer of a TLC separation to the Flash column, because the parameters are identical in both systems.

TLC screening

For TLC separation you should start with an unmodified silica and a nonpolar eluent of low viscosity (e.g., mixtures of *n*-hexane – ethyl acetate or *n*-hexane – acetone). By changing the composition of the eluent the R_f value of the TLC separation is adjusted to approx. 0.3. Increasing polarity of the eluent decreases the R_f values. The difference in R_f values between the substances to be separated should be at least 0.1 to allow a reliable separation in the subsequent flash chromatography. Variation of the eluent components (e.g., acetone, dichloromethane) can be used to enhance the separation by eluent specific selectivity.



Our program of TLC plates can be found from page 273 onwards.

Technical support for Flash RS and Flash BT

Loadability

- Due to the narrow particle size distribution, the excellent packing quality and the optimized stationary phases (acid washed silica, reduced particulate matter) our cartridges can realize highest loadability at best possible separation efficiency.
- Additionally, the large range of different cartridge lengths and diameters eases to find the optimum in loadability for a given sample amount.

Rule of thumb for the loadability

Separation	Loadability	g sample / g adsorbent
difficult	low	≤ 1 %
easy	high	≥ 10 %

Loadability table CHROMABOND® Flash RS and BT

SiOH cartridge	Average loadability per cartridge [g]	
	difficult separation	easy separation
RS / BT 4	0.04	0.4
RS / BT 15	0.15	1.5
RS / BT 25	0.25	2.5
RS / BT 40	0.4	4
RS / BT 80	0.8	8
RS / BT 120	1.2	12
RS / BT 200	2	20
RS / BT 330	3.3	33
RS 800	8	80
RS 1600	16	160

Upscaling of the optimum flow rate

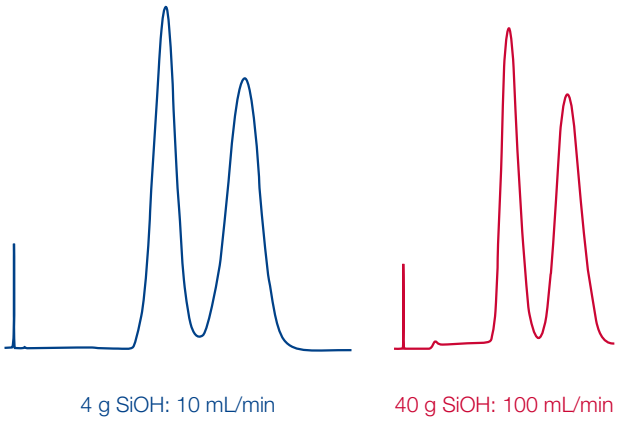
This depends on the eluent, the separation problem, the amount of adsorbent and also on the dimensions of the column.

In the simplest case the upscaling relation is proportional to the amount of adsorbent (for equal eluent polarity).

For the flow rate the following would apply e.g.,

4 g silica → optimum flow: ~ 6–12 mL/min

40 g silica → optimum flow: ~ 60–120 mL/min



Upscaling of the flow rate

Back pressure and pressure stability

The back pressure always depends on flow rate and viscosity of the eluent mixture, column length and diameter and the particle size. The high performance CHROMABOND® Flash RS cartridges up to 200 g silica are stable up to 15 bar (220 psi, > 200 g: 12 bar).

We recommend using a pressure guard, because short time pressure peaks (viscosity of eluent or gradient changes) can exceed the pressure limit.

Back pressure of CHROMABOND® Flash RS SiOH cartridges (eluent hexane – ethyl acetate 9:1 or 8:2)

Flow rate							
Cartridge	20 mL/min	40 mL/min	80 mL/min	120 mL/min	160 mL/min	200 mL/min	240 mL/min
RS / BT 4	0.75 bar	1.5 bar					
RS / BT 15	0.25 bar	0.75 bar	1.5 bar	2.0 bar			
RS / BT 25	0.5 bar	1.0 bar	1.75 bar	3.0 bar	4.0 bar	5.0 bar	
RS / BT 40		0.75 bar	1.5 bar	2.25 bar	3.0 bar	3.25 bar	3.5 bar
RS / BT 80			1.5 bar	2.5 bar	3.0 bar	3.5 bar	4.0 bar
RS / BT 120			1.0 bar	1.5 bar	2.0 bar	2.5 bar	3.0 bar
RS / BT 200			1.0 bar	1.5 bar	2.0 bar	2.5 bar	3.0 bar
RS / BT 330	(typical flow rate)		1.5 bar	2.25 bar	3.0 bar	3.5 bar	4.0 bar

Conditioning volumes for CHROMABOND® Flash RS cartridges (normally 1.5 column volumes of the eluent)

Cartridge	Volume of eluent for conditioning
RS / BT 4	20 mL
RS / BT 15	60 mL
RS / BT 25	90 mL
RS / BT 40	140 mL
RS / BT 80	280 mL

Cartridge	Volume of eluent for conditioning
RS / BT 120	440 mL
RS / BT 200	750 mL
RS / BT 330	1100 mL
RS 800	2900 mL
RS 1600	5000 mL

CHROMABOND® Flash RS

CHROMABOND® Flash cartridges

Ideal for Flash separations from 10 mg up to 160 g

Convenient operation and reliable upscaling; Complete program of ready-to-use Flash cartridges for:

- Isco Companion® and other Teledyne Isco CombiFlash® systems
- Biotage® Isolera™, Biotage® FlashMaster™
- Or as stand-alone version for all pump / detector combinations, e.g., from Biotage®, Büchi

Enhanced flexibility

- All common RP and NP phases available on request
- Adsorbent weights from 4 g to 1600 g (up to 300 g for BT)

Outstanding price-performance ratio

Increased analytical safety

- Low bleed polypropylene cartridges, organic solvent resistant, thick column walls, one piece body, sophisticated length-to-diameter ratio for high plate numbers and excellent separation efficiencies, optimal ratio of length and diameter
- Distribution of eluent stream via highly porous frits
- High pressure stability of 21 bar / 300 psi (15 bar for 80 g and 120 g cartridges, 12 bar for cartridges > 200 g, 7 bar for 3000 g), good reproducibility

High quality standard

- All flash cartridges and adsorbents undergo comprehensive during- and after-production quality assurance measures to ensure that the products conform to the specification.

CHROMABOND® Flash RS - pictures of CHROMABOND® Flash BT, DL and FM hardware can be found on page 15.

CHROMABOND® Flash RS solutions for Isco® Flash instruments

Key features

- Heavy-duty polypropylene cartridges designed for use in Teledyne Isco CombiFlash® systems (Companion®, R_f etc.) without additional connectors or capillaries.
- Column connection:
  cartridges up to RS 330: female Luer lock inlet and male Luer outlet RS 800 and RS 1600: maxi Luers

Recommended application

- Using the CHROMABOND® Flash Starter Kit, REF 730798 or the CHROMABOND® Flash Stand Alone Kit, REF 732903 (see page 78) CHROMABOND® Flash RS cartridges can also be used as stand alone system with any pump / detector / fraction collector combination (except RS 800, RS 1600 and RS 3000 with maxi Luers).

Ordering information

Description	Column length [cm]	ID [mm]	Adsorbent weight [g]	Pack of	REF
CHROMABOND® Flash RS columns with Luer exit					
Filled with standard silica, unmodified (SiOH) or endcapped octadecyl modified (C_{18} ec), 40–63 µm, specific surface 500 m^2/g, pH stability 2–8					
CHROMABOND® Flash RS 4 SiOH	9.8	12.4	4	20	732800
CHROMABOND® Flash RS 15 SiOH	11.6	21.2	15	20	732801
CHROMABOND® Flash RS 25 SiOH	16.5	21.2	25	15	732802
CHROMABOND® Flash RS 40 SiOH	17.1	26.4	40	15	732803
CHROMABOND® Flash RS 80 SiOH	24.0	30.8	80	12	732804
CHROMABOND® Flash RS 120 SiOH	25.5	36.0	120	10	732805
CHROMABOND® Flash RS 200 SiOH	20.0	60.0	200	6	732806
CHROMABOND® Flash RS 330 SiOH	27.0	60.0	330	4	732807
CHROMABOND® Flash RS 800 SiOH	38.5	82.0	800	2	732808
CHROMABOND® Flash RS 1600 SiOH	43.0	104.0	1600	2	732809
CHROMABOND® Flash RS 3000 SiOH	51.0	127.5	3000	1	732850
Corresponding TLC plates: silica (see page 273)					
CHROMABOND® Flash RS 4 C_{18} ec	9.8	12.4	4.3	2	732810
CHROMABOND® Flash RS 15 C_{18} ec	11.6	21.2	16.4	1	732811
CHROMABOND® Flash RS 25 C_{18} ec	16.5	21.2	26	1	732812
CHROMABOND® Flash RS 40 C_{18} ec	17.1	26.4	43	1	732813
CHROMABOND® Flash RS 80 C_{18} ec	24.0	30.8	86	1	732814
CHROMABOND® Flash RS 120 C_{18} ec	25.5	36.0	130	1	732815
CHROMABOND® Flash RS 200 C_{18} ec	20.0	60.0	220	1	732816
CHROMABOND® Flash RS 330 C_{18} ec	27.0	60.0	360	1	732817
CHROMABOND® Flash RS 800 C_{18} ec	38.5	82.0	880	1	732818
CHROMABOND® Flash RS 1600 C_{18} ec	43.0	104.0	1760	1	732819
Corresponding TLC plates: RP-18 W/UV_{254} (see page 284)					

On request, all column types listed above can be packed with any adsorbent from our program of CHROMABOND® adsorbents (starting from page 16). Please note that other packings often result in differing adsorbent weights.

CHROMABOND® Flash BT · DL

CHROMABOND® Flash BT solutions for Biotage® Flash instruments

Key features

- Heavy-duty polypropylene cartridges designed for use in the Biotage® Isolera™ systems without additional connectors or capillaries.
- Column connection: female Luer lock inlet and male Luer lock outlet

Recommended application

- Using the CHROMABOND® Flash Starter Kit, REF 730798 or the CHROMABOND® Flash Stand Alone Kit, REF 732903 (see page 78) CHROMABOND® Flash BT cartridges can also be used as stand alone system with any pump / detector / fraction collector combination.

Ordering information

Description	Column length [cm]	ID [mm]	Adsorbent weight [g]	Pack of	REF
CHROMABOND® Flash BT columns with Luer lock exit					
Filled with unmodified standard silica, 40–63 µm, specific surface 500 m^2/g, pH stability 2–8					
CHROMABOND® Flash BT 4 SiOH	9.8	12.4	4	20	732960
CHROMABOND® Flash BT 15 SiOH	11.6	21.2	15	20	732961
CHROMABOND® Flash BT 25 SiOH	16.5	21.2	25	15	732962
CHROMABOND® Flash BT 40 SiOH	17.1	26.4	40	15	732963
CHROMABOND® Flash BT 80 SiOH	24.0	30.8	80	12	732964
CHROMABOND® Flash BT 120 SiOH	25.5	36.0	120	10	732965
CHROMABOND® Flash BT 200 SiOH	20.0	60.0	200	6	732966
CHROMABOND® Flash BT 330 SiOH	27.0	60.0	330	4	732967

On request, all column types listed above can be packed with any adsorbent from our program of CHROMABOND® adsorbents (starting from page 16). Please note that other packings often result in differing adsorbent weights.

Partly filled CHROMABOND® Flash BT cartridges (e.g., filled up to 80 %) are available on request. By removal of the top cap the sample can be applied directly on to the cartridges (see page 77).

CHROMABOND® Flash DL cartridges solutions for direct loading

Key features

- Column connection: female Luer lock inlet and male Luer lock outlet. Each cartridge comes with 3 filter elements: one already inserted, two more filters aside.
- Suitable as solid injection system
- For individual self-filling and packing of flash cartridges

Ordering information

Description	Column length [cm]	ID [mm]	For adsorbent weight [g] SiOH	For adsorbent weight [g] Kieselguhr	Volume [mL]	Empty column Pack of	Empty column REF	PE filter elements Pack of	PE filter elements REF
CHROMABOND® Flash DL empty cartridges									
CHROMABOND® Flash DL 4	9.8	12.4	4	3	8	50	732980	250	732980FE
CHROMABOND® Flash DL 15	11.6	21.2	15	10	30	50	732981	250	732981FE
CHROMABOND® Flash DL 25	16.5	21.2	25	15	45	50	732982	250	732982FE
CHROMABOND® Flash DL 40	17.1	26.4	40	30	75	20	732983	250	732983FE
CHROMABOND® Flash DL 80	24.0	30.8	80	60	160	20	732984	250	732984FE
CHROMABOND® Flash DL 120	25.5	36.0	120	80	220	20	732985	250	732985FE
CHROMABOND® Flash DL 200	20.0	60.0	200	150	410	10	732986	100	732986FE
CHROMABOND® Flash DL 330	27.0	60.0	330	250	600	10	732987	100	732987FE

① CHROMABOND® Flash DL cartridge filled with sample on CHROMABOND® XTR on top of CHROMABOND® Flash RS or BT silica cartridge

② CHROMABOND® Flash BT cartridge partly filled with silica topped with sample on CHROMABOND® XTR

Options for solid injection

The sample is dissolved in a suitable solvent and adsorbed onto CHROMABOND® XTR (diatomaceous earth, see page 63). After removal / evaporation of the residual solvent, the adsorbent is put on top of a partly filled CHROMABOND® Flash BT cartridge or into an empty CHROMABOND® Flash DL cartridge.

Our XTR adsorbents can be found on page 63.

CHROMABOND® Flash FM solutions for FlashMaster™ instruments

Key features

- Column connection:
  open-tubular inlet and male Luer outlet

Recommended application

- Polypropylene cartridges designed for use in the Biotage® FlashMaster™ systems without additional connectors or capillaries

Ordering information

Description	Column length [cm]	ID [mm]	Adsorbent weight [g]	Pack of	REF
CHROMABOND® Flash FM columns					
Filled with standard silica, unmodified (SiOH) or endcapped octadecyl modified (C_{18} ec), 40–63 µm, specific surface 500 m^2/g, pH stability 2–8					
CHROMABOND® Flash FM 15/2 SiOH	9.0	15.8	2.0	50	730881
CHROMABOND® Flash FM 25/5 SiOH	10.0	20.5	5.0	50	730891
CHROMABOND® Flash FM 25/10 SiOH	10.0	20.5	10.0	50	730666
CHROMABOND® Flash FM 70/10 SiOH	15.4	26.8	10.0	30	730885
CHROMABOND® Flash FM 70/20 SiOH	15.4	26.8	20.0	30	730915
CHROMABOND® Flash FM 70/25 SiOH	15.4	26.8	25.0	30	730892
CHROMABOND® Flash FM 150/25 SiOH	17.0	38.2	25.0	20	730667
CHROMABOND® Flash FM 150/50 SiOH	17.0	38.2	50.0	20	730887
CHROMABOND® Flash FM 150/70 SiOH	17.0	38.2	70.0	10	730880
CHROMABOND® Flash FM 15/2 C_{18} ec	9.0	15.8	2.0	50	730890
CHROMABOND® Flash FM 25/5 C_{18} ec	10.0	20.5	5.0	20	730884
CHROMABOND® Flash FM 70/10 C_{18} ec	15.4	26.8	10.0	20	730886
CHROMABOND® Flash FM 150/50 C_{18} ec	17.0	38.2	50.0	10	730888

On request, all column types listed above can be packed with any adsorbent from our program of CHROMABOND® adsorbents (starting from page 16). Please note that other packings often result in differing adsorbent weights.

Custom filling sizes are available on request.

CHROMABOND® Flash connecting kits

CHROMABOND® Flash connecting kits allow to use CHROMABOND® Flash RS and BT cartridges as stand-alone system with any pump, detection, fraction collector combination.

REF 730798 CHROMABOND® Flash Starter Kit

Female Luer lock for column inlet

Male Luer lock for column exit

REF 732903 CHROMABOND® Flash Stand Alone Kit, Luer

Ordering information

Description	Pack of	REF
CHROMABOND® Flash Starterkit		
consists of 1/8" PTFE tubing, 1.5 mm ID, 3 m long; 5 x 1/4"-28 PP nuts; 5 x 1/8" ETFE ferrules; 5 x 1/4"-28 nylon unions; 2 x 1/4"-28 PP Luer lock, female; 1 x 1/4"-28 PP Luer lock, male; 1 x 1/4"-28 PP Luer tip, male	1 Kit	730798
CHROMABOND® Flash "Stand Alone" Kit, Luer		
consists of 1 x 1/4"-28 PP Luer lock, female; 1 x 1/4"-28 PP Luer lock, male; 2 x 1/8" ETFE ferrules; 2 x 1/4"-28 nylon unions; 2 x 1/4"-28 PP nuts	1 Kit	732903

Glass columns and accessories for Flash chromatography

Key features

- MN flash chromatography kits include a glass column, eluent reservoir, silica 60 and accessories. Glass columns of different sizes and accessories can be ordered separately.
- These columns are normally filled to a height of about 15 cm, working pressures are 1.5 to 2 bar.
- The most used adsorbent is silica 60 with particle size 40–63 µm (see page 259), however, you may also use our ranges of other LC adsorbents and of POLYGOPREP silica phases (see page 258). Particle sizes < 25 µm should only be used with very low-viscosity mobile phases, because otherwise flow rates will be very low.
- This columns are packed by the user.
- No expensive equipment required

Recommended application

- Economic low-tech method for the synthesis laboratory
- Suited for the separation of compounds up to gram levels

Ordering information

Description	Pack of	REF
Flash chromatography kits		
Flash chromatography kit I consists of 1 glass column 20 mm ID x 400 mm length, one 1-L eluent reservoir, 100 g silica 60 (40–63 µm), sea sand, silanized glass fiber wadding, 1 m PTFE tubing	1 kit	727450
Flash chromatography kit II consists of 1 glass column 40 mm ID x 450 mm length, one 2-L eluent reservoir, 100 g silica 60 (40–63 µm), sea sand, silanized glass fiber wadding, 1 m PTFE tubing	1 kit	727451
Flash chromatography glass columns		
complete with adapter and PTFE tap, fitted with a polyethylene net to protect against bursting		
20 mm ID x 200 mm length	1 column	727400
20 mm ID x 400 mm length	1 column	727401
25 mm ID x 200 mm length	1 column	727402
25 mm ID x 400 mm length	1 column	727403
30 mm ID x 300 mm length	1 column	727404
30 mm ID x 400 mm length	1 column	727405
40 mm ID x 300 mm length	1 column	727406
40 mm ID x 450 mm length	1 column	727407
Accessories for flash chromatography glass columns		
1-L eluent reservoir with adapter, covered with a protective plastic sleeve for burst protection; this also prevents build-up of UV-induced radicals in the eluent	1 piece	727420
2-L eluent reservoir as above	1 piece	727421
Pressure gauge for controlling flow rates	1 piece	727422
PTFE tubing, 3 mm OD, 2 mm ID, length 1 m	1 m	727424
Sea sand, acid washed and calcined	1 kg	727423
Glass fiber wadding, silanized	25 g	718002