



Remember when getting cash meant waiting until payday?



Things change.

Sartobind® Membrane Adsorbers
Now, chromatography can
be just as convenient.

Sartobind Membrane Adsorbers

Sartorius Sets the Pace in Membrane Technology and Quality

The base material for all Sartobind Membrane Adsorbers (MA's) is a stabilized, reinforced, cellulosic membrane. It is made of regenerated cellulose; during construction, cellulose runs through a number of stabilization and grafting steps. This results in a chemically stable cellulosic matrix. Virtually any chromatography ligand can be covalently bound to the matrix. A wide spectrum of patents and nearly two decades of continuous development, demonstrates Sartorius' inveterate position within membrane adsorber technology.

Sartobind Membranes Adsorbers come in two application formats: Sartobind SingleSep® and Sartobind MultiSep®.

Sartobind MA's are available in two convenient processing formats. The disposable Sartobind SingleSep MA's are designed for product capture, contaminant removal and polishing

applications. Sartobind MultiSep MA's can be used multiple times for all types of chromatography applications. Both formats are made of the same membrane and demonstrate similar operating performance.

Sartobind MA's are manufactured in accordance with current guidelines and standards, such as cGMP and USP. All individual components from sub-suppliers must undergo strict incoming inspection. The external manufacturer's facilities are audited on a regular basis. Of course, our clean-room production is also based on precisely defined and monitored manufacturing processes.

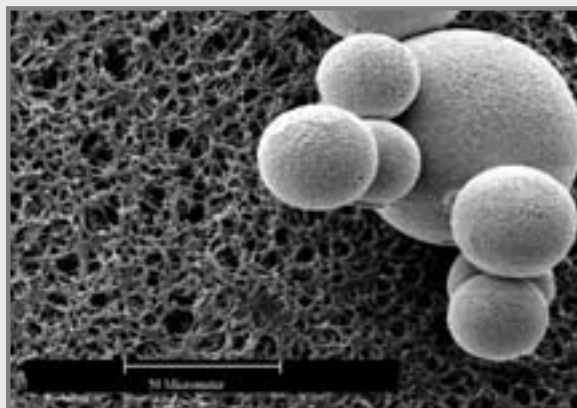
Strategic applications

Using Sartobind MA's as a concentration step before column loading will reduce conventional chromatography run times and the

amount of resin/buffers needed for purification. They can also be applied as a product concentration step before UF/DF. Beginning a TFF application with less material will reduce exposure to shearing and may increase product activity. Sartobind MA's capture larger proteins (>100kD) or dilute feed streams at accelerated flow rates.

Chemical compatibility

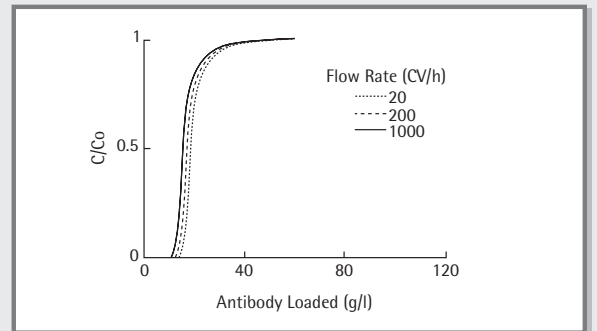
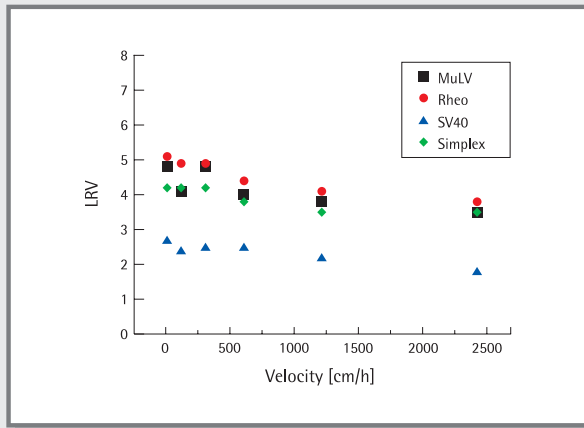
Sartobind MA's are stable against all solvents and solutions applied during general purification of biopharmaceuticals. These include alcohols, high salt concentrations, and long-term stability against 0.1 N hydrochloric acid and 0.1 N sodium hydroxide.



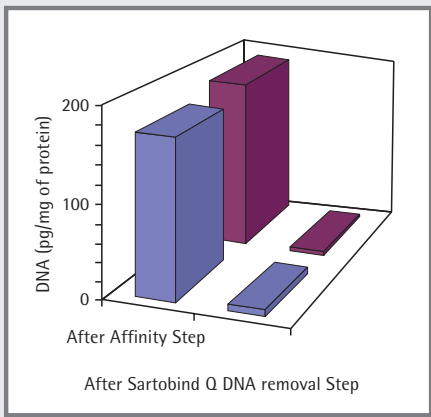
Faster flow rates

Highly porous Sartobind membrane (background) and conventional chromatography resin (foreground) express the same adsorption/desorption chemical behavior but the pore size differs by a factor of 1000. Rendering Sartobind's diffusion limitation indifferent to flow rate. This explains why Sartobind IEX may be used up to 100 times faster than conventional resins, leaving dynamic binding capacity unaffected.

The graph on the right depicts log removing value (LRV) of viruses used during viral clearance. Capacity drops slightly when flow rates are dramatically increased.



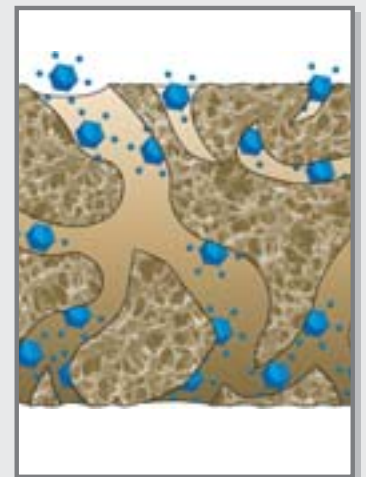
Breakthrough curves demonstrate that flow rate does not negatively affect Sartobind MA capacity. (1)



DNA is reduced to undetectable levels with the Q membrane in the graph above: a 2000 liter batch with 0.25 m² (blue) and a 12,500 liter batch with 2 m² (red). (3)

Viral clearance is made simple with Sartobind as shown in the table below. Pore sizes greater than 3 μm enable large molecules and viruses to adsorb onto the entire membrane surface. This illustration shows the Sartobind MA's generating conditions favorable for virus removal. (2)

Viruses	Size (nm)	Enveloped	Clearance by Sartobind Q Factor (log ¹⁰) Run 1	Clearance by Sartobind Q Factor (log ¹⁰) Run 2
SV-40:	45	no	1.25 ± 0.46	1.34 ± 0.43
Simian Virus -40				
Reo-3:	75-80	no	4.07 ± 0.50	3.62 ± 0.42
Reovirus Type III				
MuLV:	80-110	yes	3.80 ± 0.39	4.40 ± 0.56
Murine Leukemia Virus				
PRV:	150-250	yes	3.97 ± 0.44	3.88 ± .38
Pseudorabies Virus				



(1) Heather L. Knudsen et al, Genentech.: Membrane ion-exchange chromatography for process-scale antibody purification, J. Chromatography A, 907 (2001) 145-154.

(2) Galliher, P., Fowler, E., Millennium Pharmaceuticals Inc., Validation of Impurity Removal by the CMAPATH-1H Biomanufacturing Process IBC's Biopharmaceutical Production Week, Paradise Point Resort - San Diego, CA, November 12-15, 2001.

(3) J. K. Walter, Boehringer-Ingelheim Pharma in: Bioseparation and Bioprocessing, G. Subramanian (ed.) Wiley VCH, 1998, Vol. II p. 447-460.

Protein						
	MW (kDa)	pI	S	Q	C	D
Pepsin	35	1.0	-	-	92%	70%
BSA	67	4.5	-	-	100%	100%
β -galactosidase	540	4.6	-	-	75%	80%
Catalase	240	5.8	96%	53%	90%	93%
Ovalbumin	45	5.9	72%	75%	100%	82%
Peroxidase	40	7.2	85%	71%	-	-
LDH	140	8.5	89%	100%	-	-
Trypsin	24	10.1	65%	100%	-	-
Lysozyme	14	11	100%	80%	-	-

Low unspecific binding
High yields are a direct result of the stabilized, reinforced micro porous base material. This hydrophilic membrane is an excellent substrate for chromatographic applications because it expresses negligible unspecific protein binding.

Adsorber Chemistries		
Sulfonic acid (S)	Strong acidic cation exchanger	$R-CH_2SO_3^-$
Quaternary ammonium (Q)	Strong basic anion exchanger	$R-CH_2N^+(CH_3)_3$
Carboxylic acid (C)	Weak acidic cation exchanger	$R-COO^-$
Diethylamine (D)	Weak basic anion exchanger	$R-CH_2N^+(CH_3)_3$

Sartorius offers the widest spectrum of membrane adsorber chemistries on the market with both strong and weak cation and anion exchange chemistries.

From fermentation to final bulk –
Sartorius can satisfy all of your processing needs.



Fermentation



Cell Harvest (Sartoflow 20)



Purification with MultiSep

Sartobind SingleSep Membrane Adsorbers

The Disposable Alternative

Sartobind SingleSep Membrane Adsorbers are *the* disposable alternative to conventional chromatography. Now you can concentrate, purify and polish product with an efficient, trouble-free chromatography device. Disposability results in lower validation costs. Also, it reduces time spent: qualifying, cleaning and packing columns. Furthermore, Sartobind's patented MA design allows for faster processing times than columns.

Sartobind SingleSep MA's: Membranes that target your needs
Sartobind's 3-5 μm pore size and the availability of four ion exchange chemistries allow for quick removal of impurities. Simply bind impurities and allow your product to rapidly flow through the SingleSep Membrane Adsorber.

Sartobind Q Polishing Power:
Endotoxin removal > 5 LRV
Viral clearance > 4 LRV
Nucleic acid removal > 3 LRV

Contaminant removal:

Nucleic acid removal
Virus removal
Host cell protein removal
Endotoxins
Other contaminants

Economic purification and concentration of pharmaceuticals:

Proteins
Viral vectors
Vaccines
Plasmids
Antibodies
Dilute feed streams

Technical Data

Base material:	Hydrophilic regenerated cellulose membrane
Pore size:	> 3 μm
Average membrane thickness:	275 μm
Bed height:	4 mm
Maximum allowable differential pressure:	4 bar (60 psi) at 20°C
Sterilization/Depyrogenation:	Autoclave 121°C, 1 bar, 30 min/1 N NaOH
Capsule:	Polypropylene

Specifications

Functional group	Order numbers	Nominal pore size (μm)	Effective adsorption area (cm^2)	Bed Volume equivalent (ml)	pH Stability	
Sartobind Q	92IEX042D4-SS--A	3 - 5	250	7	2-13	
	strong basic	92IEX042D9-SS--A	3 - 5	2500	70	2-13
	anion exchanger	92IEX042D1-SS	3 - 5	6600	180	2-13
Sartobind S	92IEXS42D4-SS--A	3 - 5	250	7	2-13	
	strong acidic	92IEXS42D9-SS--A	3 - 5	2500	70	2-13
	cation exchanger	92IEXS42D1-SS	3 - 5	6600	180	2-13

For hose barb: replace SS with OO



Polishing Step with Sartobind SingleSep



Final Concentration and Buffer Exchange (Sartoflow Beta)



Sterile Filtration (Sartopore 2)

Sartobind MultiSep Membrane Adsorbers

Convenient and easy to use

The MultiSep family offers multiple formats to suit individual purification needs.

Linear scale-up values and numerous formats make scaling up with MultiSep simple. Module heights and layers increase by factors of two. For instance, standard module heights are: 3, 6, 12, 25 and 50 cm. Standard module layers are 15, 30 and 60.

Sartobind membrane types:

- Sartobind S, Q, C and D ion exchange
- Sartobind IDA (iminodiacetic acid) metal chelate
- Sartobind aldehyde-activated
- Sartobind epoxy-activated
- Sartobind Protein A (recombinant)
- Other ligands available upon request



Housings available in:

- Stainless steel or POM
- T-style or inline
- Parallel or in-series connections
- Multiple formats



Ordering information and specifications for MultiSep modules

Order numbers*	Capacity (g)	Number of layers	Flow (L/min . bar)	Effective adsorption area (m ²)	Bed volume equivalent (ml)
91-X-01K-15-03	1	15	0.6	0.12	35
91-X-02K-15-06	2	15	1.25	0.25	70
91-X-05K-15-12	4	15	2.5	0.5	140
91-X-10K-15-25	8	15	5	1	280
91-X-20K-15-50	16	15	10	2	560
91-X-02K-30-03	2	30	0.3	0.25	72
91-X-05K-30-06	4	30	0.6	0.5	144
91-X-10K-30-12	8	30	1.1	1	288
91-X-20K-30-25	16	30	2.2	2	575
91-X-40K-30-50	32	30	4.3	4	1150
91-X-05K-60-03	4	60	0.12	0.5	133
91-X-10K-60-06	8	60	0.25	1	266
91-X-20K-60-12	16	60	0.5	2	532
91-X-40K-60-25	32	60	1	4	1065
91-X-80K-60-50	64	60	2	8	2130

* X = S, C, Q or D ion exchange

Purification made simple

Sartobind MultiSep membrane adsorbers are designed to facilitate purification allowing for time and cost savings. This is accomplished by eliminating arduous steps presented by traditional chromatography resins:

- Slow process times
- Column packing
- HETP
- Cleaning challenges
- Less buffer use
- Bed cracking
- Channeling

MultiSep features:

- Composed of stabilized, regenerated cellulose
- Low protein binding
- Stable between pH 2 – 13
- > 3 μm pore size
- 0.12 – 10 liters/min/bar
- DNA capacity ~ 30 mg/ml
- Protein capacity ~ 20 – 30 mg/ml
- Binding capacity: 1 – 64 g per MultiSep module

Applications:

- Protein purification
- Virus purification
- Endotoxin removal
- DNA removal
- Host cell protein removal
- Viral clearance

Housings and cores provided separately from modules.

Housing code:

90-H0-MM---HH

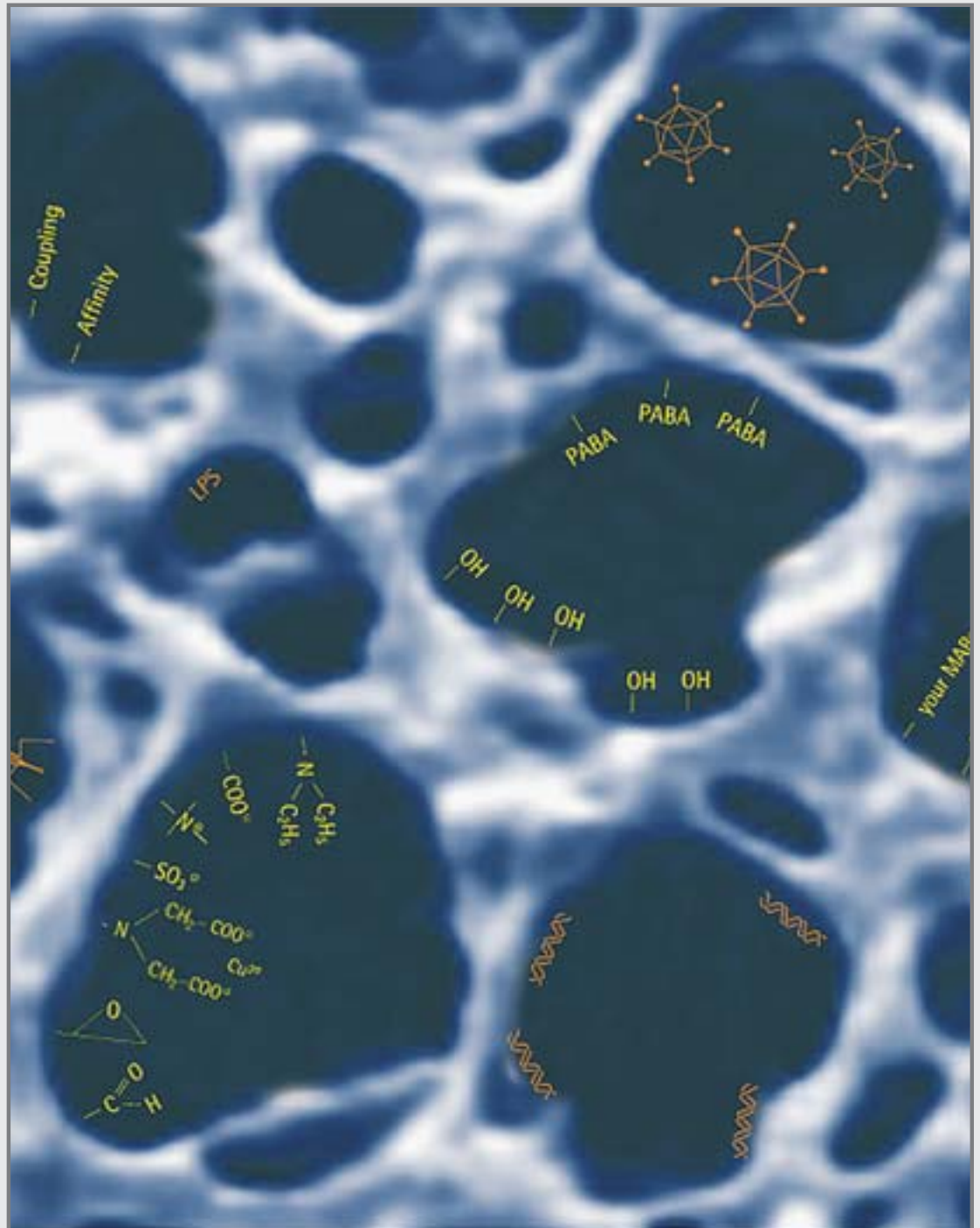
Core code:

90-CR-POLL-HH

LL = 15, 30 or 60 (layers)

HH = 03, 06, 12, 25 or 50 (cm high)

MM = SD (Stainless steel) or PO (POM)





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