Ultrafiltration Products

BETTER LIFE SCIENCE BY DESIGN



Next Generation Ultrafiltration

VIVASPIN 2

Bridging the gap between our 500µl and 6ml centrifugal concentrators, Vivaspin 2 also offers the widest selection of membranes.

VIVASPIN 6

NEW

Vivaspin 6 is the first concentrator of 6ml capacity to be sized for 15ml centrifuge tube carriers.

VIVASPIN 20

Vivaspin 20 is designed for use both as a centrifugal concentrator and/or as a pressurised cell.

VIVAFLOW 50

FEIP IO

VIVAFLOW 50

The new Vivaflow 50 further improves the economy and process flexibility of the high performance "Flip-Flow" concept.

VIVACELL 250

Vivacell 250 is a new ultrafiltration cell that combines gas pressure with a vortex shake for rapid concentration with low shear.

Product Guide and Page Index

Major Uses for Ultrafiltration **Process Alternatives Membrane Selection** Page 2 Pages 3 Pages 4 - 5 233 **VIVASPIN 500 VIVASPIN 2 VIVASPIN 6** 500µl to 5µl 6ml to 30µl Process Volume: Process Volume: 2ml to 8µl Process Volume: Centrifuge Centrifuge Centrifuge **Operating Mode: Operating Mode: Operating Mode:** Pages: 6 - 9 Pages: 6 - 9 Pages: 10 - 13 CERTE C 10000 MMC WCO SOK -100-**VIVACELL 70 VIVACELL 250 VIVASPIN 20** Process Volume: 20ml to 50µl Process Volume: 70ml to 150µl Process Volume: 250ml to 600µl **Operating Mode:** Centrifuge **Operating Mode:** Centrifuge **Operating Mode:** Gas Pressure Gas Pressure Gas Pressure 16 - 17 Pages: Pages: 10 - 13 Pages: 14 - 15 **VIVAPORE 2 VIVAPORE 5** VIVAPORE 10/20 **Process Volume:** 2ml to 20µl **Process Volume:** 5ml to 50µl Process Volume: 20ml to 50µl **Operating Mode:** Solvent Absorption **Operating Mode:** Solvent Absorption **Operating Mode:** Solvent Absorption Pages: 18 - 19 Pages: 18 - 19 Pages: 18 - 19 **VIVAFLOW 50 VIVAFLOW 200 VIVAFLUX DISCS Process Volume:** <10ml to >5L **Process Volume:** <20ml to >5L Membrane Diameter: 25 to 90mm **Operating Mode: Tangential Flow Operating Mode: Operating Mode:** Stirred Cell **Tangential Flow** Pages: 20 - 24 Page: Pages: 22 - 24 25 m







Major Uses for Ultrafiltration

Ultrafiltration is a convective process that uses anisotropic semi-permeable membranes to separate macromolecular species and solvents primarily on the basis of size. It is particularly appropriate for the concentration of macromolecules and can also be used to purify molecular species or for solvent exchange. Ultrafiltration is a gentle, non denaturing method that is more efficient and flexible than alternative processes.

Solute Concentration

Ultrafiltration membranes are used to increase the solute concentration of a desired biological species. The filtrate is cleared of macromolecules which are significantly larger than the retentive membrane pores. Microsolute is removed convectively with the solvent.



Solute Fractionation or Clarification

Ultrafiltration is a cost effective method for separating samples into size-graded components providing that macromolecular fractions differ in size by a 10X MW difference. During filtration, the permeating solute remains at its initial concentration whilst the retained macromolecules will be enriched.

Solute Desalting or Purification

A solution may be purified from salts, non-aqueous solvents and generally from low molecular weight materials. Multiple solvent exchanges, will progressively purify macromolecules from contaminating solutes. Microsolutes are removed most efficiently by adding solvent to the solution being ultrafiltered at a rate equal to the speed of filtration. This is called Diafiltration.

Typical applications for ultrafiltration

- Concentration/desalting of proteins, enzymes, DNA, monoclonal antibodies, immunoglobulins
- Free drug, hormone assays
- Removal of primers from PCR amplified DNA
- Removal of labelled amino acids and nucleotides
- HPLC sample preparation
- Deproteinization of samples
- Purification of antibiotics, hormones, drugs from biological fluids, fermentation broths

- Recovery of biomolecules from cell culture supernatants, lysates
- General purpose laboratory concentrations and desalting of proteins, enzymes, cells, DNA, biomolecules, antibodies and immunoglobulins
- Mammalian cell harvesting
- Cell washing, virus purification, cell debris removal, depyrogenation

Sartorius offers a comprehensive range of process alternatives for the filtration and concentration of biological samples. The following is a guide to selecting the most suitable filtration method, depending on sample volume, equipment available, filtration speed and process control desired.



Centrifugal Filtration

(100µl to 70 ml starting volumes)

Centrifugation provides the vector to clear solvent and micro molecules through the ultrafiltration membrane and into a filtrate container positioned below. This is a gentle process that is characterised by quick set up and fast filtration speeds with most solutions.

Vivascience offers six alternative centrifugal devices covering volumes from 100 μ l up to 70ml.



Gas Pressure Filtration

(5 to 250ml starting volume)

Pressurised air or an inert gas is used to provide the filtration vector. Agitation is used to impede macromolecules from polarising on the membrane surface and reducing filtration speed. For fastest filtration, Vivacell products are used with an orbital laboratory shaker but they can also be used without agitation. Vivaspin 20ml, Vivacell 70ml and the Vivacell 250ml can be run with gas pressure.



Pressure-fugation

(5 to 50ml starting volumes)

Pressure-fugation is a unique Vivascience method that combines gas pressure with centrifugation. This is the fastest concentration method with process times typically 30 to 50% faster than centrifugation alone. Vivaspin 20ml and the Vivacell 70ml can be run in this way.



Solvent Absorption

(1 to 20ml starting volume)

This technique uses an absorbent cellulose pad mounted behind the ultrafiltration membrane to draw solvents and micro solutes through the membrane. Retained macromolecules are concentrated into the bottom of the sample container. No additional equipment is required.

Three Vivapore devices are offered for this procedure with maximum initial sample volumes ranging from 2 to 20ml.



Tangential Flow Filtration

(100ml to several litres starting volume)

The solution to be processed is pumped under pressure across an ultrafiltration membrane and then returned to the original reservoir. The solution is progressively concentrated or purified as solvent and micro-molecules pass through the membrane into a seperate filtrate vessel.

Vivaflow 50 and 200 are offered for this procedure.

Membrane Selection Guide

Sartorius offers an extended range of membranes to cover the great majority of ultrafiltration requirements. The following is a guide to selecting the most appropriate membranes according to their typical performance characteristics. Please note however, that membrane behaviour and ultimate performance, largely depends on the specific characteristics of the solution being processed. Sartorius recommends that users experiment with alternative membranes in order to optimise their process performance.

Polyethersulfone.

This is a general purpose membrane that provides excellent performance with most solutions when retentate recovery is of primary importance. Polyethersulfone membranes exhibit no hydrophobic or hydrophillic interactions and are usually preferred for their low fouling characteristics, exceptional flux and broad pH range.

Cellulose Triacetate.

High hydrophilicity and very low non specific binding characterise this membrane. Cast without any membrane support that could trap or bind passing micro solutes, these membranes are to be preferred for sample cleaning and protein removal and when high recovery of the filtrate solution is of primary importance.

Regenerated Cellulose.

Membranes are also highly hydrophillic and are often preferred for their higher protein recovery when processing some very dilute solutions. Resistance to autoclaving, ease of cleaning and extended chemical resistance also characterises this type of membrane.

Membrane Performance Comparisons

Membrane	Relative Solute flux* (ml/min/cm ²)	Frequently preferred for:	
Polyethersulfone pH range 1-14			
5,000 MWCO	0.24	High Retention of peptides, high relative flux	
10,000 MWCO	0.41	Versatility, High flux, low absorption	
30,000 MWCO	0.41	Versatility, High flux	
50,000 MWCO	0.45	Sharp molecular weight limit	
100,000 MWCO	0.35	High retention of Immunoglobulins	
Cellulose Triacetate pH range 4-8			
5,000 MWCO	0.04	Peptide and Protein Removal	
10,000 MWCO	0.11	Micro-partition, Free/Bound drug studies	
20,000 MWCO	0.58	Sample cleaning, HPLC sample preparation	
Regenerated Cellulose pH range 3-11			
10,000 MWCO	0.18	High recovery of microgram quantities of protein	
30,000 MWCO	0.58	Speed and recovery with immunoglobulins	
100,000 MWC0	0.40	Protein Fractionation	

*0.25mg/ml BSA or IgG depending on MWCO at 4 bar pressure.

Membrane Selection Guide (Recommended MWCO)

Application	5,000	10,000	30,000	50,000	100,000	>500,000
Bacteria						
DNA fragments						
Enzymes						
Growth Factor						
Immunoglobulins						
Nucleic Acids						
MAB						
Oligonucleotides						
Peptides						
Virus						
Yeast						

For highest recovery, usually select a membrane MWCO which is at least half of the molecular weight of the solute to be retained

Maximising Solute Recovery

The advanced designs and low adsorption materials that characterise Vivascience products, offer a unique combination of faster processing speeds and higher recovery of the concentrated sample. Providing that the appropriate device size and membrane cut-off is selected, Vivascience products will typically yield recoveries of the concentrated sample in excess of 90% when the starting sample contains over 0.1mg/ml of the solute of interest.

Most of the loss is caused by non specific binding both to the membrane surface and to exposed binding sights on the plastic of the sample container:

Adsorption to the membrane.

Depending on sample characteristics relative to the membrane type used, solute adsorption on the membrane surface is typically 2-10 μ g/cm². This can increase to 20-100 μ g/cm² when the filtrate is of interest and the solute must pass through the whole internal structure of the membrane. Typically a higher cut-off membrane will bind more than a low molecular weight alternative.

Adsorption to the Sample Container

Although every effort is made to minimise this phenomenon by the selection of low adsorption materials and tool production to optical standards, some solute will bind to the internal surface of the sample container. Whilst the relative adsorption will be proportionately less important than on the membrane, due to the higher total surface area, this can be the major source of yield loss.



Section through ultrafiltration membrane showing internal binding sites

Process Optimisation

When highest recoveries are most important, in particular when working with solute quantities in the microgram range, Sartorius recommends that users consider the following:

- Select the smallest device that suits the sample volume. Eventually, take advantage of the extra speed of Vivascience products by refilling a smaller device repeatedly.
- Select the lowest MWCO membrane that suits the application.
- When available, prefer swing buckets to fixed angle rotors. This reduces the surface area of the concentrator that will be exposed to the solution during centrifugation.
- Reduce pressure or centrifugal force to approximately half of the maximum recommended.
- Avoid over concentration. The smaller the final concentrate volume, the more difficult it is to achieve complete recovery. If feasible, after a first recovery, rinse the device with one or more drops of buffer and then recover again.
- Pre-treat the device overnight with a passivation solution such as 5% SDS, Tween 20, or Triton X in distilled water. Then rinse thoroughly before use.

	BSA 0.1 m	g/ml	BSA 0.005 mg/ml		
	Total Spin Time Minutes	Solute Recovery %	Total Spin Time Minutes	Solute Recovery %	
Untreated Product					
Vivaspin 20 (single spin)	13 min	96.3%	13 min	68.8%	
Vivaspin 6 (refilled 3X)	34 min	>99%	34 min	78.8%	
After Passivation in SDS 5%					
Vivaspin 20 (single spin)	-	-	12 min	84.4%	
Vivaspin 6 (refilled 3X)	-	-	32 min	93.2%	

Solute Recovery Comparisons*

*20ml Start volume, 10,000 MWCO PES membrane, 30X concentration, 3,000 g swing bucket rotor.